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THE TRANSACTIONS

OF THE

NOVA-SCOTIAN INSTITUTE OF NATURAL SCIENCE.

VOLUME I.—PART I.

Inaugural Address. By P. C. HILL, D. C. L., President.

IF we would know the extent of our knowledge in the present day, how far man has penetrated into the mysteries of creation by which he is surrounded, we must compare the state of knowledge at different periods of the world's history; we shall thus obtain a kind of standard by which to measure the progress which has been made, and may form at least an approximate idea of our actual position; we shall see that the boundaries have been constantly enlarging themselves, and that at the present day the extent of man's knowledge in nearly every department of Nature is infinitely wider, and, at the same time, more accurate than at any previous period. Now, how has this been accomplished? Much, of course, is due to the progressive nature of all science, and to the heaven-born thirst of knowledge which burns in men of every land, and impels them to toil in its acquisition; but, however great the ardor or untiring the efforts, all such isolated labors would really tend but little to enlarge the boundaries of human knowledge or to increase its aggregate amount. Communication with each other; every laborer in the field casting his contribution into a common receptacle whence all can freely draw, can alone give these results of individual effort their highest value, and convert that which formed the recreation of a single mind into the component portions of one mighty whole.

It is, then, to aid in this important work and to afford a well constituted and organized channel for the contributions to the general stock of knowledge of those among ourselves who are interested in the fascinating fields of knowledge embraced in the term "Natural Science" that the "Nova Scotian Institute" has been established. Should our hopes not be disappointed, we look forward to the time when our "transactions" shall be exchanged with older and more important institutions, and any new and well authenticated fact, having passed the ordeal of our own local organization, shall be transmitted to the great centres of science, and become the property of the whole world.

And let us not underrate the importance of having such a channel of communication opened to us. Nothing is more characteristic of the science of the present day than the value attached to facts verified and ascertained *in situ*, if I may use the expression; thus every well authenticated specimen, either of plant or animal, procured on the undoubted place of its existence, sheds light on the theory that the *fauna* and *flora* of every distinct zone or district had a separate and local centre of creation, in contradistinction to that opinion which looks to a region of Central Asia as the original source and centre whence emanated all animal life at least, after the deluge. Closely connected with this subject are those important questions in Ethnology, which are attracting the deepest attention at the present day, but more particularly in America; and although, in my judgment, those who adopt the theory of a plurality of races in the human family, have erred in reasoning by analogy from the distinct centres of creation of the lower *faunas* of the earth, to man, inasmuch as between man and the highest form of anthropoid apes there is a wide and impassable gulf, yet every fact which tends to hasten the final solution of the question possesses the utmost importance. In this view, what a significance the acquisition of even one indisputable fact assumes! To whatever branch of Natural History the enquirer devotes his studies, he cannot divest his labors of their connection with these questions in which all that can interest man is involved.

Let us also remember that our own country presents in many aspects a new and untrodden field for research;—those representatives of the fish, of the edible mollusca, of the mineralogy of the Province, which were sent to the great International Exhibition, have not exhausted the ground: he who would advance the status of his country in the world of science, as well as add to the stores of human knowledge, has here both the incentive and the field to urge him to his noblest efforts.

The love of knowledge itself, however—that noble and unextinguishable thirst to which I have already alluded, must be the great motive animating all our efforts. And rightly viewed, what higher incentive could be presented to any intelligent mind? The works of nature are but the manifestations and exponents of the Creator's skill; the universe is not a mere agglomeration of incongruous elements thrown together at random and without mutual dependence on each other; order and system, even where unseen by man, prevail throughout every portion of creation. To discover this--to trace the harmony and connection pervading the whole universe is, in other words, to obtain some insight into the plans and designs of the Creator when He built up the habitable world, clothed it with a luxuriant vegetation, and peopled it with that manifold animal life which occupies every portion of its surface. From the lichens of the Arctic regions to the stately oak—the monarch of the woods; from the coral-building polype, almost destitute of organic life or functions, to man, made in the image of his Maker, there is a gradation and order of no human or arbitrary devising, but forming an essential and fundamental element of the whole. To have lifted the veil from some portions of this wonderful order and design; to have learned something of the true system in which the Creator has arranged His works, form the glories of modern science. Classification, which simply, in one word, embodies this idea, is now the great object of attention; thus, the orders into which the animal kingdom is divided are based on the essential and immutable diversities which modern research has revealed, and the transfers which sometimes take place of species, or even a genus, from one place to another, in the general system, are merely the result of a further insight obtained by pains-taking laborers into this universal plan of creation.

The field of labor here opening to us is unbounded; the objects presenting themselves for our studies are literally inexhaustible; and he who, in earnest sincerity of purpose, devotes his attention to any one branch, however special and circumscribed it may appear, cannot fail to see new and hitherto unknown evidences of the skill and wisdom of the Great Architect, the contemplation of which will not only confer on himself the most exalted pleasure, but will add to the general stock of human knowledge.

In these fields of observation, we have in our own Province the most extensive and interesting materials for study. The shores, the forests, the rocks, of Nova Scotia, present inexhaustible stores to the student of nature. What Dawson has done for Acadian geology, may be done by any other student in any other branch of Natural Science. The object of this Institution is to stimulate the effort to follow so bright an example, and to aid and encourage the student by giving a recognized position and permanency to the results of his labors. If we succeed, in however limited a measure, in effecting this object, our intentions in founding the Association will be fulfilled, and our humble efforts for the promotion of Science and the elevation of our native land will be abundantly rewarded.

In conclusion, I may add that the Society embraces in the field of its observations not only the Province of Nova Scotia, but also Prince Edward Island, Newfoundland, Labrador, and the Bermuda's localities, to which the scientific observer has hitherto paid but slight attention.

Art. I.—*On the common Herring (Clupea elongata).* By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

[*Read Feb.* 2, 1863.]

From five specimens before me,—one taken at Red-bay, Labrador; the second, from the "Banks," ten miles seaward; the third, from Halifax harbour; the fourth, from Annapolis Royal, Bay of Fundy; and the fifth from a cod's stomach, caught last winter, upon the Banks, I may say they are identical, except in teeth and size; they all may be called slender: the head about one-sixth the entire length, the lips dusky black, the opercles the same, and fins alike in relative position with each other, and in number of rays, and the belly slightly carinated. They all dip forward when held by the dorsal fin, and they all correspond in colour, as far as may be judged from the specimens more or less denuded of their scales, and part preserved in salt, and part in alcohol. As regards teeth, they all had teeth upon the tongue and vomer, except the one from the cod's stomach, which had none upon the tongue; but the Labrador specimens had none upon the lower jaw, the others having them there. J. M. Jones, Esq., showed me a specimen of a Newfoundland herring, with teeth upon vomer, tongue, and both upper and lower jaws. On the head of another Labrador specimen, boiled and taken apart, I found teeth only on the vomer; under a strong glass the lower maxillary was slightly serrated. In size, the Labrador measures 15 inches; the Bank, 13½; the Shore, 11; the Annapolis, or Digby herring, 7 to 8; and that taken from the cod, about 5 inches. Notwithstanding the difference in size, and in teeth, which last I shall again refer to, I can only consider them of one species.

The description of an ordinary herring taken from the market at Halifax, will serve as a type for all:

"Body, long and slender; head, one-sixth the length; 2 pectoral, 1 dorsal, 2 ventral, and one anal fin. The caudal deeply cleft. The dorsal sub-quadrate, anterior rays highest, the body covered by scales so deciduous that one fancies they owe their adherence to life; color of upper third, dark blue, with faint reflections; lower two-thirds, silvery white, a decided line of demarkation between the colors; opercles, with a yellowish tinge and violet reflections; lower lip longer than upper, both dusky black, a few dark spots of blue along the sides; belly sharp, carinated rather than serrated, sharper in the young, showing very plain in the spawn-bearing female,—irides silvery,—size, 10 to 16 inches—teeth, constant on tongue and vomer; wanting, more or less, on jaws. Fin rays, P. 16, V. 8, D. 18. Though these differ in some individuals."

Those taken on the Banks, ten miles seaward, are larger, go in separate runs, are fished for with larger meshes, and are sold as distinct fish in market from the shore herring.

During winter small specimens are frequently taken from the cods' stomach caught upon the Banks, and there can be no doubt they might be obtained if looked for during this season in any of our land-locked bays, carrying 50 or 60 fathoms, as they are at Cape Breton and Fortune Bay, Nfl'd. They approach the Nova Scotia shore early in March, at first very stragglingly and very lean; I have myself seen spawn fish in May. The fishermen tell me they find them at all seasons. As the summer advances they become fat. During the latter part of August they are in their prime, and are preparing to spawn—which operation takes places in September and October.

The warm, sandy coves, and still land-locked bays, about Sambro, Eastern Passage, Shelburne and Prospect, are favorite resorts, in from 5 to 10 fathoms. Here the fish may be seen lying upon the bottom in thousands. They may be measured by the acre. The sea is white and turbid with the spawn, and ropes, in passing through it, become as large as small hawsers. The cod and his varieties approach to feed upon it, whilst quantities are cast upon the beaches by the sea.

Before the long cold nights and stormy seas of November arrive, the herring have left the surface to reappear the following spring. In New Brunswick, according to PERLEY, the great spawning ground is Southern Head, Grand Manan. Here the herring commence in July and end in October. Along the Bay of Fundy a run of large, thin, spawn-bearing herring appear about the middle of May. About the last of June a separate run of small barren herring appear in Digby basin from the Bay of Fundy. These are fat, and about 1 in 12 have spawn, and in August immense numbers of fry appear on the shoal bars of the Basin, doubtless the spawn deposited in early spring. PERLEY reports that spawn is found in the Bay of Fundy in June.

Thus we arrive at a very curious fact, that our herring, though of the same species, spawn some in June and others in October. At Labrador, Newfoundland and the Magdalen Islands, April and May are the spawning months,—allowing from six to ten weeks for the period of hatching, from the analogy of other fish whose periods we do know, then one run must be produced during the stormy seasons of November and December, after the fish have long left the surface, whilst a second more highly favored run commences its existence during the warm tranquil season of midsummer, upon the shallow beaches and warm shoals of the basins emptying into the Bay of Fundy.

Thus, commencing life under such different auspices, it would seem that each hatching or "run" keep by themselves, at least during their early life, and revisit annually their breeding places. Self-protection keeps them from the older ones, who prey upon them equally as the cod. The most intelligent observers informed Perley, that it takes three years to perfect their growth, and that they spawn the second year.

Thus we have a small run of 7 to 9 inches of the second year, about one in twelve spawning, revisiting the shallow basins of the great Bay of Fundy (which run reappears as the famous Digby herring in all the markets of the world), during July and August, and then retiring from the surface. The shore run of the Atlantic coast of Nova Scotia, about 11 inches in size, appearing in early March, and spawning in September and October; and large Labrador, Bank, or Grand Manan run appearing in March, and spawning in April, May and June. All seek the deep soundings in winter. At Fortune Bay, Nfl'd., they are taken in nets during mid-winter, beneath the ice. Here the soundings are 70 or 80 fathoms, the water land-locked and still. The fishermen suppose the frozen surface makes the sea dark and apparently more secure for them. The return of spring warming the water, and the summer seas, seems to be the signal for this vast army, each in its separate brigade, to move upward to the surface and onward along our coasts, to fatten in the rolling pastures of the ocean, and prompted by instinct, whose causes are unknown to us, but irresistible to them, to shed their spawn now upon the ice-washed Labrador in early Spring; now upon the warm sand bars of the Digby basin; or, lastly, upon the shoals of Grand Manan, or Prospect Bay, warmed by the summer heats and autumnal sun. The pursuit of food must be another great cause for their annual migrations. A close observation of the food found in the stomachs of herring at different seasons would do much in discovering a general rule for the proverbial uncertainty and caprice of their movements.

Upon the authority of Yarrell, who quotes Dr. M'Neil, I have stated the larger ones prey upon the smaller, but our fishermen deny the fact of finding young herring in the stomach of larger ones. The surface of the sea about our coasts in Spring and Summer is fairly alive with the medusæ, and our shores are covered in winrows with small shrimps, called brit and herring bait, one cannot but fancy that these rich gelatinous masses must allure him to the surface.

To sum up all that I have obtained within regard to our herring:

1. It is of one species.

2. With regard to teeth, those upon the tongue and vomer seem constant in all; the larger specimens very rarely upon the lower lip; the smaller usually having them there. Generalsing from examining some hundred specimens, I would say the teeth became obliterated by age, and that the more readily as they have no bony origin like the genus *Salmo*.

3. Some spawn in May and June, others as late as October. This very remarkable fact, causing suggestions of how far it modifies the growth and habits of each run, stands so far without any reason.

4. These separate runs, hatched under very different circumstances, and necessarily of different age and size, revisit their old haunts, spawn the second year, and are three years in attaining adult size, and probably by that time become absorbed in the runs of older fish.

5. That great and small of all ages approach the surface, and the land in spring, and disappear in autumn. The warm seas and calm weather of the summer being necessary for their spawning and their food,—that as far as regards our coasts their only migration is from the deep soundings of the sea banks to the coasts and back again,—though I by no means assert that in higher latitudes they do not perform greater migrations. These migrations must cause a total change in the food, the temperature, respiration and external pressure during winter and summer.

Following Dekay and Storer, I have considered it a distinct species, from the Harenga, or English, though Richardson calls his taken at Bathurst inlet, Harenga; and Yarrell's description of the Harenga seems to vary but little from ours.

We have seen that our herring passes his existence alternately in a state of rest in deep soundings, (this rest not so deep though, as from recent facts, we infer the mackerel does, who, it would appear, becomes torpid and blind during winter, like certain Batrachians whom he resembles in his color), and of a highly, aerated and lively existence upon the surface. During this state he presents himself as food for man who employs his arts in securing this rich bounty, spread as it were at his door. This brings us insensibly to the history of our HERRING FISHERY.

As early as March, herring are taken in nets on our coast, but the fish are so straggling and the seas so boisterous, that except for bait, fishing does not commence till May. In this month a run of large fat herring are taken in nets upon the Banks, which lie 10 or 15 miles seaward, and carry about 75 fathoms water. A net 30 fathoms long and 3 deep is passed from the stern of a boat at anchor. The free end drifts with the tide, held to the surface by cork floats, sometimes the tides carry the net down 15 fathoms in a slanting direction,—thus drifting from night to morning,—the net is overhauled, and from 20 to 100 dozen is the ordinary catch. It is very evident from the distance from shore, the need of calm weather for the boats and nets, as well as for the fish who are very susceptable to rough seas, this fishing must be precarious. The boats are stout, weatherly keel boats, with a half deck, from 5 to 15 tons, carrying a gib, fore and mainsail, and usually called second class fishermen, when entered at a regatta.

The "in shore run," a fish of smaller size, are taken in nets set to a buoy, instead of a boat, the free end drifting to the tide. These nets are often moored from one buoy to another, to preserve a permanent position across a creek or small bay. In these various ways herring are taken by the shore population of the whole Atlantic and Gulf coast of Nova Scotia, from the Bay of Fundy to Cumberland. The immense tides of the Bay of Fundy, leaving long flats and sand bars at low tide, and the steep trap formation of its southern coast line have singularly altered the character of the fishing. Here the drift-net fishing obtains, boats and nets drifting for miles upon the flow and returning upon the ebb, the nets twisted and coiled into apparently impossible masses. The shores of the trap formation being flat tables of trap reaching plane after plane into the sea, with no crevice to hold a stake or anchor a buoy, the fishermen procure stout spruce fir trees, and lopping off the branches, leave the long lateral roots attached to them. These, they place upright in rows upon the bare rock, and pile heavy stones upon the roots as ballast, stretching their nets between them. Entirely submerged at flood, at ebb they are left high and dry, and often loaded down with fish caught by the gills in the meshes of the net. These nets are usually set for a large, lean spring herring, running for the flats in early spring to spawn. This method of fishing obtains throughout the whole trap district of the Province bordering upon the Bay of Fundy. With the exception of Briar and Long Islands, about whose coves nestle a hardy race of fishermen, whose red-tan sails are seen from Mount Desert to Cape Sable; and in all weathers, the population of these districts are farmers, rather than fishermen, tilling the southern slopes of the North Mountain, and employing their spare time in procuring their winter supply, or a few boxes of smoked herring for barter. Where unopposed by the stern barrier of trap-rock, the great Bay pours its tide-waters up St. Mary's, or through the Digby Gut, into the Annapolis Basin, or sweeps up the Avon and Horton estuaries, or stays its flood on the Cumberland marshes, Minas, Basin, or the Shubenacadie; there, a rural population, dwelling on the borders of those streams and basins, hail with delight the periodically returning wealth teeming in its muddy waters. Smooth seas, sandy bars, and mud flats dry at ebb, replace trap-dyke and boisterous waves. The fisheries are curiously modified by these physical changes. Flats and punts take the place of keel-boats and whalers. Young fir-trees are driven into the soft sand, dry at ebb. Standing eight feet high, their green branches interlacing, they are formed into circles or L's. The retreating tide, which, in its flow, swept some 30 feet above them, leaves a teeming mass of helpless fish stranded in the shallow pools within their circle. This brush weir-fishing, as it is termed, less rude than the rugged stone-loaded stakes of the trap coast, yet is inartistic enough to provoke critisism in its waste of life, fish too small for use being included in the catch; yet we must recollect that it requires capital and population to be humane, and that these fir-trees, renewed yearly, are the cheapest and only material at hand for a population, with no surpluss time or capital. In these weirs are taken the Digby or smoked herring, known so well in all markets.

The returns for the year 1861, are 190,000 bbls. of pickled, and 35,000 smoked herring, for the Province; but the number sold as fresh, in the market at Halifax, and those cured by the families living on the sea-board, for their own use, as well by those in the interior, who may be met in strings of 20 or 30 waggons, returning laden with fresh or round fish, as they are technically called, to be cured at home, would, at least, give 50,000 bbls. more.

In this paper I have endeavoured to prove by facts seen myself, by others gleaned from old and experienced fishermen, and from the best American writers—DEKAY and STORER,—and from the very able report of the late MOSES PERLEY, Esq., (whose loss, as a gentleman and naturalist, to the Lower Provinces, I may be allowed here to deplore,) that our common herring makes no long migrations as those of the British Isles are said to: that he passes his winter either in our deep bays, ice-locked, or in deep sea soundings: that the summer heats and smooth seas bring him to the surface and to the land, in seperate runs of different aged fish, caused by his spawning in early spring and autumn. I say endeavoured to prove, for I am conscious many of the facts need more proof and closer investigation, and may turn out not facts, after all. I have merely hinted at the different existences of winter under deep pressure, half torpid, perhaps beneath 70 fathoms, and his summer life on the surface—of the different times of spawning, as yet without reasons for so singular a fact, modifying, as it must, the early life of the fry. I do not advance any of these facts as new, but rather as newly put together; and I have given a slight sketch how, out at sea, he is waylaid by the fishermen, conducted in shore and beset with drift and set nets, fir-tree stakes and pine brush weirs, by a rural population intent on gathering their rich sea harvest to their homes.

The following letter of Mr. Benjamin Hardy, on the Digby Herring: its food and habits; its three separate runs; and his opinion that six years is the period of its growth is given, as it well deserves entire, though differing from other observers:—

Mr. Jones,—*Dear Sir,*—

I have not much to communicate on the subject named by you, but will give you what little information that I am in possession of, as regards the Digby Herring.

The first herrings that make their appearance in the Basin, come the last of March and first of April; about the first of May they begin to spawn, and by the 20th of May they have mostly left the Harbour. About the time they leave, a small sized run of herrings come in, they stop but a short time, about two weeks, and then leave. From the middle of June to the first of July the regular school come in—they stop generally about six weeks, sometimes longer, and then leave. There are a very few spawn fish amongst the last named; of the second there are none; the first are nearly all spawn, or what is called melt fish,—which means male and female. The spawn, or young herring, grow rapidly: I think, the first year about four inches, as near as I can ascertain. I think, in about six years they attain to what is called the large Digby herrings. Their food is a small insect, just discernable with the naked eye, which I think generally keeps near the surface of the water. Their manner of taking them is by swimming along with their mouth open, and catching them, and then emiting the water through their gills. They are timorous; thunder drives them into deep water. They follow their prey close in shore in the night, but retire as soon as broad day light appears, and then return the next night, and so on. I have heard them jumping and skipping about, till about half an hour before the weir would shew out of the water, and then retire just outside of the weir, and there stay and feed awhile. When they go over the weir, as before named, there would be about three feet of water over the weir. I have seen them, just at night, come within about 300 feet of the weir, and stay there, not coming nearer that night; their line would be, in some places, straight, and others, crooked, just as our weir's were shaped, though there were from 6 to 8 feet water over the weirs.

I do not think I have anything more that would be of service to you,

I remain, Dear Sir, Yours,

BENJAMIN HARDY.

Smith's Cove, November 26, 1861.

ART. II.—*Nocturnal life of animals in the Forest.* By Capt. C. C. HARDY, Royal Artillery.

[*Read Feb.* 2, 1863.]

IN one of the most attractive of the works of HUMBOLDT, entitled "*Views of Nature*"—a collection of thoughts and personal observations in connection with some of the noblest objects of nature in different parts of the world visited by the great naturalist—appears an interesting fragment called "The nocturnal life of animals in the primeval forest," suggesting to me comparative remarks on animal life in our own sombre woodlands.

The great writer in the commencement of this chapter describes the scene of his observations, coupled with some decisive remarks of his own, on the nature of a primeval forest, which I think it well to introduce here. It is the boundless forest district which, in the torrid zone of South America, connects the river basins of the Orinoco and the Amazon. "This region," says HUMBOLDT, "deserves, in the strictest sense of the term, to be called a primeval forest—a term that in recent times has been so frequently misapplied. Primeval (or primitive) as applied to a forest, a nation, or a period of time, is a word of rather indefinite signification and generally but of relative import. If every wild forest, densely covered with trees, on which man has never laid his destroying hand is to be regarded as a primitive forest, then the phenomenon is common to many parts, both of the temperate and the frigid zones; if, however, this character consists in impenetrability, through which it is impossible to clear with the axe between trees measuring from 8 to 12 feet in diameter a path of any length, primitive forests belong exclusively to tropical regions. This impenetrability is by no means, as is often erroneously supposed in Europe, *always* occasioned by the interlaced climbing 'lianes' or creeping plants, for these often constitute but a very small portion of the underwood. The chief obstacles are the shrub-like plants which fill up every space between the trees in a zone where all vegetable forms have a tendency to become arborescent."

Now our North American fir forests—especially in districts where woods predominate and the growth of timber is large—have so frequently —generally—been termed "primeval," that we are bound to enquire into the justice of HUMBOLDT's very decisive statement of his own views of the etymology of the word. He claims the tit'e for the South American forest from its impenetrability; had he done so from the enormous diameter and consequent age of its trees, and could have proved that they were in general the original indiv'duals planted in the present geological epoch, we should be compelled to cede the title as not applicable to our own woods—for from the natural life of our timber trees—even the giant "Pinus strobus," rarely attaining more than 1000 annular rings, though an instance is recorded of 1500 having been counted—the present generation cannot look back with those ancient trees which by some have been placed as coeval with the builders of the pyramids. Still, as it is evident that in the heart of the great fir forests of the North, even in many wooded portions of this Province, the hand of man has never stirred to remove the existing giants, whilst the bones of their ancestors lie mouldering and moss-covered beneath, I cannot see why they do not merit the term primeval—not in the VON HUMBOLDT's acceptation, but according to the ordinary recognition of its meaning, and as—"original, such as was at first," says Johnson.

Before leaving HUMBOLDT's beautiful description of the night life of creatures on the Orinoco, and for the sake of comparison, I will quote a few passages exemplifying the excitement and confusion of sounds in those strange tropical forests as compared with the calm silence of our sombre woods:

"We passed the night as usual in the open air, on a sandy flat, on the bank of the Apure, skirted by the impenetrable forest. We had some difficulty in finding dry wood to kindle the fires, with which it is here customary to surround the bivouac as a safe-guard against the attack of the Jaguar. The air was bland and soft and the moon shone brightly. Several crocodiles approached the bank; and I have observed that fire attracts these creatures as it does our crabs and many other aquatic animals. The oars of our boat were fixed upright in the ground, to support the hammocks. Deep stillness prevailed, only broken at intervals by the blowing of the freshwater dolphins which are peculiar to the river net work of the Orinoco; they followed each other in long tracks.

"After eleven o'clock, such a noise began in the contiguous forest, that for the remainder of the night all sleep was impossible. The wild cries of animals rung through the woods. Among the many voices which resounded together, the Indians could only recognize those which, after short pauses, were heard singly. There was the monotonous, plaintive cry of the Aluates, 'howling monkeys,' the whining flute-like notes of the small sapajous, the grunting murmur of the striped nocturnal ape, (which I was the first to describe), the fitful roar of the great tiger, the cuguar or maneless American lion, the peccary, the sloth, and a host of parrots, parraquas, (Ortalides), and other pheasant-like birds. Whenever the tigers approached the edge of the forest, our dog who had before barked incessantly, came howling to seek protection under the hammocks. Sometimes the cry of the tiger resounded from the branches of a tree, and was then accompanied always by the plaintive piping tones of the apes who were endeavoring to escape from the unwonted pursuit. If one asks the Indians why such a continuous noise is heard on certain nights, they answer, with a smile, that the animals are rejoicing in the beautiful moonlight, and celebrating the return of the full moon. To me, the scene appeared rather to be owing to an accidental, long-continued, and gradually increasing conflict among the animals. Thus, for instance, the jaguar will pursue the peccaries and tapirs, which densely crowded together, burst through the barrier of tree-like shrubs which opposes their flight. Terrified at the confusion, the monkeys on the tops of the trees join their cries with those of the larger animals. This arouses the tribes of birds who build their nests in communities, and suddenly the whole animal world is in a state of commotion. Further experience taught us that it was by no means always the festival of moonlight that disturbed the stillness of the forest; for we observed that the voices were loudest during violent storms of rain, or when the thunder echoed, and the lightning flashed through the depths of the woods. The good-natured Franciscan monk who (notwithstanding the fever from which he had been suffering for many months) accompanied us through the cataracts of Atures and Mapures to the Brazilian coast, used to say, when apprehensive of a storm at night, 'May Heaven grant a quiet night both to us and to the wild beasts of the forest!'"

Such is a glimpse at animal existence in a region apparently forever dedicated to nature, assuming her most wondrous and luxuriant forms and plumage, and given up to the strife and dominion of the fiercer wild animals. What a contrast presents itself on entering the solitudes of the pine forests of North America—sombre, but yet most attractive to the lover of nature, in the perfect harmony of its mysterious gloom and silence with the life of its animal tenants, their retiring and lonely habits, and their often plaintive and mournful voices! Our perceptions of the harmonies of nature as inseparably connect the mournful hooting of the great owl with the glooms of the black spruce swamp, as we can the tangled wildness and tropical vegetation of the South American forest, with the discordant notes of its gaudy parrots and the screams of its monkeys. Although almost all of our mammalia are nocturnal in their habits, and many of them beasts of prey, their nightly wanderings and strife with their victims, are conducted in the most orderly manner, compared with the scenes we have referred to. Quiet, noiseless stealth is the characteristic feature of all animal life in the forest; mutual distrust of the same species, and ever-present tendency to alarm predominates even in the wildest districts, where the sight of man is unknown, or unremembered at least. At the slightest sound the ruminants and rodents cease feeding—remaining motionless either from fear or instinct; the rabbit or hare thus frequently avoiding detection, whilst the moose can so silently withdraw if suspecting an enemy, that I have on more than one occasion, remained hours together on the stillest night believing the animal to be standing within a few yards in a neighboring thicket to which he had advanced in answer to the call, and found at length that he had suspiciously retreated. The great creature had retired, worming his huge bulk and sonorous antlers through the entangled swamp, without detection of the straining ear to which the nibbling of a porcupine at the back of a tree in the same grove was plainly audible.

The habits and sounds of animals at night are especially familiar to the hunter when calling the moose in the clear moonlight nights of September and October,—the season when this animal, forgetting his usual caution and taciturnity, finds a voice to answer the plaintive call of his mate, and often advances to sure destruction, within a few yards of his concealed foe. As the sun lowers beneath the horizon, and twilight is giving place to the uncertain light of the moon, we listen between the intervals of the Indian's calls (about twenty minutes is generally allowed) to the sounds indicating the movements of nocturnal animals and birds. The squirrels which have raced around us and angrily chirruped defiance from the surrounding trees, all through the twilight, at last have scuttled, one and all, into their holes and fastnesses, and the small birds drop, one by one—the latest being the common robin, who is loth to leave his rich pickings of ripe berries on the upland barren, on which he so revels ere taking his annual departure—into the bushes. No longer annoyed by the multitudinous hum and bustle of diurnal animal life, the ear is now relieved and anxiously criticises the nocturnal sounds which now take their place. A little pattering and cracking of small sticks, often magnified into the movements of moose, accompanied by a low grunting whine, not dissimilar from the cry of a guinea-pig, attests the presence abroad of the porcupine, come forth from rocky cavern or hollow tree to revel on the rind of young trees, berries and nuts. Lucky fellow, he fears not the talons of the wooping owl or the spring of the wild cat; he is a perfect "monitor" in his way, and woe to the peace of mind and comfort of body of his adventurous assailant. Even the moose is lamed—if not for life—for a tedious time, by accidentally treading on the back of the "Maduis."

The porcupine is essentially nocturnal in its habits, retiring at break of day, (when I have often surprised them and chased them to their dens) to a long sleep and good digestion. An answer perhaps has at length been evoked from a distant moose—if from far off, resembling the noise of the chopping of an axe—when nearer—partaking of a more guttural sound, most unmistakeably imitated by the word "quoto," when uttered through a cone of birch bark; but many a time is the too sanguine hunter doomed to disappointment; the animals appreciation and perception of his own language too frequently prove the Indian, even, to be but a sorry imitator, whilst the moose at length stands still to listen—maintaining this attitude for sometimes a couple of hours without a movement—and when the impatient hunter once more ventures to allure him by another call, he is off in silent, though hasty, retreat.

As an instance, however, of departure from their usual course of caution and quiet comportment at night, on the part of the moose, I will quote what I heard in a very wild, and then almost unhunted portion of the eastern forests, from one of my former narratives:

"Though it was very cold, and my damped limbs were stiffening under me from crouching so long in the same posture, I could not but enjoy the calmness and beauty of the night. The moon was very low, but the columns of a magnificent aurora, shooting up to the zenith, threw a mellow light on the barren, which, covered by mist as by a sheet, appeared like a moonlit lake, and the numerous little clusters of dwarfish spruce as islands. We had not heard a moose answer to our call for nearly an hour, and were preparing to move, when the distant sound of a falling tree struck our ears. It appeared to come from the dim outline of forest which skirted the barren on our left, and at a great distance.

"Down we all drop again in our deeply impressed couches to listen. The sounds indicate that moose are travelling through the woods and close to the edge of the barren. Presently the foremost moose is abreast of our position, and gives vent to a wild and discordant cry. This is the signal for a general uproar amongst the procession of moose, for a whole troop of them are following at long and cautious intervals.

"The timber is crashing loudly opposite to our position, and distant reports shew that more are still coming on from the same direction. A chorus of bellowings respond to the plaintive wail of the cow. The branches are broken more fiercely, and horns are rapidly drawn across stems as if to whet them for the combat. Momentarily I expect to hear the crashing of rival antlers. One by one the bulls pass our position, and I long to get up and dash into the dark line of forest, and with a chance shot scatter the procession; but to do so would entail wanton disturbance of the country; so we patiently wait till the last moose has passed.

"Never before had I heard the calmness of the night in the Nova Scotia forest so disturbed; they had passed as a storm, and now the barren and the surrounding country were once more enveloped in the calm repose of an autumnal night, unbroken, save by the chirrup of the snake in the swamp."

The family of Strigidœ are now very busy hunting mice, shrews, and even hares, through the darkest swamps and occasionally uttering their melancholy hootings. That of the cat owl, horned, or eagle owl, is one of the most impressive sounds of the forest at night. Coming on the ear of the sojourner in the woods most frequently just before day-break, and emanating from the darkest recesses, the voice of this bird is eminently suggestive of most melancholy solitude and ghostliness, and one instinctively awakens the dying embers of the fire. I believe there is nothing of its own size that this powerful fierce bird will not venture to attack under cover of the night. The poor hare constantly falls a prey to it—the settler frequently loses his poultry—even geese—through its nocturnal visits. An Indian, of my acquaintance, nearly lost a small woolly dog last fall by the attack of a cat owl; and there is one confined in a separate cell at Downs' gardens who actually committed the crime of fratricide a short time since. This bird is not so exclusively nocturnal as some of the other species. I have frequently started them sitting exposed to open daylight, and perfectly well able to find their way to another hiding place—particularly by the wooded banks of the Shubenacadie and its tributaries.

Of all premonitors of the approach of a storm the night voices of the barred owl and the loon are the surest. "The coogogues is noisy again; more rain coming," says the Indian, and whether we hear the unwonted chorus of wild hootings soon after sundown or at daybreak, the storm will come within the twelve hours. Such is the case when we hear in summer the frequent screams of the great northern diver answering each other from lake to lake. The barred owl seems the most impatient of daylight of the whole family; the white owl least so, but none of them are so incapable of finding their way in broad daylight as the common barn owl of England, inhabiting ruined buildings and towers, or the wood-owl disturbed from his dark ivy-covered cavity in the hollow tree. The little Acadian owl commonly called the "saw-whet," is not uncommon in our woods—uttering, morning and evening, its peculiar and (until known) mysterious tinkling sound from the thickest groves of spruces. In one of these I once captured one just about sundown when going to a barren to call moose. The Indian made a noose on the top of a long stick, and after a little manœuvring, during which the bird kept hovering round us, hissing and setting up its wings and feathers in great anger, he got it over its neck and secured it without injury. This little owl weighing but two ounces and a copper, will actually kill a rat.

Wherever there is mystery there lies a charm. Mr. Gosse, an eminent naturalist, in describing his feelings on hearing this bird, speaks thus:

"In the forests of Lower Canada and the New England States, I have often heard in Spring, a mysterious sound, of which, to this day, I do not know the author. Soon after night sets in, a metallic sound is heard from the most sombre forest swamps, where the spruce and the hemlock give a peculiar density to the woods, known as the black growth. The sound comes up clear and regular, like the measured tinkle of a cow-bell, or gentle strokes on a piece of metal, or the action of a file upon a saw. It goes on with intervals of interruption, throughout the hours of darkness. People attribute it to a bird which they call the whetsaw; but nobody pretends to have seen it, so that this can only be considered conjecture, though a highly probable one. The monotony and pertinacity of this note had a strange charm for me, increased doubtless by the uncertainty of its origin. Night after night it would be heard in the same spot, invariably, the most sombre and gloomy recesses of the black-timbered woods. I occasionally watched for it, resorting to the woods before sunset and waiting till darkness; but, strange to say, it refused to perform under such conditions. The shy and recluse bird, if bird it was, was doubtless aware of the intrusion and on its guard.

"Once I heard it under peculiarly wild circumstances. I was riding late at night, and, just at midnight, came to a very lonely part of the road, where the black-forest rose on either side. Everything was profoundly still, and the measured tramp of my horse's feet on the frozen road, was felt as a relief to the deep and oppressive silence; when suddenly, from the sombre woods, rose the clear, metallic tinkle of the whetsaw. The sound, all unexpected as it was, was very striking, and though it was bitterly cold, I drew up for some time to listen to it. In the darkness and silence of the hour, that regularly measured sound, proceeding, too, from so gloomy a spot, had an effect on my mind, solemn and unearthly, yet not unmingled with pleasure."

There is a bird, that long after sundown, and when the moose-caller begins to feel chilled by long watching on the frosty barren, will rush past him with such velocity as to leave no time to catch a certain view of its size or form. It passes close to the ground and with the whizzing sound of an arrow. Almost every night, whilst thus watching, I have noticed this bird; can it be the night hawk? But October is late for so tender a bird; the latest day in which I have observed it in Nova Scotia, was the 28th September.

Another mysterious sound which many of the Indian hunters connect with superstition, and attribute to spirits of the Orpheonist description, is that curious, rushing sound of music—an indescrbable melodious rustling in the calm atmosphere of a still October night, with which the ear of the moose-hunter becomes so well acquainted. Most probably the cause exists in the tension of the nerves of that organ.

The fierce yell of the lucifee, and the short sharp bark of the fox, often are heard in wild parts of the country: they are both in pursuit of the unfortunate hare which falls a frequent prey to so many of the carnivora and raptores. I once heard the startling cry of the former close to my head, whilst reposing in the open, after a night's moose-calling away from camp. Its bounds upon its prey, having stealthily crept to within sight, are prodigious. I have measured them as over twenty feet in the snow.

I have always noticed that in the small hours of the morning there appears to be a general cessation of movement of every living creature in the woods. Often as I have strolled from camp into the moonlight at this time, I never could detect the slightest sound—even the busy owls seemed to have retired. The approach of dawn, however, seems to call forth fresh exertions of the noctural animals in quest of food, and all the cries and calls are renewed—continuing till the first signs of Aurora send the owls flitting back into the thick tops of the spruces, and calling forth the busy squirrels and small birds to their daily occupation.

Once and only once did I hear the little red squirrel utter his wrathful chirrup at night—a bad sign, say the Indians; they firmly believe that it prognosticates the death of one of their friends. Neither does the chip-munk or little striped ground-squirrel come out at night; the only member of the family of nocturnal habits is the flying squirrel, a rare but most beautiful little creature. Lying in an open camp, I once saw its form sail in a curved line from tree to tree in the moonlight.

Of night songsters amongst our small birds we have few examples. The whip-poor-will is our only systematic nightingale, if we may call him so. Arriving in June, and choosing the pleasantest retreats in copses, by picturesque intervales, and generally preferring the neighborhood of man, the plaintive song of this bird is strongly associated with the pleasantness of a summer's evening in the country. Occasionally, however, the white throated sparrow, or the common peabiddy bird, (*F. Pennsylvanica*) strikes up his piping note at various times of the night, and is often heard when the surrounding woods are suddenly lighted up by the application of fresh fuel to the camp fire. Still, as a general rule, the pleasing notes of song birds are foreign to the solitudes of the large fir forest whose gloom is appropriately increased by the wilder voices of predatory birds and animals. With these imperfect remarks, I close the present sketch of the night life of animals in the woods.

ART. III.—*Some recent movements of the earth's surface.* By THOS. BELT.

(*Read before the Institute, Feb.* 2, 1863.)

I have thought it well, in the first geological paper read before our Institute, to take a subject of general interest and to treat it in a less technical manner than is usual before scientific societies. To address rather my non-geological hearers, who must in a young society like ours, form the large majority; and to ask the indulgence of my more scientific friends.

I well recollect the interest with which I first saw sea shells encased in hard rocks, hundreds of feet above the sea, and how that interest was increased, when proof upon proof showed that nearly every sandstone had been a sea beach—nearly every limestone had been deposited in the deep ocean,—and yet, there they were, hundreds of feet above that ocean, beneath which they had all been accumulated, and where the various animals whose remains were now imbedded in their hard casing had lived and died. It was easy to understand how corals could build up, in the course of time, great masses of limestone, and how the hard casings of shell fish might be imbedded and preserved in sediments at the bottom of the sea. The difficulty was to account for the breaking up of these ancient sea bottoms and for their upheaval.

Further examination shewed that a simple or a single upheaval would not account for the phenomena. That there must have been oscillations of level. Fathoms deep, over the sandy bottom, mailed fish had pursued their feebler brethren. Then palm trees and ferns waved in the breeze over wide mud flats, and then again the ground on which they grew was submerged, and the finny tribes resumed their sway.

As we examine the geological records of the earth's surface, no truth is more apparent than this: that every where the sea and the land have held alternate dominion—where we have now broad continents or rocky islets, the sea once flowed, and where the unfathomed deep now rolls, rocky coasts once defied the ocean's roar, and reared their crested peaks, apparently immutable. Are these upheaved and shattered rocks the monuments of mighty convulsions to which the earth was once subject, but from which it is now free? of stupendous forces once active, but now quiescent? Thirty years ago these questions would have been answered unhesitatingly in the affirmative, for it was then usual for geologists to construct ingenious theories, by which, according to some, the world at one time was in a state of complete fusion,—a ball of igneous molten matter,—whilst others jumbled up water, earth and metals, and allowed them to sink down according to their specific gravities.

The theory of primeval chaotic fluidity is almost abandoned; that of universal fusion still finds many able advocates; but there is a large and increasing school of geologists, headed by the illustrious LYELL, who teach that nature is working now as ever. Slowly, almost imperceptibly remodelling continents, raising some, lowering others, and that the forces that raised the ancient sea beds are still at work, busy as ever, at their ceaseless toil.

Geology is not merely a dry catalogue of names of minerals and shells, but a study of vast changes, both of the animate and inanimate world, extending over long ages; the key to explain which is to be found in the attentive observation of natural phenomena now going on around us. The same agencies existed in the earliest geological periods as at present. In the oldest rocks we have slabs of sandstone marked with the ripples of a retiring tide, and there recognize, not only the presence of the ocean, but the influence of the moon,—whilst the impressions of rain-drops, slanting as they were driven by the wind, attest meteorological conditions similar to the present. And on the other hand, in the sediments accumulating around the mouths of our large rivers—in the coral reefs building up in tropical seas, and in the lava flows of modern volcanoes, we have limestones, slates, sandstones and whins, in course of formation.

I purpose to night to draw your attention to a few instances where the forces that have raised the mountain chains of the world may be detected still at work, and to pourtray some oscillations of level of different parts of the earth's surface in recent geological times.

It has been my fortune to reside for some years in a country slowly and gradually rising from the sea, and near to another, also rising, not gradually, but by sudden jerks, that every half dozen years is lifting it bodily and at once from one to six feet.

The first of these countries is Australia. There it has been known for several years that the whole southern coast is slowly but surely rising. In South Australia, the railway between Adelaide and the port, is said to have risen four inches in twelve months—the height being measured from the mean level of the sea,—other observers have also stated the average rate of elevation for the whole coast to be four inches yearly. I do not think that the rate has been satisfactorily determined; but there is no doubt that the coast is really rising, and at a very rapid rate. At Williamstown, near Melbourne, land is now in cultivation, that in 1854 was covered by the tide, and as similar evidences of elevation have been noticed hundreds of miles apart, it can be due to no local cause. It has been in operation for a long period; shells of species of mullusca now living on the coast are common in marine deposits at various heights up to three hundred feet above the level of the sea. The elevation is participated in by all the neighbouring islands. At Green Island, in Bass' Straits, and in Tasmania, there are old sea beaches, one hundred feet above high water mark. One of the most remarkable and suggestive facts connected with this recent elevation, is that the movement is so comparatively rapid, that bones of sheep and oxen and pieces of pottery thrown out of the first emigrant ships are raised above the reach of the tide, mixed amongst sea shingle and shells. In one of these deposits I found bones of the sheep along with sea shells three feet above high water mark.

The rise of the southern coast of Australia is a slow continuous one, without tremblings or quakings or sudden shocks. Silently, imperceptibly (for although the effect of the movement is seen, the motion itself is unseen, unfelt, unheard,) this elevation has been progressing so long that it has raised the coast at least three hundred feet in very recent geological times, or since the present species of mollusca lived upon the coast. The only change of species is, where the deposits last formed chronicle the arrival of the European with his domestic animals—where the bones thrown out of the ships conveying the gold seekers of 1850–51, are slowly being upraised to form future "old sea margins." Supposing this upheaval to continue as far into the future as it has progressed during the past,—future geologists in marine deposits raised hundreds of feet above the sea, may point to geological records of the advent of the European on the shores of Hobson's Bay, as they now point to the advent of a shell, a fish, or a reptile in older strata.

I have here shewn you a movement of the earth's surface extending over several degrees of latitude and longitude, continuous and regular—let me now take you to another part not far removed from the last, where the land is being raised by successive sudden jumps. On the 23rd of January and succeeding days, violent earthquakes were experienced in both islands of New Zealand, which shook down many houses in Wellington, in the north island, and injured others at Nelson, on the south side of Cook's Strait. After the shocks, it was found that the southern part of the north island had been bodily upraised, in some parts two, in others as much as eight feet vertically, and shells attached to the rocks near tide mark were raised above the reach of the sea, and soon died. The Bally rock, off Point Jerningham, which was formerly eighteen inches below low water, was found to rise two feet above it. At Wellington, they were celebrating the anniversary of the foundation of the settlement, and the amusements were brought to a sudden termination by the overthrow of every brick and stone building in the town. Fortunately most of the houses were of wood and only one storey high, for the inhabitants had been warned by similar disasters in former years.

In 1848 a similar shock had been felt, and it was then also noticed that the country was bodily uplifted a few feet, and I have been assured by New Zealand colonists that all around the coast there is evidence at various heights of the successive jerking up of the country.

Alongside of, and probably in connection with this immense area of upheaval, is a corresponding area of subsidence. Whilst New Zealand, Tasmania, and the south western side of Australia, is being raised, Mr. Darwin has shewn that immense areas in the adjoining South Pacific and the Indian Ocean are slowly sinking. The north eastern side of Australia is included in the area of subsidence, so that whilst new land is being gained on the south western side of the continent, the north eastern is being gradually submerged, and the whole continent must be slowly moving towards the south west, the movement being exactly similar to a great wave of the sea, which is always rising in front and sinking behind.

The western coast of South America is being jerked up in a similar manner to New Zealand. In November, 1837, a violent earthquake threw down the town of Valdivia, in Chile, and afterwards, most, if not the whole of the coast, was found to have been raised about eight feet above its former level. Only two years before this, in 1835, a violent earthquake (or rather a series of earthquakes) had destroyed the town of Conception in the same country. Fortunately for the interests of science, Capt. FITZ ROY, R.N., (who was surveying the coast), was at the time in Conception bay, and with him, the celebrated naturalist, DARWIN. These gentlemen have published a minute account of the catastrophe, and of its effect upon the coast line. They found that the whole of the land around Conception Bay had been permanently raised from two to four feet. Thirty miles from the bay, the elevation was much greater; for, at the island of St. Maria, Capt. FITZ ROY found beds of putrid mussels, still adhering to the rocks, ten feet above high water mark. If it had not happened that Capt. FITZ ROY and Mr. DARWIN were present at the time of this earthquake, we might indeed have heard of the overthrow of the town and the loss of life and property; but it is probable that we would not have heard of this permanent upheaval of a considerable tract of country.

Mr. DARWIN satisfied himself that the country had been subjected to a long series of such upheavals. He found shells of recent species 600 feet above the sea, and at Valparaiso even up to a height of 1300 feet.

Whilst the western coast of South America is thus rising, there is strong evidence that the eastern coast of North America is sinking, although at an exceedingly slow rate, the movement being a much slower one than any of those we have been considering. As Nova Scotia has participated in this depression, I will confine myself to the proofs that this country afford—merely premising that American physicists have arrived at similar conclusions for the whole eastern sea-board.

In several places in Cumberland Basin and in Coquebid Bay, there are found stumps of trees standing as they grew, but now far below high water mark. Mr. DAWSON, in his Acadian Geology, has described one of these submerged forests at the mouth of La Planch River in Cumberland county. The stumps are found irregularly scattered over a considerable space, some of them as much as thirty feet below high water mark. On digging around one of them, DAWSON found it rooted in what appeared to be forest soil. All these stumps were entire and retained their bark. They belonged to two species—the beech and the pine. There is here a direct proof that part of Nova Scotia has been depressed in very recent times, and that the movement is still going on may be inferred from the fact which I have on the authority of Dr. GILPIN, that several hundred acres of dike land in Annapolis, formerly in cultivation, are now given up to the sea, and the farmers say that the tide rises righer now than it used to do.

The subsidence of the eastern coast of North America attains its maximum amount on the west coast of Greenland. For a space of six hundred miles from north to south, ancient buildings on the sea shore have been submerged, "and the Moravian settlers have had to move inland more than once the poles on which their large boats are set." * In Australia, the elevation of the land is bringing up from the deep. articles cast into it by man,—in Greenland, on the contrary, his handiwork is being gradually carried beneath the waters. It is a remarkable and suggestive fact that on the other side of the Atlantic, opposite to this great area of subsidence, there is a corresponding great area of elevation on the coasts of Sweden and part of Norway, and there likewise the greatest amount of movement is towards the pole. Perpendicular cliffs of gneiss, mica schist and quartzite confront the sea and resist decomposition for ages. On these rocks permanent marks have been made, and from them the rate of elevation ascertained. The movement has been proved to extend from Cape Cod, in the north, where the elevation is at least four feet in a century to Gottenberg, in the south, where it only amounts to a few inches in the same time.

I have thus shewn you that immense areas of the earth's surface do not possess that stability we are accustomed to associate with the idea of *terra firma;* but that movements are in progress which must, in the course of ages, modify in a great degree the relative positions of land and water. I have confined myself to the larger of these movements, for the limits of this paper will not allow me even to glance at the numberless instances of local changes that have taken place in recent times; but before passing to another branch of my subject, I may remark that although many earthquakes are considered mere vibrations of the earth's surface, we must remember that all vibrations are the result of some direct movement, and whenever any part of the earth's surface vibrates, we may be certain that somewhere a blow has been struck; somewhere a portion of the solid earth has been suddenly let down or raised up.

I now pass on to the consideration of another class of phenomena, of which the earth movements we have been considering, afford an easy and complete solution.

When we leave historical for geological records, we soon find that there is no land, however stable it might now seem, that has not alternately been above and below the sea.

On my return to England, in 1860, my attention was directed to those superficial deposits of sand, gravel and clay, that are spread over the

* Lyell's Principles of Geology—page 531.

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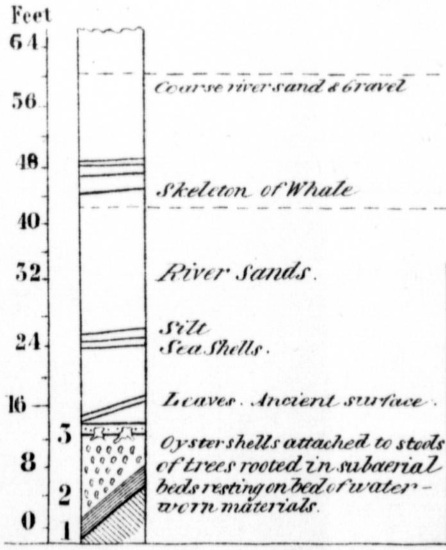

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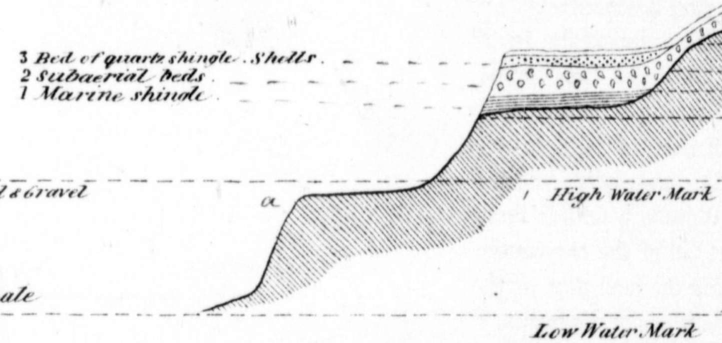


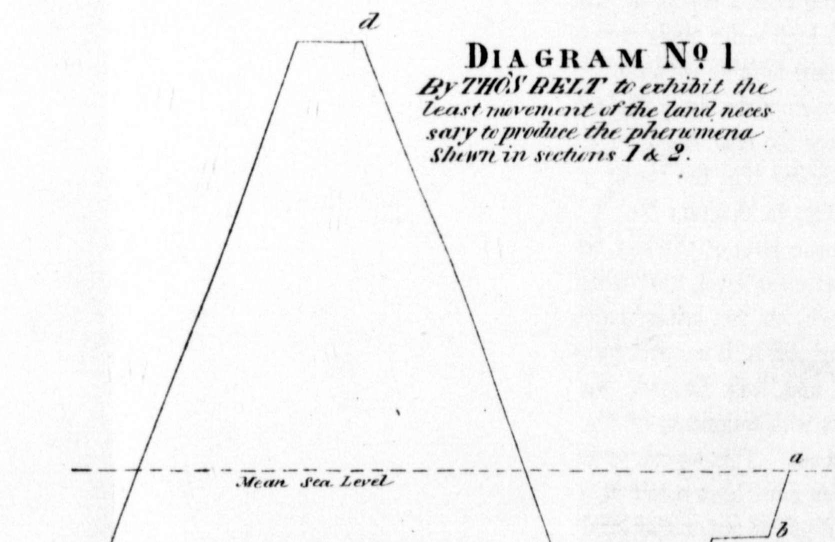
Reduced copy of Sections from Mr. Austins paper on the English Channel Jour. Geol. Soc. Lon. 1851 P. 120.

No. 1. Section of the Pentuan Valley. Stream Tin Works.

No. 2 Section through Cliffs near Plymouth.

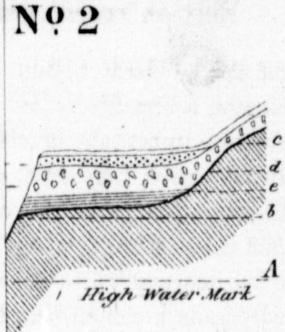
DIAGRAM No. 1

By THOS. BELT to exhibit the least movement of the land necessary to produce the phenomena shewn in sections 1 & 2.



C. & A. Clarke, Lithog. Bedford Row, Halifax, N. S.

No 2



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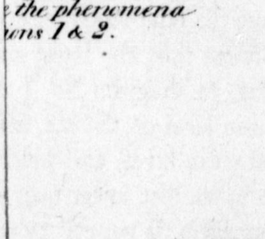

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greater part of Great Britain. The evidence that they afforded seemed at first most contradictory and puzzling. In some places there seemed to have been upheavals, in others, depressions.

But convinced that some general law must govern the movements, I collected and collated from various sources, sections of the deposits from different parts of England and Scotland. It occurred to me that I might make the movements more intelligible, if I depicted them by means of curved lines in a similar manner to that by which meteorologists shew the rise and fall of the barometer.

Taking the land now at the mean level of the sea, as my starting point, I drew a series of diagrams, shewing the least changes of level that would account for the formation of the deposits. A few instances will best illustrate this:

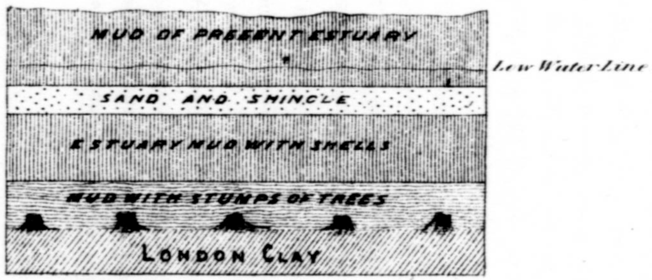
Figures 1 and 2 are sections taken from a paper read before the Geological Society of London, by Mr. Austin, on the English Channel, and I have constructed diagram No. 1 to shew the least necessary amount of oscillation of the land now at the mean level of the sea to produce the phenomena shewn in the sections. To explain this, I must first direct your attention to section 2, which represents the cliffs near to Falmouth, capped with beds of shingle. The limits of the tide are shewn by the dotted lines A and B. Between high and low water the sea is slowly wearing back a beach a. into the hard fundamental rocks. A few feet above high water mark we come to an older sea beach b. exactly similar to that now forming between high and low water mark, but removed beyond the reach of the sea. To allow the sea to wear out this old beach we must suppose the land stood once at least ten feet lower than it now does; and I represent this, the latest movement that we have any evidence in these sections, in diagram No. 1 at b., where the dotted line A. B. represents the mean level of the sea, and the point a. shews the land now standing at that mean level, and which must have stood during the formation of the beach b. ten feet lower than now, or as shewn in the diagram at b.

The cliff b. is capped by a series of beds of shingle, of which the topmost and least formed, No. 3 is a bed of rolled pebbles of quartz, and gneiss with fragments of shells. The shells all of species now living on the coast. This deposit is evidently a marine one, and when it was formed the sea must have stood at a relative level, twenty-four feet higher than it now does, or rather the land must have stood that much lower, or as shewn in the diagram at c.

Beneath the bed of sea shingle No. 3, is a bed of angular fragments of rock without any rolled pebbles amongst them, or sea shells. It is composed of fragments of the adjoining rocks, and as there are other evidences of the prevalence of an extremely cold climate at this period, it has been suggested that this bed has been formed under subaerial conditions, and that the severe winters of that period caused the breaking up of the rocks of which it is formed. Fortunately we have other evidences of the existence of a land surface at this period. This subaerial bed is found at various levels around the coast, down to fifty feet below high water mark, at which level it has been cut through at Pentuan Valley stream tin works, as shewn in section No. 1, and its subaerial character fully confirmed by finding stools of trees rooted upon it. To admit of the formation of the subaerial bed in section 2, the land must have stood at least as high as it now does, whilst to allow of the growth of the trees shewn in section No. 1, it must have stood at least sixty feet higher than it now does; and we thus arrive at the stage d. in diagram, at which the land stood much higher than now. Beneath the subaerial bed is an old sea beach with a bed of marine shingle and shells, No. 1 in section, and from it we learn that the land now at the mean level of the sea (and which we have just seen, had stood sixty feet higher than it now does) must at some still earlier time, have stood at least twelve feet lower, or as shewn in the diagram at e. Such is the story told to the geologist by the rocks and beds of pebbles, and angular stones of which we have here a section. Before leaving it, there is one other remark may be made concerning it. When the beach now being worn between high and low water mark, reaches the base of the second or higher beach, all traces of the latter will be merged in the former, and if the rocks had not been of a very hard nature, this would have been accomplished before now. It is probable that this result has been achieved by the waves around the greater part of the coast of England, as most of the shore rocks are of a much softer nature than those of Cornwall and Devon.

The movements of the earth's surface above depicted have taken place at the most southern point of the English coast. At the other extremity of the island there are many proofs of similar oscillations. Thus a careful consideration of the raised beaches, buried forests, ice scratchings and boulder drift of Scotland, has demonstrated that immediately anterior to the present period, there was a time when the land stood thirty feet lower than it now does; that this was preceded by a period when it stood at least one hundred feet higher than now; and that that again was preceded by a geological period when the whole country (Scotland) stood at least five hundred feet lower, and the stratified gravels with sea shells of the boulder period were deposited. These oscillations are shewn in diagram No. 2,

Section No. 4
NEAR PORTSMOUTH.



Section No. 3
TEAM VALLEY, DURHAM.

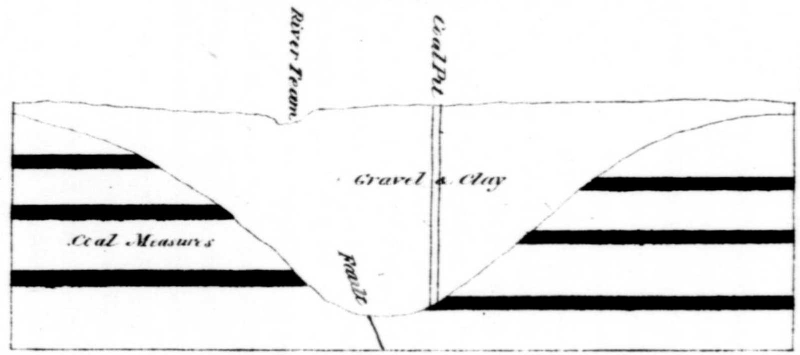
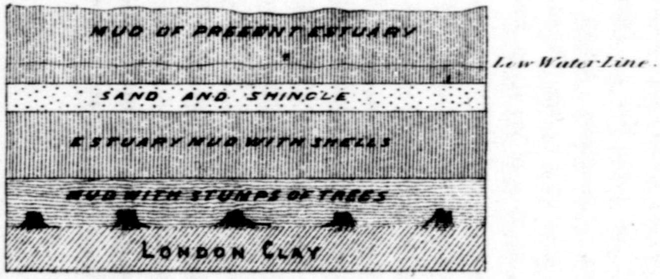


DIAGRAM No. 3
To illustrate changes of level in Nova Scotia

DIAGRAM No. 2
To illustrate changes of level in

Section No. 4
NEAR PORTSMOUTH.



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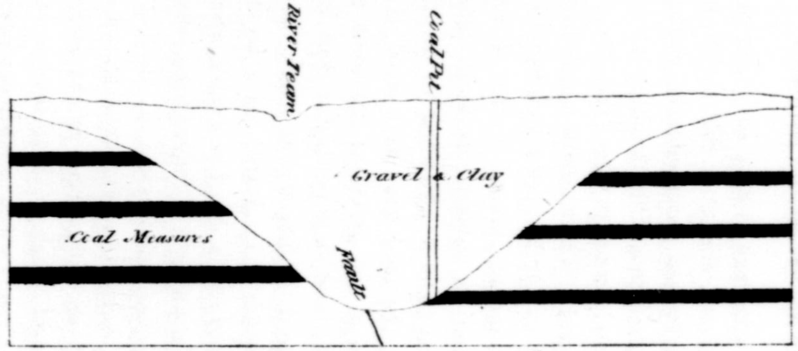

DIAGRAM No. 3
To illustrate changes of level in Nova Scotia during Post tertiary times.

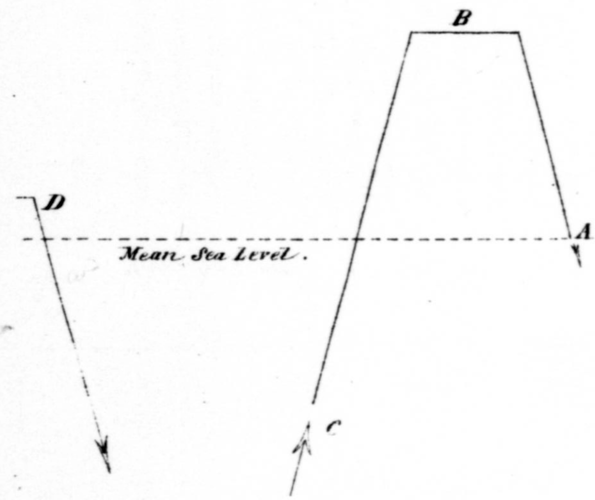

DIAGRAM No. 2
To illustrate changes of level in Scotland during Post tertiary times.

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and have a remarkable resemblance to those of the extreme south of England.

Of the first of these stages, going backwards from the present, that at which the land stood thirty feet lower than it now does, we have the most evidence, because the last action of the sea tends to obliterate the records of preceding events. This stage must have been of very long duration, for all around the Mull of Cantyre, the former sea level is marked by long caves now high above the reach of the tide. From the length of these, it has been computed that the sea must have stood much longer at that level than it has at the present. Beneath the gravels and clays of this period, lie buried peat beds and forests, speaking to us of that earlier period of elevation; whilst these, in their turn, are underlaid by the northern drift of the great submergence.

I have purposely drawn my illustrations from two points three hundred and fifty miles apart, to shew how general these movements have been; but from almost any part of the British islands I might have drawn similar conclusions, or I might say on the other hand, facts for the explanation of which our diagrams would afford the key. Take for example the section of the valley of the Team, a small tributary of the Tyne (section No. 3.) We have here a stream cutting its way through beds of gravel and clay raised twenty feet above high water mark, and these beds being sunk through at a. for a coal pit, are found to occupy a deep valley cut through the old rocks of the coal measures. The bottom of this old valley is sixty feet below high water mark, and must have been excavated when the whole country stood much higher than now. We have now an insignificant stream, but when this valley was scooped out a large river must have rolled down it, and this is curiously confirmed by other evidence that at one time the river Wear once joined the Tyne by way of the Team valley. This old valley was probably scooped out, at a period anterior to the great submergence of the northern drift and re-excavated during the elevation that succeeded it. By the last depression shewn in diagram No. 2, it was filled up with gravels and clays, and by the last elevation, these beds have been raised twenty feet above the tide, and are being cut into by the present stream. There is not a tidal river in all England that does not afford some evidence of a former elevation and of this last depression.

Section No. 4 was obtained during some excavations in Portsmouth harbour, when remains of an ancient forest were found beneath estuary mud and sand. The forest probably grew during the elevation shewn in the diagram at c. As the land was gradually carried downwards, it was covered with estuarine mud, similar to that forming at present. At the lowest point, reached by the depression, the sand and gravel of the section was deposited by the action of a more open sea, whilst the last elevation has brought it to a similar stage to that at which the old estuarine mud was formed.

Whatever part of the world we visit we find similar proofs of elevation and submergence—some countries are slowly rising, others slowly sinking, others now stationary; but all without exception in their raised marine beds and buried forests, shew that they have been alternately above and below the waters.

I have constructed diagram No. 3 to shew changes of level which Nova Scotia has experienced in very recent geological times. We have first, a bed of peat uderlying the boulder clay at the River of Inhabitants, Cape Breton, which gives us a land surface (d. in diagram) anterior to the period of the deposition of the boulder clay, or the glacial period. During the glacial period there is proof in the shells of the St. Lawrence and other parts of North America, that the land stood at least five hundred feet lower than it now does, as shewn in the diagram at c. Next we have the period when the land stood at least thirty feet higher than now, and the submerged forest at La Planche river flourished, and then the subsidence that has continued to the present time and is still in progress.

The illustrations I have given are sufficient to convince the most sceptical that the general opinion respecting the stability of the earth's surface is illusive and unreal, and that the upheavals and depressions, shewn in geological records, do not speak to us of convulsions and catastrophes to which the earth was once subject, and from which it is now free, but are part of a general law still in operation.

The right appreciation of these oscillations of level, lie at the foundation of geological knowledge. The upheaval of sea sediments—the submergence of land surfaces—the carrying down into the very bowels of the earth, beds of sand and shingle and their metamorphism by electrical, chemical, or igneous agencies, are but a part of the phenomena on which a flood of light is thrown. Whilst the superficial deposits are being reconstructed or covered up by those later formed, we must suppose the movements we have been considering, extending far below those, to, and through the older and solider rocks, which are rent and fissured and contorted. The rents so formed are filled with foreign materials, and we are thus led to the origin of mineral veins, and their subsequent upheaval and exposure by denudation.

The oscillations I have portrayed in the diagrams, have taken place in the most recent geological times, they lie indeed at the very threshold of geological enquiry,—and yet so slow are these movements, that the whole of man's existence, on the earth, that we have any trace of, does not extend beyond the first depression. The flint implements found at Amiens and at Biddenham, near Bedford, are found in the reconstructed drift of this period, and the ancient canoes found in raised beds of silt, near Glasgow, cannot be older than the commencement of the last elevation.

Whilst ethnologists are pushing back the creation of man to a much earlier period than was once supposed,—geologists shew how brief was even that extended time compared with the long roll of ages during which the world has existed in subjection to the natural laws that now prevail. What the astronomer has done for space, the geologist has done for time. We find space so vast (and I speak not of space in the abstract, which is illimitable, but of space that the astronomer has measured and shewn to be studded with shining globes), that to give an idea of the distance of some of these worlds, we have not expressed it in millions of miles, but in the number of years that light, travelling at the rate of 12,000,000 miles per minute, takes in reaching us from these remote orbs. We stand in the clear night, looking at the firmanent studded with a thousand gems, and we can scarcely realize the fact, that we are not looking at the stars themselves, but at rays of light that left their surfaces in some cases, hundreds of years ago—so vast is space.

And in regard to time, not in the abstract, but during which the geologist has shewn the world to have been peopled with animal and vegetable life, I think no one who has examined the evidences, will accuse the geologist of exaggeration, when he speaks of millions of years, of the roll of uncounted ages. Man's history—his whole existence on the face of the earth, does not fill up a single beat of the oscillations we have been considering—scarcely bridges across the last small depression in the diagrams. We have depicted in the diagrams the commencement of a series of curves that run back to the earliest Silarian times, and only at the end of the last of these do we find any trace of man; like a little skiff, borne on the last wave next the shore and beyond an ocean extending to the horizon, and how far beyond our ken cannot reach.

I know there are those who are startled at these assertions of the extreme antiquity of the world, who think that they tend to sap the foundations of religion—that they are opposed to the teaching of the Scriptures. To those I would say—There was once an island in the midst of the ocean, around it next the sea shore were extensive sand banks, and the islanders, fearing that in some storm, the angry sea might overwhelm their island, had erected wooden bulwarks, fixed in the sand, to stem the force of the waves; but one by one these had been washed away until only a few remained. And then came a mighty storm, such as they had not before known. The crested billows, mountains high, dashed against the shore; and as night closed around them, the fear-stricken islanders, saw that the sand banks were undermined, and the last of the buttresses were tumbling into the flood. All through the long night they listened to the howling of the storm, and trembled lest the whole island should be swallowed up. But when morning came, they found that the sea had washed away the sand banks that had accumulated through long centuries, and had exposed a bed of solid granite, that, before unknown to them, had formed the foundation of their island, and against which the angry sea raged in vain. And is not so with religion? have we not reared bulwarks and buttresses, which we, puny mortals, think are necessary for its support? The sea of knowledge ever spreading, sweeps them away, but exposes the eternal rock of truth on which religion is built.

ART. IV.—*On the characteristic Fossils of different Coal seams in Nova Scotia.* By HENRY POOLE.

[*Read March* 2, 1863.]

AT a late meeting of one of the Scientific Societies in England, I noticed that the question had been asked, whether any law governed the position of fossils in the Coal Formations, and if any attempts had been made to classify or tabulate the *loci* or places in which certain fossils were found, above, or below coal seams, so as to guide explorers in their search for workable seams of coal.

In reply, it was regretted that much attention had not been paid to the subject; and, with the exception of the fact observed by Sir William Logan, that the Stigmaria ficoides, when found in an underclay, always indicates a seam of coal, even if only half an inch in thickness, I am not aware of any other general law having been established.

I am inclined to believe that further research will shew that the difference in quality of the different coal fields is owing to the difference of the vegetation that produced them. That this vegetation varied, according to the nature of the subsoil in which it grew; whether arenaceous, argillaceous, or calcareous; or whether it grew in fresh water or saline swamps. My observations lead me to infer that almost every—perhaps every—coal seam has some distinct fossil which belongs to its own period; while there are other fossils, particularly ferns, which appear to prevail through a large number of coal seams indiscriminately.

I think it is very important that the fossils of every coal seam should be carefully noted; and particularly the position, whether above or below the seam, or in any parting which may occur throughout the thick seams.

Theory is of little value, unless it can be supported by facts. I have, therefore, collected and grouped together such facts as I am able to extract from my notes on the different Coal Fields in this Province which I have visited, and which are necessarily very imperfect, as they were not taken at the time, with reference to the subject now under discussion.

Albion Mines Coal Field, Pictou,—commencing at Robert Culton's farm on the east river, one and a-half mile to the south of the Fraser Coal Mine District, and which is the lowest place in geological position that I have examined, I found the coal measures situated on the McCulloch brook to dip 22° N. 40° E., by magnet; but a fault has disturbed the measures, which are here in confusion. They consist of bright bitumenous coal, and cannel-like curled oil coal, with bitumenous shales. In the latter is an abundance of fossils. I obtained Lepidodendron, Cordaites, and other markings, like fruits similar to the Cardiocarpon acutum of Mantell; also, a stalk with a head like ryegrass, supposed to be "Antholithes." One band or more of the shales contains innumerable Spirorbis and Cyprides shells, and accompanying them are ganoid fish scales, teeth, and spines. Thick plates or scales are also found on the same slab with the Cardiocarpon, and many of them resemble the figured plates of the Coccosteus cuspidatus.

Proceeding down the McCulloch brook, but following the coal formation in ascending order, there are appearances of "crops" of coal and shales in several places, but they have not been examined. On coming within the boundary of the Fraser Mine there is the crop of a coal seam five feet thick, dipping 21° N. 25° W., of inferior quality, with a band of Calc spar running through it, with Stigmaria, Sigillaria and Cordaites, in the soft crumbly coal. Overlying this coal at about 200 feet of section, is a thin seam of coal dipping 16° N. 65° W.; and 30 feet above it is a band of oil coal dipping 13° N. 67° W., which is very rich, and varying from 2 to 20 inches in thickness; and from the free way in which it burns, throwing off stars or sparks of light, it has been named Stellar Coal to distinguish it.

There is a black friable clay above the oil coal with ironstone balls in the shale above the clay. Lepidodendron and Stigmaria have been found in the coaly bands; and Cordaites in small fragments, with one Cardiocarpon (similar to those found on Robort Cutton's farm) have been found in the clay ironstone; also a few ganoid scales and nodules full of soft ochreous matter of no decided character. In a trial pit sunk at 200 feet above the oil coal, a large bifurcated Stigmaria rootlet was found in an underclay, 3 feet in length, 12 inches in diameter of the main root; and about 6 inches across on either fork. About 250 feet of section above the stellar is the crop of a seam of bitumenous coal in the brook,—thickness not known, with a band of shale full of Cypris shells dipping N. 20° W.

A short distance further north, in ascending order, some bands of sandstone crop out dipping 15° N. 22° E.; a 5 feet seam of good coal was next observed dipping 7½° N. 26° E, but no fossils obtained in this pit. About 100 feet further north, a seam of coal 19 feet 5 inches, dipping 12° N. 40° E., was sunk through, and Lepidodendron found in the band about 3 feet from the bottom. This seam is thought to be a continuation of the deep seam, but the land is here much disturbed by faults. One hundred and fifty feet above the deep coal seam on section, is another coal seam dipping N., which extends for 40 yards across the brook, so corresponds with the main coal,—Stigmaria were got in the underclay of this seam. A trial pit sunk in advance on the crop of this seam, outside of the General Mining Association's bounds, struck the coal at 32 feet down. At 40 feet the bore rods dropped 3 feet, and the water went away, but returned again. While sinking, the miners plugged this hole, but the water made them abandon the sinking. Sixty yards to the north another pit was sunk 15½ feet in arenaceous shales dipping 18° N. 45° E., containing many impressions of Calamites, Poacites, Neuropteris, and Lepidodendron. Beyond this point on the McCulloch brook, one quarter mile from the General Mining Association's No. 4 corner, where the Garloch road bridge crosses the brook, a sandstone quarry was opened dipping 25° N. 40° E., containing fucoid markings, but nothing well defined.

In a trial pit near Wm. Porter's wood road, Poacites and Cypris shells were found in the shales, but the hole had caved in, so I could not obtain the dip.

Below the middle river road, half a mile on the McCulloch brook, is a sandstone bluff about 30 feet high, which shows a dip of 14° S. 25° E., or reversed to the previous measures; therefore I conceive it has been affected by the ridge of conglomerate which rises up further to the north; and extends across between the east and middle rivers.

Turning to the section of the coal brook on the East River, the deepest underlying measures observed are some bands of sandstone, and a thin seam of coal containing Stigmaria about 30 feet below the Fraser oil coal.

The Fraser Oil Coal is a very peculiar and valuable product, and therefore I think it deserving of a minute description. It is found at a vertical depth of 528 feet below the Albion Mines' deep seam. The roof of this deposit consists of soft, friable shales, with bands of Ironstone nodules, Stigmaria, Sigillaria, and detached Neuropteris leaves, then 14 inches of inferior bituminous coal, directly above the o l coal, which varies in thickness from 4 inches up to 20 inches, and has a smooth, regular parting, both above from the bituminous coal, and below from the oil shale. Throughout its entire thickness, it has a curled and twisted structure. Many of the fractures look like the casts of shells, and the sharp edges are polished and slickersided. No fossils have hitherto been found in this curly oil coal, but scales of calcareous spar are often met with in the joints.

The oil shale next below is about 2 feet thick, and contains ganoid fish scales; also, two or three varieties of Lepidodendron, beautifully preserved; also, leaves of Cordaites of various lengths and breadths, which have undergone so little change, that pieces 4 to 6 inches long, when first removed from their slabs, preserved their elasticity. In the argillaceous shales below are innumerable Cypris and Spirorbis shells. Stigmaria roots are found in some of the overlying ironstone bands.

In sinking a shaft 150 feet deep to the Dr. McGregor coal seam, an upright Sigillaria stem was found, which measured 21 inches across the one way, and 16 inches in the opposite direction, with a coaly bark surrounding it; but the miners, unfortunately, could not take it out in a good state of preservation. Neuropteris leaves were also obtained, and one large leaf, supposed to be a Cordiates, which had apparently undergone very little change. This is, I believe, the first instance of an upright stem having been found in the Albion coal measures; and was not to have been expected in a thick coal seam, according to Dr. Dawson's reasoning in the Acadian Geology—page 246.

Borings and trial pits down the coal brook have shewn some small veins of coal, with shales and sandstone, but no fossils have been collected in them, or in the ironstone bands, of which the exact position of the fossils has been particularly recorded. I therefore pass on to the deep seam, which, in sinking the engine pit, was found to be 24 feet 9 inches. In the roof was found a thin band of fish teeth, much decayed; also, Coprolites; but, as they have not been observed in the roof of the deep seam elsewhere, it would appear to be a partial deposit. I have no record of any other fossils found in the trial pits sunk on the crop of this seam.

The Main Coal is one of the thickest known bituminous coal seams, and measured 39 feet 11 inches in the engine shaft sunk through it to reach the deep seam 157½ feet below. It is overlaid by an extraordinary thickness of shales and ironstone bands, without any intervening sandstones or limestones. In sinking the engine shaft, 450 feet of shales were passed through, but the only fossils observed were Cordaites. Some of them were several inches broad, and from a foot to 18 inches long, found in the shales when cutting the inclined railroad to the Dalhousie pits. In the sample sent to the New York Exhibition, vegetable remains and Spirorbis were found in the top 3 inches. In the "holing stone," about 6 feet from the roof, are found remains of large fishes and Coprolites; also, Spirorbis, attached to much decayed plants,—in the same way as we find their living representatives at the present time attached to the sea-weed growing on our shores,—large scales of ganoid fishes, and fragments of the large, bony spines with which those fish were armed. It was also in this bed that Dr. Dawson found the upper part of a skull 7 inches in breadth and 5 inches in width, and armed with strong, conical teeth. This fossil was described by Professor Owen under the name of "Baphetes Planiceps." Alluding to its supposed amphibious habits, and the flatness of its skull, Professor Owen believed the creature to which it belonged to have been a gigantic batrachian, or frog-like reptile. From the same band at the Dalhousie pit, a bone was obtained 4 inches in length, broken at each end, and about quarter of an inch in diameter, with a hole through it similar to a tobacco pipe. There was an enlargement at one end, but nothing sufficiently distinct to prove satisfactorily what it was. It was given to Sir Charles Lyell; and Sir Philip Egerton and Professor Owen differed as to whether it belonged to a fish or a reptile; and it is to be regretted that no more bones were discovered. There is also a fine species of Diplodus tooth found in this band, which Dr. Dawson considers to be new, and has named it *Diplodus Acenaces*.

In the next ironstone band 16 feet from the roof, prostrate trunks with coaly layers are found of Lepidodendron, Ulodendron, Sigillaria, Stigmaria, &c. In the coal band, from 20 to 24 feet down, many minute species of fish are found throughout the coal. At 35 feet a fossil trunk in pyrites was observed; but very little is known about the lower part of the main seam, as only an occasional cross-cut is made into that part of the seam. All these seams on the coal brook dip pretty uniformly,—about 18° N. 40° E.; or about one foot to three. In sinking the furnace shaft for the

Dalhousie pits, down on to the main coal, they found, a little above the coal roof, a band of concretionary clay iron-stones,—which many people called fossil oysters: they were nearly round, about 3 inches in diameter, and about 1½ inch in thickness. I could never find any fossil nucleus in them; and I have thought they have been formed by the decomposition of jelly fish.

Going westward from the Dalhousie pits, a band of sandstones crops out, which has been extensively quarried for the use of the works. A great many fucoid and other fossil markings are found through this sandstone, which is not conformable to the main coal measures, but dips to the north. In a trial pit sunk through this sandstone, a fossil fruit was found resembling an olive. This sandstone is overlaid by small seams of coal, of a similar character to the Sydney coals, alternating with shales and sandstones. One seam of coal I traced for upwards of half a mile between two brooks, by observing the change in the forest trees from birch to spruce,—the former growing on the slates overlying the coal, and the spruce growing on the sandstones. In one of these shale bands I obtained a fine fossil Lepidostrobus, which looked like a head of bearded barley, and which is supposed to be the seed-bearing head of the Lepidodendron; but fossils were not often found in these measures, which were much disturbed and broken up by faults, as we went to the north, or towards the New Glasgow Conglomerate. About one quarter mile to the north of the main engine pit, on the west bank of the East River, and at the mouth of the coal brook, the measures shew a dip to the S. E.; and at the mouth of a small brook half a mile further north, near Pensioner Calder's house, a fault shows dipping S. E., with Cypris shells in the shales; and Stigmaria and Calamites in the sandstone dipping 63° S. 20° E. Proceeding further north, near the Gondola wharf, the sandstones dip 36° S. 20° E.; with ripple marks and worm tracks, and shales dip 50° S. 43° E.

Two small seams of coal were found years ago, where Blackwood's mill was erected, dipping at a high angle to the S. E., and near them a trial pit was sunk for oil coal to some depth, but unsuccessfully, and filled up again. On the quarry road, oil coal was found dipping 26° S. 45° E.; and a few yards further east, a pit was sunk 15 feet down, and one foot of good oil coal obtained; dip 50° S. 20° W., but it soon thinned out to a mere thread; it is close upon the back of the conglomerate ridge; and about 50 yards to the east of this pit, red sandstone dips 64° N. 80° E. There is, therefore, upwards of a mile of the coal measures which dip to the S. E., or nearly in an opposite direction to the workable coal seams.

The Conglomerate ridge dips about 54° N. 10° E., where it shows in the bank near New Glasgow bridge, and is upwards of 200 yards in breadth. It consists of many bands of coarse conglomerate, and red sandstone of irregular thickness and false stratification; and at least one distinct line of a fault through it. Continuing down the west bank of the East River, there are the remains of a freestone quarry, where good building stone was obtained, and of which I have understood the Province Building was constructed. I have not got the exact dip of these measures to refer to, but they dip moderately to the N. E., and Stigmaria roots, upwards of three feet long, have been found in the lower bands.

At the Deacon's Cove, upwards of a mile below New Glasgow, several trial holes were made in the shales near the mill dam in search of oil coals. One seam was 14 inches thick, dipping 5° a little to the east of north; an inch of coal shews about 15 feet above this seam, containing fish remains. In other trial holes the oil shale was poor, dipped 16° due N., contained Diplodus teeth, a fin, Calamites, and other markings. A pit was sunk in the bank above the dam through light blue arenaceous clayslate, containing an abundance of fossil stems, Neuropteris and Sphenopteris leaves; but all very friable, and hard to preserve. At 23 feet down this pit, was a band containing well preserved Unio shells. At 26 feet down the oil shale was found of a good quality, but only 6½ inches thick, so would not pay to work. There was a hard band full of fish remains just above the oil shale, containing scales, plates, teeth, and spines, but all mixed up in confusion together; also, a band with Cypris shells, but its exact position was not ascertained.

One conical tooth Dr. Dawson thought was probably a Rhizodus, but a new species. Broad, flat scales were punctured, and lined after the manner of the Osteoplax, of McCoy; others marked with fine, wavy lines, as in Holoptychius, or Rhizodus. The flat, sabre-like spines resemble in form those of the Devonian Machœracanthi.

Proceeding down the river towards the north, the land is low, and does not shew any rock sections. At Skinner's and Dunbar's Points are thick gravel banks, which have been cut through in making the railroad.

Opposite to the Loading Ground, on Matheson's farm, a thin vein of coal, 1 foot 3 inches thick, was obtained, in a pit sunk near his house, at a depth of 19½ feet. It was overlaid by a band of soft, blue sandy clay-slate, dipping 5° N. 25° E., and containing many Pecopteris, Neuropteris, Lepidostrobus, and Calamites, with sandstone bands below the coal, through which a borehole was put down for 70 feet, but no coal obtained. At 50 feet, a heavy spring of water was tapped, which will be a valuable discovery to the farm.

On Forbes's Point, a borehole was put down 75 feet, but nothing obtained but red and white sandstones, in thick bands. At low water mark, on the extreme point called Skinner's Point, an inch of coal and fireclay is seen to crop out, but no other coal has been observed along the shore of the Middle River.

The overlying sandstones on the point dip 7° N. 74° E. Thick measures of disturbed conglomerate underlie the coal and fireclay near the Little Gut on the north side.

Returning towards the head of the McLellan brook, which is to the eastward of the Albion Mines, and flows into the East River above New Glasgow, the coal measures have been much disturbed, and none of the thick seams of coal have been discovered in the sections exposed upon its banks; while its coal seams and shales do not correspond with any of the sections of the East River. On McLean's brook, which is the point furthest south that I have examined, and about a mile up from the road, are thick bands of conglomerate and slate; then a coaly band said to be 4 feet thick; then sandstones in thick bands with Calamites and Stigmaria dipping 20° N. 70° W. with slate below dipping 50° N. 35° W. This appears to be the lowest part of the coal measures, as the limestone shews a little further up the brook.

A small coal seam, about 2 feet, has been slightly worked, which crops out in the bank on the side of McPherson Fraser's mill dam; and another seam is seen in the brook a short distance below the mill. Water prevented me from getting their exact thicknesses, or bearings, but the latter appeared to be to the N. E.

At Andrew Patrick's mine, the shales, bituminous shales and sandstones which are in ascending geological order, dip 16° N. 38° E. A slope has been driven down 70 feet. There was 1 foot thick of bituminous shale at the crop; 7½ feet thick at the face; curly at the roof, and yielding over 60 gallons of oil to the ton; slickersided at the floor, in which I found a Lepidodendron at the face of the slope; the shale dipped 30° N. 45° E. A second seam about 4 inches thick, and of richer quality, (and at a distance of 44 yards on the surface,) above the worked seam dipped 29° N. 20° E. These works soon came to an end, for the measures reversed about 150 yards down the stream to the north, and dipped 25° S. 20° E.

Lower down the stream, on Turnbull's farm, the measures dip 17° S. 15° E.; and on McDonald's farm, the shales dip 21° S. 15° E., where I got Lepidodendrons and a few Neuropteris leaves in the shales; also ganoid scales, and some peculiar flat wrinkled fossils; which Professor

Agassiz named Holoptychius scales, but which Dr. Dawson has pronounced to be shells, and named them *Naiadites obtusa.*

Following down the windings of the McLellan brook, thick bands of sandstone are seen dipping 16° S. 58° E., and 19° S. 35° E.; also a seam of coal one foot in thickness with a dip of 7° S. 77° E. At S. Black's burnt mill dam, a fault or disturbance has caused the measures to be thrown out of their position; bands of rippled marked and curled sandstone dip 8° S. 20° E. By the bridge thick bands of shales dip 6° S. 25° E.; and one band about 14 inches is bituminous, and yields about 30 gallons of coal oil to the ton. At Rock point, on the opposite side of Geo. Fraser's intervale, are thick beds of shale which have been cut through by the river, and dip 9° S. 70° E., and contain Cyprides, fish scales, and spines, and leaf markings.

Going west, and crossing the underlying measures—as shewn in the brook at 100 yards from the east side boundary line of the General Mining Association,—are bands of cannel coal dipping 10° S. 70° E. The best quality at top is 10 inches; then shaly 2.6; bottom best, 1 foot; total thickness 4.4; abundance of Cypris shells are found in the shales below.

Near McLellan's house on the road side, the shales dip 22° N. 60° W., and in the brook 19° due east.

Going towards New Glasgow, a coal seam crops out in Potter's brook, dipping N. W.; also a seam 3 6 of coal at the back of New Glasgow, worked by John McKay, dips 13° N. 60° W. A coaly shale band directly above this coal, contains innumerable scales and plates of fish, named Rhizodus by Dr. Dawson. Teeth of *Diplodus penetrans*—a small and pretty species of shark-like fish of the Hybodont family; also, teeth supposed to belong to the Ctenoptychius, another shark. In one slab, 4 by 6 inches on the surface, I counted 15 teeth of a larger kind of Diplodus: they averaged half an inch in diameter. No underclay but a band of limestone lies just below this coal. At Wright's adit, not 100 yards higher up the brook, the coal seam is worked 4.7 high, and dips 18° N. 10° E, and has the same kind of roof, with fish scales and teeth, and a pavement of limestone 22 inches thick. The measures dip steeper at the face of the level driven in 100 yards; but as this coal is near the Conglomerate ridge and dips towards it, it is not likely that it will hold good very far.

The Conglomerate ridge on the New Glasgow side of the East River is much higher (upwards of 200 feet), and apparently wider than on the western side, and as the surface is covered with gravel, the dip is not visible.

About half a mile below New Glasgow, a trial pit was sunk 31⅓ feet at Sinclair's cove, looking for oil coal. They passed through 16 feet of drift; 9 feet of shales; 1 foot 2 inches of black bat and ironstone; then 10 inches of good curly oil bat dipping 10° N. 20° E.; then 9 inches of inferior quality which would burn; then 6 inches of curled fireclay which would not burn, succeeded by a mottled limestone 3 inches thick, dipping 8° N. 25° E.; fireclay below, 2 feet thick.

This limestone is also visible on the top of New Glasgow hill, about two miles off on the line of strike. I could not find any fossils in this pit.

Continuing down the bank side of the East River, near to the junction of the Smelt brook, were indications of the crop of sandstone bands; then a band of 4 inches thick of concretionary limestone, with the lime weathered out. The sample sent to Dr. Dawson contained a fish scale, marked like Gyrolopis. This was overlaid by a thick band of coarse sandstone, full of hard, red, flattened concretionary balls, and ripple marked.

At the point of junction, on the north side, between the Smelt brook and East River, quantities of pieces of bituminous shales were lying on the shore, similar to band No. 1, described hereafter, and which I was not certain whether they had fallen out of the bank above, which was much decomposed, or if they had been washed down the Smelt brook, from where the No. 1 band crosses that stream to the eastward. I am inclined to think the former, as the shales are of too friable a nature to travel far. Then succeed sandstones, with Stigmaria roots and Calamites, and above them soft, yellow, sandy shales, containing Unio shells; then a half-inch vein of coal, with fireclay above and below it, which is succeeded by a sandstone 1 foot 6 inches thick, in which is an "Upthrow Fault," to the north or rise of the measures of several feet, which was not accurately ascertained from the bank being covered with debris. Above this sandstone is 4 feet of arenaceous shale, then 10 inches of oil shale (3rd band of section), in the roof of which were Poacites and Lepidodendrons; also, fish jaws of a Lepidoid fish, perhaps Palæoniscus; teeth were like the Diplopterus; ganoid scales and spines, sabre-shaped, like the Machœracanthus, of Devonian age. Coprolites were also found. Then came 1 foot 6 inches of shale above, then 6 inches of sandstone, then 4 feet of shale, succeeded by No. 2 oil shale, one foot thick, the richest in quality, and containing fish scales, then 1 foot 6 inches of sandy shale, overlaid by No. 1 oil shale, 6 inches thick, containing Corprolites and Diplodus teeth, buckler-shaped scales, resembling the Coccosteus. The whole of these measures dip 10° N. 30° E., but were found to be too thin for profitable working. No actual measurements have been taken to the north of this place, but sandstones are seen cropping out at several points and bends in the river; while at about 2 miles distance is a freestone quarry, of very good building stone, called the Eagle Rock quarry.

On the opposite side of Pictou harbour, at the Acadia quarry, the freestones dip 22° S. 67° E. At Dickson's mill, near the Town Gut, Pictou, the sandstones dip 22° S. 85° E., and have numerous erect Calamites shewing through the measures. There is a good deal of drift covering the hills, so that the rocks are not visible, except where cuttings have been made, or trial pits sunk. One pit was put down at the back of the town of Pictou 27 feet. A 6 foot band of sandstone, with coaly markings and pyrites, dipping 17° to the S. E., was passed through, succeeded by light blue shaly marl, dipping 24° not regular. I did not see anything to encourage the expectation of finding a workable seam of coal there. At a hole dug on Mr. Paterson's farm, near the gas works, underlying sandstone, is a small seam of coal, about 7 inches thick, dipping 22° south, with an underclay. Fossil ferns and stigmaria markings are found in the sandstone. A deep borehole has been put down by Mr. Primrose, in his field, but no coal found; and, from the position of these measures overlying the conglomerate ridge of Roger's hill, it would appear that they correspond in geological position with the carboniferous formation to the north of New Glasgow, or the newer coal formation of Dawson. I had intended to have prepared a section of the coal measures, on the eastern side of Cape Breton, so as to compare their fossils with those of the Pictou coal field, but I found that it would extend my paper to an unreasonable length, and I shall therefore only refer to those fossils incidentally for comparison.

The distance from Robert Culton's farm to Skinner's Point is about 7 miles, and the measures dip about one foot to three for 3 miles; that is, from Robert Culton's to the conglomerate ridge at New Glasgow, equal to a vertical thickness of 5280 feet, and the 4 miles from the conglomerate to Skinner's Point have a dip of about 1 to 10, equal to a vertical thickness of 2112 feet, or a total thickness of 7392 feet. Only 3 small coal seams have been yet found in the latter section, and the thickest of them is only 15 inches, and the other two do not exceed an inch apiece, while to the south of the conglomerate there are 18 known seams, giving a total thickness of 136 feet.

Professor Forbes has stated that all varieties of sea-bottom are not equally capable of sustaining animal and vegetable life. In all the zones of depth, there are occasionally more or less desert tracts, usually of sand u, N. S.

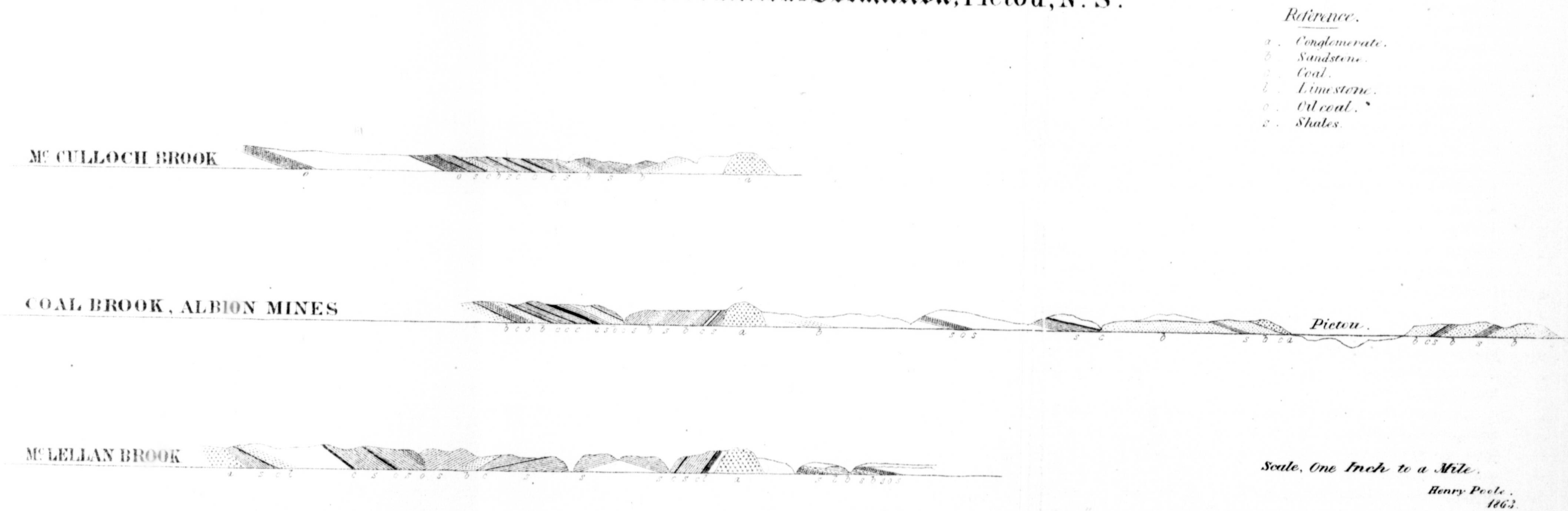
Reference.

a. *Conglomerate.*
b. *Sandstone.*
c. *Coal.*
l. *Limestone.*
o. *Oil coal.*
s. *Shales.*

Scale, One Inch to a Mile.

Henry Poole.
1863.

Sections of the Carboniferous Formation, Pictou, N. S.



C. & A. Clarke, Lithographers, Bedford Row, Halifax, N. S.

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or mud, on which few animals are found, or, if present, are only peculiar to those localities,—each species being adapted to live on certain sorts of sea bottom, only beds of molluscs do not increase in an indefinite extent. They may die out, in consequence of their own increase changing the nature of the ground. Thus a bed of scallops (*Pecten opercularis*), or of oysters, having increased to such an extent that the ground is completely changed, in consequence of the accumulation of the remains of dead scallops, or oysters, becomes unfitted for the further sustenance of the tribe. The young cease to be developed there, and the race dies out, and becomes silted up or imbedded in sediment; when, the ground being renewed, it may be succeeded either by a fresh colony of scallops, or by some other species. It is precisely the same as what takes place among plants: the American forests of pine and spruce are succeeded by the deciduous birch.

I consider this is a plausible way of accounting for the formation of our oil coal shales in the coal formation, which are irregular in their thicknesses, varying from a few inches up to 2 feet, and also of limited areas, not being found distributed over large surfaces. The homogeneity of the bands does not indicate a succession of thin deposits; while the nearly total absence of vegetable fossils, and the more frequent abundance of fish and mollusc remains, lead me to suppose that animal and not vegetable life has produced the deposit from which our coal oils are being extracted. The streak of these oil shales is also brown, instead of black, which is the characteristic of all true coals.

Dr. Dawson has divided the coal formation into three groups. The upper or newer coal formation is about 3000 feet thick—the characteristic fossils are Carboniferous wood, Calamites and Ferns. The localities are north of Cobequid mountain, Colchester, Joggins' coast, west coast of Northumberland, and Pictou. No workable seam has, I believe, been found in this group in Nova Scotia. The second group—lower or older coal formation—is about 4000 feet thick. Its characteristic fossils are Stigmaria, Sigillaria, Lepidodendron, Poacites or Cordaites, Pecopteris, Neuropteris, Sphenopteris, Odontopteris, Dictyopteris, Favularia, Astrophillites, Calamites, Equisetœ among plants. Cypris, Spirorbis, Modiola and Unio among shells. Palœoniscus Holoptychius, Megalicthys, Diplodus, and Diplopterus among fish; and Baphetes Planiceps as a reptile. The localities are, north and south sides of Cobequid mountain, Joggins, East River of Pictou, Port Hood, River Inhabitants, and eastern part of Cape Breton. The finest sections exposed are at Sydney, and Joggins' shore.

The third group, lower carboniferous or gypsiferous formation is about 6000 feet thick. Its characteristic fossils are, Productœ, Terebratulœ, Encrinites and Madrepores among shells found in limestone, Coniferous wood, Lepidodendron and Poacites found in shales and sandstones. Scales of ganoid fish, Trilobites, at Debert river; and Phillipsia, at Windsor. Reptilian footprints, at Partridge Island, near Parrsborough. The localities are Northern Cumberland, Colchester, Hants, Pictou, Musquodoboit, Guysborough, Inverness, Richmond, Victoria, and Cape Breton; also at Chester.

Coal is usually associated with black and gray shales in the carboniferous formation, and the same association occurs in other formations where the coal is too impure, or in too small a quantity to be valuable, Black and gray shales also occur in parts where there is no coal, and in other formations entirely devoid of coal. The coal miner, being accustomed to see coal associated with black and gray shales in other formations, naturally looks upon the occurrence of black and gray shale as indicative of coal. The geologist, on the other hand, having a wider experience, knows that not only do black and gray shales occur where there is no chance of coal being found, but that even thin seams of coal occur in formations where no coal worth working has ever been found. He therefore knows that all "indications" are worthless, as evidence of the presence of the carboniferous formation, except the occurrence of the carboniferous fossils. Even where the fossils occur, there may be no coal; but all sinking for coal, in beds containing any other than the carboniferous fossils, is pure waste of labor and money. The explorer for coal in Nova Scotia should, therefore, bear in mind that no workable seam has been found below the gypsum, or limestone, containing Producta (which, in England, has been called the Farewell coal fossil), Terebratula, or Encrinites; and it would be useless to search for coal in shales below the bands where those fossils occur up the East River, at Stewiacke, Chester bay, New Canaan, Windsor, or other similar formations. At the same time, if the overlying measures continue regular for any distance, I would recommend a careful examination; and should the shales yield fish remains, to carefully note their thickness, and have them tested for oil as well as gas. Many shales are bituminous, from containing innumerable microscopical shells, (Cypris and Spirorbis) and which might be profitably employed as a manure from the quantity of lime which they contain (the present representatives of the former live in ponds or lagoons, and the latter are similar to the *Spirorbis spirillum* now found adhering to the seaweeds on our shores), these shells have been found in many bands with the coals, and generally in the strata overlying the coals.

As might be inferred, when grown where they are found, the Stigmaria or roots of the Sigillaria are found in the underclay; while the upright Sigillaria are met with in a cylindrical state crossing the coal measures at right angles to the present line of dip; and the flattened stems are found in the roof along with innumerable varieties of fern-like leaves which may have belonged to gigantic trees of similar growth to the Sigillaria, or perhaps they may hereafter be found to belong to those very Sigillaria, the same as the Stigmaria are found to be their roots.

Sigillaria stems are rarely found in the Pictou coal measures, while they are abundant in the roof of the Sydney coal mine, and of great size. One that I measured crossing the roof of one of the roadways diagonally, was upwards of forty feet long and over three feet across, but was flattened so that the fossil was not more than two inches thick, and must therefore have been of a cellular nature when growing. There was no branching or break in the whole forty feet, and the side walls of coal prevented the ends of this stem being traced.

The Lepidodendron or "scale marked" plants; like the creeping club moss of our woods, is more commonly met with in the lower coal measures and oil shales of the Pictou coal field. Some specimens obtained at the Fraser mine were beautifully preserved; the markings very sharp and distinct, so that I believe they cannot have been removed from the places where they grew. Some pieces are several inches across, so must have been of much larger growth than the club mosses of the present day. The fruit markings, like Cardiocarpon, having been found only in Culton's shales, would indicate fossils of the lower coal measures; and if found in future explorations would lead me to suppose that the productive coal measures are at some distance above them in geological order. The true Ferns, Pecopteris, Neuropteris, Sphenopteris, &c., are rarely found in the measures of the thick coal seams, and then only as detached leaflets; so may have been drifted, and not grown *in situ*. When found in the Pictou coal measures in any abundance, they are in the overlying clays of the small seams in connexion with the sandstones. They are the most abundant fossils in the roofs of the Sydney and Lingan Mines, which are overlaid by sandstone, and therefore I conclude they are of an arenaceous character, while the overlying argillaceous shales at the Albion Mines seldom contain any thing but the Cordaites, or long narrow leaf markings. I have not observed the Astrophillites in the Pictou coal field, but found them in the roof of the Glace Bay coal, and of an unusually large size by the road side, three miles from Sydney, going from thence to Miré: pieces of coal were dug out of the soil, but no satisfactory exploration has been made in that locality. The Calamites are more frequently found in connexion with thin, than workable seams of coal. Their congeners are the Equisitœ or Horsetails of our swamps and damp shady localities; but I have also observed the latter growing luxuriantly on the sides of the Pictou railroad embankments, where the shales and slack coal have been deposited, and which must be dry localities. I am therefore led to infer that their luxuriant growth is caused by the excess of carbon in the soil, and to theorise that in the period of the coal formation, there was an excess of Carbonic acid in the atmosphere given off from the underlying Limestones, producing the rapid growth of the endogenous plants of those days. Our hops and many other plants annually grow twenty feet and upwards, and therefore there is nothing unreasonable in considering the luxuriant fossils of the coal measures as of annual growth, and consequently rapidly forming a thick bed of decaying vegetable matter; to be afterwards converted into coal.

The following extract, I took from one of our Halifax papers some time ago: —"According to a statement made by Professor Rogers, the number of coal seams in Nova Scotia is about 50, though only five of them are of workable thickness, being equivalent to about 20 feet coal."

In a new edition of the Student's Manual of Geology, by Mr. J. B. Jukes, Director of the Geological Survey in Ireland, published in 1862, page 532, is the following quotation from Dawson's Acadian Geology:— "Altogether there is a thickness of more than 14,000 feet without reaching any exact base, or arriving apparently at the very highest beds of the series. There are 76 beds of coal, of which, however, most are only one or two inches thick, and the thickest not more than four feet." This quotation refers to the Joggins coal field, and not to the whole of Nova Scotia; and it is strange that Mr. Jukes should have overlooked the large coal fields of Sydney and Pictou. The former coal field Dr. Dawson states to show a cross section of 5,000 yards, containing 37 feet of coal included in 34 seams; while further on, he gives the Indian Cove seam at 4 ft. 8 in., the main seam at 6.9; Lloyd's Cove at 5.0, and Cranberry Head seam at 3.8.

Dr. Dawson does not give a detailed section of the Pictou coal field; but he mentions the main seam having a vertical thickness of 37½ feet, and the deep seam 22¼ feet, respectively. As a pillar 36 feet high of the main coal was sent to the Exhibition in London, it is to be hoped that Mr. Jukes will amend this quotation in his next edition.

I feel that the paper which I have just read has not been made as interesting as I could have wished it to be; but I have had to confine myself to facts; and my reason for bringing it before this Society, is to have the little information I have collected about the Pictou Coal Field preserved among your archives for future reference; and also with the hope that others may also be stimulated to collect facts in this and other fields of enquiry, and make this Society the source from whence any useful knowledge in reference to Nova Scotia may be disseminated.

ART. V. — *Contributions to the Icthyology of Nova Scotia.* By J. MATTHEW JONES, F. L. S.

[*Read April* 6, 1863.]

ICTHYOLOGY has unfortunately been a much neglected branch of zoology, and while we have many works treating upon mammalogy, ornithology, and entomology, there are comparatively few authors who have touched upon the natural history of fish. Perhaps this may in some measure be accounted for by the difficulties attending their study, it falling to the lot of few to be situate in the vicinity of a fishing station; a matter of necessity, when not only the habits, but the forms of fishes, are to be carefully observed; as a naturalist, even if placed in the most eligible locality for procuring specimens, can never expect to complete a perfect list of the several species frequenting that locality, without the assistance of fishermen and others, who, from daily experience can add so much valuable information, which it would be almost impossible for one individual, by his own exertions, to become possessed of. At the present day, however, the value of fish considered as an article of food for the human race, attaches an importance to this branch of science which is growing every year, and it is to be hoped that ere long the investigations of naturalists will afford some clue to the occurrence or absence at particular seasons, of those great annual gatherings of fish, which appear on the coasts of north-east America and Europe, and which I would venture to suggest are more particularly influenced by the paucity or abundance of the peculiar food preferred by each genus, and the instinctive habit of searching for suitable positions for spawning.

An interesting fact in connection with the habits of fish is that of the extremely local range of some species, shoals being observed in one particular bay or inlet, while in those contiguous, and only distant a short space, not a specimen of that species can be taken. On our own shores here, this local habit in a more distant degree is well known; the shad, so abundant in the Bay of Fundy, is almost unknown on our eastern coast from Cape Sable to Cape Breton, while looking farther north we find the mackerel, which is common on this coast during the season, absent, in a great measure, from the waters of Newfoundland and Labrador. At the Cape of Good Hope, M. Pappe, an observant naturalist, resident at Cape Town, states that several South African fishes are possessed of similar habits, but more strictly confined, even to bays merely divided by a small promontory; and in the Bermudas, where you would imagine, from the small size of the group, that the waters of the shores would be common to all, I find that some species are only taken on the south side of the islands, and others on the north, although these two positions are only divided from each other by a narrow strip of land, in places not much more than a quarter of a mile in width.

Now, the solution of this apparent mystery is not so difficult as some persons would imagine. We are all aware that each animal has a partiality for some particular kind of food, and wherever that food is to be found in the greatest abundance, there will be found the animal that feeds upon it. Indeed, so well known is this habit to English entomologists, that, when in search of insects, the sight of a field of thistles, or a patch of nettles at a particular season, proclaims the habitat of certain species which frequent those plants. The buffalo of the west prefers the open prairie, clothed with rich succulent grass; the moose, as Capt. Hardy informs us in his widely-known "Sporting Adventures," loves to dwell in forest solitudes and browse on the leaves and tender branches of deciduous trees; while the tiny mole scoops its tortuous way through the rich mould of the alluvial valley, where it finds an abundant supply of its favourite earthworm. And so it is with the various fishes: the halibut, whose ponderous form we so often see in the market, resides, as it were, on the sandy slopes of the deep, where it feeds upon the smaller flat fish, mollusks, and crustaceans. The cod seeks it preys on the well known "banks," while the shad delights in the muddy waters of estuaries, where it fattens, according to Perley, on the shrimp and shad worm. In each position these fish find the food they are partial to. But, although I imagine food to be the great inducement for fish inhabiting particular localities, there is yet another reason to be advanced,—search for a suitable position for spawning. These two circumstances, I firmly believe, have more to do with the appearance of vast shoals of fish, visiting, or residing in particular districts, periodically or otherwise, than aught else. In no other way can we account for the vast annual or continual gatherings of certain fishes in the waters of Europe and north-east America, than by presuming that this search for food and suitable positions for spawning are the main motives. Take the cod fishery of the Grand Bank of Newfoundland, that wonder of icthyology, where, throughout an extent of submarine formation measuring no less than six hundred miles from north to south, and in places, two hundred miles from east to west, countless myriads of gadoid fishes have afforded for more than three centuries and a half, profitable employment to the fisherman, and wholesome food for tens of thousands of the human race. To account for this, we have in the first place to consider the formation of this vast submarine bank, and the peculiar inducements it presents to the innumerable company congregated there. The bank lies as it were at the point where the Gulf Stream and Arctic Current meet each other, and struggling for the mastery deposit the foreign matter they contain on this spot of contention. The Arctic Current it is which has formed and is still forming the bank itself by bringing down annually, through the medium of icebergs, thousands of tons of earth, rocks, and gravelly matter from the frozen north. These icebergs ground upon the bank, and thawing in that position, deposit their geological burdens, thus year by year adding to the mass. To render this conclusion more satisfactory, it will be well to refer to the hydrographer's chart, by which we ascertain that the ocean bed above the bank is shelving, while after passing it, the depth suddenly increases by a precipitous descent of some three thousand feet, thus showing that it is formed from the north, while the current of the Gulf presents a barrier to this deposit, which would otherwise be washed away to the southward, and the great cod fishery of Newfoundland be diminished to a considerable extent.

Now, what an area is here presented for mollusks and crustaceans to inhabit—gravelly beds, sandy slopes, rocky masses large and small to give them shelter, while those thousands of tons of earthy matter filled with minute organisms are continually being brought down from the northward to afford them food. And as it is such a promising pasture for these smaller residents, which, congregating there in myriads to feed and propagate their species, we may readily conclude that these creatures, which form the principal part of the food of the cod, attract those fishes to the position, and finding there an abundance of prey at all seasons, remain to spawn, and as codfish reproduce by millions annually, we can in a measure account for the immense stock which for hundreds of years has filled every part of that immense icthyological storehouse, and proved such a blessing to mankind.

These currents have also a great effect upon the migration of fishes, and to prove the same I have only to call your attention to the following facts. In summer time, when the Gulf Stream extends its northern boundary, which commencing at Cape Cod runs close to our coast, and thence to Newfoundland, several kinds of southern fishes are observed in our waters, one of these I have the pleasure of exhibiting, a species of *Monocanthus,* which is so truly a southern genus that only one species has been recorded as having been captured so far north as Massachusetts. Another, the albicore, so well known in warmer latitudes, is abundant here during the months of July and August, the Rev. John Ambrose having observed twelve at one time off French Village, St. Margaret's Bay. Then as to northern fishes, when in winter time, particularly during the later months of that season and those of spring, when the great Arctic current comes pouring down from the north, forcing the waters of the Gulf to the southward, and washing the banks of Newfoundland, exerts a cooling influence even to the latitude of 40°, brings with it many fishes to our shores whose presence during that particular season I have just mentioned could in no other way be satisfactorily accounted for—for we have the occurrence of the Greenland Shark (*Scymnus borealis*) recently brought to our notice, an inhabitant of the seas of the far north; the Norway Haddock (*Sebastes Norvegicus*), a fine specimen of which I have here before me, an extreme northern fish—and the Cusk (*Brosmius vulgaris*), another strictly northern form, having its proper habitat between the parallels of 60° and 73° north latitude, is also found in our waters. I could add other instances in support of my views, but those I have given, will, I trust, be sufficient to enable you to form some idea of their correctness.

A great question with naturalists has been, as to whether certain fishes inhabiting the seas of Europe and North East America are identical in regard to species, and if identical, how they managed to traverse two or three thousand miles of ocean from their original home. Now, if we can prove the arrival at our shores of fishes from distant latitudes, by means of the great ocean currents which as highways, or I should say, *seaways,* pass as it were our own doors, may we not conclude that these very currents or seaways are the means of affording a communication from or to either side of the Atlantic. And while some of the Carribean types may be carried by the Gulf Stream to our shores, and on to Europe, the Europeon types can be carried to our shores by the Arctic current, which setting from North Europe to Spitzbergen, washes the east coast of Greenland, and passing Iceland arrives at our position.

Some species are more adapted than others from their *peculiar forma-*

tion to wander about the broad expanse of ocean, and like the hawks among birds cleaving the air, propel themselves at a prodigious rate through their watery element. Naturalists are therefore prepared in some measure for the occurrence of such forms in situations where no currents prevail. The most violent storms at sea cannot affect the migration of fishes, even if they blow from a direction contrary to that of the fish's course, for observations prove that the gale which agitates the surface to so great an extent, is not perceptible at a comparatively small depth, and on the principle that migratory birds are generally known to take their course at a great elevation, in order to escape the agitation of the air near the earth's surface, so we may presume that these wandering fishes, gifted with similar instinct, avoid the currents and counter currents of the ocean surface by stemming their way at a depth free from such circumstances. But in case of species known more particularly as inhabitants of the littoral zone, and not endowed with a formation favorable for extensive migration,—I may instance the Blennies or *Gobioidæ*, which are chiefly found in shore waters, rock pools, and among sea weed—we must look to some other agency than the mere motive power of the fish itself. Now, during my investigations in the Bermudian waters, I found that the gulf weed *(Fucus natans)* which is brought to that latitude from the Bahamas, on the eastern edge of the current, and being thrown aside as it were, drifts along from and to all points of the compass as the winds blow, is a perfect preserve for the naturalist, being tenanted by various species of crustaceans, and affording shelter and food to several kinds of fishes. To give you an idea of the vast extent of the fields of this gulf weed which float upon the ocean about the latitude of the Bermudas, I may state, that when a southerly gale blows for some days, the whole coast line of the Islands facing that quarter, becomes choked up with this sea weed, and on gaining an elevated position on land, vast fields are observed still setting in from the ocean. Have we not here again an excellent conveyance for many kinds of fishes, (particularly those unable to take long journeys without assistance) which keeping within the covert of these masses of *fucus* are carried along hundreds of miles, and obtain, the whole voyage, good shelter and abundance of food, which is all a fish requires to bring it safe to other positions, where the temperature of the ocean will not interfere with its constitution. And although the constitutions of fish are in some cases influenced by the temperature of the element they inhabit, and a few degrees above or below a certain temperature will drive them to seek other positions, yet, in many cases, they are not so influenced; and the fact is well authenticated that certain species can bear the test of being frozen in solid ice, and on being gradually thawed, will regain their former signs of vitality, while others have been observed swimming about in hot springs at Manilla and in Barbary, in water of a temperature of from 172_{0} to 185_{0}, and a species of *Silurus*, according to Humboldt, was observed by him thrown up alive with the heated waters of a South American volcano, which were proved to be of a temperature of 210°, *or within two degrees of the boiling point.*

Some marine fish, and certain species of fish-like mammals, appear in some instances to live in fresh water as well as salt. As to the mammals, my friend Capt. Blakiston, the celebrated explorer of the Yangste, states in his recent work that porpoises were seen rolling about in the upper waters of that river, 1,000 miles from the sea, and in reply to a question of mine, he states that the water was perfectly fresh far below this point; so that we have here marine mammals, generally supposed to be unable to exist long in fresh water, disporting themselves hundreds of miles from their briny home, in an element very different in its component parts from that to which they are usually accustomed. Again, I have myself observed in the Bermudas a species of *Gobius* existing in a lively and healthy state in rock pools above the highest tidal mark in which the water, chiefly rain, but partially salt, had become perfectly putrid and offensive.

With these preliminary remarks, I will proceed to describe four specimens which I have recently examined.

The generic characteristics are those of DeKay.

Fam.—GOBIDÆ.

Gen.—GUNNELLUS.

Sp.—GUNNELLUS ————— ?

GENERIC CHARACTERISTICS.—Body elongate, much compressed. Head, oblong. Mouth, small. Teeth velvet-like, or in cards. Dorsal rays, spinous throughout. Ventrals excessively small, and reduced often to a single spine.

DESCRIPTION.—Body elongate, strongly compressed, tapering, covered with minute scales, the whole coated with a slimy secretion. Extent, 5 in. 2 lines. Depth, at deepest part, 13½ lines; from lower jaw tip, 5¾ lines; at commencement of anal, 5¼ lines; at caudal extreme, 1¾ lines. Head, small, elevated; occipital ridge, arched; breadth over opercles, 3 lines. Mouth, vertical gape, 1½ lines; horizontal gape, 1½ lines. Teeth, borne of two rows in under jaw, conical, the largest one-fifth of a line in length; upper jaw armed of several rows extending over vomer. Eyes, partially ovate; vertical diam. ¾ line; horizontal diam. 1 line opercles and branchiostegous rays entire, joined beneath by membrane, free of thorax Vent, nearly equidistant between either extreme, 1 line in advance of first spinos ray of anal.

The dorsal fin, having its rays spinous, and being highest posteriorly, commences immediately over base of pectorals, and is continuous to caudal extreme, where it unites with the caudal fin. Pectorals commence $\frac{3}{4}$ of a line behind posterior edge of opercles; extent, $3\frac{1}{2}$ lines; basal width, 1 line. Ventrals consist of two bony spinose processes, $1\frac{1}{4}$ line in extent, sheathed at base, and situate immediately beneath the pectorals. Anal, commences nearly in a line with the thirty-first dorsal ray, and is continuous to caudal, joining that fin similar to the dorsal. The first two rays are spinose. It presents an almost uniform depth of $1\frac{1}{4}$ line throughout. Caudal partially rounded, small, extent $3\frac{3}{4}$ lines.

COLOR.—Upper parts, dark purplish brown, changing to a dark yellow beneath; beneath the head, lighter still. Dorsal and anal spotted with dark spots at regular intervals.

D. 74,—P. 9,—V. 1 × 1,—C. 16,—Br. rays, 5.

[The anal rays, from their being so branched, I found it impossible to count correctly, even with a powerful lens.]

I am indebted to my kind friend, the Rev. J. AMBROSE, for this specimen. It was taken by himself while using the dredge between Shutting-in Island and the main land on the east side of St. Margaret's Bay, in August, 1860. The depth of water was from 12 to 14 fathoms. From a careful examination, I have every reason to suppose that this specimen will prove to be identical with the spotted Gunnel, or Butter-fish of Yarrell; the *Gunnellus vulgaris* of Richardson; the *Murœnoides guttata* of Storer, and the *G. mucronatus* of DeKay—and that like many other marine fishes found on our coast, it is common to the seas of northern Europe and America.

Fam.—PLANIDÆ.

Gen.—PLATESSA.

SP.—PLATESSA ———— ?

GENERIC CHARACTERISTICS.—Body rhomboidal. Eyes and color usually on the right side. A row of cutting obtuse teeth in the jaws, and frequently paved teeth in the pharyngeals. The dorsal advances over the upper eye, and leaves a naked interval between it and the caudal.

DESCRIPTION.—Body, elliptical, depressed, covered with scales, largest along the region of the lateral line. Extent, 20 inches; posterior edge of opercle to caudal extreme, $15\frac{1}{2}$ inches. Depth, from a line drawn across body, 7 inches from chin point, 7 in. 3 lines; at caudal base, 2 in. Breadth, at broadest part on shoulder, 6 in. from chin point, $10\frac{1}{2}$ lines. Head, 4 in. $2\frac{1}{2}$ lines in extent from chin point to posterior extreme of opercles. Eyes, one above the other; superior eye cup much the largest. Mouth, small, vertical gape, 16 lines; horizontal gape, $5\frac{1}{2}$ lines; under jaw longest, both fully armed with acute teeth of 1 line in length in front. Lateral line very distinct, commences at upper angle of posterior opercle, bends gradually over pectorals down to a position $4\frac{1}{2}$ inches from its commencement, and then proceeds very nearly in a straight line, losing itself in the base of the 9th caudal ray. Cheeks, opercles, and orbital ridges, scaled.

The dorsal fin commences a little in advance of the pupil of the upper eye, and is continuous to within 13 lines of caudal extreme, gradually rising to the 44th ray, which is longest, and as gradually falling to its termination. Pectorals, small, having their third and fourth rays longest, about $19\frac{1}{2}$ lines in extent. The ventrals were absent. The anal fin rises nearly in a line with the pectorals, but slightly behind it, and has at its commencement a partially concealed short but strong spine.

The fin in character equals the dorsal, and has its 22nd ray longest, with an extent of $20\frac{1}{4}$ lines. Caudal, slightly pointed; width at base, 2 inches; spread of rays at termination, 4 inches $3\frac{3}{4}$ lines.

COLOR.—A uniform pale brown throughout, the head of a darker shade.

D. 88,—A. 68,—P. 12,—C. 18.

I am also indebted to Mr. AMBROSE for this specimen, who procured it at St. Margaret's Bay. It will, I believe, prove to be the *Platessa plana* of DeKay—a species, according to Perley, common on this coast. If it does prove that species, DeKay must have taken his description from a damaged specimen, for he states that the half of the jaws next the colored side is destitute of teeth, whereas in this specimen that condition does not occur.

Fam.—ANGUILLIDÆ.

Gen.—AMMODYTES.

SP.—AMMODYTES ———————?

GENERIC CHARACTERISTICS.—Body and head elongated. Dorsal fin extending nearly the whole length of the back. Anal fin long, and both separated from the caudal. Caudal forked. Lower jaw, longest. Branchial aperture, large. No cœca nor air-bladder.

DESCRIPTION.—Body, elongate, slightly compressed. Extent, $6\frac{3}{4}$ inches. Depth at base of pectorals, 4 lines; at anterior base of anal, $3\frac{1}{2}$ lines; at posterior base of anal and dorsal, $1\frac{3}{4}$ line. Lateral line commences at upper posterior angle of opercle, gradually descending to about the middle of pectorals when closed to the body, and thence in a straight line to caudal base. Head, extent from chin point to posterior angle of opercle, $12\frac{1}{2}$ lines; depth, from capital ridge to lower edge of opercle, $4\frac{1}{2}$ lines; width, between eyes, $1\frac{1}{4}$ lines; at juncture with body, $2\frac{3}{4}$ lines. Gill aperture very large; opercle $7\frac{1}{4}$ lines in extent, opening its whole length. Lower jaw projecting 1 line beyond the upper. Teeth absent. Vertical gape, $2\frac{3}{4}$ lines; horizontal gape $\frac{3}{4}$ line. Eyes large, ovate; vertical diam., $1\frac{1}{2}$ line; horizontal diam., $2\frac{1}{4}$ lines.

The dorsal fin commences $15\frac{3}{4}$ lines from chin point, attains its greatest height of $1\frac{3}{4}$ lines about its centre, gradually reduced to $1\frac{1}{4}$ lines at its termination, which takes place $2\frac{1}{4}$ lines from caudal extreme. An indented line, more strongly marked than the lateral line, runs on either side of the dorsal ridge, commencing above the operculum and running the whole extent to the caudal base. Under the microscope the line presents a series of oval depressions. Pectorals, partially pointed, originate immediately behind the posterior edge of opercle; extent, $5\frac{3}{4}$ lines, width at base, $1\frac{1}{4}$ lines. Anal fin commences about 4 lines behind the centre of the dorsal, and is coterminal with that fin. Caudal fin, partially forked; extent of forks, 5 lines; middle rays, $3\frac{1}{2}$ lines; basal width, $1\frac{3}{4}$ lines.

COLOR.—Above lateral line, olive brown; beneath, silvery white; whole upper parts, including shafts of dorsal and caudal rays, spotted with minute black spots, which are larger in the vicinity of the lateral line. These spots extend a little below the lateral line, but are only observable under the microscope. Fins, transparent. Irides, silvery white, metallic lustre, dotted above with minute black spots; pupils, dark.

D. 63,—P, 13,—A. 33,—C. 16.

The specimen from which my description is taken was kindly presented to me by Mr. J. R. WILLIS. It was taken from the stomach of a codfish.

I have little doubt that this is the American Sand Launce (*A. Americanus*), of DeKay, which appears to be identical with *A. tobianus* or the Sand-eel of the British coast.

Fam.—BALISTIDÆ.

Gen.—MONOCANTHUS.

SP.—MONOCANTHUS ———— ?

GENERIC CHARACTERISTICS.—Body covered with very minute scales, assuming the form of prickles. Extremity of the pelvis, salient and spinous. A single large dentated spine, in place of the first dorsal; occasionally a small and almost imperceptible spine.

DESCRIPTION.—Body, greatly compressed, partially ovate, extended at caudal extreme, and bearing a granulate surface covered with minute irregular spines, in centres of six or eight. Extent, 4 inches 4 lines. Depth, 2¼ lines from commencement of dorsal to vent. From base of dorsal spine across pectorals to outer margin of pelvic bone, 1 inch 9½ lines. Breadth, at broadest part, nearly midway between base of dorsal spine and pectorals, 5½ lines. Caudal extension, 4½ lines; depth at caudal base, 5 lines. Facial outline from dorsal spine to mouth, declivous. Mouth prominent; armed with six cutting teeth in upper, and four similarly formed, in lower jaw, protruding from fleshy lips; the two centre ones in lower jaw longer on their inner sides, raising them to a sharp angle in the centre; horizontal gape of mouth, 1½ lines. Eyes, somewhat oval horizontally; horizontal diameter, 2⅛ lines; vertical diameter, 2½ lines; irides golden, pupils black. Nostrils, double, the posterior smallest, and situate immediately behind the anterior. Extent from anterior nostril to frontal extreme, 7¼ lines. Branchial orifices lying obliquely above and close to pectorals, extent, 2¾ lines; distant from frontal extreme, 10 lines.

The dorsal spine is situate 9½ lines in advance of the dorsal fin, and is distant from frontal extreme, 1 inch 2¾ lines; extent, 5 lines; armed on its dexter side with five, and on its sinister side with four, claw-like spines, bent downwards, and its whole surface covered with minute spines, as the body; when upright it exhibits a connecting membrane posteriorly. The dorsal fin commences slightly in advance of the vertical line of the anal, and is continuous to base of caudal extension; higher anteriorly, greatest height, 5 lines; rays armed basally with minute spines. Pectorals, small, somewhat pointed; rays basally armed with minute spines, distant from frontal extreme, 11 lines; extent, 5 lines; width at base, 2½ lines. Pelvic spine commences two inches from frontal extreme, and is connected by a cuticular dewlap, covered at its extremtty with interstitial spines, and of a width of 4 lines. Anal, commences at about 1½ line behind the outer margin of the pelvic dewlap; deepest anteriorly, greatest depth 4½ lines; rays armed basally with minute spines. Caudal, partially rounded; extent, 8¾ lines; rays branched, armed basally with minute spines.

COLOR.—Light brown, streaked and dotted with dark blue blotches throughout, extending over the caudal fin; beneath, light yellow. Dorsal and anal fins transparent. Pelvic dewlap, opaque.

D. 31,—P. 13,—A. 29,—C. 12.

This fish was also kindly presented to me by my friend Mr. AMBROSE, who procured it at St. Margaret's Bay in the autumn of 1861. It was, I believe, taken in a fisherman's net. It was very similar in many respects, and will, I have no doubt, prove to be the *Monocanthus Massachusettensis* of DeKay. As a Nova Scotian fish, this specimen is most probably an unique example, and although a very minute creature, may prove valuable addition to the Cabinet of this Institute in which it will be placed.

ART. VI.—*Gold and its separation from other Minerals.* By ABRAHAM GESNER, M. D., F. G. S.

[*Read May 4th*, 1863.]

Gold has long been known and esteemed as the most precious of all the metals. From the earliest ages of antiquity, it has been employed to decorate the human person, ornament temples, and cast into coins. It now forms the true standard by which other substances and property of all kinds are valued. The history of gold is one of peculiar interest. This metal formed the chief adornments of Solomon's Temple. The sacred vessels that "pertained to the House of the Lord," the altar, the table, the candlesticks, the lamps, the censers, and even the hinges of the doors of the temple, were of pure gold. The walls of the New Jerusalem, as described by the Apostle St. John, were of twelve precious stones, "and the building of the wall of it was of jasper, and the city was of pure gold, like unto clear glass."

Some of the Israelites and the nations around them, had their idols of gold and silver; and up to the present day the images worshipped by idolatrous nations are made of gold, whenever that metal can be obtained; and it is to be feared that gold is the god of many, after it has been stamped into coin.

It is not, as some have supposed, that the scarcity of the precious metal imparts to it its great value. Gold is the most malleable of all metals. It is easily worked by the smith, and will not oxidate or rust under ordinary circumstances. Whether buried in the earth, or in the sea, it remains unchanged. In ancient times Ophir was celebrated for its gold. It occurs in the East, and Africa has its golden sands, the continent yielding to the amount of 5,000 pounds avordupois annually. It is now found along the slopes of almost all the mountain ranges of the earth. It occurs in the mica slates of the Tyrol. In Siberia it appears in alluvial sand; and in the country eastward of the Ural Mountains, masses of gold have been found weighing from ten to twenty pounds. The mines of Hungary, Transylvania, and those of the Alps, are worked for their gold. Scotland and Ireland have deposits of the precious metal. It has also been discovered at several places in England, and at Devon it is found in the stream tin works; but the gold of England and Scotland is in their coal, iron, tin and copper.

The annual gold produce of Hungary is valued at £470,000 sterling. The mines of Spain, formerly rich in the noble metal, are now much neglected, from the increased cost of deep mining, and she still receives much of her gold from Mexico. The sands of the Danube, the Rhone, the Tagus, and other European rivers, contain gold, but the quantities they possess will scarcely pay the cost of working. In some of these sands the spangles of gold are so thin that one thousand of them will not weigh a grain.

The gold mines of Russia, or rather those of Asia, are eastward of the great barrier of the Ural Mountains. Here the matrix of the metal is in general a coarse gravel, and much gold is found in the *debris* of the surface. The great marshy plain on the banks of the River Tacknou Targeuma, is rich in gold, and the houses have been removed to obtain the precious metal. In 1842, at the depth of three yards, under the corner of a building, a mass of gold was dug up which weighed upwards of 36 kilogrammes, or 80 lbs. English. This specimen is now in the collection of the Corps des Mines, at St. Petersburgh. It has been stated by Sir Roderick Murchison, that the reign of the Emperor Nicholas, has been distinguished by the important discovery that portions of the great eastern divisions of Siberia are highly auriferous. The total produce of gold in the Russian Empire, now exceeds £5,000,000 sterling annually.

Long before the treasures of California were discovered, America was celebrated for her gold mines. The gold region of the American States extends along the eastern slope of the Apalachian chain of mountains, from the Rappahannock, in Virginia, across the State of Alabama, and along the flanks of the mountainous country, known as the Blue Ridge. In this quarter, the most productive labor has been that applied to the sands of river beds, where few machines, except rockers, are required.

Spurs of the Alleghany mountain chain extend into Canada and New Brunswick, and the central granitic ridge of Nova Scotia is composed of rocks similar to those of other auriferous countries.

In South America, the gold is found on both sides of the great mountain ridges that run nearly parallel with the coasts. The precious metal is gathered from the beds of streams flowing from the lofty heights of the Andes, and the volcanic *foci* along its flanks.

Gold is widely disseminated in Peru, Bolivia, and Chili. Along the sides of the Rocky Mountains, in North America, gold has been found at a number of sites. At Whitehall mine, in North Carolina, gold to the value of $10,000 was obtained in the course of five days, and in a space not exceeding 20 feet square. The gold of the Rappahannock appears to be confined to a space 200 yards wide and about 1,000 yards long. A profitable quantity of gold exists in rock, which has no appearance or indication of the precious metal whatever. The present unhappy war has stopped the working of the mine, which is situated near Fredericksburg, and the surrounding country is now the theatre of rapine and bloodshed.

In 1847, gold was discovered on the property of Capt. Sutor, a wealthy Swiss immigrant, who had settled on the banks of the Sacramento river in California. A contractor for building a mill observed the glittering particles in the sand of a stream. The tidings flew upon the wings of the wind; the town of San Francisco was nearly abandoned by its inhabitants; the crews of ships deserted, and every kind of population proceeded to search for the promised riches. The news went rapidly abroad, and there was a rush of emigrants, Jews, Turks, and infidels, as well as christians from all nations, to share in the search for wealth. The half-civilized country was soon overspread by gold-seekers. The gold was found in digging a well at San Francisco, and then a hundred miles off, it was dropping from the cliffs into the sea, and slowly settling through the sands of the shore. The seekers had to dig pits, to climb mountains, to turn rivers, to sink shafts, to run galleries, to uncover plains, to break, crush, shake, wash, to amalgamate and distill. Seven Mexicans realized in a few days $217,000 dollars. In the course of the five succeeding years thirty millions of gold were poured into the commercial world. The results of the discovery are well know, and among them is the fact, that of multitudes that went to California, few made fortunes—many were ruined, and returned to their friends and families pennyless, and numbers were buried in the sparkling sands of the Pacific coast.

But, before the world had recovered from the California excitement, it was announced that Australia was a land of gold; and although Great Britain had received the lion's share of the American gold, she had a special interest in her Australian colony. The first discovery in that quarter was made by Messrs. Stutchbury and Hargraves; the latter washed gold from buckets of earth. Results similar to those which had taken place in California, followed in quick succession, and thousands who had been engaged on the Pacific shores sailed away to the new El Dorado. Gold was found in surprising quantities. Lumps of the metal were picked up, and it has been stated that a poor man who went to the diggings, with only a forked stick and a frying pan, raked up £5 worth of gold in half a day.

Besides the gold field in the neighbourhood of Sydney and Bathurst, at Buninyong, 80 miles from Melbourne, and 50 from Geelong, 8 square feet were supposed to be ground enough for any man to make a fortune. One man found $1500 worth of gold in a week, another £1000 in the same time, and a party of three had met with 20 lbs. in weight in one day. Thousands of all classes hastened to this land of promise. Ships were deserted, and to man the Commercial Marine the jails were opened to the relief of sailors who had been confined on short sentences. The scenes that occurred are perhaps more indescribable than the mines themselves.

Next in order comes the finding of gold in Nova Scotia, which took place in 1861, near Tangier. This discovery was immediately followed by others in different parts of the Province, and along certain lines of strata belonging to the metamorphic group of rocks, and to great extent. Subsequently new gold fields have been discovered from time to time. The metal has also been washed from s me of the river sands, and the superficial drift of the country. Nuggets have been found from $100 to $500 in value, and companies and individuals are now engaged in mining. I have visited almost every mine in the Province, and I am led to the belief that the resources of the metal in Nova Scotia will be found to be enduring and remunerative. As usual, from the commencement, many of the farmers deserted their ploughs, tradesmen their tools, and professional men and merchants embarked in searching and mining for gold. The government also proceeded to grant licenses to the numerous applicants for auriferous grounds. The prospects are now favorable, and when capital, science and skill shall be more widely introduced, this island-like Province will prove to be a still more happy home for her people, and a rich appendage of the British Empire.

Scarcely had a year passed by, after it was known that Nova Scotia was an auriferous country, when it was announced that the noble metal existed on the shores of Fraser's and Thompson's rivers, in the Territory of the Hudson's Bay Company, in British Columbia; and, from the accounts which have been received from that quarter, it was evident that gold is also abundant in that part of Her Majesty's dominions. Notwithstanding the remoteness of the country and the severity of the climate, the hardy gold-seeker has found his way to the tops of the mountains and depths of the vallies, and the riches of the earth accompany the furs of the Arctic regions homeward to a market.

The latest gold discoveries of importance are those reported from New Zealand, in the South Pacific Ocean, into which there has already been an influx of immigrants searching for the metallic riches of the remote

Islands. Thus, in the course of 15 years, profitable quantities of gold have been found in no less than five different countries.

California in	1847
Australia in	1851
British Columbia in	1860
Nova Scotia in	1861
New Zealand in	1862

When the gold of California began to pour in its harvest, many were the prophecies of ill that would befall the world. It was thought by many that the sudden influx of the coveted metal would demoralize the nations, derange commerce, and finally lose its value; but the gold-seekers and gold diggers have gone on, and none of the results from the cause apprehended have taken place. Indeed, to the contrary, the American States, in which the metal is abundant, seek it at a premium of 50 per cent above its ordinary value against their National paper money. Like silver, gold will probably never lose its value as coin, for the instant its price falls a little below the ordinary rate it is converted into jewelry and articles of luxury, for which all nations have a fancy.

The annual amount of gold added to the metallic wealth of Christendom at the beginning of the present century, amounted in round numbers to about $15,000,000; in 1848 it rose to nearly $40,000,000; at present it is about $190,000,000. The total quantity of gold obtained on the whole continent of America, from the era of Columbus to the discoveries in California, amounted to two billions of dollars. One-tenth of this sum is now added annually to the commerce of the world. Sir Roderick Murchison, the distinguished geologist, in an address delivered in London in 1847, asserted that the gold of California would be constantly on the decrease. He stated that all gold veins on the surface of the earth diminish and deteriorate downwards, and can rarely be followed to any great depth, except at a loss to work them. "As the richest portions of the gold ore have been aggregated near the upper portions of the original vein-stones, so the heaps of gravel, or *detritus*, resulting either from abrasion or tear and wear of ages, and derived from the surface of such gold-bearing rocks, are, with rare exceptions, the only materials from which gold has been or can be extracted to great profit." Since the above period, that gentleman has greatly modified his opinions, as gold has been found in quantities yielding profit at very considerable depths in the earth; and improved methods in the application of mercury and machinery, under the direction of science and skill, now gain profits from ores which formerly did not pay the cost of working. Taking all the recent discoveries and improvements in working into consideration, it is reasonable to conclude that the quantity of gold will be augmented rather than diminished in years to come. Since the early part of 1861, reports have been circulated through the medium of scientific papers, that a chemist in France had succeeded in making gold from the baser metals. It has also been reported that Napoleon the III. had purchased the secret; and political apprehensions have arisen, from the power thus placed in the hands of the French Emperor. Gold is a simple substance, and differs from all other metals—and although it may be imitated in color, it has a specific gravity, and other characters beyond the reach of composition. As the philosopher's stone has not yet been discovered, the world need have no fears of the riches of France; indeed, the efforts of the Emperor to obtain the gold and silver mines of Mexico, do not indicate that he possesses the power of manufacturing the metal at home.

Gold is found in the sands and mud of rivers and rivulets, in the boulders and diluvial drift of the surface, diffused over plains, and collected in rocky chasms and fissures. It occurs set deep in friable and compact quartz, mixed with desintegrated granite, or forming a garnish on micaceous and argillaceous slates. The mode of its extraction must always conform to the conditions in which it occurs, and these conditions are various. Among the sands of rivers and diluvial *debris*, with a pick-axe, shovel, pan and cradle, a man may gather more than ordinary wages; but even here hydraulic engines are necessary. But, in the flinty veins of rock, individual industry is lost without the aid of all the appliances of mining and the best modes of extraction; hence the absolute necessity for the expenditure of capital, in order to render the work profitable.

Gold is always widely and meagrely disseminated, and generally a large quantity of material must be mined, broken and pulverized, before even a small quantity of the gold can be obtained. The individual miner may occasionally find a valuable nugget, but these are few and far between, and frequently mislead him into rash speculations and expensive labor.

In Nova Scotia, the principal part of all the gold discovered, has been found in exceedingly hard veins of quartz, and overflown masses of that siliceous mineral. So far, comparatively small quantities have been obtained by washing the river and beach sands, and the diluvial *debris*; and for this object, almost the only means employed have been the common cradle and pan. The improved instruments for this purpose are the large cradle, and what is called in California and Australia, the "Long Tom," and the "Hydraulic Jet."

From the fact that Ophir signifies a place of ashes, it has been inferred that the ancients employed heat only in the separation of gold from its matrix, and by a method still practised by the Persians. Gold dissolves speedily in mercury, at ordinary temperatures; and the Spaniards were probably the first to adopt the process of amalgamation, which is the cheapest mode of operation upon large quantities of material. The Mexicans grind the auriferous rocks and mercury together in rude stone basins, surmounted by heavy rollers, and the Spanish raster, so called, is still in use. The amalgam, when formed, is collected and distilled in iron retorts, the quicksilver passing over into a receiver, and the gold remaining in nearly a pure state in the retort. But in order to obtain an amalgam it is necessary that the gold and mercury should be brought together in absolute contact, and therefore it is important that the rock should be finely powdered, before the mercury is applied. For this object various kinds of crushers have been invented, and of them, none have been found more useful than the common stamper, now in general use. (Several kinds of crushers and amalgamators were exhibited, with a variety of gold ores from Foreign Countries, and a beautiful wreath of the gold of Nova Scotia.)

To extract every particle of gold from quartz by amalgamation, is a very difficult operation, and one that requires time and much experience; yet like all other inventions which have not been brought to perfection, almost every miner professes to have a knowledge of the art. Already have a number of the schemes introduced into Nova Scotia, to remove the gold from its gaugue failed, and some of them have been relied upon without any knowledge of mechanics, chemistry, or the properties of matter. In California and Australia, companies have been successful in obtaining gold, by following th se who had first crushed the rock, or cradled the sand, and from the tailings of the first adventurers, fortunes have been won. In regard to the richness of quartz, the expectations of the miner are always too high; and as a general rule, excepting in rare instances, it is only by the continued operations of well-conducted labor and machinery upon meagre rock, that large amounts of gold are obtained. I have no doubt the time will arrive when the various interests of many parties now engaged in gold mining in Nova Scotia, will be more or less united, and the work of extraction will be successfully performed. In the mean time, the gold-seekers will extend the present discoveries,—men and machinery will come in and prevent the abandonment of other useful pursuits and branches of industry, such as agriculture and the fisheries,—and finally, by the united efforts of all, under a wise and harmonious government, the Province will lift up her head, and shine as one of the brightest gems of the British Empire.

ART. VII.—*The Festival of the Dead.** By R. G. HALIBURTON, F.S.A.

IN European Calendars, the last day of October, and the first and second days of November, are designated as the Festivals of All Halloween, All Saints, and All Souls.

Though they have hitherto never attracted any special attention, and have not been supposed to have been connected with each other, they originally constituted but one commemoration of three days duration, known among almost all nations as "the festival of the dead," or the "feast of ancestors."

It is now, or was formerly, observed at or near the beginning of November by the Peruvians, the Hindoos, the Sandwich Islanders, the people of the Tonga Islands, the Australians, the ancient Persians, the ancient Egyptians, and the northern nations of Europe, and continued for three days among the Japanese, the Hindoos, the Australians, the ancient Romans, and the ancient Egyptians.

Halloween is known among the Highlanders by a name meaning the consolation of the spirits of the dead, and is with them, as with the Cinghalese,† the Sandwich Islanders, and almost every race among whom the festival

* At the suggestion of the writer, the above paper was substituted for one read before the Institute, which had been privately printed. In the previous one, on "New materials for the History of man, derived from a comparison of the customs and superstitions of nations," it was endeavored to show that the source of these superstitions, so far from being "absolutely unattainable," as it has been hitherto considered by all who have treated of them, could be arrived at by a comparison of the customs of civilized and savage races; and that those superstitions, being possessed of a marvellous vitality, are valuable historical memorials of primitive society.

As an illustration of the duration and universality of primitive superstitions and customs, those connected with the habit of saying "God bless you!" to a person who sneezes, were selected. This absurd custom, referred to by Homer, and found in Europe, Asia, Africa, Polynesia and America, was traced to a belief found in the Arctic regions, Australia, and Central Africa, (and it might have been added in Ireland), that death and disease are not the result of natural but of supernatural causes; and that when a person sneezes, he is liable to be a victim of the spirits, or as the Celtic race express it, "to be carried off by the fairies." It was also argued that this custom, the trivial nature of which precludes the idea that it could have been borrowed by nations from each other, or that nature can everywhere have suggested it to the human race, plainly must have been inherited from a common source, and is a very conclusive argument in favor of the unity of origin of our race. These views have been confirmed by the observations of Captains Speke and Grant—(see Illustrated London News, July 4, 1863, p 23.) An interesting little work by W. R. Wylde, on "Irish Popular Superstitions," published by William S. Orr & Co., London—which the writer was unable to procure until after the paper was read before the Nova Scotian Institute—supplies very curious facts, which corroborate his conclusions as to the origin of this custom. See from p. 120 to 135; also p. 51 to 58. See also Strada's Prolusiones—*Cur sternuentes salutentur* Lib. iii. Præl. iv.

† See Brady's Clavis Calendaria, as to Oct. 31st.

is observed, connected with a harvest home, or, south of the equator, with a first fruits celebration. An old writer asks why do we suppose that the spirits of the dead are more abroad on Halloween than at any other time of the year?* and so convinced are the Finns and the Irish peasantry of the fact, that they discreetly prefer remaining at home on that ill-omened night.

The Halloween torches of the Irish, the Halloween bonfires of the Scotch, the Coel Coeth fires of the Welsh, and the Tindle fires of Cornwall, lighted at Halloween, are clearly memorials of a custom found almost everywhere at the celebration of the festival of the dead. The origin of the lanthorn festival has never yet been conjectured. It will be found, I believe, to have originated in the wide-spread custom of lighting bonfires at this festival.

The Church of de Sens, in France, was endowed by its founder in the days of Charlemagne, for the purpose of having mass said for the dead, and the grave yard visited on All Halloween.† Wherever the Roman-Catholic Church exists, solemn mass for *all souls* is said on the first day of November; on that day the gay Parisians, exchanging the boulevard for the cemetary, lunch at the graves of their relatives, and hold unconsciously a funeral feast on the very same day that savages in far distant quarters of the globe observe in a similar manner their "feast of ancestors."‡

Even the Church of England, which rejects *All Souls*, as based on a belief in purgatory, and as being a creation of popery, devoutly clings to All Saints, which is clearly a relic of primeval heathenism.

On All Souls day, the English peasant goes *a-souling*, begging for "a soul cake for all Christen souls." He has very little suspicion that he is preserving a heathen rite, the meaning of which is not to be found in the book of common prayer, but (as I shall heareafter show) is to be discovered in the sacred books of India, in which country the consecrated cake is still offered, as it has been for thousands of years in November, to the souls of deceased ancestors. But, though the festival of the dead is so generally observed in November, there are some exceptions. Thus it was observed in February by the Greeks, the Romans, the Persians, and the Algonquins, and in August by the Japanese and Chinese. The traces of its being observed in May are very few, and those of its being

* See Brand's Popular Antiquities, v.I, p. 388, 396. (Ed. 1853.)

† Hodie in Ecclesia Senonensi, sit Anniversarium solemne, et generale pro defunctis.—*Thiers' Traité des Superstitions*, iii. 98.

‡ Atlantic Monthly for May, 1862.

held at any other times of the year, are of exceedingly rare occurrence. Before, therefore, I can attempt to treat of the festival of the dead, or refer to its origin and history, and the influence it has exerted on ancient mythology, it is necessary to confine this paper simply to questions connected with the Calendar, and the times when the festival is found to be observed. It is important to trace the ancient November festival to the primeval year, which must have fixed it in that month among races South, as well as North of the Equator. This year, I believe I have succeeded in discovering; and, as it appears to have originated in, or at least only now exists in, the Southern hemisphere, I have designated it as the Primitive Southern year. It is also necessary to show that the festival of the dead, occurring in February or August, indicates a change having taken place, and a more recent year commencing in February having been substituted. As we only find this year north of the Equator (so far as I have been able to learn), I have designated it as the Primitive Northern year.

Wherever the festival occurs in November, it is, or at least originally was, the new year's festival, of the primitive Southern year. Where it is held in February, it is, or once was, the commemoration of the commencement of the Northern year.

As the mode of investigation pursued on this point materially adds to the credibility of my conclusions, I may be pardoned for referring to it.

The startling fact that "this feast was celebrated among the ancient Peruvians at the same period, and on the same day that Christians solemnize the commemoration of the dead, (2d November)"* at once drew my attention to the question, how was this uniformity in the time of observance preserved, not only in far distant quarters of the globe, but also through that vast lapse of time since the Peruvian, and the Indo-European first inherited this primeval festival from a common source?

It was plain that this singular uniformity could never have been preserved by means of the defective solar year in vogue among ancient nations. How then could this result have been produced? It was apparent that the festival must have been regulated by some visible sign, or mark, that nature had supplied—such as the rising of some constellation.

Remembering the ancient traditions as to the Pleiades, I naturally turned my attention to them. Professor How kindly offered to ascertain from an excellent astronomer whether the Pleiades could have ever risen in November in Asia or Europe. I was fortunately, however, able to save

* Peruvian Antiquities, by M. Rivero and Von Tschudi, translated by Dr. Hawks, New York, 1855, p. 134.

that gentleman the calculation. On turning to Bailly's *Astronomie Indienne*,* I found him state that the most ancient year, as regulated by the calendar of the Brahmins of Tirvalore, began in November, and I was much gratified at finding that, in that Calendar, the month of November is called Cartiguey, *i. e.* the month of the Pleiades,—a circumstance which M. Bailly says, would seem to indicate that that Constellation by their rising or setting in that month, must have regulated the commencement of the ancient year in November.

But here a fresh difficulty arose, as respects the Calendar. To suppose that the Pleiades rose in that month, and commenced the year in the autumn, was not only opposed to ancient traditions respecting them, and to their name as the Stars of Spring *(Vergiliæ)*, but also to their actual movements, at the present day at least.

We could not assume that great astronomical changes could ever have produced this result. How then could we account for the anomaly? I discovered the clue in extending my researches to the Southern hemisphere, where I found the festival of the dead to occur in November, and to be the vernal New Year's festival of a year commencing in November, and regulated by the rising of the Pleiades *in the evening*. Before concluding this prefatory paper, it may be as well to state that the whole subject referred to by me, both as regards the primitive New Year Festival of the Dead, and the primitive year, has altogether escaped the observation of the learned. De Rougemont, in his "Peuple Primitif," published at Paris in 1856, has, out of three volumes, not devoted as many pages to "Les Fêtes des Morts," though they are unquestionably the most remarkable memorials we possess of Le peuple Primitif. Festivals connected with the seasons, he says, cannot now be investigated, from our ignorance of the primitive calendar; and he therefore only selects those that took place at the time of the Vernal Equinox, and the Summer Solstice, *i. e.* associated with a solar year, and hence of a comparatively recent date, and subsequent to those of the two primitive calendars which I have referred to.

"Nous ne pouvons ici faire une étude spéciale de celles, qui se rapportent avant tout aux saisons; les calendriers des anciens nous sont trop imparfaitment connus, pour que nous puissions espérer de reconstruire celui du peuple primitif."†

The primitive year of two seasons, commencing in November, and the connection of the Pleiades with the primeval calendar, are not even referred to in the latest work on the astronomy of the ancients, published last year

* Vol. 1. p. xxxi. 28, 134.
† Vol. 1. p. 523.

in Paris.* Though very many remarkable facts in the history of the calendar, and of our race, to which the study of the festival of the dead has afforded me a clue, are referred to by Greswell in his learned works on the Calendars of the Ancients, he has attempted to explain them by resorting to the miracles in the Bible—as to the sun having stood still or gone back on certain occasions—events which he contends must not only have disturbed, but have even left their impress on the calendars of the ancients. But they are, I believe, capable of a more common-place solution. I trust that I shall be able to prove that these subjects are susceptible of an explanation, without having, with Greswell, to refer to miracles in the days of Hezekiah, or with Ovid, to leave the knotty point to be unravelled by the Gods—

> "Dicta sit unde dies, quæ nominis extet origo
> Me fugit, ex aliquo est invenienda deo."†

THE FESTIVAL OF THE DEAD BROUGHT TO EUROPE AND ASIA BY A MIGRATION OF RACES FROM THE SOUTHERN HEMISPHERE.

"Mudan de pays y de estrellas."‡—*Garcillasso de la Vega.*

"Who can restrain the pleasant influences of the Pleiades?" we are asked in the book of Job, the most ancient production of sacred or profane literature. "The lights in the firmaments of the heavens," "for signs and for seasons, and for days, and for years," are supposed to have reference to that constellation, as well as to the sun and moon, for in early ages neither the sun nor the moon could have indicated the length of the year, or its division into seasons. The extreme veneration of remote antiquity for the Pleiades, or *Ver*giliæ, for having marked the seasons, and the beginning of spring, are amongst the most venerable traditions of our race, and are now only realized among Australian savages, who still worship the Pleiades as announcing spring, "and as being very good to the blacks;" and at their culmination hold a great New Year's corroboree in November, in honor of the *Mormodellick*, as they call that time-honored constellation. The name given to these stars by the Romans, *Vergiliæ*, is plainly connected with the strange tradition of Northern natives, of the Pleiades having marked the commencement of spring. They are popu-

* "Antiquité des Races Humaines. Reconstitution de la Chronologie, et de l' Histoire des Peuples Primitifs. Par l' examen des documents originaux, et par l' Astronomie,"—by Rodier.

† Fasti, Lib. v.

‡ They change their country and their stars.

larly known, from France to India, by the same name—a circumstance which proves, says Mr. Bailly,* that our first knowledge of these stars was derived from the most ancient nations of Asia.

The question naturally suggests itself, whence arose this veneration for a constellation, that among us, at least, are no longer reverenced? When and where can they have marked the beginning of spring, and what were those "pleasant influences," referred to in the book of Job, and still celebrated by Australian savages?

So far from rising in Europe or Asia in the spring, they first appear in June, a summer month. How could the *Vergiliæ*, then, have acquired their name, as the stars of spring? It is plain that they could not have marked a vernal commencement of the year, as the most ancient year commenced in the autumn, and among most ancient nations we find traces of a traditionary or civil year commencing in the autumn.

We also find traces of a very singular year of six months, the very existence of which Sir Cornewall Lewis has somewhat hastily questioned. "These abnormal years," he tells us, "are designated by Censorinus as involved in the darkness of remote antiquity."† Dupuis suggests that we must turn to the Pleiades, as well as to other constellations, to account for these "abnormal years," as well as for the ancient year commencing in the autumn,—"pour expliquer les fictions relatives à ce commencement, d'année, soit chez les Juifs, soit chez les autres peuples, qui ont eu le commencement d'année en automne. Tels etaient ceux qui avaient des années de six mois."‡ In confirmation of his conjecture, I have found that in the Arabian calendar of lunar mansions, which is made up of two divisions, one belonging to summer, and the other to winter,—one of the mansions is designated by the name of the Pleiades. Let us see if his suggestion will prove equally correct respecting the autumnal year; and let us endeavor to find in that constellation a clue to the remarkable circumstance of the festival of the dead having been observed in Hindostan, Peru, Ceylon, Egypt, and Europe, in November.

I may here state that the classical nations of antiquity, with whom the influence of the Pleiades was rather a matter of tradition than of practical use, when they spoke of the rising of the Pleiades, referred to the

* This name was the *Hen and Chickens;* among the Hindoos, Pillalou Codi; among the Jews, Succoth Benoth (?); among the Italians, Gallineta, and among the French, *La pousinière.* See Dupuis De l' origine de tous les Cultes, ix., 192. Bailley's Astronomie Indienne, I. xxxv., 134, 328. See, however, Landseer's Sabæan Researches, Lecture XI., p. 19.

† Historical Survey of the Astronomy of the Ancients, p. 31.

‡ L'Origine de tous Les Cultes, v. 1, p. 104.

heliacal rising of the constellation in the morning, *i. e.* the time, when at dawn, the stars where first visible—*

"The grey dawn and the Pleiades
Shedding sweet influence."

This took place in the middle of May, 2000 years ago, and marked the beginning of summer in the South of Europe and Asia.† But we must conclude either that the Pleiades must have once, in some other manner, than by their heliacal rising, indicated the beginning of spring, or else that there must have been, by a long lapse of years, a change in their movements, that rendered their rising inconsistent with their very name as the stars of spring. It must, however, have been nearly 5000 years since the heliacal rising of the Pleiades occurred at the beginning of April, and even then it could not have indicated the commencement of seed time in the South of Asia and of Europe, or marked the beginning of spring. Their name, the Hesperides, too, would seem to connect them with the evening rather than the morning. But, if at such a remote era, the Pleiades regulated the seasons by their heliacal rising at that time of the year, they must have left their impress on primitive calendars, and traces of the connection of the calendar with the heliacal rising of the Pleiades, would still be found among many races, either in their names for March or April, or at least in their traditions as to the time when their year once commenced. But this is not the case. There are no traces of a primitive year in general use in remote antiquity, commencing in March, April or May; the only apparent exception being the solar year, regulated by the vernal Equinox, which was of comparatively recent invention.

But on examining the calendars of ancient races, we find in Persia India, Egypt and Peru, that the month in which our first of November festival would fall, bears in its very name a singular impress of its former connection, either with the Pleiades or the festival of the dead.

In the most ancient calendar in India, the year commenced in the month of November, which bears the name of Cartiguey, *i. e.*, the Pleiades; a constellation which, Bailly suggests, must have by their rising or setting at that time, once have regulated the primitiveyear. We

* Pleiades adspecies omnes, totumque sororum
Agmen; ubi ante Idus nox erit una super.
Tunc mihi non dubiis autoribus incipit aetas,
Et tepidi finem tempora veris habent.
Ov. Fast., Lib. v.

† See as to the cosmical and heliacal risings of stars, Greswell's Fasti Catholici. v. III, p. 18.

find also that towards the end of October, the Hindoo like ourselves, have three days which are connected with the festival of the dead.

In the ancient Egyptian calendar the same resemblance can be traced between the name of the Pleiades, which among the Hebrews and Chaldeans is Athor-aye, with that of the Egyptian month of November, which is Athor. The Arab name for the Pleiades, Atauria, also suggests a resemblance.

In November took place the primeval festival of the dead, clad in a veil of Egyptian mythology. The Isia, the solemn mourning for the God Osiris, "the Lord of Tombs," lasted for three days, and began at sunset, like the Lemuria of the Romans, and the festival of the dead among the Persians and other nations.

The singular custom of counting the days from the sunset of the preceding day, or the noctidiurnal system, was so universal, that Greswell refers to it as a conclusive proof of the unity of origin of our race. *The bible tells us, "the evening and the morning were the first day." Our words "fortnight" and "sennight," are traces of this primitive custom; and he might have added the first day of our festival of the dead, a still stronger illustration, as it is called Hallow*een*. The origin of this system has not been explained by Greswell. He tells us, however, of the Egyptian belief, that whoever could discover the origin of the Isia, or the Egyptian festival of the dead, would know why the day came to be counted from the evening of the preceding day. Hence the origin of this wide-spread noctidiurnal system is to be found (if the Egyptians were correct) in whatever caused the festival of the dead to commence at sunset, or with a Hallow*een*.

Let us turn to the primitive races of the Southern Hemisphere to find a solution.—

1st—For the festival of the dead being connected with an agricultural celebration. 2d—For its being held in November. 3rd—For its commencing with a Halloween. 4th—For the primitive year commencing in November. 5th—For the Pleiades being connected with that month. 6th—For their being reverenced as the *Ver*giliæ and Hesperides, the stars of the spring and the evening. 7th—For the "abnormal year" of six months, found North of the Equator.

A reference to the Australians and Pacific Islanders, will enable us to give a very simple explanation for these various points, without imagining that miracles must have given rise to some, or that we must leave the solution of others to the gods.

* See Volmer's Wörterbuch der Mythologie, verb Athor, p. 371.

We find that, among these Southern races,* when the Pleiades are in the evening first visible at the horizon, which is at the beginning of November, they mark the beginning of the year, and the vernal new year's festival, a feast consecrated to first fruits, and to the dead. As long as at evening they continue visible, they mark a season called *the Pleiades above.* When they cease to be visible in the evening, the second season commences of *the Pleiades below*: these seasons nearly equally dividing the year. Hence we can understand why tradition has connected the Pleiades with November, as the first month of the year, has preserved their name as the stars of the evening and of the spring, and has caused the festival of the dead to commence in the evening, or with a Halloween. We can also understand how the year of six months arose, that has so puzzled Astronomers.

In the voluminous report on the Aborigines, by a Committee of the Legislative Council of Victoria, Session 1858–9, we find W. Hull, Esquire, J. P., a gentleman who has written a work on the Aborigines, stating "their grand corroborees are held only in the spring, when the Pleiades are generally most distinct; and their corroboree is a worship of the Pleiades as a constellation, which *announces spring.* Their monthly corroboree is in honor of the moon." (p. 9.)

In another place Mr. Hull says, "referring again to their worship of the stars, I may mention that one night I showed Robert Cunningham the Pleiades, and he said 'they were the children of the moon, and very good to the black fellows,'—a remark that recals to our mind 'the pleasant influences of the Pleiades.'"

C. J. Tyers, Esq., Commissioner of Crown Lands, Alberton, (p. 79,) says in confirmation of the foregoing,—"Regarding their religious practices very little is known, so little that Europeans generally believe them to be devoid of any. Yet they do, according to their manner, worship the hosts of heaven, and believe particular constellations rule natural causes. For such they have names; and *sing and dance to gain the favor of the Pleiades,* (Mormodellick,) the constellation worshipped by one body as the giver of rain." Now the Pleiades are most distinct at the beginning of the spring month of November, when they appear at the horizon in the evening, and are visible all night. Hence their vernal festival of the Pleiades takes place in honor of the Vergiliæ, the stars of spring, at the beginning of November, the very month called in the calen-

*I have only been able to fix the date of this festival among the natives of the Society and Tonga Islands. The difficulty of procuring necessary works of reference in a Colony will plead, I trust, an excuse for many omissions.

dar of the Brahmins of Tirvalore, the month of the Pleiades, and among the ancient Egyptians connected with the name of that constellation.

But we are told by another gentleman examined by the committee, that all the corroborees of the natives are connected with a worship of the dead,* and *last three days*. If this be the case, is it not somewhat startling to find that Australian savages, at or near the time of Halloween, All Saints and All Souls, also consecrate three days to the memory of the dead, as a vernal New Year's celebration, regulated by the time-honored Pleiades,—and like the northern festival of the dead, beginning in the evening, or with a Halloween?

> "Hinc ubi protulerit formosa ter Hesperus ora,
> Ter dederint Phœbo sidera victa locum;
> Ritus erit veteris nocturna Lemuria sacri;
> Inferias tacitis Manibus illa dabunt."†

In the Tonga Islands, which belong to the Feejee group, the festival of Inachi, a vernal first fruits celebration, and also a commemoration of the dead, takes places towards the end of October,‡ and commences at sunset.

"The Society Islanders," Ellis tells us, "divided the year into two seasons of the Pleiades or Matarii. The first they called the *Matarii i nia*, or the *Pleiades above*." It commenced where, in the evening these stars appeared, at or near the horizen," (*i. e.* at or near the beginning of November), and the half year during which, immediately after sunset, they were seen above the horizon, was called *Matarii i nia*. The other seasons commenced when, at sunset these stars are invisible, and continued until at that hour they appeared again above the horizon. This season was called *Matarii i raro*, *i. e.* "*the Pleiades below.*" The Pleiades are visible at the horizon in the evenings at the beginning of November. They then culminate near midnight, and are visible till morning. Ellis says that this year began in May; but it is evident that what he calls the first season, "the Pleiades above," commenced at or near the beginning of November, and the second division must have begun towards the end of April, or early in May. If they appear at the horizon in the evening, on 5th November, they continue visible at that time till the 24th April following. But, not only was the month of November connected with the

*** In confirmation of this, a member of the N. S. Institute, who has been at these annual corroborees, tells me, that as the natives for these occasions paint a white stripe over their arms, legs and ribs, they appear, as they dance by their fires at night, like so many skeletons rejoicing.* The custom, however, is peculiar, I believe, to Australia. *White* paint is used for mournful, and *red* for joyful festivals. See Report on Aborigines, p. 70, 94.**

† Ov. Fast., Lib. v.

‡ Mariner's Tonga Islands, p. 157, 381, 385.

rising of the Pleiades, but also with a festival of the dead, and a first fruits celebration, as among the people of the Tonga Islands.

"The most singular of their stated festivals was the ripening or completing of the year. Vast numbers of both sexes attended it; the women, however, were not allowed to enter the sacred enclosure. A sumptuous banquet was then held. This ceremony was viewed as a *national acknowledgment to the Gods.* When the prayers were finished, and the banquet ended, a usuage prevailed *resembling much the popish custom of mass for souls in purgatory.* Each one returned to his home or family marae, there to offer special prayers for the spirits of departed relatives." Ellis does not tell us to what mode of dividing the year he refers (for they appear to have had three); but, as the Inachi of the Tonga Islands, a precisely similar celebration, as well as the festival of the Pleiades in Australia, took place near the beginning of November, we may assume that this was the new year's festival of the seasons of the Pleiades.

Let us turn from the Islands of the Pacific to Peru, and there we find this primitive calendar of two seasons marked by a new year's festival of the dead, occurring in November; and celebrated at precisely the same time as in Europe and Polynesia.

The month in which it occurs, says Rivero, "is called Aya-marca, from Aya, a corpse, and *marca*, carrying in arms, because they celebrated the solemn festival of the dead, with tears, lugubrious songs, and plaintive music; and it was customary to visit the tombs of relations, and to leave in them food and drink. *It is worthy of remark that the feast was celebrated among the ancient Peruvians at the same period, and on the same day, that Christians solemnize the commemoration of the dead,* (2nd November)."

Finding the festival held at the beginning of November, I felt convinced that it never could have been fixed in that month by a solar year, such as was in use in Peru, but that it must have been originally the New Year's festival of the year or seasons of the Pleiades, that must have once been in use in that country. Subsequent investigations bore out the conclusion.

M. Rivero tells us that in November took place the termination of the year and of seed time. Garcilasso* bears distinct testimony to the existence of a traditionary year of seasons.

* Book II. ch. xi. Garcilasso says the harvest time was in March; but Rivero (p. 132) places it in May.

"Yet, for all this sottish stupidity, the Incas had observed that the Sun accomplished his course in the space of a year, which they called *huata;* though the commonality *divided it only by its seasons*, and reckoned their year to end or be finished with their harvest," (*i. e.* in May.)

Here we have the year ending with the months of November, and May, a plain proof that the Southern years of the Pleiades ending in November and May, must have existed there before the Incas invented or introduced the solar year; and were the seasons referred to by Garcilasso. As the festival of the dead is, however, the new year's festival of the year of the Pleiades, we may assume that it must have, in Peru, originally marked the commencement of the year at the beginning of November. Wherever the festival of the dead occurs in November, even among nations now far north of the equator, the same inference may, I believe, be adduced. The race by whom it is preserved must have once regulated that festival in November, by the rising of the Pleiades, like the Australians and the Pacific Islanders.

In Persia we find a singular light thrown on the calendar by the festival of agriculture and of death celebrated south of the equator. In the ancient calendar November was consecrated to the angel who presided over agriculture and death. We have seen that the month in which this festival occurred in Peru, was called "the month of carrying corpses." The month of November, was formerly called in Persia Mordâd, the month of the angel of death. In spite of the calendar having been changed, at the same time as in Peru, the festival of the dead took place as a new year's festival, (although the year no longer commenced then.) It is called by some writers the *Nouruz of the Magi*, because the Magi still adhered to their primitive new year's festival.* It commenced in the evening with a Halloween, which was regarded as peculiarly sacred. "Unde hujus diei *Vespera* quibusdam Persarum, peculiari nomine signatur Phristâph.† Bonfires were lighted at this festival as they are in Britain, and in most portions of the globe, at this season of the year.‡

In Ceylon, Sir Emerson Tennent says a festival is held that is a species of harvest home and a commemoration of the dead. It must, however, be rather a first fruits celebration, like that of nations south of the equator, as the harvest is over in May or June. This festival of agriculture and of death took place at the beginning of November.§

We now turn to Mexico, and there we find that the great festival of the

* Rel. Vet. Persarum, 238. † Id. 237. ‡ Id. 249.

§ Tennent's Christianity in Ceylon, 202, 228. Forbes' Ceylon, 2, 322. See Mahavansi transl'd. by Upham, III. 164.

Mexican cycle was held at the beginning of November, and was regulated by the Pleiades. It began at sunset; and at midnight, as the constellation approached the zenith, a human victim, Prescott says, was offered up to avert the dread calamity which they believed impended over the human race. This belief* was so remarkable that I cannot omit a reference to it here. They had a tradition that at that time the world had been previously destroyed; and they dreaded lest a similar catastrophe would, at the end of a cycle, annihilate the human race.

Now it is most remarkable to find that the Egyptians, with their Isia, or new year's festival of agriculture, and of the dead, that took place on the 17th day of November, associated traditions as to the deluge, and it is still more surprising to find that the 17th day of November is the very day on which, the Bible tells us, the deluge took place.†

Greswell has devoted several chapters, and much learning, to the 17th day of November (Athor),‡ to show how remarkable a landmark it has always been, through a long lapse of centuries, for the corrections of the Egyptian calendar, and he derives from it some curious arguments in support of his view. De Rougemont and other writers have referred to this day, but have thrown no light upon it. They seem, however, not to have observed that even among the Persians the same day was peculiarly venerated. Hyde says that in the ancient Persian calendar the 17th day of November was held so sacred, that all favors asked by rulers were granted on that day;§ but why it was so venerated he does not attempt to conjecture. Even tradition has been unable to preserve the history of this day, that must be sought for in the very earliest ages of the world, or among

* Prescott's Conq. of Mexico, I., b. 1, ch. iv.

† While the above was going through the press, as I was convinced that the memory of the deluge had been thus preserved among the Hebrews, Egyptians, Greeks and Mexicans, in the traditions connected with the new year's festival, and that the date of the commencement of the deluge, the 17th day of the first month of the primitive year, was not of an historical but of an astronomical character, I more closely examined the Mosaical account of the deluge, and found my conjecture singularly verified. The deluge commenced on the 17th of the 2nd month of the Jewish year (*i. e.* November); the ark rested on Mount Ararat on the 17th day of the 7th month; and the dove returned with the olive branch on the 17th day of the 11th month. Though the connection of this with the traditions and calendars of heathen races is somewhat startling, I am convinced that should the study of *Ethology* afford a clue to the primeval origin of pagan idolatry, it will at the same time conclusively prove how entirely different and distinct must have been the source from which the Hebrews derived the great truths and principles of our religion.

‡ Those wishing to examine into these points, will find the following references bearing on them:—Greswell's Fasti Catholici, I., 82, 152, 154, 168, 181, 196, 198, 200, 225, 228, 229, 343, 356: II., 104, 115, 226; III., 88, 89, 112, 113, 131, 160, 166, 330, 405, 407, 413, 416: IV. 173, 610. See Origines Kalendariæ Italicæ, I., 344, 348, 351 to 390, 423, 430: III., 33, 460, 516.

§ See Rel. Vet. Pers., p. 243.

the rudest existing types of man. In the mysteries of Isis, the goddess of agriculture and of death, the funereal part of the ceremonies, the lamentations and search for Orisis, commenced on the 17th and ended on the 19th. There was also an obsolete year of the Egyptians, which commenced, Greswell says, about the 18th of November.

Herodotus tells us, what is very plain, that Isis is the same as the Greek goddess Ceres, who, with her daughter Proserpine, presided over agriculture and the dead.*

Among the Greeks, besides existing in other ceremonies, the primeval new year's festival appears under a veil of mythology in all the ancient mysteries, but above all in the greatest of them, the Eleusinian. The Greeks, however, must have at some remote era changed the beginning of the year from the 17th of November to the 17th of February, when the Attic year commenced. On the 17th, 18th and 19th days of February, the funereal part of the Eleusinian mysteries, the lament for Proserpine, took place.

The Macedonians retained the primitive year beginning in November.† It is peculiarly interesting to note that with the new year's festival, the tradition as to the deluge was also transferred by the Athenians to the 17th day of February. Even in some other months, the 17th seems to to have been a conspicuous day in the Greek calendar. In Persia, in every month, there were three days of sadness and fasting; but as the 17th and 18th days were dies nefasti, on which no work was done, we may assume that the 19th was the ultima dies placandis manibus,‡ and the 17th, 18th and 19th were the days of mourning.§ In Europe, Asia and Africa, we find days in every month consecrated to the memory of the dead.

Let us now look south of the Equator for an explanation: 1st—Why the 17th, 18th and 19th of the month were so funereal. 2nd—Why the primitive year of the Egyptians and of other races, and their funereal mysteries, began on the 17th day of the month. 3rd—Why, not only at every new year's festival, but even monthly, the dead were commemorated.

Almost all savage races, like all nations in remote antiquity, regulate

* It is strange to mark how they were connected together. The dead were called Demetriakoi, or belonging to Ceres; while the name of Proserpine means the bringer of fruits. They were evidently originally one Deity, presiding over the festival of agriculture and the dead. See Müller's History of the Dorians, translated by Sir Cornewall Lewis, II., 405.

† See as to the commencement of ancient year, Clinton's Fasti Hellenici, 355, 364, 366, 618.

‡ Greswell's Origines Kal. Ital. I, 429.

§ Hyde Rel. Vet. Pers., p. 230, 232, 248, 262.

their months by the new or the full moon, and hold festivals of a funereal character at the time of the new moon, or when the nights are darkest.

The Australians not only hold an annual corroboree of the Pleiades, but also a monthly corroboree of the moon, of three days duration, and apparently connected with a dread of ghosts, or a worship of the dead. They regulate their months by the full moon. The Hindoos offer in every lunar month, on Mahacala, the day of the conjunction, and defined as "*the day of the nearest approach to the sun*, obsequies to the manes of the *pitris*, or certain progenitors of the human race, to whom the *darker* fortnight is *peculiarly sacred*." Sir William Jones, also says, referring to a Hindu work, "many subtle points are discussed by my author concerning *the junction of two*, or even *three lunar days in forming one fast or festival*."*

The Chinese, the Africans, the Caribs, and other races of America, the Greeks, the Romans, and almost all ancient nations, kept a commemoration of the dead in the dark nights of the moon.†

Here we have an explanation for a monthly commemoration of the dead; but why were the 17th, 18th and 19th days of each month, among some races, especially of a funereal character? Ellis tells us that the Society Islanders regard the 17th, 18th and 19th nights, as seasons "when spirits wander more than at any other time,"‡ a plain proof that even among the Pacific Islanders, these three days, in every month, must have been consecrated to the dead, as to this day, it is still believed in Britain, that on Halloween, when the festival of the dead once commenced, "the spirits of the dead wander more than at other times of the year." "This is a night when devils, witches, and other mischief making beings, are all abroad on their baleful midnight errands."

But the question arises, how came the beginning of the year to be, among some nations, on the 17th day of the month? The explanation, I think, is plain. The Chinese, the Hebrews, and other races, regulated the beginning of the year at the time of the new moon, *i. e.*, at the time of the festival held in the dark nights of the moon. With many races, the 17th, 18th, and 19th days after the full moon, or the three succeeding the new moon, or month, were evidently regarded as peculiarly sacred

* Sir William Jones' Works, (ed. 1807) vol. IV. p. 129.

† De Rougemont Le Peuple Primitif, 2, 246, 263, 355. Boulanger, I, 269 to 297 301. Horace, Odes III. 23.

‡ Ellis' Polynesean researches, I, 88. Ellis is evidently in error, in making the month commence at the new moon. If the Society Islanders commenced the month at the new moon, the nights peculiarly consecrated to the dead, would be the light nights, instead of the dark nights of the moon. If their month was like that of the Australians, the Hindoos, and other races, the 17th, 18th and 19th, would be the three dark nights succeeding the new moon, and would correspond with those devoted in Hindostan, and other countries, to a commemoration of the dead.

to the dead, and were the monthly days of rest, or the monthly *Sabbath* of heathen races.

Our own mode of regulating Easter, will serve to explain the commencement of the ancient year. The common prayer-book says: "Easter day is always the first Sunday after the full moon which happens upon or next after the 21st day of March." But the Hebrews substituted four sabbaths in place of one monthly time of rest, and used the vernal equinox, instead of the rising of the Pleiades, to regulate their Passover. Let us substitute the monthly festival of the dead for the word sabbath, and the rising of the Pleiades for the 21st March, and we read, "New Year's day is always the monthly sabbath after the full moon which happens upon or next after the culmination of the Pleiades at midnight." But as this would occur near the month of November, we can understand that when the months commencing with the full moon ceased to be lunar, and their festivals "moveable," the new year would, for some time at least, continue to commence on the 17th day of November, and that the 17th, 18th and 19th days of every month would still appear in ancient calendars as funereal days. We can also understand that a traditionary veneration for the 17th day of the month, especially of November, would long continue, like some old sea margin, to show the changes which time had effected; and that the new year's festival of the dead, preserved in the mysteries of Isis and of Proserpine, would long be held on the 17th, 18th and 19th nights of the first month, though no longer those dark nights of the moon in which the spirits of the dead are wont to wander forth from their Maraes and their temples to receive the offerings of their trembling worshippers.*

Among the Romans we find a trace of a partial observance of the festival of the dead in November.† With the Northern year, commencing in February, the Romans borrowed from the Athenians their new year's festivals of the dead, the popular Anthesteria, and the mystic Eleusinian mysteries. The more ancient institution was the Lemuria, or festival of the ghosts, celebrated in May—a month, therefore, so unlucky that no marriage took place in it. Ovid and Greswell both agree as to the antiquity of the Lemuria. It is evident that this festival, transferred from November to May, was originally regulated by the heliacal rising of the Pleiades in the morning. Yet the offering to the spirits took place at

* This view is confirmed by a festival of Callee, the Hindoo Isis, taking place at the new moon after the full moon of November.

Wherever we find the festivals of a nation, especially those of a mournful or funereal character, occurring on the 15th or on the 17th, 18th and 19th days of the month, there is strong reason to assume that the month must have originally commenced, not with the new, but with the full moon. Among the Hindoos, both systems are in vogue. See on this point Greswell's Fasti Catholici, I. 62. Sir William Jones' works, IV. 128.

† Sauberti de Sacrificiis, 89.

midnight, a time when that constellation was invisible. What can have made that hour so peculiarly marked?

"Non haec Pleiades faciunt, nec aquosus Orion."*

Greswell connects this circumstance with the November festival of the Aztecs, which commenced in the evening, and in which midnight was the hour of sacrifice. On this he constructs a theory as to their festival commemorating the event of the sun having gone back ten degrees in the days of Hezekiah. His remarks as to the Astec festival, supply a clue to the fact, that the Lemuria must have been moved from November to May, from the month when the Pleiades rose in the evening and culminated at midnight, to May when they were invisible till early dawn; and above all, they will prove that a miracle should be the *dernier ressort* of a philosopher, and that he should be the last to consider "omne ignotum pro mirifico."†

Before concluding this necessarily superficial sketch of this primeval new year's festival, a subject respecting which scores of volumes might be written, I must turn to Britain to see if we have among us any traces of this primitive year, or seasons of the Pleiades. That it did exist among the Celtic race‡ has long been known to those who have studied its history and customs. Wylde says "the first great division of the year was into summer and winter, Samradh and Geimradh, the former beginning in May, or Bealtine, and the latter in November, or Samhfhuim, summer end. On the first of May took place the great Druid festival of Beal or Bel, and at the beginning of November All Halloween;§ and it is strange

* Propertius II, 16, 51.

† "The ceremony of the secular fire among the Aztees, the oldest, the most solemn, and most sacred of all in their calendar, seems to imply the same thing of them; for that was celebrated at midnight; that is though the ceremony itself *began at sunset*, the consummation or conclusion, by the lighting anew of the secular fire, took place *at midnight*. The primitive rule of the cycle," (the noctidiurnal system, the day commencing in the evening,) "and a co-ordinate rule borrowed from midnight, seem both to have been associated in this one ceremony.

"We have very little doubt indeed that, were the truth known, both the ceremony of the secular fire, and the change of the rule of the noctidiurnal cycle (if it must be so called) among these nations, would be found to be ultimately due to the miracle of B. C. 710, and to the circumstance under which it took place among them, and to the effect which it produced on their fears and apprehensions." But the connection of the Pleiades with the Aztec festival, seems to have somewhat puzzled Greswell, "We recommend this point to the notice of astronomers. The fact is certain that the culmination of this particular constellation, was one of the phenomena presented by the heavens, to which the Aztecs in particular, for some reason or other, looked with peculiar interest, and attached peculiar importance. It was associated with the ceremony of the secular fire, and apparently from the first; the moment prescribed for the offering of the stated sacrifice, followed by the rekindling of the extinguished fires, being precisely that when the Pleiades were in the middle of the sky. What, too, was so likely to give occasion to a ceremony of this kind (the extinction of fires of every kind at a stated time), as the sudden extinction of the light of the sun itself in the midst of its meridian splendor."—Fasti Catholici I, 362; as to Lemuria, p. 356; also see risings of stars being reversed, p. 343.

‡ Wylde's Irish Popular Superstitions, p. 38.

§ That Halloween was not only a funereal, but also an agricultural festival, is perfectly clear. Associated in Britain with a harvest home, the *Kernbaby*, or Cornbaby, must have once been one of its features. The following passage is in point:

Shaw, in his History of the Province of Moray, p. 241, says "A solemnity was kept on the eve of the 1st November, as *a thanks giving for the safe ingathering of the produce of the fields.* This, I am told, but have not seen it, is observed in Buchan, and other Counties, by having *Hallow eve fires* kindled on some rising ground." Brand's Pop. Ant. 388.

that both the eve of May day, and Halloween, are ill-omened nights, on which prudent persons in Ireland, from fear of encountering fairies and ghosts, avoid being out after dark.*

Classical writers of antiquity tell us that in Britain Ceres and Proserpine were worshipped in the same manner as in the mysteries of the Cabiri. Now we have seen that Proserpine and her mother Ceres are really the same Deities, both being connected with agriculture and the dead. In Sicily, Ceres was worshipped in May, and Proserpine in the autumn.† The latter was called Core, or the damsel. Are there any traces of her still in Britain? It is manifest that the May queen, and the Kernbaby of the harvest home, are either relics of this deity, or the origin of the myth. But we have evidence that they are as old, if not older than Proserpine herself. In the Tonga Islands, at a first fruits celebration, a child presides as a sort of Southern queen of the spring, a November queen, if I may give her a new title.

The Tow Tow, a species of first fruits celebration, takes place "at the time when the yams are approaching maturity, *in the early part of November*," when prayers are offered up to A'lo A'lo, the God of weather. Mariner, in describing it, says "a deputation of nine or ten men from the priests of A'lo A'lo, all dressed in mats, with green leaves round their necks, arrives with a female child, to represent the wife of A'lo A'lo".‡ They offer up a prayer for a fruitful season to the god, and then divide the provisions collected for the occasion. One pile being assigned to A'lo A'lo, and to other gods. Mariner tells us that "she is selected from the chiefs of the higher ranks, and *is about eight or ten years old;* during the eighty days of this ceremony, she resides at the consecrated house of A'lo A'lo, where, a day before the ceremony, a cava party is held, at which she presides, as well as at a feast which follows. She has nothing to do on the actual days of the ceremony, except to come with the deputation and to sit down with them." Here then we have, South of the Equator, a "queen of the May," or a *Kernbaby*, whichever we may call her. But in China, Core, or the damsel, assumes more distinctly the funereal cha-

* See Wylde, 52 to 58; Brady's Clavis Calendaria; also, Brand's Popr. Antiquities, v. I, p. 380.

† This festival is such a conclusive proof of the myth having reference to the two seasons of the Pleiades, that I cannot omit mention of it. In the autumn, for three days, Ceres mourns for her daughter, who, for six months, is visible on earth, and for the rest of the year is compelled to reign with Pluto in hell. Now, it is manifest that she was invisible from May to November, because after three days' search in November, she rises to light once more, and is received with great rejoicings. But this is the very time of the year when the great festival "of the Pleiads above" is celebrated by the Australians. The fact that there was a temple in Sicily,* in which Ceres or Proserpine, and the Pleiades were jointly worshipped, confirms my view of this strange myth.

* See Dupuis, V. 270.

‡ Mariner's Tonga Islands, 385.

racter of Proserpine.* At the festival of the dead, a child presides, who receives the offerings made to deceased ancestors.† In the South she is the wife of A'lo, the god of weather, but in Grecian mythology, she is "in autumn wed"‡ to Pluto, the god of the dead; and in Egyptian fables, she is doomed, at the November festival of the new year, to mourn Osiris, the God of Agriculture and "the Lord of Tombs." It would be strange, if, in the half naked little Fiji savage, the wife of A'lo, we should find a clue to her, who was "the ancient goddess" in the days of the Patriarchs, and whose statues bore the inscription, "I am all that has been, that shall be; and none among mortals has hitherto taken off my veil."§

Such then, north of the Equator, are the scattered fragments of, what

* Since writing the above, I have met with a very interesting confirmation of my views Callee, the Hindoo Core, "who appears," says Sir William Jones, "in the *calijug, as a damsel twelve years old,*" presides over a festival of the dead at the beginning of October. "She wore a necklace of golden skulls descriptive of the dreadful rites in which she took so gloomy a delight." The offerings which were prescribed by the Vedas were human sacrifices, for which, however, bulls and horses were substituted. Soul cakes are also consecrated to her, as they were to Proserpine in Greece, as the deity presiding over the dead.

Our soldiers found at Cawnpore an ode invoking "the black Goddess," the cruel Callee, written by Nina Sahib before the outbreak. The soul cake, the symbol of revolt among the Hindoos, was the emblem of this bloody goddess; and there can be but little doubt that the slaughter of our unhappy countrymen was regarded by the fanatical Sepoys as a welcome offering to their sanguinary deity. If any of her victims had ever in their native land been at a rustic "maying," or harvest home, how little could they have dreamed, as they looked at the May Queen or the Kernbaby, that they saw before them the primitive type of a cruel deity, at whose altar they were doomed to be sacrificed!—See Sir William Jones' works IV. 185.—Maurice's Indian antiquities, II. 181. Hardwicke, the late Christian Advocate at Cambridge, is strangely in error on this point; see "Christ and our other Masters," part II, page 19.—See as to worship of the dead, III, 32, 125, 176, 196, IV, 78.

† De Rougemont, Peuple Primitive," v. II, p. 356.

‡ See Orphic Hymn to Proserpine.

§ Exhibiting a funereal and agricultural character, the ancient mysteries were, as we have seen, clearly connected, by their very time of observance, with the new year's celebration of the South, the festival of first fruits, and of the dead. But even their obscene rites and their peculiar secrecy, may be solved by a reference to the savages of Australia and of Central Africa. Europeans, who have been initiated by the Australians into their mysteries, which they describe as being of an obscene nature, whenever they make themselves known to the natives by the secret signs they have learned, are implored not to divulge the sacred mysteries.

The same freemasonry exists among the natives of America, and of Central Africa. Among the latter the priest is called an *Obi* man, and the temples where these secret rites are observed are called *Oboni*, or houses of *Obi*, and are ornamented with phallic emblems, or symbols of generation.

Now, I have found, that *Obi* means, in Central Africa, *an ancestor*, one who begets. Hence the Obi man is inspired by ancestors, and the Oboni are temples of the dead. Our very word necromancy (prophecying by aid of the dead) carries us back to the Obi of the Africans. At the Oracle of Delphi, the priestess, before she uttered responses, was inspired by Ob, and must have been originally nothing more or less than an Obi woman.

Is it not strange that phallic emblems, though so very offensively significant, have been assigned by the learned to almost everything except the worship of ancestors?—See Report on Aborigines, p. 64, 69, 70.—See Bowen's Central Africa, (New York, 1857,) p. 271, 315 to 319; also Dictionary of Yoruba Language, Smithsonian Contributions, X., xvi. xix. 109.—De Rougemont's Peuple Primitiff, II, 363. I refer those who may take an interest in such matters, to the following authorities as to the funereal character of ancient mysteries, and the time of their observance, &c.: Dupuis 1., 234, and seq., 312, 340, 349, 364, 390, 402, 410, 422, 427, 439, 443. Boulanger L'antiquite devoilee, 1., p. 269 to 303; III., 178 to 186. St. Croix sur les Mysteres du Paganisme, I. 54, 55, 66, 75, 78, 317, 340, et passim. Le Monde Primitif, III. 329. Ouvaroff on the Mysteries, p. 1, 27; also Christie's notes, 169, 172. Warburton's Divine Legation of Moses, Faber's Origin of Pagan Idolatry, and Bryant's Mythology, are principally devoted to a subject, which has caused more learned and fruitless speculation than any other topic connected with the history of ancient nations.

we can only regard as the wreck of the primitive Southern year, and of its New Year's festival of first fruits, and the dead. I have endeavoured to collect together these *disjecti membra*, diffused and hitherto lost in vague myths, confused calendars, uncertain traditions, and obselete customs.* Yet, in the New, as well as in the Old World, civilized and savage races gaze with equal wonder on the memorials, that everywhere exist, of the observance of this festival by primeval man. In the large deposits of ashes, and of the remains of food, found in vast burial tumuli in Australia, America and Asia, the graves of races long extinct,† we have significant evidence of this new year's commemoration dating back to the most remote ages; while even at the burial cave at Aurignac, to which an antiquity of not less than 8000 years is assigned by some authorities, we have the same memorials of the feasts and fires of this ancient festival.‡ Its memory has long been forgotten. Preserved only in the rites of heathen races, or merely lingering, among civilized nations, in the customs and superstitions of the peasantry, this festival has never been considered worthy of the attention of the historian or of the ethnologist; and

* Though it has required much time and labor to collect even the materials which I have used, respecting this festival north of the equator, the difficulty has been far greater in obtaining any definite information regarding its observance in the southern hemisphere; first, because travellers are generally ignorant of, or inattentive to the festivals of savage races, and rarely specify the time or the particulars of their observance; and secondly, because in a colony, from the absence of extensive libraries, it is almost impossible to glean precise information, which, even if it exists, can only be procured from a large number of writers. As regards Polynesia, I have felt this difficulty very much. Ellis, on whom I have had mainly to rely, though he regards the Polynesians as belonging to the same race, and almost identical in their customs and religious ideas, does not clear up a point of no little importance in these investigations; as to the festival of the dead, and the year of the Pleiades existing universally throughout the Pacific Islands, his remarks being, in a great measure, confined to the groups of numerous Islands, known as the Georgian, and Society Islands. Even his work I could not procure while writing this paper. I had therefore to rely on notes made some years ago, while reading his works, before my attention had been particularly drawn to this subject. As, however, south of the equator, on the west coast of South America, among the ancient Peruvians, as well as in the southern Pacific, in Tahiti, the Tonga Islands, and Australia, we find the year of the Pleiades or its New Year's festival, there can be but little doubt that equally distinct traces of them will be found in the more northern islands of the Pacific. A reference to Crawford's "Indian Archipelago" will confirm this view. See I., 28.

† See Report on Aborigines, p. 62. The work of Messrs. Squier and Davis on the Mississippi mounds, and Dr. McPherson's researches at Kertch, throw a light on this subject.

‡ The existence of articles resembling American wampum in the cave at Aurignac, is peculiarly interesting, both as tending to throw light on the habits of the race that then existed in Europe, and as giving some clue to their representatives among existing nations. The cowrie (Cyprea moneta) is used in Asia and Africa, and is entirely different from the relics to which I refer. In America, shell money is made from the shell of the hard shelled clam, (mercenaria violacea, Schum.) which is cut into small oblong pieces, perforated for the purpose of being strung into *"belts* of wampum," which are buried with the possessor at his death. Hence in most Indian graves we find numerous pieces of perforated shell. This throws a light on the following passage in Sir Charles Lyell's "Antiquity of man," (p. 188.) "Mixed with the human bones, inside the grotto, first removed by Bonnemaison, were eighteen small, round and flat plates of a white, shelly substance, made of some species of Cockle (cardium), and pierced through the middle, as if for being strung into a bracelet."

As there is no further remark made concerning these specimens resembling wampum, soon after the work appeared, I drew the author's attention to the point. They are plainly not cowries, as the shape precludes such an inference.

Should the use of wampum be limited to the New World, an inquiry into this subject may lead to interesting conclusions. The mode of making wampum is described in a note to "Rule and Misrule of the English in America," by the author of Sam Slick, b. ii., ch. v. See Prehistoric Man. by Dr. Danl. Wilson, I, 218, 443, II. 147.

this paper is the first attempt that has been made to throw any light on its history or its origin.

I have restricted my remarks to such points as connect it with a year commencing in November, a branch in itself far too extensive for the space at my disposal. My next paper will show the light which this festival, occurring in February, throws on the primitive northern year; and my third will be devoted to a far more interesting and easier branch of enquiry, as to the prime origin of this festival of the dead, and the influence it has exerted on the idolatry, the mythology, and the religious rites of all ancient nations, an influence even still descernable in the customs and modes of thought of civilized nations.

That, from Australia to Britain, we have all inherited this primitive year and its new year's festival, from a common source, is plainly manifest. Was it carried south by northern nations; or, has there been a migration of southern races to northern latitudes?

That the "Feast of Ancestors," which still lingers in our All Halloween, All Saints and All Souls, is the same as the *Inachi* of the South, and was originally the New Year's festival of a primitive year commencing in November, is a matter, which can, I believe, be established beyond any question; but in what part of the world it first originated, is necessarily, with me, a matter of vague conjecture only, especially with the limited materials I possess respecting the festivals of southern races. The fact, that the year of the Pleiades, as well as the ancient reverence for that constellation, only now exists south of the equator, is, however, in itself very significant.

We have hitherto examined the universal customs of nations, let us now turn to those wide spread primitive traditions, which, though hitherto unexplained, and apparently inconsistent with each other, have been regarded from the days of Plato to the present, as embodying the dim outlines of primeval history.

First—We have the very remarkable tradition of remote antiquity, referred to by Plato, and by modern writers, as to the sun, moon and stars having once risen in the opposite quarter to what they now do. Greswell* regards the tradition as historical evidence of a miracle. Can it be explained by natural causes? It can; but only in one way—by supposing a migration of races from south to north of the equator.

To the Tahitians, the sun, moon and stars rise on their right hand; to us, they rise on our left.

* Fasti Catholici I, 343.

Second—The most ancient tradition perhaps in the world, one that has left its impress on the astronomical systems, the religious rites, and even the social customs of nations from Syria to Japan, preserves the belief of the Chaldæans that the first inhabitants of Asia were a maritime race that landed on the shores of the Persian gulf.*

Third—From China to ancient Britain prevailed the uniform belief that the ancestors of the human race came from Islands; and from the time of Plato to the present, scores of volumes have been written on the subject.† A celebrated French philosopher asks us, "Ne trouvez vous pas, Monsieur, quelque chose de singulier, dans cet amour des anciens pour les îsles ? Tout ce qu'il y a de sacré, de grand, et d'antique, s'y est passé : pourquoi les habitans du continent ont ils donné cet avantage aux îsles, sur le continent même?"‡ An enthusiastic Welshman has gone near home for the primeval paradise, though a mistaken impression undoubtedly existed among ancient nations, that Britain much more nearly resembled the infernal regions.§

Let us imagine that a migration did take place from Southern latitudes, and what would be the result? The wanderers would bear with them a recollection of the Islands of the south, which they had left. They would see with dread, and remember long, that the stars that once rose on their right hand, had apparently reversed their movements. They might bring with them a year of seasons only suited to their former homes.

The stars that once announced spring would long continue to be reverenced as the Vergiliæ, though rising at the beginning of summer. Once marking the commencement of the year by appearing to their worshippers on the southern Halloween, and hence causing "the evening and the morning" to be "the first day," the Pleiades would long retain their name as the Hesperides (the stars of the evening), even when they had ceased to regulate the year, when their "pleasant influences" had been forgotten; when their rising in the evening was no longer reverenced, and their heliacal rising and setting in the morning was alone regarded;‖ when even that mode of regulating the seasons, had become disused, and the past influence and history of the Pleiads only existed as a matter of fable, and of doubt even to Astronomers themselves.

* Faber's, II. 378, De Rongemont, I. 325. Dupais, V. 1. Layard's Nineveh and its remains II. 466.

† De Rougement, II. 248. Faber's origin of Pagan idolatry, 1. 393.

‡ Letters sur L'Atlantide, par M. Bailly, p. 361.

§ Davies' Mythology of the British Druids, 158, 181.

‖ See Greswell's Orig. Kal. Ital. III, 58, 460, 516. Also, Fasti Catholici, II. 110, which is partcularly in point, also 104. Dupuis IX, 183. Sir Cornewall Lewis' Astronomy of the Ancients, p. 11, 25, 60 to 67.

Yet we find among ancient nations, that the Hesperides were connected most singularly with the traditions as to the primitive abodes of our race. The Southern Garden of the Hesperides recalls them to our mind;* while the name of these daughters of Atlas and of the Ocean, is blended with the memory of the lost Island of Atlantis. The key to many a mysterious myth will yet be found in the history of the seasons of the Pleiades.†

It is not less interesting to mark the wreck of the southern year, and of its New Year's festival of first fruits and of the dead, over which the Virgiliæ once presided.

In some cases, as in ancient Egypt, in Britain and Persia, we find it stranded in November as an ancient popular observance, though the year had long ceased to commence in that month. In other countries it drifted off from the autumn to form a New Year's festival in February. In one instance it shared the fate of the Pleiades, and took place, as the Lemuria of the Romans, in May, in which month it must have once been regulated by the heliacal rising of the *Hesperides* in the *morning;* while the year of two seasons only survived in fables as to the two-faced Janus, or as matters of doubt and mystery to astronomers.

So entirely have the history and "the pleasant influences of the Pleiades" been forgotten, that the latest work on the astronomy of the ancients does not even refer to the primitive year commencing in November, or to the Pleiades as dividing its seasons. Even where history has

* See Dupuis I, 329. De Rougemont, II, 248.

† As the fables of Io and Icarus, hitherto unexplained, seem to relate to traditions as to a migration of races, and to changes in the seasons, it may be worth while to refer to them here. Io, the daughter of *Inachus*, is the same as Isis, who, we have seen, is plainly a mythical embodiment of the primitive year, and of its funereal and agricultural New Year's festival. The name of the Hindoo Isis, Cali, means *time*. Mythology tells us that Io, accompanied by the Pleiades, after wandering over the whole earth, and being persecuted by Juno, on account of Jupiter, arrived at last at the Nile, where she was worshipped as Isis. To what can this refer, except to a year regulated by the Pleiades, having been brought from some distant country, and embodied in the myth of Isis. The fable of Io appears plainly in the Hindoo god, *Carticeya*, (the Pleiades?). A reference to the representation of him, given by Sir Wm. Jones, will leave but little doubt on this point. By his name, as well as by his crown of seven stars, he represents the Pleiades. By his faces looking in opposite directions, and by his six arms on each side, Janus bifrons, and the year of two seasons of six months each; while in the peacock, on which he rides, we have the well known classical emblem of the many eyed Argus, the watchful keeper of Io.

Sir William Jones calls Carticeya the Hindoo Orus; but Orus or Horus, Bunsen says, unites in himself all the myths of Isis and Osiris.

The persecutions of Io, probably refer to traditions, as to the seasons having changed, in consequence of a migration of races, and having become unsuited to the year and its festivals.

Icarus falling short in his flight, from Jupiter or the sun having melted the wax with which his wings were fastened on, must also have reference to a change in the time of harvest.

Now it is a curious coincidence, if nothing more, that in Africa, to this day, *Oro* is still worshipped, as he is in Polynesia. *Isi* means a new period of time, *isimi* a feast or festival, and *ikore the harvest.*

See Sir Wm. Jones' works III, p. 363.

Bunsen's Egypt's Place in Universal History, I. 434 to 437.

Dicty. of Yoruba Language—introd. XVII.

Bowen's Central Africa, p. 272, 317.

The learned have invariably ignored the fact, that Greek mythology points, with singular uniformity, not to Egypt or to Asia for its origin, but to Ethiopia, and the ocean beyond Africa.

preserved the tale of the Aztecs regulating their cycle in November by the culmination of the Pleiades, Greswell considers the circumstance so remarkable, as to deserve the special attention of Astronomers, and assumes that, if explained, it will favor his view as to there having been once a miraculous suspension of the laws that govern the universe.

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 conclusion 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 natives of Polynesia.*

Yet the Islands of the southern ocean most nearly realize the memory of the Fortunate Isles, "where the air was wholesome and temperate, and the earth produced an immense number of fruits, without the labors of men." The early European voyagers, transported with the beauty and salubrity of the Islands of the Pacific, fixed upon them as the primeval abodes of our race. Even nature would appear to confirm the impression. There the very ocean and the stars seem subservient to man. The tides with unvarying regularity† mark morning and evening, midday and midnight; the Pleiades divide the seasons and regulate the year; and "the celestial clock,"‡ the brilliant Southern Cross, by its deflection in the heavens, proclaims the hours of the night.

The conclusions to which ethology§ has led me, that we must look south of the equator, if we would find the origin of our November festival of the dead, or a solution for the traditions as to the Pleiades, receive a very significant confirmation from the following passage in a lecture

* I refer here to the singular remains in the Easter Islands, that have attracted so much attention.—Ellis' Pol. Res., III. 325.

† "But the most remarkable circumstance is the uniformity of the time of high and low water. During the year, whatever be the age or situation of the moon, the water is lowest at six in the morning, and at the same hour in the evening, and highest at noon, and midnight. This is so well established, that the time of night is marked by the ebbing and flowing of the tide; and in all the Islands, the term for high water and midnight is the same."—Polynesian Res. I. 29.

‡ Humbolt's Cosmos, translated by O. C. Otte, (N.Y. 1850) II. 290.

§ I may, I trust, be pardoned for coining a new word for researches into a subject hitherto considered to be either unworthy of attention or closed against regular investigation. That the customs and superstitions of nations are most wonderfully enduring memorials of the past, will, I trust, be apparent from some of the facts contained in this paper. When I come to treat more particularly of the festival of the dead and of its origin, this will be much more conclusively established. Even should the interpretations, which I have given, prove entirely incorrect, it will be plain that, to more competent enquirers, the study of customs opens up a new and most interesting field, that is even more susceptible of scientific research, and that will shed more light on the social and religious life of primitive man, than philology itself.

The Father of History says, "Pindar appears to me to have truly said that custom is the king of all men;" and Sir William Jones, the only modern writer, who seems to have duly delivered February 23rd, 1863,* by Professor Max Müller. His remarks, coming from one whose profound researches have shed so much light on the history of our race, are entitled to a peculiar weight. Referring to his attention having been recently drawn to the supposed similarity in the structure of Polynesian, and Indo-European languages, he says, "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." "There are other theories not less startling than that, which would make the Polynesian language the primitive language of mankind."

Art. VIII.—*On Magnesia-Alum, or Pickeringite, containing a little nickel and cobalt, occurring in slate, in Hants Co.* By Prof. How, D. C. L., King's College, Windsor.

[*Read May 4th*, 1863.]

The mineral forming the subject of the present communication was found in the spring of 1862, and sent to me for examination, through Dr. Weeks, of Brooklyn. A gentleman working in the laboratory of this College at the time, Mr. Lyttleton, examined the small quantity of substance furnished, and brought out the fact that it contained the elements of Magnesia-Alum, with a little cobalt. Interested in this result, I proceeded to the locality in the autumn, and procured a supply of the mineral. I found it to occur on a nearly perpindicular cliff of slate, some 60 feet high, on the land of Mr. F. Parker, in Newport. It is met with as an efflorescence on the slate, protected from rain by overhanging ledges of the rock, in the form of compact and also of loosely coherent masses, of a white or yellowish colour, which are sometimes apparently amorphous in structure, sometimes distinctly crystalline, in short silky needles, (as shewn in the specimens sent for the cabinet of the Institute.) It is soluble

recognized the value of these historical materials, suggests that if a comparison of the *times of observance* of the festivals of nations were made, "there would be found striking resemblance among them; and an attentive comparison of them all might throw great light on the religion, and perhaps on the history of the primitive world." See Sir W. Jones' Works (ed. 1807,) IV. p. 165.

I use the word *Ethology*, for although Ethics would really embrace these researches, that word has now acquired a limited and conventional meaning, while Ethology is quite as admissible as *Ethnology*, although Herodotus, I am aware, uses a different word from that which I have selected, when he refers to customs. Those desirous of knowing the views hitherto entertained as to the possibility of tracing popular customs and superstitions to their origin, are referred to Brand's preface to his Popular Antiquities.—(Ed. 1853) p. vii. to xi.

* Published in Macmillan's Magazine for March, 1863.

in water, and has the taste of alum. When heated it loses much water, and swells up considerably, leaving an opaque white residue, which gives the alumina reaction before the blowpipe, with nitrate of cobalt. On submitting it to qualitative analysis, I obtained the same results as Mr. Lyttleton, but, having more material at command, I was enabled to find nickel and manganese also present. The results of quantitative analysis I place below, by the side of those obtained by Dr. Hayes,* of Boston, in the examination of a mineral from Iquique, in Peru; the material I employed was airdry, the water was determined by careful heating below redness, and the nickel and cobalt were separated by means of nitrite of potass.

	How.		Hayes.
Oxide of copper,	.02	Lime,	.126
Alumina,	10.64	Protoxide of iron and manganese,	.430
Protoxide of iron,	.13	Alumina,	12.130
Magnesia,	4.79	Magnesia,	4.682
Oxide of cobalt,	.06	Hydrochlorice acid,	0.604
Oxide of nickel,	.14	Water,	45.450
Oxide of manganese,	.45	Sulphuric acid,	36.322
Potassa,	.23		99.744
Water,	46.06		
Sulphuric acid,	36.33		
Slate,	.72		
	99.57		

It appears from these analyses, that the Nova Scotian and Peruvian minerals are identical; the leading constituents are seen to be magnesia, alumina, sulphuric acid and water. Dr. Hayes named the mineral from Peru pickeringite, and, from its resemblance in taste, and, as has been wrongly thought, in constitution, to alums, it has also been called magnesia-alum. It is rather curious that just as natroborocalcite is only found at Iquique, in Peru, (and perhaps one other place,) and, as I shewed† some years ago, at Windsor, Nova Scotia, so this mineral has no other locality assigned to it in the manuals of mineralogy than Iquique, and now we meet with it also in this Province. Strictly speaking, the mineral has neither the exact chemical constitution nor the crystalline form of a true alum;‡ but its taste and some of its properties are those of such salts, and it would admit of use in the place of common alum in various

* Dana's Mineralogy, 4th Ed., p. 382.

† Silliman's Journal, Sept. 1857.

‡ This has been shewn in a paper by myself, read before the Chemical Society of London, and published in the Journal of the Society for July, 1863.

operations; for some of these it would require purification, especially from iron; it has been employed in Newport in some simple process of domestic dyeing. The slate in which it occurs would yield it largely if properly treated, and there is an immense quantity of the rock; common alum, however, is sold at a very low price. The presence of nickel and cobalt in the mineral is interesting—the former has never, so far as I know, been found before in the Province. Since Hunt has met with* small quantities of nickel in various minerals of the Silurian rocks of Canada, these metals may be generally distributed in such rocks here in like amount; there may also be richer ores of both nickel and cobalt in the range of rocks affording the magnesia alum containing these metals.

ART. IX.—*Notice of the occurrence of a Trilobite in the Lower Carboniferous Limestone of Hants Co.* By PROF. HOW, D.C.L., King's College, Windsor.

THE object of the present notice is to acquaint the members of the Institute with the fact of the existence of an undoubted Trilobite in the Lower Carboniferous Limestone of the Province. This rock has been, it is well known, a great deal examined in various parts of the country, and numerous fossils have been obtained from it. It is interesting to have the addition of a well marked trilobite to its varied fauna, as affording precise means of comparison with corresponding deposits in other places There is a "trilobite or limulus" mentioned in the list of fossils given in the appendix to Acadian geology, as occurring at De Bert River, Cumberland Co., but as there is no description of it in the body of the work, I could not compare it with the fossil now noticed. Several specimens of this were found by myself, last July, in a quantity of blue limestone rock, brought here for the purpose of building the new College Library. On enquiry I was told that the rock was brought from the mouth of the Kennetcook River, Hants Co. I sent specimens of the fossils to the Rev. Mr. Honeyman, during the Exhibition, and they proved a welcome addition to the illustrations of the Geology of the Province. Mr. Honeyman informed me that the trilobite belongs to the genus Phillipsia.† This is nearly if not quite the sole genus remaining to the carboniferous period

* Report on Geology of Canada, 1863, p. 507.

† It has since been described by Mr. Billings, Paleontologist to the Geological Survey of Canada, to whom I sent specimens, as a new species, under the name of Phillipsia Howi, in Canadian Naturalist, July, 1862.

of the large order of the trilobites. Various other fossils occur along with it which resemble closely, but are not I think entirely identical with, those found in the Lower Carboniferous Limestone of other localities in the Province, but their exact nature is not yet made out. Specimens of the trilobite are sent for the Cabinet of the Institute, together with some of the fossils found in the same rock, viz: Producta, Spirifer, Cyathophyllum, Encrinite, Fenestella, etc.

King's College, Windsor,
February 23rd, 1863.

ART. X. — *On the occurrence of Littorina Littorea on the coast of Nova Scotia.* By JOHN R. WILLIS, Halifax, N. S.

I HAVE been induced to present for the consideration of the Nova Scotia Institute of Natural Science, the following brief remarks on the occurrence of this fine Littoral shell on such portions of Nova Scotia coast as I have been enabled personally to examine.

Some time since (Dec. 1857), I sent a large number of specimens, animals and shells, to the celebrated Dr. A. A. Gould of Boston, author of Reports on Invertebrata of Massachusetts, &c., and to Professor Stimpson, of the Smithsonian Institution, Washington, D. C., author of several valuable works on the Invertebrata of United States; both gentlemen expressed themselves astonished at the occurrence of this shell on the coast of Nova Scotia, and agreed in asserting that it had not been met with on any part of the eastern coast of the United States. Some time afterwards Professor Stimpson visited England in order to prosecute his researches among the British Mollusca, in the course of which, he ascertained, by carefully comparing our Nova Scotia species with that on the British coasts, under the same name, that there was not the slightest specific difference between them. On his return to Washington, via Halifax, I had the pleasure of a lengthy interview with him, and he informed me that he had found it nearly impossible to convince several eminent British Conchologists, that Littorina Littorea was ever collected on the coasts of Nova Scotia at all. He had managed to convince himself, however, by ocular demonstration of my veracity, for, on landing from the Steamer at Messrs. Cunard's wharf, it was the first thing he sought for, and, on one of the logs of the wharf, he collected several specimens, which he showed me with no small gratification.

These circumstances naturally made me feel somewhat anxious to establish beyond a doubt, not only the identity of the partly disputed species, but to ascertain personally its veritable range around our coast. I was enabled last summer, 1862, through the great kindness of the Provincial Government, to visit, in the Revenue Cutter "Daring," a great portion of the northern and eastern coasts of Nova Scotia and Cape Breton Island; and determined to make this the special object of my voyage, I collected Littorina Littorea in company with the other usual Littoral species, at the following places: Halifax Harbor, Bedford Basin, Northwest Arm of Halifax Harbor, fine specimens, and very common; Beaver Harbor, common; Ship Harbor, common; White Haven, common; thence through the Straits of Canseau, common; St. George's Bay, common; Pictou Harbor, common; Sydney Bar, common; Louisburg, common; thence to Sable Island, where I have collected several specimens.

I have compared very carefully, ours, not only with the figure but with the description of the British species, in Forbes' and Hanley's "British Mollusca," and can discover no difference whatever, except an unimportant and inconstant shade of color; *our* specimens are, however, *much finer* than the one figured in the splendid work above referred to. There is then no doubt on my mind as to the identity of Littorina Littorea.

I have not yet examined the remainder of the northern, southern, or western portions of the Nova Scotia coast line, and am not therefore prepared to say that we have or have not a zone of the species around the whole coast; my simple opinion is that it *will* be found on all our coasts. Dr. J. Bernard Gilpin, A.B., M.R.C., of Halifax, informs me that he has met with it on the shores of the Bay of Fundy, Digby County; these facts are, I consider, conclusive proofs of its real occurrence on our coasts.

It may, perhaps, be said that, notwithstanding its occurrence and identity are proved, it may be, after all, only an imported species; if so, the same means which conveyed it from its original habitat across the boisterous Atlantic, would certainly have sufficed to carry it to hundred of other localities where it is unknown.

I regret that I am unable to procure any information with reference to the time when it was first noticed here, as there are no records of Natural History matters in the past history of the Province. Some of the *oldest inhabitants*, whose words I safely rely on, have assured me however, that they "have often picked the Periwinkle, the same as the English one," on the shores contiguous to Halifax, when they were only school boys. From all of the facts I am strongly inclined to the opinion that Littorina Littorea, is common (but not imported) alike to England, Nova Scotia, perhaps to Prince Edward Island, and Newfoundland; though why it should not be equally so, to the eastern shores of the United States, I am free to confess that I am at a loss to explain.

N. B. Since writing the above I have had an opportunity of carefully examining the Islands of St. Paul's and Scattarie, the extreme north and east portion of the Province, and at both localities I have collected very large and fine specimens in great abundance. I have also ascertained that it is very abundant in Shelburne Harbor, (the extreme southern coast of Nova Scotia) Lunenburg Harbor, and St. Margaret's Bay.

July, 1863.

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VOLUME ~~II.~~ PART 2.

ART. I. SORICINÆ OF NOVA SCOTIA. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

[*Read November* 2, 1863.]

THE following paper is a list of the members of this group identified as inhabiting Nova Scotia. I have added none that have not been identified by myself. I have no doubt one or two more species may be found hereafter.

GENUS, NEOSOREX.

Neosorex, Palustris.—One specimen of this species was sent me by A. VanBuskirk, Esq., and was obtained at Aylesford, N. S. It agreed with *Sorex Palustris,* Richardson, Bachman, Audubon. As my sole specimen is a skin, I do not give the measurement. It differs in being larger, having a longer tail, and the feet being edged with long stiff hairs. I have taken upon myself to separate this species into the new genus, *Neosorex.*

GENUS, SOREX.

Sorex, Thomsoni, (Baird.)—This species is by no means rare in the Province. I have obtained five or six specimens, one of which was one of those types that Dr. Baird formed his new species from. These are so elaborately described in "Mammals of North America," that I refer you to that work.

Sorex, Acadicus.—In collecting specimens of *Thomsoni*, I soon found that they differed in size, and especially length of tail, breadth of fore palm, and length of sole. In referring the specimen to Dr. Baird for identification, he detected a new species, unless the long lost *Fimbripes*, of which one specimen alone exists, may be identical with this. I possess six or eight specimens of this species in alcohol.

I would remark that all difference as regards palms and soles and tubercles, when taken from alcoholic specimens, must be received with great deductions. All the specimens in my possession, when received, had the palms and soles dry and hollow, but after being in alcohol they spread, became bleached, and swelled into tubercles. Alcohol contracts the bodies, perhaps two-thirds of an inch, but at the same time swells the tail and feet. The specimens in a natural state vary very much in the same species,—some are very fat, others lean, altering the whole figure and proportion. One specimen, a female, had six mammæ, very prominent and projecting. I suppose the peculiar and pointed muzzle of the young requires such a form of mammæ.

The measurement of five specimens obtained by myself, are as follows:—

			Inches.		Inches.
No. 1.—	Total	length	$3\frac{9}{10}$.	Tail	$1\frac{18}{20}$
2.—	"	"	$3\frac{9}{10}$.	"	$1\frac{15}{20}$
3.—	"	"	$3\frac{6}{8}$.	"	$1\frac{15}{20}$
4.—	"	"	4	"	$1\frac{12}{20}$
5.—	"	"	4		2

The colour of all, olive brown above, silvery grey beneath, feet and legs flesh colour (in the recent specimen). The fur of No. 4 and 5 thicker, bodies more robust, and nose less sharp than the others. The tail subquadrate, with fine annular rings, most observable on the lower side, well covered with hair upon the upper, compressed at base, a fine pencil of hair on the tip, and brown olive above, light ash beneath. Five toes, each with a nail upon both fore and hind feet; toes all annulated; palms broad, resembling *B. Talpoides;* both palms and soles dry and hollow in the recent specimen, but softened into tubercles by alcohol,—a very slight edging of stiff hairs on outside of sole.

Should this species prove to be undescribed, the name *Acadicus*, as proposed by Dr. Baird, seems to be the most appropriate. In the length of tail—one specimen 2 inches—it certainly differs from any described species.

Sorex, Platyrhinus.—One specimen of this I have obtained only, picked up dead near Halifax.

Sorex, Personatus.—It is with doubt I refer the single mutilated specimen obtained by myself at St. Clement's, Annapolis County, to this species.

Total length, $3\frac{3}{8}$ inch; tail, 1 inch; hind foot, $\frac{3}{8}$ inch; colour, brown olive above, lighter beneath; the tail nearly bare of hair, no pencil at tip, and annulations very distinct. The tail was short, peculiar in appearance, having a tactile appearance,—in this resembling *Fosteri*. In the shortness of the tail it agrees rather with *Personatus*.

Genus, Blarina.

Blarina, Talpoides.—This species is very common in Nova Scotia. In comparing some fifty specimens, I found them all agree in a peculiar septum between the upper lip and front teeth. In colour, they varied from nearly black to light silvery blue above, below all plumbaceous; feet and nose, rose colour in the recent specimens. In size they varied from nearly 6 inches total length, with length of tail $1\frac{1}{4}$ inches, the largest I obtained, down to 3 inches and $\frac{5}{8}$, total length, with length of tail, $\frac{7}{8}$, the smallest; this last, doubtless, a young one.

Blarina, Cineria.—One specimen, only, of this species, I have seen obtained in the Province. It was taken at Truro, and mounted by Mr. Winton. The very short tail ($\frac{1}{2}$ inch) and light colour, prevented it from being confounded with the last.

I have never but on two instances seen any of this family alive—once in midwinter, and again in midsummer. In both instances they exhibited great alacrity in their movements. It is certain that some, perhaps all, swim and dive under water. They readily burrow beneath the snow. Their tracks are seen in midwinter in snow lying four feet deep in the forest, through which they must ascend to the surface, sometimes perhaps along the side of a stalk of grass. They readily enter log camps, and detached houses, pilfer meat and bread; when caught, bite at the finger; die very soon on being handled, emitting faint squeaking noises.

This concludes the *Soricinæ*, identified by myself. They are all classed from "Mammals of North America," to which work, and personally to its author, Dr. Baird, I am happy in expressing my acknowledgment. One more species nearly allied to the *Soricinæ*, *Condylura Christata*, is common to the Province. One species, only, the tail diminishing in size as the animal becomes lean; increasing during the sexual season, or when it fattens. Animals of this order have a great tendency to fatten. I also remark that I have never seen a true mole in the Province; from which I infer that at least they are rare. Although some one may have been more fortunate than myself.

ART. II. ON THE CAPLIN.* *(Mallotus Villosus.)* BY CAPT. C. HARDY, R. A.

[*Read December* 7, 1863.]

ALTHOUGH not found on the coast of Nova Scotia proper, the Caplin annually visits northern Cape Breton, and so is to be included amongst the seafish of this Province; but, independent of this fact, so much interest is connected with its habits, the vast armies in which it approaches the coasts which it favors as its favorite resorts in the spawning season, its use and abuse as an article of food or manure for the land, and finally its almost nameless value as bait for the cod, in the prosecution of the great cod-fisheries on the banks and along the shores of Newfoundland and the Labrador, that it deserves a prominent place in the history of the most curious of the finny tribes.

Richardson has carefully described the fish in his "Northern Zoology." After Linnæus, he places it amongst the Salmonoidæ, or Salmon family, of which it is the smallest known member. He

* Hugh Miller in his "Popular Geology," thus speaks of the Caplin as an inhabitant of the deep, in the latter days of the tertiary period:—"Clay nodules of the drift period in Canada and the United States, are remarkable for containing the only ichthyolite found by Agassiz among seventeen hundred species which still continue to exist, and that can be exhibited in consequence in duplicate specimens—the one fit for the table in the character of a palatable viand; the other for the shelves of a geological museum, in the character of a curious ichthyolite. It is the *Mallotus Villosus*, or Caplin."

states that it swarms on the coasts of Norway, Lapland, Iceland, Greenland, Newfoundland, the Welcome, Coronation Gulf, and, believing the *Salmo catervarius* of Steller to be the same, it inhabits, he says, the Sea of Kamtschatka. He also believes it to be an inhabitant of the icy Sea of Siberia, and thus shows that it completes the circuit of the Arctic coasts. Its southern limits on our shores appear to be about the harbour of Louisburg, C. B.,* where, I believe, its visits are not always annual or certain, and thence around the North Cape, in increasing abundance. Perley classes it among the fishes of New Brunswick, and states that it is found at Miscou, entering the Bay of Chaleur in great numbers. Found everywhere on the Canadian side of the Bay. It continues plentiful round Cape Gaspe, and ascends the St. Lawrence, according to Mr. Robert Bell, as far up as Rimouski on the southern shore. On the north shore its range continues along the Labrador as far north as Gros Bay; † whilst it is found throughout the coast of Newfoundland and the smaller islands of the Gulf. Richardson describes a fish, *Salmo (Mallotus?) Pacificus*, called the North-west Caplin, as entering the Columbia annually in immense shoals, on the Pacific coast of North America; and a Mr. Lord, late naturalist to the British North American Boundary Commission, speaks of the same fish as driven out of the Columbia by the steamers which now go panting and snorting along its banks, but says, it is still taken in vast quantities by the Indians above 50° N. latitude. However, there are doubts as yet whether to class this species as a Caplin, or as a Smelt, to which last it seems to be allied by its habit of ascending rivers to spawn. Of the Caplin under our notice as inhabiting the Arctic regions of Europe and America, there is but one species.

The following description of this fish is given by Mr. Jones, to whom I forwarded the specimens before me, on my return from Newfoundland, in July last:—

Description.—Body, elongate, compressed, extent 7 inches. Scales, small. Lateral line straightened to the region of the anal, where it

* About ten years ago a school of Caplin made their appearance in Halifax harbour. My informant is Mr. Andrew Downs, who purchased some of them in the market.

† Where my informant, Mr. Davis, for many years connected with the Labrador fishery, resided for a long time. Indeed, he questioned whether they visited the north side of this large bay at all.

bends upwards to the caudal base. Eyes, large, diameter $3\frac{1}{4}$ lines. Nostrils, double, horizontal, having the posterior cavity $1\frac{3}{4}$ lines from ocular margin. Mouth, small; vertical gape 5 lines; horizontal gape, 3 lines, the lower jaw longest; width above eyes across occiput, 3 lines. Depth, immediately in advance of anal, 10 lines; at caudal base, 4 lines. Width of body, immediately in advance of dorsal, 6 lines. Extent from point of lower jaw to posterior margin of opercles, 1 inch 4 lines; from frontal extreme to base of occipital cleft, 10 lines. Upper and lower jaws armed with sharp conical teeth, bending inwards, extending on the former to the base of the maxillaries. A row of similar teeth on either side of the palate. Head, compressed, attenuate; facial outline, declivous. At upper angle of operculum arises a filamentous fin-like process, which runs parallel with, and immediately above the lateral line to the caudal base, the mass partaking of the character of flaccid fringe.

The dorsal fin commences 3in. $3\frac{1}{4}$ lines from frontal extreme, and has its first ray longest, 8 lines; last ray shortest, $4\frac{1}{4}$ lines. Basal extent, $6\frac{3}{4}$ lines.

The pectoral fins flabelliform, commencing immediately behind the lower angle of the opercles, 6 lines beneath the dorsal ridge. Basal extent, $4\frac{3}{4}$ lines. The twelfth ray longest, $8\frac{3}{4}$ lines; expanse, $6\frac{3}{4}$ lines.

The ventrals commence in a line with the dorsal, the sixth ray longest, $8\frac{1}{4}$ lines; basal extent, $3\frac{1}{4}$ lines; expanse, 10 lines.

The anal commences in a line midway between the dorsal and adipose fins, having its fifth ray longest, $5\frac{1}{4}$ lines; basal extent, $7\frac{3}{4}$ lines.

Caudal, forked; lobes equal, $9\frac{1}{2}$ lines extent; cleft, $3\frac{1}{2}$ lines; expanse, $8\frac{1}{2}$ lines.

Adipose fin commences $9\frac{1}{4}$ lines behind dorsal; basal extent, $3\frac{3}{4}$ lines.

Colour.—Whole upper part (including the head) from the regions of the lateral line, olive green, fading to a silvery pearl beneath; the opercles dotted with dark spots, and the whole body, under the lens, more or less covered with dark specks. The whole fish shines with metallic lustre; cheeks and gill covers, silvery; fins transparent.

D. 13,—V. 8,—P. 18,—A. 22,—C. 17.

Besides Richardson's description, I have found notices of the Caplin in "Cuvier's Nat. Hist.," in Perley's report of the Gulf fisheries, and in an account of a voyage to Newfoundland and Labrador, published in 1818, by Lieut. Chappell, R. N. They all notice the ridge or process which runs along each side of the male, parallel to the lateral line. The great naturalist speaks of it adorning the fish in the *spawning season*, implying its absence at other times. He calls it a broad band all along the flank, furnished with long, narrow and raised scales, which have the appearance of hairs; and they are particularly recognised, he says, by the broad round pectorals, which almost touch one another underneath. Richardson states, that "it approaches the shores in dense shoals in the spawning season, the females preceding the males. The latter at this period acquire elevated bands at the sides, composed of soft, tumid, elongated scales, by which, it is said, they adhere together, sometimes to the number of ten or more, and in this state are occasionally driven on shore by the wind in immense quantities." As I heard from fishermen in the out-harbours near St. John's that Caplin were sometimes caught in the deep waters of the bays in winter, when the males are found to be destitute of the elevated ridges, it would appear that these singular appendages only occur in the spawning season, and must therefore be imagined to have some specific purpose in the operation of spawning,—the well known manner of which performance is a most curious fact in the natural history of the Caplin. Chappell first notices this: "The manner of the Caplin depositing its spawn is one of the most curious circumstances of natural history. The male fishes are somewhat larger than the female, and are provided also with a sort of ridge projecting on each side of their back bones, similar to the eaves of a house, in which the female is deficient. The latter, on approaching the beach to deposit its spawn, is attended by two male fishes, who cuddle the female between them until her whole body is concealed under the projecting ridges before mentioned, and only her head is visible. In this state they run all three together with great swiftness upon the sands: when the males by some imperceptible inherent power compress the body of the female betwixt their own, so as to expel the spawn from an orifice near the tail. Having thus accomplished its delivery, the three caplin separate, and paddling with their whole force through the shallow surf of the beach, generally succeed in regaining once more the bosom of the deep."

Perley speaks of this peculiar habit of the Caplin as a fact. It is thus described in the evidence taken before a committee appointed during the last session of the Newfoundland Parliament, to enquire into the cause of the decline of the fisheries, and in which much mention is made of the Caplin, in its economic relations to the codfishery; and, finally, so generally did I find, during my recent visit to Newfoundland, this curious feature in the Caplin's history, known and spoken of by the fishermen of the out-harbours, and by long residents in St. John's, of the upper classes, that, in my estimation, it deserves the credence of an authenticated fact. It is difficult to say in what precise manner the processes or ridges of the male are used during the act of the female spawning; probably they exert some amount of downward pressure in running upon the sand, thus assisting the female to exude the ripe and easily-expressed spawn.

The Caplin arrives at its spawning beaches on the south-east coasts of Newfoundland, about the 20th June, and remains close in-shore for about five weeks; beyond this period the fish is rarely seen or taken under any circumstances. The warm days with light fogs occurring at this season, are looked upon by the expectant fishermen as favourable to their striking in; they call such days "caplin weather." Now all is rivalry as to who shall get the first haul for bait; a bucket-full would command any price—like the first strawberries at Covent Garden, or the first salmon at Boston. In a few days' time they will be rolled over the roads by strings of carts, selling at 3s. a load, and exported by thousands of barrels to the eager French fishermen on the Banks; for now is the great banquet of the cod: and herring and clam, mackerel and sardine, are each refused for the new and delicate morsel. It was the height of the Caplin season when I arrived in St. John's last summer. Caplin were being wheeled through the streets, caught in tubs, buckets, and ladled up in scoops by everybody from the wharves of the town; the air was strongly impregnated with the smell of Caplin; they were scattered about in the streets, and you trod on, or drove over them everywhere. The fish flakes, roofs of houses, and little improvised stages attached to nearly every dwelling, were strewn with Caplin drying in the sun. In the country, on the roads to the out-harbours, a continual stream of carts was passing loaded with glittering cargoes of fish; the whole mass moving together like a jelly, and so very likely to spill over the sides, that division boards are placed across the cart to separate the fish into two masses, and thus keep them steadier. In the fields men were engaged in spreading them broadcast, or sowing them in drills with potatoes; whilst others were storing them for manure, by burying enormous masses of fish in great mounds of earth. But it is on the beach only that a just conception can be formed of the great multitudes in which this fish approaches the shore, when sometimes the surface of the water appears as a living mass, as far as the eye can reach, and, with their heads towards the land, they lie close in like a black line, each succeeding wave dashing them on the beach, where, as the tide ebbs, they remain and die. The seine, the cast-net, and the dip-net are being plied by the busy fishermen, whose families are collecting the dead fish, and depositing them in heaps, or in pits for manure. Sometimes the mass is so dense that a boat is impeded in sailing through them, and in dipping them up more fish than water are taken up in a bucket. Numbers of the lively little tern wheel screaming through the air over the school of fish, every now and then making a dash on their prey; whilst out in the deep water lies the great army of codfish, ready to feast on them as they return from the beach. In fact as regards their finny foes, every fish large enough to swallow them preys on the Caplin. Capt. Murray, R. E., informed me that he had taken a salmon with five, and a sea trout with two Caplin in the stomach; the latter being only 2 lbs. weight. A friend of his once thought he had hooked a sea trout, but after a little play succeeded in landing a dead Caplin, to which the hook had affixed itself in the trout's mouth, the latter being apparently too full to complete the act of swallowing.

A scene of this description is exceedingly interesting, as I saw it one deliciously warm sunny afternoon in July, on the pebbly beach at Topsail, near the head of Conception Bay. As we approached the village from the road leading to St. John's, the prospect from the top of the last hill was charming. The little neat village at our feet, with its fish stages and patches of garden, bounded by the rough barren sandstone cliffs of Portugal Cove; a pebbly beach in front dotted with groups of fishermen throwing their cast nets over the black patches which indicate the approaching beds of Caplin; the activity prevailing on board the boats and schooners moored a few yards off; the men dipping up the fish, and throwing them over their shoulders into their boats: formed a pleasing and animated foreground to a picture where the distance was formed of the lofty blue mountains across the bay, whilst in middle distance reposed the well cultivated islands of Great and Little Belleisle. In the centre of the bay lay grounded a large iceberg, evidently melting away in torrents under the influence of the hot July sun.

Nothing could exceed the beauty of the iridescent colours of the fish, as I handled them fresh caught. The back of the male between the ridges was of an emerald blue as it caught the light. I observed a remarkable absence of timidity on the part of the fish. It seemed as if no amount of splashing over them with the heavily-weighted cast nets could frighten the remainder away from the shore. They seemed impelled to push close in by strong instinct, and even when wounded and dying from being struck by the lead weights of the net, their heads would still point to the beach. We could easily take them with our hands, scarcely wetting our feet, as they swam close in. The sand and gravel of the beach was mixed with a large proportion of spawn. I found the latter in the stomachs of all the male fish which I opened.

In concluding these remarks on the habits of Caplin in spawning season, I append an extract from the letter of Mr. W. H. Warren, of St. John's, who was engaged for 28 years in the fisheries off the Newfoundland and Labrador coasts, to the chairman of the Select Committee on Fisheries. After describing the manner in which the two males accompany and assist the female in the act of spawning, he continues: "From the observations I have been enabled to make, I believe the Caplin approach the coast and spawn at spring tides. By the next spring tides the spawn has become vivified, and is washed off and mixed with the sand and gravel. In about six weeks the young Caplin are about the size of a cambric needle, and half the length. About this time the codfish come in after the young spawn in great numbers, and I have had 70 to 100 quintals often taken in a seine at a single haul, at a beach that was a favourite spawning place of Caplin." I also give the following observations on the Caplin in Labrador, kindly forwarded to me by Mr. Davis of this city, many years engaged in the fisheries on that coast: "These fish," he says, "make their appearance about the latter part of June or beginning of July, in such immense quantities as to appear quite fabulous to persons who have had no opportunity of witnessing the sight. On a clear calm day may be seen from the highest hill, as far as the eye can reach, the ocean literally covered with these fish, forced to the surface of the water by their different enemies preying on them; and it has been clearly ascertained that for hundreds of miles east and west a similar sight has been observed on the same day. The object of their annual visit to these shores is undoubtedly to deposit their spawn. The myriads to be seen on the sandy beaches at this season, baffles description. The manner in which this is performed is one of the most singular and interesting facts in the character of this fish. It may be observed that the male and female differ so much in appearance that it would be difficult for a stranger to believe they were of the same species. In the female the skin is perfectly smooth, with no other obstruction than the fins. The male, on the contrary, has a beautiful ridge on each side, resembling velvet, and when first taken out of the water has the colours of the rainbow. The time for the female depositing her spawn having arrived, she is assisted by two male fish, one on each side, and when the surf offers, they all force themselves on the beach, taking particular care that the female is kept in the middle, and by thus compressing her, the object of their visit is accomplished. Many repetitions are undoubtedly required. If the sea remains undisturbed for several days, so that the spawn may accumulate, and a moderate surf then follows, the spawn may frequently be found on the beach to the depth of twelve or even eighteen inches. The Caplin commences its departure about the last of July."

The Caplin was leaving the harbours in the vicinity of St. John's, this last summer, on the 25th July, and the squids, the next bait in succession used in codfishery, making their appearance.*

It remains to say a few words in connection with the uses of the Caplin to man, and its present unlimited wholesale capture and wasteful application. The primary and most important use of the Caplin in Newfoundland, Labrador, and the Gulf fisheries, is as a bait for the cod. During the spring, all the cod have been taken, both on the Banks and along shore, by herring, but in inconsiderable numbers; now, however, the fish look for their great annual glut, and Caplin alone will take them. Every shore boat must have its fresh Caplin, as well as every Frenchman on the Banks. It is the bait of the hook-and-line fisherman, as well as for the destructive bultow. If the supply of Caplin were withheld, by an act of the Newfoundland Government, from the French, their great

* It is generally noticed by the fishermen as a sign of the approaching departure of the Caplin, that the eyes assume a red or bloodshot tinge.

fishery fleet could do nothing: as, having exhausted the supply from their own islands of St. Pierre and Miquelon, by taking and wasting the fish with too great prodigality, they are now entirely dependent on the supply from the harbours of the main island. Many attempts have been made to associate the failure of the cod-fishery, with a decrease of bait, such as herring, caplin, &c. This year, however, the take of cod has been unusually bad in all directions, whereas Caplin struck in in unwonted numbers. It is said by some that they were so glutted with the live fish that they refused the dead bait. Again, I find it stated that a decrease in the Caplin would be advantageous, as the cod would take more readily. However this may be, it must be evident that any material and permanent decrease in the bait must tell on the fisheries. For example, the Caplin may, as has been shewn to be the case, be so thinned by wholesale destruction whilst spawning on the beach, whilst many are driven off and compelled to drop their spawn in deep water, where it will not vivify, as finally to desert a locality forever. On many parts of the Newfoundland coast this has been the case, and PERLEY states that the codfishery of the Bay of Chaleur has greatly fallen off since the Caplin have almost ceased to visit parts of it, and many houses in consequence found it necessary to break up their establishments. The great complaints of the scarcity of bait along the western shore of Newfoundland, is owing to the complete failure of a celebrated baiting place at Lamaline, where formerly the strand looked like a bed of spawn, but now is completely ruined: the Caplin no sooner approaching the shore than they were hauled before they had time to spawn. In fact little argument is required to prove that the codfishery must stand or fall with the supply of Caplin. The wasteful practice of manuring the land with Caplin is another incentive to taking these fish wantonly. Not only are the dead fish which are strewn in myriads on the beaches collected for manure, but live fish are hauled for the same purpose, and hundreds of cartloads have I seen upset to form a heap of putrefaction, and be afterwards spread on the soil, every fish composing which was good and wholesome food for man, eaten fresh on the spot, or simply dried for exportation or winter use. But Newfoundland is shamefully prodigal of the great natural resources afforded to her. It is true that the fish is dried and exported to the markets of Europe—and a more delicious dried fish than the Caplin does not exist; but why this shameful conversion of food into manure from sheer laziness? Neither does the Caplin manure prove so very beneficial after all. Though very efficacious for one year for grass and all root crops except potatoes, it then requires renewal—the land cannot do without the stimulus—or soon falls off. About five loads of earth are mixed with one of Caplin, which is bought at three to four shillings. The fish, well covered, are allowed to decompose till October; then mixed and ploughed in the land either that fall or the ensuing spring. On the other hand the Caplin requires little or no attention in drying, to become an article of food. A few hours in pickle, and a few more exposed to the sun, on a stage, or roof, or even on the ground, and they may be packed loosely in a barrel, without salt, and headed up. Before those who enjoy the luxury of a dish of fresh Caplin, a more delicious repast cannot be placed. Eaten very hot, and nicely browned, they are far superior to the common smelt in flavour and delicacy. The flavour much reminded me of the famous whitebait of the Thames.

In conclusion, it appears that the Caplin, though its range is too great, and its spawning ground too far extended to render extinction of the species possible, yet, in the baiting places whence it is obtained for the use of the neighbouring codfisheries, it has been in many instances rendered exceedingly scarce; and its final total departure from these resorts must ensue, unless it is protected from being hauled before or in the act of spawning, and for such a wasteful purpose as that of manuring the land. The total absence of bait will at once ruin the fisheries in a most direct manner; the immediate effects of which must be the ruin, starvation, and abandonment of their present residence, on the part of thousands; and to such a state the affairs of the Newfoundland fisheries, including its very vitality as a colony, seem rapidly drifting.

ART. III. CONTRIBUTIONS TO THE NATURAL HISTORY OF THE BERMUDAS. BY J. M. JONES, F.L.S.

PART I. MOLLUSCA.

To the naturalist, the little islands, known as the Bermudas, present many points of interest, and although they cannot boast of a single form peculiar to them, yet as illustrative of the great question of geographical distribution, a knowledge of their fauna cannot fail to prove an addition to that already treated of in volumes pertaining to Natural Science. Their marine zoology is, as far as I have been able to ascertain, West Indian, but from comparison of specimens, I find the 'Mudian forms much smaller than those of that district. The shells are particularly so, and will hardly bear comparison with the well developed types from the Caribbean Sea.

To those who may not be acquainted with the precise position of the Bermudas, I may say that they lie in 32° 15' north latitude, and 64° 51' west longitude, the nearest land being that of Cape Hatteras, in North Carolina, distant six hundred miles; while from Sambro Island to St. David's head, the north-eastern extreme of the islands, the distance is seven hundred and thirty miles. The appearance they present on the approach of the voyager, is by no means striking, for the land in no part rises more than 250 feet above the sea level, and the whole are more or less clothed to the water's edge by a verdant mass of the scented cedar *(Juniperus Bermudiana)*. The group, we may almost say, owes its existence to the presence of the reef building coral zoophytes, of the genus *Meandrina*, *Astræa* and *Madrepora*, which, at this position, the most northern they are known to thrive in, where the temperature of the ocean sinks as low as 64°, form barrier reefs of great extent all around the islands, which act as a breakwater to stay the fury of the tremendous seas which in stormy weather dash on these reefs, and cover the waters around with a mass of seething foam.

As may naturally be supposed, the labours of the shell collector are confined *within* the reefs, for apart from the ocean swell outside being too great for dredging operations, the water is far too deep. The whole of the bottom between the outer reefs and the land is dotted over with patches of coral, rising from the foundation to within a few feet of the surface in places, while the intervening space presents a pretty even surface of sand, broken shells and coral. By far the greater number of marine shells are found on the reefs, and it is a curious fact that the dredge rarely brings up any variety of forms when dragged along the open sandy bottom, its collection consists chiefly of broken coral mixed with white sand and chalky mud, and dozens of the small purple *echinus*. The best way to collect marine shells in the Bermudas is to search the rocky shores and rock pools at low water, especially at neap tides, when not only shells but thousands of other forms in nearly every department of marine zoology may be obtained. Many of the recent shells may be found in a semi-fossil state in the shore rock, shewing how rapid has been the formation of the sandstone in these islands; and the process of such formation may be witnessed daily, where sea shells, broken coral, sand, and gulf weed, are thrown up into a mass at high water, and left to harden by natural process. There are no fossil shells found, however, which have not their living representatives at the present day, although I must confess that some specimens of a large *Helix*, which I found in a mass of hard rock at Tucker's Town, would favour the presumption; but as they resemble in some particulars the common *Helix Bermudensis*, they may only prove exaggerated individuals of that species, and a more extended search may reveal their representative in some unfrequented part of the islands. The list I have been enabled to make out up to the present time includes some hundred and twenty species, which are as follows:—

Class.—Cephalopoda.

Fam. SPIRULIDÆ. Gen. Spirula.

S. Peronii.—This fragile little shell is very common without its cephalopod, on both north and south shores of the Bermudas. It is borne amid the vast masses of gulf weed (*Fucus natans*) which are carried from the Caribbean Sea to this latitude by the ocean current, and is cast upon the beach after heavy gales. Some specimens are nearly perfect, but the majority generally suffer damage in their transit. Specimens have been collected at Sable Island, and also on the south-west coasts of England and Ireland, having taken the course of the Gulf Stream.

Class.—Gasteropoda.

Fam. STROMBIDÆ. Gen. Strombus.

S. gigas ("King-conch" of the fishermen).—This fine species, so well known to the cameo and porcelain makers of England, is common in the Bermudas. The fishermen generally take it with a baited hook, and after capture, allow the mollusk to decay inside, when they intend to preserve the shell. The shell is frequently used to call the labourers to meals; the spire having been broken off, the mouth is applied to the orifice in the usual way, and on blowing hard a sound like that of a horn is produced, which may be heard some distance.

Gen. Hemi-fusus.

H. morio, Linn.—Rare.

Fam. MURICIDÆ. Gen. Pisania.

P. bilivatum, Reeve.—Rare. Harris's Bay, Smith's Parish.

P. ———————— ?—Rare. South shore rock pools.

Gen. Triton.

T. lanceolatus, Kiener.—Rare. Only one specimen, dead, taken on south shore.

T. pilearis, Lam.—Rare. Only one specimen collected.

T. variegatus, Lam. ("Queen-conch").—Common about the reefs. It is difficult to obtain a clean shell, nearly all being coated with a limy concretion.

T. chlorostoma, Lam.—Rare. In a rock pool at Harris's Bay. The mollusk was absent.

Gen. Fasciolaria.

F. distans, Lam.—Rare. I only obtained a specimen in a semi-fossil state, partly imbedded in the sandstone rock.

Fam. BUCCINIDÆ. Gen. Nassa.

N. ambigua, Mont.—Common under stones at low water.

Gen. Purpura.

P. deltoidea, Lam.—Common on the rocks at low water mark. Syn. *P. triserialis*, Smiths. Cat.

P. undata, Lam.—Common on the rocks at low water mark. Some specimens are much brighter than others. Cuming makes this and *bicostalis* to be one and the same species; but Reeve, Tristram, and others, separate them. I am inclined to Cuming's opinion, for I have only found this and the former species after diligent search.

Gen. DOLIUM.

D. perdix, Linn.—Not uncommon. Usually of small size; but one taken, by the Rev. J. B. Freer, at the Flatt's, was a remarkably fine specimen.

Gen. COLUMBELLA.

C. mercatoria, Linn.—Very common. There are two or three varieties of this shell; one of an orange colour, very pretty. At Gibbons' Bay and Shelly Bay, dozens may be picked in a short time, but these are all dead shells.

C. cribraria, Sow.—Very common on sandy beaches in sheltered bays, dead.

Gen. OLIVA.

O. reticulata, Lam.—Not uncommon in sandy bays.

O. bullula, Sow. ("Rice Shell").—Common on the sandy beaches Gibbons' and Shelly bays, Flatt's harbour, &c.

Fam. CONIDÆ. Gen. CONUS.

C. mus. Linn.—Dead on the beach, south shore.

Fam. VOLUTIDÆ. Gen. MARGINELLA.

M. avena, Val.—Common on sandy beaches, in similar situations with *oliva bullula*.

Fam. CYPRÆIDÆ. Gen. CYPRÆA.

C. cinerea, Linn.—Paget Sand Hills; semi-fossil in rocks. On the beach in the Somerset bays.

C. quadripunctata, Gray.—Dead specimens are very common in sandy bays. Children gather them in cups for sale.

C. cervus, Linn.—Dead specimen; on the beach at Cox's bay, Devonshire parish. The mature shell attains a much larger size, nearly three times as large as this. Mr. Bartram of Mullet Bay, who possesses a very fine specimen, informs me that they are only found during the hottest months of summer. This species is very common at Turk's Island, Bahamas.

Gen. OVULUM.

O. gibbosum, Linn.—Not uncommon; on the stems of *Gorgonas*, and on the reefs. Lieut. Slessor, of the Royal Artillery, procured a fine specimen at the North Rock. This specimen was taken on a sea fan at Cox's Bay. The mollusk itself has its mantle of a most lovely colour, variegated with markings of red, orange, green, and yellow.

Fam. NATICIDÆ. Gen. NATICA.

N. canrena, Linn.—Dead on the beach. Not common.

N. Marochiensis, Lam.—Sandy bays. Not common.

Fam. CERITHIADÆ. Gen. CERITHIUM.

C. nigrescens.—Very common in rock pools on south shore, as well as at the Flatt's at low water.

C. ———— ?.—In great abundance in rock pools on south shore, where these shells are tenanted by a minute species of soldier crab (*Pagurus*).

C. eriense, Val.—Very abundant in rock pools at low water, where they may be taken up in handsfull. It is very similar to *C. nigrescens*, but is darker in colour.

C. literatum, Barn.—Not common. Among the rocks at low water.

Gen. PYRAZUS.

P. albivitatum, Ad.—Very common at low water in the sand and on the stones, Flatt's harbour.

Fam. TURRITELLIDÆ. Gen. VERMETUS.

V. Knorrii, Say.—Very common in sandy bays, but generally much broken.

Gen. SCALARIA.

S. coronata, Lam.—Not common: sandy bays.

Fam. LITTORINIDÆ. Gen. LITTORINA.

S. muricata, Ad.—Very common in crevices of rocks, above high water mark. Some specimens are coated with a dull stone-coloured epidermis, like the rocks on which they rest, while others are of a handsome bright cream, mingled with a cast of blue. The apex of this bright-coloured variety is generally very perfect, the dull variety, not. I have never observed the shell *close to* the water. In the vicinity of Tucker's Town, on the south shore, I have taken it in abundance on the sandy cliffs, some twenty feet above high water mark.

L. dilatata, Ad.—Very common, and of the same habits as *L. muricata*, but not usually found together on the same rock. It is, if anything, more common than that species, and is particularly abundant in the vicinity of Harris's Bay, in Smith's parish. Some specimens are more spinose than others.

L. zigzag, Lam.—This shell is by no means common, although six or eight specimens may be obtained in an hour's search. It frequents the same situations as *L. muricata* and *L. dilatata*, viz., holes in the rocks; but it appears to approach nearer the water than those species. It is gregarious in habit, four or five being generally together.

L. scabra, Linn.—Common among the mangroves in a bay at Port Royal.

L. mauritiana. Very rare. Rocks on south shore.

Gen. MODULUS.

M. lenticularis, Chem.—Common; under stones at low water, south shore.

Gen. PHORUS.

P agglutinans, Linn.—"Carrier shell." Rare. This specimen was taken from a cavernous hole, some feet below the surface, while cutting Queen street, Hamilton. Presented by Dr. Higgs.

Gen. LITIOPA.

L. atlantica, Rang.—Very common; under stones at low water, Gibbons' Bay.

Gen. RISSOINA.

R. micans, Ad. Common; under stones at low water, Gibbons' Bay.

Gen. TRUNCATELLA.

T. succinea, Ad.—Common; under stones in the cedar grove at Spanish Rock, Smith's parish. Woodward, quoting Lowe, says that the *Truncatellæ* frequent stones and seaweed between tide marks.

These specimens I took under stones at Spanish Rock, some hundred feet above the sea.

Fam. NERITIDÆ. Gen. NERITA.

N. peloronta, Linn.—"Bleeding Tooth," or "Bleeding Gum." Not common; south shore rocks about high water mark. I observe that the largest specimens have not the red markings so distinct as the medium sized ones. Very small specimens are marked as brilliantly as the larger. These shells command a ready sale among strangers, and the coloured children soon realize a few shillings by the traffic. They are also prized in England as curiosities. The mollusk is gregarious in habit.

N. versicolor, Lam.—Common on rocky shores about high water mark. Some specimens are brighter than others. The mollusk is gregarious in habit. This and the preceding species are frequently found together.

N. tessellata, Gmel.—Probably more common than any other shell in the Bermudas. In rock pools at low water, and under ledges of rocks, where they keep together in masses. To every mass of these shells there are generally two or three of the latter species. Some specimens are much duller in colour than others, and have the apex much eroded. It occurs abundantly in the Bahamas.

Gen. NERITINA.

N. viridis, Lam.—Under stones; not uncommon.

Fam. TURBINIDÆ. Gen. TURBO.

T. pica, Linn. *Trochus pica*, d'Orb.—This shell, as far as I am aware, has not been found with the living mollusk, but it occurs in such vast abundance on the beaches and sand hills, as to prove beyond all doubt that it does exist in the 'Mudian waters, somewhere. It must be a handsome shell in a living state.

Gen. IMPERATOR.

I. calcar, Linn. *Turbo inermis*, d'Orb. *Calcar magus*, Chem. *Trochus calcar*, Gmel.—Not common. A dead specimen on south shore.

Fam. HALIOTIDÆ. Gen. IANTHINA.

I. communis, Lam.—Abundant, particularly after a continuance of southerly gales. In April 1861, after a heavy gale from that quarter, the bays and inlets of the south shore were visited by thousands of these shells, some with their rafts attached, and others separated from them. In company were countless myriads of the *Valella vulgaris*.

I. globosa, Swains.—Nearly as common as the preceding species on the same occasion.

Fam. FISSURELLIDÆ. Gen. FISSURELLA.

F. Barbadensis, Lam.—Very common on the rocks.

F. firmata, Reeve.—Very common in the sand at Shelly Bay, &c.

Fam. PATELLIDÆ. Gen. GADINIA.

G. mamonillaris, Linn.—Rare.

Gen. SIPHONARIA.

S. brunnea, Han.—Very common, adhering to the rocks at low water. These shells appear to take the place of the *Patellæ* of northern climes. There are three varieties of this species.

Fam. CHITONIDÆ. Gen. CHITON.

C. squamosus, Linn.—Very common; south shore at low water, under stones and in holes of the rock where the surface is smoothed by the action of water. In January 1860, I procured the largest specimen I have seen, at Cox's Bay, Devonshire parish. It was five inches in length, by 2 inc. $3\frac{1}{2}$ lines in width. If touched at all while on the rock, these chitons immediately "suck the rock," as the 'Mudians say, and adhere so tenaciously to it, that if forced from the position, the shell will come away, leaving a portion of the flesh behind. The larger specimens are generally covered with limy concretions, and those inhabiting exposed situations have the shells worn down and smoothed.

ORDER.—PULMONIFERA.

Fam. HELICIDÆ. Gen. HELIX.

H. Bermudensis, Pfr.—Quite as common as the garden snail (*H. aspersa*) is in England, and frequenting similar situations, holes in trees, old walls, &c. The finest specimens are about $\frac{3}{4}$ of an inch in diameter, and richly banded with dark brown; others have irregular longitudinal stripes of dark brown on each whorl, while others again are of a transparent yellow tinge.

H. circumfirmata, Redf.—Common in sheltered places, under old walls, &c.

H. microdonta, Desh.—This is by far the most common land shell in the Bermudas, and covers the ground in multitudes. The living shell found under stones, old bones, and boards, has a rich brown colour, while the dead ones are bleached quite white.

H. ———— ?—Under stones; not common.

Gen. SUCCINEA.

S. Texasiana, Pfr.—On the roadside near Smith's parish church. Common. When the mollusk inhabits the shell, the latter appears of a mottled muddy green colour; but when the mollusk is removed, the shell assumes a light orange hue. This species occurs in several places, and is found bleached, by exposure on the ground, among the cedar groves and sage bushes.

S. ———— ?—On a rock near "Spanish Rock."

Gen. BULIMUS.

B. ventrosus, Ferr.—Very common; in crevices of trees and sheltered places. Sir William Jardine informed me that it occurs in Madeira, and it is also included in the "List of shells of the Canaries," by M. d'Orbigny.

Gen. PUPA.

P. chrysalis ?—This specimen, presented to me by Lieut. Jardine, R. N., was obtained on one of the Bahama Islands, where the M. S. "Conqueror" was lost; but it is identical with those found by Mr. Marrett on the Port Royal Hills.

P. ———— ?—Not common. On an old tree in the grounds at Hermitage; under stones at "Spanish Rock."

Fam. AURICULIDÆ. Gen. MELAMPUS.

M. Redfieldii, Pfr.—Common under stones on side of mangrove swamps, Hungary Bay.

M. flavus, Gmel.—In same position as the preceding species, and equally as common.

Fam. CYCLOSTOMIDÆ. Gen. HELICINA.

H. subdepressa, Poey.—Very common; on roadside near Smith's parish church, at David's Island. This species seemed partial to the stems of the young cedar trees that were springing up above the road, as I picked several in that position. It is amphibious, for I observed it upon the grassy weeds under water at "Peniston's Pond."

ORDER.—OPISTHO-BRANCHIATA.

Fam. BULLIDÆ. Gen. BULLA.

B. physis, Linn.—Rare.

B. nitidula, Lister.—Common; among sea weed at low water.

B. punctulata, Ad.—Dead shells very common in muddy bays.

Fam. APLYSIADÆ. Gen. APLYSIA.

A. ——— ? ("Sea Cat.")—Very common; crawling upon the reefs of the south shore at low water. Its habits are those of a slug, crawling slowly along, precisely like that terrestrial mollusk. It appears to feed principally upon a species of red *algæ*, as I find its excrement is almost entirely composed of this marine plant. When roughly handled it emits a violet coloured fluid, which tints a large quantity of water, if the creature is thrown into it.

SECTION.—NUDI-BRANCHIATA.

Fam. DORIDÆ. Gen. DORIS.

D. ——— ?—Not common; on coral; sides of rock pools, &c., south shore.

CLASS.—CONCHIFERA.

Fam. OSTREIDÆ. Gen. PLACUNOMIA.

P. ——— ? Attached to a shell of *Meleagrina placunoides*.

Gen. PECTEN.

P. zigzag, Linn. ("Scallop.")—Very common. This is the common edible scallop of the Bermudians; David's Island, Crawl, Harrington Sound, and other places. It is difficult to procure perfect specimens of this shell from the fishermen: for their taking them with the "nippers"—an instrument constructed on purpose—generally breaks off some portion of the outer rim of each valve. They vary much in colour, some having the flat valve prettily marked with yellow, brown, and white, in zigzag form, while others have it of a rich dark brown, with a few yellow spots. The concave valve, again, is sometimes wholly brown, even over the umbo, but is generally white at that point.

P. Gruneri, Reeve.—A young individual; among the sand at Baylis's Bay.

Gen. LIMA.

L. fragilis, Sow.—Rare; under stones at low water.

Gen. SPONDYLUS.

S. ustulans, Reeve.—Not uncommon. Reefs in Harrington Sound, &c.

S. ericinus, Reeve.—Not uncommon; in the same positions.

Fam. AVICULIDÆ. Gen. AVICULA.

A. ———— ?—Rare. Attached to a frond of the "sea rod" (*Gorgonia*) brought up from the bottom; Harris's Bay.

Gen. MELEAGRINA.

M. placunoides, Reeve. ("Oyster.")—Very common in muddy bays; Flatt's Harbour, &c. Attaches itself in bunches to old roots and sticks. It is eaten by the 'Mudians as an oyster, but the taste is rather sickening. The interior shell is always very pearly.

Gen. PERNA.

P. ephippium, Linn.—Very common. Attaches itself by the byssus to roots of trees growing in the water, crevices of the rocks, &c. The shell is very heavy for its size. I have not observed this species on the south shores of the islands.

Gen. PINNA.

P. rudis, Linn.—Common; in mud, Somerset bays; Long Bird Island.

Fam. MYTILIDÆ.

M. Domingensis, Lam. ("Black Shell.")—Very common, particularly on the south side of the islands, where it fills the cavities of the rocks in clusters at low water. Some specimens have the umbo widely separated and curved upwards. It is frequently used as bait for fishing, when better cannot be procured. The fishermen mash a quantity together and tie on the hook.

Gen. MODIOLA.

M. tulipa, Lam.—Very common; in the sand of the beaches; Flatt's harbour; Spanish Point.

Fam. ARCADÆ. Gen. ARCA.

A. Noæ, Linn.—Very common; crevices of rocks, and under stones at low water; Flatt's harbour, and north and south shores generally. Always coated with a limy concretion.

A. Americana, Gray.—Very common; sandy beaches; Flatt's harbour.

A. gradata, Brod.—Common; under stones.

Fam. CHAMIDÆ. Gen. CHAMA.

C. macrophylla, Linn.—Common: under ledges of the rocky shore, west side of entrance to Flatt's harbour.

C. lingua-felis, Reeve.—Very common; usually found in masses of several individuals; Flatt's harbour, &c.

Fam. CARDIADÆ. Gen. CARDIUM.

C. serratum, Linn.—Very common; in sandy beaches, where it is found some inches below the surface. Its habit is similar to that of the common edible cockle *(Cardium edule)* of England. Some specimens are much larger than others.

C. cygnorum, Desh.—Rare; one valve only.

Fam. LUCINIDÆ. Gen. LUCINA.

L. tigrina, d'Orb.—Very common; sandy beaches. Fine specimens are obtained at Spanish Point. I have observed this species in a semi-fossil state, in the shore rocks at Point Shares.

L. domingensis.—Fossil. Only one specimen; shore rock at Point Shares.

Gen. LORIPES.

L. chrysostoma, Menscke.—Rare. One valve only, on the beach at Scour Inlet, Somerset.

Fam. VENERIDÆ. Gen. VENUS.

V. cancellata, Linn.—Rare. One valve only. Occurs also in a semi-fossil state, in the Somerset shore rock.

V. crenifera. Sow.—Rare. One valve only.

Fam. TELLINIDÆ. Gen. TELLINA.

T. lævigata, Linn.—Very common; sandy beaches, a few inches below the surface at low water. Dead valves abundant in sandy bays.

T. magna, Speng.—Common ; sandy beaches, a few inches below the surface at low water. Dead valves found with those of the former species, in sandy bays.

T. radiata, Linn.—Common ; in similar positions.

T. interrupta, Wood.—Not uncommon ; in similar positions.

Gen. CAPSA.

C. spectabilis, Hanley.—Very common ; Flatt's harbour ; at low water.

Gen. SEMELE.

S. ——— ?—Very common ; Flatt's harbour.

S. ——— ?—Rare. One valve only ; found on sandy beaches.

Fam SOLENIDÆ. Gen. SOLECURTUS.

S. ——— ?—Common ; Somerset bays.

Fam. PHOLADIDÆ. Gen. PHOLAS.

P. striata, Linn.—In pieces of drift timber.

Gen. TEREDO.

T. ——— ?—On the reefs and rocks under water ; Harrington Sound ; tubes standing upright above the rocks.

NOTE.—Supply omission at commencement. (*Read December* 7, 1863.)

ART. IV. ON THE WATERS OF THE MINERAL SPRINGS OF WILMOT, N. S. By Prof. HOW, D. C. L., *University of King's College, Windsor, N. S.*

[*Read January* 4, 1864.]

IN a paper "On some Mineral Waters of Nova Scotia," read before the Natural History Society of Montreal, last summer, and published in its journal, "*The Canadian Naturalist*," for October last, I put together nearly all the information in my possession respecting the Mineral Springs of this Province ; and though I had the tolerably complete analysis of two only of the waters (published in newspapers here and in Cape Breton at the time they were made) to present, I was enabled by means of these and by general descriptions in other cases, to show that the waters of Nova

Scotia "are of varied character;" and it was remarked that "there would be much scientific interest in an extended and thorough investigation into their qualities and composition. At the same time, if the results were duly published, the medicinal virtues which reside in some of the waters would be made generally known; it is probable, too, that new medicinal springs might be discovered. This is obviously a matter of sufficient importance to the Province, both in a sanitary and economic point of view, to demand the care and attention of an enlightened Government. Mineral Springs have been, and are still so frequently the sole means of rendering localities famous and wealthy, by attracting residents for more or less lengthened seasons, that it is well worth while to possess any water of great curative value, and to make its merits known as extensively as possible. Nova Scotia appears to be able to add valuable medicinal waters to her mineral productions, awaiting exploration and development."

Among the waters mentioned were those of Wilmot, better known probably by reputation than any others in the Province; concerning which I gave only part of the information conveyed in the following letter, obligingly written last April, in reply to a note requesting particulars with regard to the Springs, by Rev. Dr. ROBERTSON, rector of the parish in which they are situated:—

"The water of the Wilmot Springs is cold, with an abundant flow, and is highly charged with mineral solutions, chiefly of iron and copper. No *correct* analysis of it, I rather think, has as yet been made. It is said to contain a small proportion of Iodine.

"In former times the Springs were much frequented; but of late years very few visitors have been near them. The water, however, is remarkably efficacious in curing *cutaneous* complaints, or eruptions, and has the singular property of resisting all tendency to stagnation; for I have myself kept a bottle of it for a whole year in this house, and on opening it the water was found to be as sweet as when it was bottled.

"In my own opinion, the Wilmot Springs deserve to be better known, and more frequented than they are at present. If the proprietors were men of substance and energy, I have not a doubt but that their locality would be one of the best known in Nova Scotia."

Finding it, contrary to my expectation, to be the case that no analysis was accessible, even if any had been made, of waters so esteemed, I was curious to get at their composition, and being at Margaretville, about five miles from the Springs, last July, I came round to Windsor by land, and took the Springs on my road, so as to be able to examine the spot and collect some of the water for analysis. On the journey I found that their reputation had extended to the United States, people of property having come thence and resided for months at Wilmot, for the purpose of using the water; also, that the proprietors were once, if they are not still, in the habit of exporting the water to order, either to the States or New Brunswick. My informant, a very intelligent young man from Margaretville, had himself drunk the water for a twelvemonth or more, and though he found it rather unpleasant at first, he came to prefer it to any other; the effects were described as being decidedly purgative to those unaccustomed to its use.

Arrived at the Springs, I found them situated under lofty trees, a few feet off an excellent road, and filling two basins. One of these was perhaps six feet in diameter, affording a considerable overflow of water, conducted away along a trough, from which an uninterrupted and rapid stream of about an inch in diameter (speaking from memory) enabled me to procure a supply with the greatest ease. The second was situated at a distance of some three or four yards from the other; it was, perhaps, one-third the size, and was not furnished with a trough, whence I conclude that it is not, generally, at any rate, made use of. However, thinking it possible that the two waters, though so close at their outlets, might really be dissimilar, I filled some bottles from the smaller basin also: both appeared beautifully clear, and in neither did I perceive any odour or particular taste. As I had no thermometer, I can only say that as regards temperature, they seemed moderately cold. I observed several bathing chambers close to the larger basin, and, unless my memory deceives me, there was provision for hot baths; but the whole arrangements bore the air of not being much called into requisition. I can vouch, however, that the water is believed in, for, as I may mention, not only as evidence of the faith in it, but also of the different modes in which the water is employed, I observed a young man rising from near the larger basin, with one leg swathed in apparently numerous wet bandages, so that the lower part of his limb appeared about twice or three times its natural size; and he told me that he had cut his leg badly with an axe, and had just put on a thick coat of mud from the Spring, in hopes of deriving benefit from the application.

I think it proper to record, that the summer season of 1863 was well known to be wet, and that for a day or two before my visit there had been very heavy intermittent rain, which, however, had entirely ceased for seven or eight hours when I collected the waters. How far this rain-fall would affect copious springs, having their origin possibly considerably below the surface, would only be shown by the results of analysis made in a dry season being compared with mine; probably it would not produce any sensible effect; but still I think it as well to make the statement, because differences are often found in the composition of waters, from time to time, and it is right that all the possible causes of alteration should be taken into consideration.*

On proceeding to examine the water from the larger basin, in September, I found that during the two months it had been kept it had undergone great change; although clear and without odour when collected, it had become, in a closely stoppered bottle, impregnated with sulphuretted hydrogen, and smelt strongly of this gas; it was opalescent, and a white sediment was forming. Analysis, however, was made with the following results; the quantities of ingredients being calculated for the imperial gallon:—

Contents of the Water of the Larger Basin in 70,000 grains.

	Grains.
Lime	54·69
Magnesia	2·74
Soda and Potash	6·00
Sulphuric Acid	78·03
Chlorine	1·09
Silica	0·70
Phosphoric Acid	traces
Organic Matter, Carbonic Acid	undetermined
Iron	traces
	143.25

Specific Gravity at 62°..............1002·012

The organic matter was considerable in amount, as the residue left on evaporation of the water at a low heat turned decidedly brown on ignition, and its presence accounts for the change in the water, which consisted in the reduction of the sulphates by the organic matter to the state of sulphides. The sulphuretted hydrogen was evolved by the action of carbonic acid on the sulphides, and the sediment appeared to be chiefly sulphate of lime; it did not effervesce sensibly with hydrochloric acid. As this decomposition had taken place, of course there is less sulphuric acid than there ought to be given in the analysis; and the results are to be taken as not closely expressing the composition of the water, which is evidently one having sulphate of lime for the leading ingredient. A mere trace of deposit was formed on boiling the water for two hours. On comparing the results with the contents of Dr. Robertson's letter, it is obvious that analysis is necessary to bring out the real character of waters; there were but traces of iron, and copper was absent, as the water remained colourless though full of sulphuretted hydrogen: as for the presence of this gas contradicting the statement that the water remains sweet, it may be that Dr. Robertson had the water from the smaller basin, which, as I shall shew presently, remained perfectly sweet in one bottle, and gave but a trace of sulphuretted hydrogen in others; or there may have been organic matter accidentally present at the basin, or in the bottle in which the water was collected in my case, the bottle was one procured at the hotel at Margaretville, but well washed there, and at the Spring, by myself; or the gas may have been formed and decomposed during the year Dr. Robertson kept his sample.

The water from the smaller basin was examined in November, and three out of four bottles were found to contain a mere trace of sulphuretted hydrogen, the fourth being quite free from the gas; the water in all was perfectly transparent and without sediment. Assuming that the cause of the change above-mentioned was in the larger basin itself, we see that there is a difference in the two waters; but analysis shews that they belong to the same class, the chief variation in composition being in the amount of organic matter. That waters found close together often vary much in character, is shewn by Hunt,* who mentions various cases;—to quote but one—he says, "At Caledonia, three waters are found within a few feet of each other; one of them being sulphurous, while the others are not so, and are much more strongly saline."

* Geology of Canada, 1863, page 562.

The following ingredients were found in a gallon of the water; for comparison with that of the larger basin the results are stated in the same way.

	Grains.
Lime	51·74
Magnesia	2·94
Soda and Potash	4·65
Sulphuric Acid	79·07
Chlorine	·76
Silica	·55
Phosphoric Acid	traces
Organic Matter	traces
Iron, Oxide	·09
	139·80

These, properly calculated and arranged, the carbonate being determined by boiling the water, stand as follows:—

Contents of the water of the Smaller Basin in 70,000 *grains.*

	Grains in Imperial Gallon.
Carbonate of Lime	2·70
Carbonate of Magnesia	0·37
Carbonate of Iron	·14
Sulphate of Lime	121·98
Sulphate of Soda	8·35
Sulphate of Magnesia	5·35
Chloride of Potassium	1·60
Silica	0·55
Phosphoric Acid	traces
Organic Matter	traces
	141·04

Free Carbonic Acid..................undetermined.

In making the calculations it was found that after combining the bases with sulphuric acid, 1·44 grain of magnesia remained over; this was added to the sulphate of magnesia, as the phosphoric acid and any other acids present in small quantities, were not determined. I tried in both waters for Iodine but could not detect any in the residues of 7,000 grains in each case. I thought I detected a trace of nitric acid in the water of the larger basin; but it is impossible to decide with certainty on the presence of such small amounts of constituents as frequently exist in waters, unless a much larger quantity of material is operated on than I had at command. As before mentioned, the waters from the two basins are seen to differ essentially only in the amount of organic matter;

and apart from this they may be considered alike in composition. They are seen to be poor in carbonates and chlorides, and comparatively rich in sulphates, while of the latter the sulphate of lime is by far the most abundant ingredient; although the solubility of salts is much modified by the presence of other salts, I may mention as a guide, that cold water can only contain about 163 grains of sulphate of lime, while we have about 123 present in the Wilmot water without any large quantity of other salts to render it more soluble. Such waters are uncommon; for example, in the extensive series of Canadian waters examined by Hunt, there are none which at all closely resemble those now described; there are two* mentioned as forming the sixth class in his description, viz. those neutral saline waters in which the sulphates of lime, magnesia, and the alkalies predominate, chlorides being present only in small amounts; in each case brought forward there are only 77 grains of *Sulphate of Lime* in the gallon; and on looking over the analysis of many waters from other countries, I find very few at all like them; but there is one in Nova Scotia not very dissimilar, viz., that flowing from the Spa Spring, at Windsor, of which the following is my analysis, made in 1858, showing the

Contents of Spa Spring Water in a gallon of 70,000 *grains.*

	Grains.
Carbonate of Lime	17·50
Carbonate of Iron	0·40
Carbonate of Magnesia	0·31
Sulphate of Lime	106·21
Sulphate of Soda	0·68
Sulphate of Potassium	0.38
Chloride of Sodium	0·80
Silica	0·60
Phosphoric Acid	traces
Organic Matter	traces
Sulphate of Magnesia	11·02
	137·90

in which we observe a pretty close general resemblance to that given of the Wilmot water, and particularly in the same great preponderance of sulphate of lime. This is so marked, that a separate class might almost be made of such waters.

* Those of Charlotteville and Hamilton.—*Geology of Canada*, 1863, pp. 532-7, 8.

However this may be, when we consider the geological character of the two places, and attempt to discover the origin of the contents of the waters arising in each, the comparison just instituted becomes very interesting. Windsor is in a gypsiferous district of lower carboniferous age, sulphate and carbonate of lime being its characteristic rocks; and in describing* the Spa Spring water I did not hesitate to attribute its curious composition to this circumstance, considering it to have been long in contact with, if not to have originated in gypsum: but Wilmot Springs are in a district held to belong to the new red sandstone formation, in which gypsum has not been yet found in this Province in any quantity, the trap rocks adjoining the valley of the Annapolis, thought to be of the same age, only containing it in thin veins, as at Blomidon, and probably in quite small isolated deposits, as I have found it imbedded, as selenite, in the same rock at Two Islands. Gypsum is abundant in the upper new red sandstone in England, and it would be interesting if it should prove to be so here. It is curious to observe the small quantity of chlorides found in both these gypsiferous waters of this Province, as the gypsum of England, and of Virginia also, is closely associated with vast deposits of rock salt; and in many, if not most waters which contain much sulphate of lime, there is a larger quantity of chlorides.

As before remarked, such waters as those of Wilmot Springs (and of Spa Spring, Windsor,) are uncommon, and their medicinal qualities may depend on the presence of the large quantity of sulphate of lime they contain, although this salt has not, I believe, been hitherto considered valuable as a medicine; it is not to be kept out of view, however, that an elaborate analysis executed on large quantities of the waters, might reveal the presence of other bodies more generally recognised as of medicinal value. This would be one of the points to be taken up in a Geological Survey of the Province.

* Canadian Naturalist, Oct. 1863, p. 373.

ART. V. SOME ACCOUNT OF THE PETREL—THE SEA SERPENT—AND THE ALBICORE—AS OBSERVED AT ST. MARGARET'S BAY,—TOGETHER WITH A FEW OBSERVATIONS ON A BEACH-MOUND, OR KITCHEN-MIDDEN, NEAR FRENCH VILLAGE. BY REV. JOHN AMBROSE, M. A., OF ST. MARGARET'S BAY, N. S.

[*Read January* 4, 1864.]

HABITS OF THE STORM PETREL,

As observed at Green Island, off the Coast of Lunenburg Co., N. S

HAVING heard that Petrels were in the habit of breeding on Green Island, I visited that place on the 28th day of June, 1860. The island is situated at a distance of about ten miles out at sea, off the mouth of Chester Bay, and having no harbour or inlet of any kind, can be approached only in calm weather, and when the sea is smooth. The best landing place is in a sort of nook in the rocks, on the north-east side of the Island. I had been informed that the Puffin was also in the habit of breeding there, but when I landed not a bird was to be seen but some terns and mackerel gulls flying overhead, whilst the whole island under foot was perforated and undermined by the Petrels.

I first took a tour all around the grassy edge of the cliffs, to look for gulls' eggs. I found two dozen of the terns' eggs, and the men who rowed my boat found eight dozen. Then commenced the search for Petrels' eggs,—tearing up the turf with my hands, and following the little galleries with my fingers, I soon secured four-and-a-half dozen of the eggs, and two of the parent birds, as specimens. I could have obtained almost any number of the eggs, and every parent bird therewith, as the poor little things cower back into their holes, making not the slightest noise or resistance, whilst they behold the robbery of their property, and the destruction of their dwellings. In no instance except one, did I find more than one egg in a nest, and in that there were but two; and yet some of the birds were hatching, as some of the eggs contained the embryo, with its head and body so far developed as to clearly identify the species.

The smell of the birds is at first very offensive, and so strong that we easily perceived it at a distance of two miles from the island, *to*

* I am informed by an officer of the *Petrel*, surveying ship, that Petrels' eggs were found in the nests on Green Island, by the surveying party, in the months of May and September.

windward. A gentle air from the south-east often carries this odor to Peggy's Cove, a distance of about fifteen miles. This smell, which can also be perceived on the gull species, and which is something akin to the odour of the ram and goat among quadrupeds, belongs in a peculiar manner to the Petrel and its egg, and is particularly perceptible in the dark brown oily fluid which, seemingly in self-defence, these birds squirt from their bills.

These Petrels are nocturnal in their habits—at least during their residence on our shores; as, like the owl they are never seen abroad in daylight, except in dull or foggy weather. It was just sunrise when we landed on Green Island, and although we had seen several Petrels flying about the boat during the night, and at dawn of day, on our passage, yet on the island not one was to be seen. All were underground, where at first you could hear their twittering, like the squeaking of mice, whilst seemingly arranging about nests and accommodations; but soon after sunrise they became entirely silent, at least so far as the screaming of the gulls, which was always about the same, would allow you to judge.

On taking a Petrel out of its nest, it would not at first, on being set down, attempt to fly, but would endeavour to dig and shuffle its way down into one of the broken holes. Most of the nests seemed to be old ones newly fitted up, and I found several such where the birds had brought quite a sprinkling of fresh dirt out to the surface. The galleries run in zigzags, parallel with the surface, and at an average depth of about six inches. In making their nests in the angles of these galleries, the birds take care to have at least two ways of access to the surface, perhaps lest one should be trampled in by heavier animals than themselves, as instinct is always equal to chronic necessity. Each nest is merely a little recess on the side of the gallery, so that the incomer or fugitive need not disturb her neighbours. The nest itself is composed of a very little firm dry grass, and is always scrupulously clean.

In digging their holes, these birds use the bill for a pick-axe, and throw the loose earth behind them very rapidly with their webbed and shovel-like feet, kicking with each foot alternately, and wallowing and pressing along, as I could see by setting one, just taken out into the light, at the edge of one of the broken holes, before she had sufficiently recovered her sight and scattered faculties to fly away.

Sometimes in spring and autumn a very heavy gale drives these Petrels inland, where they are occasionally found lying in the fields, unable to fly. Mr. Richard Daubin, of Peggy's Cove, informs me that his family, one morning in the month of June, found a Petrel on the mantel-piece in the kitchen, which they thought could not have entered the house otherwise than by the chimney, during the night. Mr. Daubin laughingly adds, that on the previous day he had brought a large number of Petrels' eggs from Green Island, and supposes the bird had arrogated to herself the "right of search." If, however, the sense of smell is more keen in the lower animals than in man, and if the odour of the birds can be perceived by the people of Peggy's Cove when the wind is fair from Green Island, is it not within the bounds of possibility, that a smaller quantity of this scent could be traced by the bird, perhaps flying in the neighbourhood of the house in which the eggs were deposited?

After the foregoing visit to Green Island, having found the opinion very widely prevalent among our fishermen, that the Petrel hibernates on that lonely spot, I made a second visit to the place, in a schooner owned by Mr. William Crooks, of Peggy's Cove, on the first day of March, 1861. The sea being smooth, we landed on the island at sunrise, provided with a crow-bar and an old axe, with which we soon broke up several holes, but found no birds, and only one addled egg, a sad memento of love's labour lost, in the previous summer. This widely-spread opinion concerning the hibernation of the Petrel, may therefore be safely classed with the ancient and kindred myth regarding the winter quarters of the swallow. It is remarkable, that so many respectable persons had assured me that the birds remain in their holes, in a torpid state, all winter, and that they themselves had dug them out in very cold weather. But as the Petrel does remain until November, and the flocks commence to return about the beginning of April, I conclude that some stragglers or early birds may for a short space remain behind, or precede the main body, and that such were the individuals secured by my informants. Indeed, a man from Great Tancook Island, who saw me digging, assured me that he had dug Petrels out of the ground on "Ironbound Island," near Tancook, in the month of February.

I am convinced that the habit of our Petrels is to spend the months of December, January and February, somewhere south of our coast; and the greater part of that time at sea, near the edge of the Gulf Stream. Our Peggy's Cove bankers see them about thirty miles broad off to the southward, about the end of March, on their first trip for codfish. Several of our fishermen who have sailed to and from the West Indies, in the winter season, inform me that they never fail to see myriads of those birds during winter, in and about the Gulf Stream. They are to be found in their burrows again, on Green Island, about the middle or latter part of April.

The geological formation of Green Island is transition slate, with quartz veins. It is covered with a soil of turf, varying from one inch to two feet in depth. The Island is one hundred and twenty rods long, by fifty-four rods wide, and takes its name from the quantity of grass which grows on it during the summer.

At the time of the first settlement of Lunenburg, and until within about the last fifty years, a species of sea-bird bred on this and the neighbouring islands, which by the description given by the old people, I think must have been the Penguin. The Puffin is forsaking the place, as it is now much haunted by duck-shooters. Its habit was to lay its eggs, not in burrows, but under nooks and clefts of rocks around the edge of the Island, especially on its south-west side.

The Sea Serpent in St. Margaret's Bay.

In the Summer of 1846, James Wilson, teacher, and John Bœhner, both of Peggy's Cove, being on board a schooner lying off Mill Cove, on the west side of St. Margaret's Bay, saw in the water at a distance, something which they took to be a large fleet of nets. Their attention having been for a few moments drawn off by the appearance of a school of grampuses entering the Bay, they were surprised, on again looking at the supposed fleet of nets, to see it straightening itself out, and moving off so swiftly as to leave a wake as large and as much agitated as that of a schooner in swift motion. They now perceived the object to be a large Serpent, with a head about the size of a barrel, and a body in proportion, and with something like a mane flowing down its neck. It carried its head erect, with a slight inclination forward. A fisherman belonging to Mill Cove, now came rowing with all his fast decreasing strength, to the schooner, and having barely leaped in over the side, fainted with terror on the deck. Wilson thinks the animal was about from seventy to one hundred feet in length. Its colour seemed to be a sort of steel-gray.

George Dauphiney, Esq., of Boutilier's Point, Lower Ward, also saw this, or a similar serpent, near Hackett's Cove, as he was inadvertently rowing over it in his skiff. He made no examination of it, but rowed away from so dangerous a proximity, as fast as possible.

In the Summer of 1849, Joseph Holland, now living near Port Medway, being in company with Jacob Kedy and two other fishermen, on South West Island, at the west side of the entrance of this Bay, saw something very large and long in appearance, swimming on the surface of the water, at some little distance from the land. Curiosity at length induced the men to launch a flat, and row out for a nearer inspection of the object, which apparently did not perceive them until they had rowed over where it was swimming. They now found it to be no other than an immense snake, about sixty feet in length, and as large in circumference as a puncheon. It was proportioned like an eel, *i. e.*, tapering towards the extremities, with no caudal fin perceptible, but one very high fin, or row of spines, each of about an inch in diameter at the base, erected along its back, serving indeed for a dorsal fin, like the folding fin of the *Thynnus vulgaris*, or albicore. This spinal erection seemed to occupy about one third of its length, each end of it being about equi-distant from the Serpent's extremities; and at a distance, somewhat resembling, in size and appearance, the sail of a skiff. The animal's back was covered with scales, about six inches long and three inches wide, extending in rows *across* the body, *i. e.*, the longer diameter of scale being in the direction of the circumference of the body. The colour of the back was black. The men had no opportunity of seeing the belly, but what the Americans would call, "a smart chance" of becoming acquainted with the inside of it; for the creature, perceiving the boat, raised its head about ten feet above water, turned towards it, and opening its jaws, showed the inside of its mouth red in colour and well armed with teeth about three inches long, shaped like those of the cat-fish. The men now thinking it high time to terminate the interview, pulled vigorously for shore, followed for some distance by the snake, which at length gave up the chase and disappeared.

All these accounts are but the recollections of terrified persons, and yet their descriptions of the object of their terror remarkably agree with each other, and with the accounts of the Sea Serpent given by persons of better education, viewing it under safer circumstances.

A few years ago, one of these Serpents was stranded on Turk's Island, and the description given in one of the public prints by a lady, who saw and examined its dead body, tallies closely with Wilson's account.

On the 31st December, 1848, a naval officer on board H. M. S. "Plumper," saw between England and Lisbon, an immense serpent, with its head about six or eight feet above water, and about twenty feet of its back visible, showing a kind of mane. A sketch of this creature was forwarded to the Lords of the Admiralty, previous to the return of the "Plumper."

On the 6th of May, 1863, the African Royal Mail Steamship "Athenian," on her passage between Teneriffe and Bathurst, fell in with one of these Serpents. It was discovered to be a snake about one hundred feet long, of a dark brown colour, head and tail out of water, the body slightly under. On its head was something like a mane or sea-weed. The body was about the size of the ship's mainmast.

The Sea Serpent has not been seen in St. Margaret's Bay since 1849. It is supposed by some of the inhabitants of the place, that there were two of these creatures in the Bay, at or near the same time. This may account for the difference between the descriptions, especially in colour, given by Holland and Wilson. It may be that, in these as in other animals, the sexes are distinguished by peculiarities of shape or colour.

I have not been able to ascertain the motion of these animals in swimming, whether vertical or horizontal in its sinuosities. Wilson's first idea of the *corks*, would seem to indicate a succession of vertical motions.

The eyes of these Serpents must, like those of all their congeners on land, be small, as we never find much said of them in hurried observations, or by persons who have seen the animals from a distance.

The discrepancy which seems to exist between the descriptions of the mane, may be accounted for on the supposition that it is capable of erection or depression at pleasure, like the dorsal fin of a fish, and that the upper edge of it, when depressed, is pendulous. Indeed, the spines seen by Holland favour this hypothesis.

In connection with this subject, I may mention the account given by Mr. William Crooks, a respectable inhabitant of Peggy's Cove, of a large Serpent seen by him and his son Henry, a few years ago, at the entrance of the inlet to the "Canal Lake," between Peggy's Cove and Dover. It was, he affirms, not less than sixteen feet long, with a circumference of about two feet, and was of a dark brown colour. It was swimming and splashing in the landwash, apparently endeavouring to get ashore, which consummation to its labours appears not to have been wished by Mr. Crooks, who, with his son, incontinently took to their heels, nor did they consider themselves safe until once more surrounded by the houses at Peggy's Cove.

The Albicore.

The Albicore, *(Thynnus vulgaris,)* was first seen here by the oldest inhabitants now living, about forty years ago. Since that time, however, it has increased in numbers, and is now a regular annual visitor of the Bay, arriving about the first of June, and leaving about the end of October.

These fish sometimes reach a size of fifteen feet in length. On their first arrival in June, they contain little or no oil, but after the arrival of the summer herring, soon fatten. Various modes of capture have been tried with them, but the only one now in vogue is harpooning. The harpoon iron is well secured to a good strong ¾ in. rope, and set, but not fastened, on the end of a pole, which the harpooner holds in his hands in the bow of the boat, whilst an assistant paddles around the herring nets, occasionally throwing overboard a fresh herring, which is soon noticed and seized by the Albicore, prowling below. These fish take their prey with a rush, and so swiftly, that although not more than six or eight feet below the surface, their presence is only known by a white streak, like a flash of light through the water, and the sudden disappearance of the bait. The harpooner darts his weapon at the head of this streak, and thereby strikes the fish as near as possible to the pectoral fin; for if the weapon strikes any further back, it generally tears its way out.

If the iron be well struck home, now commences the tug of war. Out runs the line from its coil in the tub, some fifteen or twenty fathoms, the harpooner checking it as much as possible with his mittened hands, until the fish begins to rise. Now he begins to haul in his line, the boat meanwhile making rapid headway, to the speedy exhaustion of her fugitive motor, who soon comes to the surface. Now a noose is dexterously thrown over his tail, and his expiring efforts are spent in thoroughly splashing his captors, who tow their prize ashore in triumph, cut all the flesh from the carcase, except the lean and sinewy part near the tail, and boil it, in order to extract the oil, which, in a large and fat fish, will amount to some twelve or fifteen gallons. The largest proportion of oil is around the eye and in the vicinity of the pectoral fin. A small quantity of liquid oil is found in a cavity in the skull.

After the extraction of the oil, the residue or muscle is thrown away, as our fishermen have an idea that it will poison their pigs; though of late years some, to their profit, have discovered the fallacy of this notion.

The capture of those fish is not unattended with danger. Some years ago a fisherman struck a large one off Indian Harbour, in this bay. The line not being properly laid in the bow, but partially extending abaft the harpooner, was made fast amidships. It quickly ran out the bow coil: perceiving which, the man looked around to see that the end was secure, but found to his horror that the boy who had been with him in the boat had been carried overboard, far below the surface. Providentially, the fish by this time was at the end of his downward rush, so that with trembling haste the man drew in the slack line, and with it, entangled by the foot, the apparently lifeless boy, who, however, soon recovered.

A similar, but more disastrous termination to an Albicore chase, took place in the same locality, in the summer of 1861. A young man's leg was caught by the harpoon line, which dragged him overboard, tearing out the "rising" of the boat, *i. e.*, the strip on which the ends of the thwarts are secured; his foot happening to be caught under this strip. His body was never recovered.

Kitchen Middens, or Beach Mounds.

There are two of these on the bank of Dauphiney's Cove, or Frost-fish Cove, in French Village: one within about a mile of an ancient burial ground on Indian Point—so called from its being the favourite camping ground and place of sepulture of the Indians, before and at the time of the first white settlement in this place. The other Midden is at the head of the Cove. Having heard that in both of these, Indian arrow-heads and hatchets of stone had been found at various times by the white settlers, I had the curiosity to dig into the lower one, and found it to be the deposit of a large quantity of shells, such as those which I shall this evening offer for your inspection. One of these, the *Venus mercenaria*, I think cannot now be found anywhere in this Bay in shoal water, from which I infer that either the Indians must formerly have had some means, not now possessed by them, of obtaining these fish from deep water; or else the habits of such fish in this Bay have changed; or lastly, the race in-shore must have been exterminated by the feasters around those Middens: for I cannot suppose that the land under the Bay has become depressed since that time, so as to form depths of former shallows, since these mounds are now found at the usual convenient distance of a few steps from the water's edge.

A neighbour having given me some small bones of what I take to have been a land animal, obtained by him from the lower Midden, I exhumed in the same spot a few more bones of the same sort, as also a piece of ancient pottery, evidently part of the lip of a cup. It was lying only five or six inches below the surface of a heap of shells, from which I venture to infer that these mounds were formed before the introduction of either French or English pottery into this country, and are therefore not less than two hundred years old; for I am willing to allow the large margin of fifty years for the gradual introduction of the implements of civilization among the Indians.

I have but broken the surface of the lower mound, and the upper one is yet untouched, awaiting the investigation of this most useful and necessary Institute. Some few of our members made the lower Mound a flying visit, last summer, and also snatched a few moments to look at the ancient Indian burial-ground on the Point below, where I showed them a granite rock inscribed with a number of hieroglyphics. It is to be hoped that the mementos of a fast-fading race in these interesting and picturesque spots, may have a visit from the members of the Institute, some long day next summer, (D.V.), when an early start from the City, and a moonlight evening to return, will enable them to honour the rectory with their presence, where they will find a "*cead mille failthe*," from the lady of the mansion, and her lord, and his boat at their service. It might be well to suggest that the ground should be trenched before their arrival.

It now remains for me to crave your pardon for occupying so much of your valuable time with this unscientific dissertation "*de omnibus rebus, et quibusdem aliis*" I feel safe, however, in the hands of true Naturalists, who are ever ready to encourage the tottering steps of the tyro in their beloved science. The multifarious and pressing duties of a pastor among a large and scattered flock, must claim my chief attention; but since my happy acquaintance with our worthy President, who first drew my thoughts toward natural science, I have found that one of the very best and most improving recreations of the clergyman, is the study of God's wisdom in His works of creation and providence, as saith the Psalmist: "O Lord how manifold are Thy works; in wisdom hast Thou made them all; the earth is full of Thy riches, so is the great and wide sea also,* in which are things creeping innumerable, both small and great beasts." What lively illustrations may we, like our Great Master, draw from earth and sea! And whilst the infidel or the scoffer resorts to the book of Nature in the pride and prejudice of a short-sighted human intellect, thus wresting its lessons to his own destruction, be it ours to read that book as we read God's written Word, with the prayer that He who wrote it for our learning may enable us in such wise to read, hear, mark,

* Ps. 104.

learn, and inwardly digest it, that by *patience* and comfort of His holy Word, we may, instead of making shipwreck of our belief in inspiration, embrace and ever hold fast the blessed hope of everlasting life through the incarnation of our Lord. Amid the strife and turmoil of worldly cares, how good it is to withdraw our minds from such trifles, and enter the temple of Nature where—

> "In that great cloister's stillness and seclusion,
> By guardian angels led,"

we may find the wisdom of the Apostle's exhortation: "Finally, brethren, whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report, if there be any virtue and if there be any praise, think of these things."

Art. VI. The Rocks in the Vicinity. By William Gossip.

[*Read February* 1, 1864.]

The Rocks in this vicinity, and those on which Halifax is built, would seem to be an uninviting study, except for the practical purposes of the mason, or architect. They are unsightly in aspect, and nearly bare of vegetation. There is about them the wildness of desolation without much of its grandeur. Indurated beyond a common degree of hardness, they have so little disintegrated during the unknown ages in which their surfaces have been exposed to the atmosphere, that the soil which covers them is only now sufficient for the growth of ferns and mosses, shrubs and stunted trees, chiefly of the fir and spruce varieties. Wherever indeed there is a soil, it must be ascribed to other causes than the disintegration just noticed, and requires to be fostered by all the skill of the agriculturist, ere it make a due return toward the sustenance of man. Yet these rocks of so uninviting an aspect, and that soil so unprolific of itself, must have had a wonderful history in the past. The one carries us back, as nigh to that record of time when God created the heavens and the earth, as Geology has yet attained to; the other dates from a more recent period, yet probably so remote, that man had not *then* appeared upon the face of the earth, although creation was approaching his advent—when beasts of huge bulk, and birds of fabulous proportions dwelt upon it, which have since become extinct: whose remains are only now and then developed to show us that such things were, and to teach us not to be incredulous to facts connected with the Earth's age and history, that the patient and laborious investigations of science may be able to demonstrate and prove.

The Rocks on which I purpose, in the first place, to make a few observations, are those on the western side of the North West Arm, embraced within the limited space of the Government Quarries and the granite hills in their rear,—and those which cover the peninsula of Halifax. I begin with the former, as I believe the phenomena attending them (the lines of demarcation between the slate and granite,) are there more striking and better marked than elsewhere in the vicinity, although, doubtless there must be other places where they may be just as readily observed.

Professor Dawson, in his excellent work, "Acadian Geology," classes these Rocks as probably of a series older than the Silurian period, and, as probably belonging to a still older, or Azoic series, which has been recognized in Canada. In a supplementary chapter to his latest edition, he somewhat modifies this opinion, but without educing any positive proof to sustain his new view. No fossils* have been found in these Nova Scotia rocks, which is perhaps sufficiently accounted for by their metamorphism. He indicates their position, however, (by the evidence of the older slate series in Newfoundland, which has afforded trilobites of the genus *Paradoxides*,) to be in the lowest part of the Lower Silurian series; while further on, he states "that on a comparison of these rocks, with a series of altered deposits from eastern Canada, collected by the Canadian Survey, they appear more nearly to resemble those of the Hudson River group, than any other of the series—which

* Subsequently to writing the above, I found the following paragraph in "*The Citizen*" newspaper of Halifax, which I also read, but have not had opportunity to corroborate its statement, which is not very clear upon the subject:— W. G.

"The Oldest Inhabitant.—Rev. D. Honeyman, whose geological eminence helped to increase the reputation of Nova Scotia at the Great Exhibition, has been the first to discover a trace of ancient life in the metamorphic clay slate strata on which Halifax is built. It is a minute reticulated zoophyte, noticeable enough to the unassisted eye. This important discovery, while it adds to the accessions with which Mr. Honeyman has enriched our Silurian geology—is valuable as settling the age of our gold fields, which are thus proved to be lower Silurian like those of Australia, where graptolites, the kindred of this little Haligonian fossil, are found. The discovery will make a sensation among geologists."

group belong to the upper formations of the Lower Silurian period.

But, although it is not easy to *class* the Metamorphic Rocks of this District, and there is some doubt as to their *true position* in the Geological scale, they must certainly be of an age long anterior to the granite which has broken through, partly absorbed, slightly lifted, and further hardened them. The belief may be reasonably entertained, also, that they had been subjected to a metamorphism long previous to the granitic eruption with which they are now in contact. Their strata, inclination and dip, in some places, and in some degree, go to shew, that the cooling granite had sluggishly overlaid and become cemented to them, without possessing heat enough to change their character. In other places the powerful leverage of the hot interior, has suddenly and cleanly fractured and tilted them up, affording sections which separated from the fracture, exhibit the strata and bedding dipping to the north, but running in a line with the granitic upheaval, east and west, doubtless meeting the granite at a low depth, but forming angles wide apart at the surface.

I have collected a few data in connection with my subject, from the Government Quarry on the western side of the North West Arm, called the Flag Quarry, nearly opposite to the Chain Battery on the eastern shore. It lies a short distance in a south-west direction from the wharf where the stone is shipped. At this place the rock is covered with loose slaty and granitic debris, interspersed with small weather worn granite boulders, to a depth of one to four feet. Upon the surface, lichens, ferns, and berry bushes, find a genial soil; atop, the rock is a good deal broken; at a depth of six to ten feet the Quarrymen begin to find excellent building material. The rock is here regularly stratified in a descending series of beds, from three to six feet thick, which may be called the main bedding. These exhibit, both in their upper and under faces, a curious appearance, which I can liken to nothing else than a line of gougings, running in the direction of the beds, east and west—the gougings of the lower deposit fitting accurately to the ridges of the upper, and *vice versa.* I may be allowed a little digression here, to state, that on one of our pleasant field excursions, last summer, I fell in with an old acquaintance opposite to the Three Mile House, a large stone, scooped after the fashion of these beds, the markings on which had often been a puzzle to me. I imagined I had found a surface scratched and torn by the harrow teeth of a glacier or iceberg, and on this occasion showed the stone to a gentleman who was with us, who was evidently a good geologist. He thought it a very remarkable stone! Our esteemed associate, Mr. Belt, who was also with us on that occasion, thought it a very strange marking! On a closer inspection, however, and chipping it, he split off a piece which exactly fitted a scoop beneath it, and then it was pronounced to be, not a glacial phenomenon, but a conchoidal fracture. The rocks at the North West Arm, show, that it is the character of the true bedding of a peculiar class of metamorphic rock.

The rock at this quarry, and in the vicinity at the same level, is a bluish-gray quartzite, highly indurated. It partakes a good deal of the influence of the granitic upheaval—nor has the granite altogether escaped *its* influence. The quartzite here, has not been altered in composition, or changed into gneiss, and yet it is curiously laminated. There is, between many of the laminæ, an exceedingly thin scaly film of silica, cementing them—in others, a thicker layer, more nearly resembling gneiss. All the laminæ are in the direction of the main bedding. How, or by what process they were infused, or infiltrated, I am not geologist enough to pretend to conjecture. They have, however, a decided influence over the workable and merchantable character of the rock. The thinnest markings make the best cleavage, and are divisions of the best stones. When looking at this excellent material for pavement, and the little difficulty there is in quarrying it, and its apparent abundance in this vicinity, I could not but feel mortified at the spectacle exhibited in Halifax, of a large importation of Caithness flag, when an imperishable article, as good at least, if not much superior, may be found at our very doors.

There have been two depositions in this district, and at two different periods. One, and the earliest, the hard blue compact rock, which I call a quartzite, which is often highly micaceous, and has no doubt originally been a deposit from earlier formations, containing more or less of iron,—two, the dull leaden-blue clay slate, of various degrees of hardness, sometimes highly micaceous, also containing iron, and now much broken and disturbed—which may have accumulated long after the quartz rock had been hardened, and both further metamorphosed. This idea, which is thrown out for the investigation of future commentators on these Rocks, to be either justified or disproved, as it deserves, seems to be corroborated by the geological sequence, and relative position of the rocks. The clay slate appears to have overlain the other formations to a great depth previous to the granitic upheaval, and being then broken and disturbed, has since suffered considerable erosion. Whenever gneiss is found in that vicinity, it may be considered a compound of the granite era, to which the quartzite, slate and granite have each contributed their portions; and, where the slate is more than usually hard, micaceous and crystalline, it will be found in close proximity to the granite, and flanking it at a higher level than the quartzite.

The junction of the slate and granite, follows the water line, at an elevation of forty or fifty feet, from the head of the N. W. Arm, along its western shore, to York Redoubt, stretching beyond these limits to a much greater distance in both directions. At that elevation the granite begins to predominate, and is found *in situ,* over a wide extent of country, east of Halifax harbour.

At more than half a mile back, eastwardly from the quarries, a distance occupied exclusively by the granite, a depression discloses the Coal Pit Lake, a pretty sheet of water which drains the surrounding hills, but has no apparent communication with any of the lakes in the neighbourhood. In this depression which falls to the level of the slate, at least, that rock is found, its surface, wherever smooth, covered with striæ; an evidence of glacial action, which may be deemed a sufficient apology for the sterility of an otherwise romantic picture.

There can, I think, be very little doubt, that, under similar circumstances, throughout the granitic district, the slate and quartzite will be found at nearly the same level as at the Coal Pit Lake, and that they underlie the granite with more or less of metamorphism from contact, to a considerable depth on this side of its true axis.

The denudation, however, has been complete. Whatever formations may have covered these rocks in previous geological eras, or whatever changes they may have undergone, the mighty currents, and the grinding action of the glacial period have swept all away;

and it is not improbable that both the early deposits, and the later drifts in this district, may have contributed to rear the Isle of Sable, or to raise a compensation to man for his agricultural loss, in the banks of the coast, that provide a rich piscatorial harvest to his active industry on the great waters.

The discovery of gold in the slate and quartzite of the Atlantic coast of Nova Scotia, in all directions, east, west, and northwardly of Halifax, makes it of importance that the rocks in its vicinity should be carefully inspected. Hitherto, however, while there are indications that imply a possibility of auriferous deposits, none, I believe, have been discovered. The slate is, in some places, penetrated by vein quartz, which may prove to be auriferous. The hard blue rock, lower than the slate, does not present any probability of gold. The granite is sometimes traversed by vein quartz; but so far as I know, gold has rarely, if ever, been found in quartz of the granitic formation. At the present, therefore, nothing positive can be said as to the existence of gold in the slate of this district; and being entirely of opinion, that it would be a waste of money and labour to institute a search for it, I shall turn to the granite, and conclude with it my observations upon the rocks on this side of the North West Arm.

There are two descriptions of granite, within a short distance, in this locality—one is much harder and finer grained than the other—and they are different in colour. The granite nighest to the blue rock and slate, has apparently partaken of the chemical action which has produced the colour of those rocks. It becomes somewhat porphyritic, and acquires a light greyish-blue tint, very observable as a means of contrast. Wherever also it approaches the lower rocks, it grows harder, and, although in some places of good quality is more difficult to work. It also seems to have imbibed some of the iron which weathers conspicuously upon the exposed quartzite and slate. There appears to be a well defined line of division between the two descriptions of granite. It is, as though the molten mass had, for some distance, overlapped and absorbed the lower material into its own composition, and had then cooled against the compact resistance offered to its further advance. It is during this mingling process, that the gneiss has been formed, and at its close, what we now term *the junction* of the granite with the slate. A natural gully leading from the south Government wharf to the granite quarry on the hill beyond, has on one side this bluish hardened granite, and on the quarry side the purer description, untainted as it were by extraneous contact,—fresh from the interior abyss—a clear white quartz and feldspar, with black mica —of which it is but truth to say, that there is nothing superior, any where to be found, of granite rock. Blocks of the largest dimensions may be quarried here, and the supply at this height seems inexhaustible. Some very pretty cabinet specimens of porphyritic granite, *i. e.*, granite with crystalline feldspar and quartz in large pieces, and the mica interspersed in scales from one half inch to an inch in length and breadth—may be collected at a short distance from the quarry.

I would recommend the lover of Natural Science, who may visit this locality, intent on its pursuit, to ascend this region to a greater altitude; and then, mounting the conspicuous granite boulder on the top of the hill, which serves as a landmark to the pilot and fisherman, he will be amply compensated for the extra fatigue, by a panorama beautiful beyond description. I shall endeavour, however feebly, at the risk of being thought tedious, to give such an idea of this glorious scene, as I hope will tempt others to visit the spot, and enjoy it likewise :—

We look from our airy pedestal, and westward, as far as the eye can reach, the white granite prevails, intermingled with stunted vegetation rich in autumnal tints; while here and there its deep recesses disclose a pretty lake, stealing out upon the rocky solitude, and charming the eye and mind with its silver sheen. Southwardly, the eye takes in York Redoubt, its village and churches, and fifty miles of ocean, where the white sails of commerce move east and west, at the will of the mariner, to the several havens whither he would go A long line of coast stretches eastwardly as far as Jedore, covered with dark green fir and spruce, which impart a sombre hue to the distant hills. Nigher, break on the view the verdant isles and verdant main of the Eastern Passage; and nigher still, the gem of the harbour, McNab's Island, with the dreaded Thrum Cap standing out from its shore, its picturesque beach and light-house, its green vistas and mingled forest and cultivation. The harbour is studded with inward and outward bound; and from the deck of some tall admiral or royal steamer entering the port, floats upward the national anthem; while George's Island, or the citadel, salute them with the cannon's welcome.

We turn, and beneath us, for a long reach, stretches that scene of rural beauty—the North West Arm—only now beginning to be appreciated as a site for the villas and cottages of opulence. At our feet are the picturesque coves that grace its entrance. Across the Arm, the defences of the harbour fix the attention for an instant—further north the citadel rears its impregnable height and flies its flag of sovereignty,—and Halifax and Dartmouth mingled in the view, and toned and softened in the smoke of their own civilization and refinement, make up the splendid picture—which has its appropriate completion in a background of distant hills that encircle Bedford Basin.

This much beyond the Geology of our subject as an inducement to visit the boulder. Nor may it be unedifying, as we descend from this eminence, to contrast with the latest work of creation, which has man for its highest intelligence,—when the great Architect of the Universe, looking abroad, "saw everything that he had made, and behold it was very good," those progressive geological eras which for millions of years may have preceded it—following them down with their varied formations, and changes of seasons and productions, their wonderful flora and fauna, their vast deposits of mineral and vegetable treasure, their grand upheavals and depressions, their disturbances, floods and erosions,—to that beginning, when "the earth was without form, and *void*, and darkness was upon the face of the deep,"—when, probably, the very rocks that have been our subject this evening, which now form the everlasting hills, were deposited in the depths of a heated ocean.

PART II.

The subject naturally resolves itself into two parts. I have treated the first very imperfectly, for there is a wide field of exploration open to the Geologist in that slaty-granitic area, which may yet lead to important mineral discoveries. The second part takes me to this side of the Arm, and to the rocks and deposits that cover the peninsula of Halifax. Professor Dawson, in the excellent work to which I have before alluded, and to which I am again indebted, styles the whole Atlantic coast line—the Granitic Metamorphic District. There is, however, a great gap between the granite, as it comes down to the North West Arm, and the granite, as it again appears on the coast, eastwardly. On the peninsula of Halifax, there is not a particle of granite, *in situ;* the Dartmouth shore is also entirely bare of that rock; equally so is the coast to a considerable distance, and the interior also. The absence of granite therefore, over a wide range of country, is a plain indisputable fact. There may, however, be some reason for the application of the term. If the granitic disturbance beneath has been the cause of the shifting of strata, and the contortions and breakage and cleavage of the superimposed slate rock of the Peninsula, it should be deemed admissible. Dr. Gesner, in his first work on the Geology and Mineralogy of Nova Scotia, mentions the granite as appearing at the Grand Lake in an east and west direction; and the western side of Lake Thomas, I suppose, marks the nearest point east, where it again comes to the light, as part and portion of the granitic upheaval. It is just as likely, however, that the depressions and elevations which this extensive district must have undergone, subsequent to the granitic eruption, have been the cause of the disturbance which prevails amongst the slate and quartz rock, over all this wide tract of country.

The slate rocks of the Halifax Peninsula are evidently a continuation of the North West Arm formation. Near Point Pleasant, in some places, they alternate with the quartzite; the cleavage, however, is always more or less uneven, not continuous in one direction, and the strata often obscured. Where this last is observed, it varies considerably. In some places the east and west direction prevails, as at the Government quarries on the western side of the Arm, with a downward westerly inclination, and a northerly dip. At other places the dip is W. by S., and on the harbour side is S. by E. at some points, favouring the idea of an anticlinal. Large detached masses of rock are scattered over the surface, in the Point Pleasant woods. The face of the rock *in situ,* wherever denuded, is covered with striæ, and glacial erosion may be frequently detected. East of the road, at a short distance this side of the tower at Point Pleasant, the contortions of the strata appear upon the smooth surface of the rock, in vari-coloured undulations. These are all evidence of disturbance which this area has at several periods undergone. Very good sections of the slate may sometimes be observed in the excavations for drains made in the streets of Halifax. The rock will be found to alternate between the compact and slaty structure — large solid masses are succeeded by others exceedingly fissile, with a cleavage generally in one direction east and west, but very irregular — the joints of rock, or headers as they are termed by the workmen, go north and south across the cleavage, and nearly in the line of the street, affording facility for excavation which is of advantage in the formation of the trench. The slate is sometimes highly charged with iron pyrites, and quartz veins are frequently discovered running through it. Gold has, I am informed, been seen in some of these quartz veins,* but if so it has never been indicative of any quantity of the precious metal worth a diligent search.

The highest range of the slate on the peninsula of Halifax, is probably 180 feet above the water level of the harbour, from which it rises in a sharp ascent to the Common, falling more gradually, but still at a steep decline, to the eastern shore of the North West Arm. Were the whole peninsula of Halifax denuded of the drift which forms its soil, and the boulders which are scattered over its surface, there can be no doubt that the face of the slate rock then exhibited, would be perfectly smooth, as seen at Point Pleasant. We should then have a tongue of land beautifully rounded and covered with striæ — the polish and scratching being the action of the icebergs and glaciers that have been borne upon it, which on one side may have scooped out the harbour, and on the other the North West Arm, on their onward march, driven by the mighty stream that then deluged this latitude of the northern hemisphere.

The evidences of glacial action are perhaps, nowhere more distinct than in the boulder clay and drift, which overlie the slate rock at many places on the Peninsula and along the shores of the

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*I have seen one *sight* (as it is termed) of gold taken from quartz out of a trench in Barrack Street.—W. G.

harbour. The fact seems to be, that our harbour and the adjacent country (looking at their present conformation) have been the embouchure of one of the mighty streams that deluged the northern latitudes of this continent, and which discharged its ice-laden waters over our rocks into the ocean. Very thick deposits of clay are found at many places, less on the peninsula however, than along the eastern shores of the harbour. It is found at Veith's farm, a short distance from the city, on the old Three Mile road, and at other places in that direction. On the Dartmouth side and at the Eastern Passage, it occurs of considerable thickness, and is used for making bricks. In some places (as at the asylum for the insane) it is freer from stones than at others. There is very good brick clay also, at the head of Bedford Basin, and at some places along its shore. I have no doubt that McNab's Island has a substratum of clay resting on the clay slate. Over this boulder clay lies the unstratified gravelly drift. In it are found angular stones, quartz pebbles, boulders of the adjacent rocks, and sometimes pieces of red sandstone and trap rock, which show a foreign origin and remote descent. It forms some large mounds on and around the Peninsula and North West Arm. There is one of these on the approach to the town from the Three Mile House, by the Kempt Road. Fort Needham and the Jennings' Farm, form another of these conspicuous deposits. The most important, however, because it concerns the safety of Halifax, is the hill upon which the Citadel stands, which to a considerable depth is made up of the unstratified gravelly drift. We find hillocks also, of the same material, at the head of the North West Arm, along its shores, and at its entrance. At the head of the Arm it appears to partake a good deal of the nature of the substratum, and is highly coloured by the peroxide of iron. In some places it is exceedingly hard to excavate; but in no instance since its deposit, so far as I know, has it been formed into a solid compact rock. It is of itself a very unprolific soil.

It may be deemed strange, that neither in the slate, nor in the boulder clay and drift that cover the peninsula and the shores of the harbour, are there any traces of ancient or marine organisms. It is not improbable, however, that in the early period in which the slate was deposited, the water may have been so heated, or so impregnated with chemical ingredients held in solution, as to be incapable of supporting animal life; and that the metamorphism of the slate took place ere the requisite conditions were attained. Subsequent denudation and erosion may have swept away all the accumulations, and fossil remains contained, of more recent periods. Coming down to the close of the Tertiary and Post Pliocene periods, we find thick mounds of unstratified drift and clay, which might reasonably have been expected to reveal facts of this nature connected with their history. They, however, tell no tale. Other drifts and deposits of the glacial period, contain marine shells, and remains—but those of Nova Scotia nothing of the kind. I do not know that this has ever been satisfactorily accounted for, or that it can be satisfactorily accounted for; but it is a fair subject of research, and any novel ideas started upon it, may be suggestive, and lead at one time or other, to a solution of the mystery.

If we examine a large map of North America, in the direction of the zone of depression, which during the glacial era was at its lowest point, we find all that immense system of lakes and rivers forming the great watershed of the country east of the Rocky Mountains, and approximately about half way between them and the Atlantic, discharging either into Hudson's Bay and the Arctic Sea, or finding an outlet by the Gulf of St. Lawrence. We see further, that another extended watershed existed, connecting the system of great lakes and rivers included in the latitudes of the drift, with the Gulf of Mexico, by other great lakes and rivers. Call it a stretch of fancy, or what you will, this conformation of land and water afforded strong evidence to my mind why our unstratified drifts and clays, differ from those of other countries, even from those of the Gulf of St. Lawrence, in possessing no marine fossils. It is not difficult to suppose, that the depression of the period collected all the fresh waters of the continent north, and many of those south of the latitudes of Lake Superior, into one vast area, and that from this centre an entirely *fresh water drift*, swept over the Nova Scotia peninsula, and the countries included, to the 42° N. latitude.* Or, that another mighty stream diverging and mingling with the waters of Hudson's Bay, fresh and salt combined, may

* May it not have materially affected the Southern climate with cold at that period?

have swept over a portion of Labrador, and discharging itself by the Gulf of St. Lawrence, deposited in the drift boreal shells, and fossil capelan. If the present conformation discharges the waters of the great lakes and rivers, at a latitude much further north than their own latitudes — the *depression* that then existed may have poured them, irresistible in volume, and with all the icebergs from their glaciers, over that portion of Nova Scotia which was subjected to it; and over those parts of New Brunswick, Maine, New England, and New York, which have been proved to come under its influence. The gradual re-elevation of the land, diverting these mighty streams, may have been accompanied by an encroachment of the ocean in some places; and the still further and final elevation, circumscribing the waters, may have formed the St. Lawrence as it now exists—the Red River and others that fall into Hudson's Bay and the Arctic Sea—the Mississippi and its great tributaries—and the other great waters that now drain the continent.

However long the subsidence, or alternate rising and sinking, with its accompanying cold, may have continued, a change at last took place, and the gradual and final re-elevation of the land, left our rocks with their present outline denuded and bare, except where was deposited the legacy of the period—the boulders, the clay and the drift. We may with a fair approach to truth assert, that the land must have sunk during this great depression, at least six hundred feet,—for any evidence to the contrary that exists upon the seaboard, it may have been double that measure, and the present line of coast only a partial re-elevation. The high land of Aspotogaen, between St. Margaret's Bay and Chester, is 500 feet above the level of the sea, and at the summit Mr. Poole found a travelled boulder, and striæ are there as plainly marked as on the rock at its base. We may therefore very safely conclude, that at that time Nova Scotia must have been nearly all overflowed.

I have slightly alluded to the glacial action which may on one side have scooped out the harbour, and on the other side of the peninsula the North West Arm. There are various grounds for supposing such action to have formed both of these channels. In both there is a parallelism that goes to prove a strong current sweeping over the land in one particular direction, and that in the course of the striæ seen upon the surface of the rocks. If the mounds on the peninsula are conclusive proof of ice-borne drift, its character, I think, will oblige us to admit a landward voyage of the ice by which it was deposited. We must also claim a depression of the land at least 400 feet, to admit of the stranding of these drift laden bergs, or a current swollen to nearly that volume pouring over it to seaward. There may be some reason for both of these conditions. The depression undoubtedly existed. The country being clothed with thick-ribbed ice, glaciers came down to the head of the fiord, now represented by our Basin, and filled it. The Narrows, twelve fathoms deep now, may then have presented an obstruction to their passage; but the mighty force found and burst the weak barrier, ground and eroded their depths, and gave a passage to the ice masses, which piled themselves on the eastern shore, and did their part in depositing the boulder clay now found there in beds of considerable thickness, and in helping to form the shallows of the Eastern Passage. The principal force was no doubt exerted in that direction; but another glacier of less elevation and momentum, was pushing along in a lateral direction across the depression which is now our isthmus, and finding the ravine formed by the upheaval of the granite, further eroded its depth, and scooped the channel of the North West Arm. When this took place the land may have been sinking, or at its lowest depression. As the climate ameliorated and the land gradually rose again, many icebergs grounded on the heights of the peninsula, and melting deposited their burdens and formed the mounds which cover it. Channels were thus prepared for the ice laden currents that subsequently passed over the land, in the springs and summers of the warmer climate that accompanied the re-elevation, and found their way to the ocean. If we are prepared to admit the theory of glacial action as forming the various sections of our noble harbour, the relative depths of water in the Basin, the Arm, the Harbour and the Eastern Passage, become intelligible. At the Basin where the erosion commenced and was longest continued, the depth is in some places near the Narrows, 27 fathoms. The North West Arm, where the glaciation was less forcible and extensive, shows a depth of 5½ to 9 fathoms. The Narrows are 12 fathoms deep. While at the Eastern Passage, where are the principal clay deposits, there is scarcely depth of water to float a small schooner. The depth of the harbour is pretty uniform with that of the basin, and varies from 9 to 17 fathoms. As the great landward current gradually ceased, from the natural causes of elevation, melted ice, and deflections owing to the reconstruction of the land, the ocean which must have been sensibly driven back by the overflow of this mighty river, resumed its ancient sway, and beat against a bare rocky coast, and covered depths completely eroded. It now fills the harbour, basin and arm with a placid stream, and a tide that has a rise and fall of not more than five feet. It has made deposits of sand and mud, but it offers no phenomena to prove that the clay and the drift were deposited from its bosom. Countless ages may have elapsed since it resumed its sway; but we are not warranted in believing that the depth of the sand or mud is very great. The most that can probably be said is, that there is good anchorage in any part of our noble harbour, perhaps an excavation of twelve to twenty feet would exhaust all their superficial contents. This much in favour of the glacial theory as accounting for some of the circumstances by which we are surrounded.

Geologists who engage in the study of soils will find a good field in this granitic and slaty district, in which to pursue their labours. Time has rounded the granite eminences, but has had little effect upon the rocks in general. In many places, although covered with trees, they have not been covered with decomposed matter. In others the decomposition barely nourishes mosses and lichens. The borders of our lakes sometimes exhibit a few feet in depth of peaty growth; but the debris of the rocks since their denudation, has never afforded a soil capable of itself of extensive cultivation, although it may have contributed, in many instances, to enrich the overlying deposits.

Could a human eye have looked abroad upon the land when Aspotogaen was regaining its five hundred feet of elevation, it would have been thought a hopeless scene. Yet now we know that it was a preparation for the advent of the human race—a grand operation of Divine Power, gradually forming the country for the habitation of living creatures. In process of time vegetation spread over the drift—the stunted spruce and fir—the alder and birch—the flowering shrubs and evergreens—the ferns, mosses and lichens,—hid the deformities of nature. The bear, the moose and carriboo, the fox, the wild cat and the hare, tenanted the woods. The beaver dwelt undisturbed by his watery domain, and reared a numerous industrious progeny in plenty and security—fowl increased on the surface of the waters—and fish innumerable made the banks which the rushing inland flood and icebergs had formed scores of miles away, their habitual resort, and countless shoals filled our rivers, bays, and harbours. Lastly, a band of strangers from a distant land, allured by the plenty which a kind Providence had placed within their reach, and clad in the spoils of the brute pre-occupants of the forest, reared their wigwams on the shores of our noble sheet of water, and there acknowledged the goodness of the Great Spirit in silent adoration and worship. If the knowledge of the present era should ever pass away from the earth, and future intelligences should examine this region for evidence of the antiquity of man, they would not, as now in Europe, find a gradual sequence of improvement—or, as upon this continent, an age of barbarism succeeding traces and remains of civilization and refinement; but they would be puzzled by the fact connected with the ancient people,—that there were mingled in one strata, the stone weapons and implements of savage life, with those of finished manufacture, and other remains, which attested high cultivation in the arts and sciences.

The history of Nova Scotia is written on the modern page, and not far removed from the recollection of the immediate ancestors of the present generation. Columbus discovers a new world, and Anglo-Saxon energy is mainly instrumental in developing its vast resources. A century and a half has scarcely gone by, since the Briton reached these shores, and the civilization, refinement, intelligence and aptitude of progress of Europe, have taken root and flourished. Our barren rocks are beginning to be known abroad, and appreciated; and are already assisting to build up the great cities of this continent. They may yet prove a profitable staple of commerce; and time and scientific investigation may discover mineral treasure at our very doors. If these are but mere speculations, more unlikely things have come to pass. In the meantime there can be no mistaking our course. Let it be onward,—and our motto—"PERSEVERANCE."

Art. VII. On Introduced Species of Nova Scotia. By J. Bernard Gilpin, A.B., M.D., M.R.C.S.

[*Read Feb.* 1, 1864.]

Man in his wants has seized upon different species of animals, has domesticated them to his use, and in doing this has so modified their outward figure, their color, and their habits, that it has become almost impossible to trace the different wild stocks to which their progenitors belonged. It is a matter of controversy, perhaps never to be settled, whether the varieties of dog now existing have descended from one, two, three, or more primal stocks. Domesticated individuals are continually escaping from man's control, and founding races of their own, which thus are trying back again when left to their mutual selection, as it were, to refound the old primal stock from which they were in remote ages derived. These new races are called feral, to distinguish them from the original wild stock. Whenever such a process is going on, and its various phenomena noted, it will be found to be of the highest importance in solving many of the questions of natural selection, original species, species altered by progression, or by circumstances, which are vexing the present day.

In the following paper, then, I purpose to draw the attention of the Society to the breed of wild Ponies, which, originally turned loose on Sable Island (lying seaward of Nova Scotia, about ninety miles south-east), have been left to themselves, perhaps, for one hundred and fifty to two hundred years,—to note carefully their form, color, habits, and to compare them with the present wild stock, now existing solely in Tartary, with the several feral breeds in America and Asia, and with the modern artificial races now existing among men. I have been led to do this, the rather, because some remarks made formerly on this subject, by myself, have been noticed in some of the works of the present day, and inferences drawn from them.

From proclamations still extant of the then Governors of Nova Scotia, we are certain these animals existed about one hundred and fifty years ago. We may assume that they sprung from two or more individuals, perhaps one stallion and several mares, and that these were the ordinary New England stock. The difficulty of procuring and landing them at that period, and the fact of Le Mercier, who transported them, being from New England, are proofs sufficient of these facts. One hundred and fifty years after this event, I noted with great interest their descendants. I found them about four hundred in number, divided into about six herds, or gangs (so called), each gang headed by an old male, who was sufficiently conspicuous by his masses of mane and tail. Each herd had its separate feeding ground, to which the individuals composing it seemed to be equally attached, as to their leader. On driving over the Island, and mixing all herds, promiscuously, as we once did, by the next morning they had returned to their separate feeding grounds, some of them travelling ten or twelve miles during the night. On riding towards them the herd was seen grazing at the distance of a mile, with several outlying parties. The leader was observed repeatedly to drive these outlying mares and young horses into the general herd, who all now began a general retreat at a slow trot, with the exception of the old stallion, who faced the approaching party, passing backwards and forwards, frequently stopping and tossing back the mane from his eyes. The resemblance to a convoy crowding all sail to leeward, and a frigate in stays awaiting the enemy, was perfect. On pressing him, however, with our riding horses, he joined his herd now in a gallop, but keeping always in the rear. His instinct taught him the unequal match with man, but the air of leadership was unmistakable. They often fight among themselves, one stallion visiting the herd of a second. I saw a horse nearly disabled in one of these encounters. The young horses, between two and three years old, are driven out of the herd by the leader. I watched one, hour after hour, driving a young grey colt with the most furious bites, to a distance. The young horses live in small bands on the outskirts of the herd, and sometimes an old or disabled mare, unable to keep up, drops behind; she is an object of the greatest attraction to them, soon produces foals, and thus a nucleus of a new herd is formed.

I never saw one lying down to rest. They seem to sleep standing. They persistingly refuse the shelter of a stable, or the society of man, always moving from him. In the roughest weather escaping from the stable they would put a mile or two between them and it, before they stopped to graze; in this respect differing widely from the semi-wild cattle, which besieged the barn doors with their lowing during the winter. On concealing myself in the coarse grass to watch them, I observed the whole herd to move forward, grazing as they slowly moved. I have been thus minute in order to compare their habits with the only original wild stock that have never been tamed, now existing in the world, according to Col. Hamilton Smith—(no mean authority). This primal stock called "Tarpans,"* and the "Tarpany," exist in Tartary, extending to China. When describing the form and color of the Sable Island poney, I shall refer again to them.

From these quotations, one cannot fail to see that in one hundred and fifty years these animals have returned, almost literally, to the habits of the old primal stock, never yet subdued by man. The term "Sultan Stallion" seems singularly appropriate to the "master horse," that we have seen sweeping between us and his mares, or cruelly banishing his colts, some thousands of years after the epithet was applied.

We will now accurately describe his form, and compare it with the "Tarpans,"† with the several feral or escaped breeds of the

* "The Tarpany form herds of several hundred, subdivided into smaller troops, each headed by a stallion; the stallions leading and occasionally going round their troop. Young stallions are often seen at a distance, and single, because they are expelled by the older until they can form a troop of young mares of their own. The sultan-stallion is not however suffered to retain the chief authority for more than one season without opposition from others. The sultan-stallion of a great herd was anciently an object of research for the chiefs of armies, who endeavoured to catch them, and then make them their chargers."—*Col. Hamilton Smith.*

† "Real tarpans are not larger than ordinary mules, the head small, forehead greatly arched, ears far back, either long or short, eyes small and malignant, chin and muzzle beset with bristles; the neck rather thin, crested with a thick rugged mane, which like the tail is black,—the croup as high as the withers.

The other wild horses of Asia, such as the white woolly animal of the Karakoom, is about fourteen hands high, with a large head, small eyes and ears, thick muzzle, short and thin neck joining the head at a considerable angle, mane short, and ragged, the tail not very abundant, shoulder low and vertical."—*Col. Hamilton Smith.*

Varro, Strabo, and all the ancients in relating of wild horses, refer to a sturdy form of ponies, with broad foreheads, strong lower jaws, heavy manes, great forelock, long bushy tails, robust bodies, and strong limbs.

"It was a gaunt ugly animal, with a large head and bristly mouth,—small, pale, often blue eyes,—a haggard and abundant mane and tail,—hips high,—legs nodose,—feet broad and flat, hidden in an immense quantity of long hair about the fetlocks."—*Col. Hamilton Smith.*

Certainly this is a very good description of the Sable Island poney; the pale blue eye being what is now called the "wall-eye," is common among them.

world, and with the ordinary artificial races of the present day. He may be described as low, from twelve to thirteen hands, scarcely approaching fourteen hands; head large and ill-set on, with usually the round Roman nose and thick jowl; the ear small, short, and square at the top; crest very thick and heavy in the male; neck cock-thrappled, or swelling out in front; withers very low; quarters short and sloping; legs very strong and robust, with thick upright pasterns; the eye not large or bright; the mouth very short; the forelock and mane abundant; tail also reaching on the mane nearly to the ground, and covering the nostrils; the weight of the mane often pulls the crest over, so that, especially in the mares, the neck seems ewe-necked; the fore toe usually turned outward, or paddle-footed; and the withers seemingly lower than the rump or quarters, although they are exceedingly short and sloping; the coat is, during winter, long and shaggy, especially under the chin and on the legs. Thus, the descendants of the first stock, in one hundred and fifty years, have become a race of large headed, low withered ponies, with tail set on very low into a very short quarter; a cock-thrappled neck, and a short square ear. As regards colour, their changes are so important that I reserve it for a separate section, and proceed to compare their outward form with the "Tarpany."

We will now compare them with the most ancient form of domesticated horses extant, carrying us back to the days of Nineveh. Comparing him with the thorough bred horse of the present day, we find the changes more striking, but better seen by comparison of an outline figure of Ellis, a fine English racer, by Langar, out of Olivia, by Sir Oliver.*

Thus then, those ponies left to themselves have returned in some degree to the tarpany, and woolly wild horse of Tartary, in form, having in common the short thick neck, the shaggy beard, rough coat and stout hairy legs, the small stature, the low withers; but the tarpany, from the figure, has a much better croup and quarter, and does not possess the abundant tail and mane, his tail barely reaching to the hock, and his mane short and hagged. Compared with the figure of the most ancient domesticated horse, from the

* The original paper was accompanied by a series of drawings.

sculptures of Nineveh,* they have reproduced, spontaneously, if we may so speak, but no doubt by a fixed law of nature, pre-existing created forms, died out with the race of men who from their backs gained universal empire. But from Frank Forrester's poetic and eloquent description, we must turn and remind you of the large head, thick crests, cock-thrappled neck ("like a game cock when he crows," says Xenophon), abundant tail and mane, and low stature, common to both. The Elgin marbles give the same form of horse in the battles of the Centaurs.

Comparing him with the present thorough bred, the entire divergence of head, neck, crest, withers, and croup and quarters, tail and mane, are at the greatest extreme. That the low withers and low setting on of the tail is not from climate and exposure altogether, but in accordance with some fixed law, I quote Frank Forrester (p. 116). I also give a figure of a Mustang, taken from one of the illustrated papers of the day, but evidently a portrait from its spirit and excellence. I may add, those sketches are all traced from the original prints, so as to leave nothing to my imagination. The few Barbary horses that I have seen had this peculiarity very apparent, especially a black barb imported from Africa by Mr. Thos. R. Grassie, of Halifax, a most noble animal, but having this peculiarity very marked, and transmitting it to his get. According to Capt. Shakespeare, the tendency of the pure Arabian to a low croup and tail is so strong, that the breeders resort to artificial means to obtain that high carriage of tail usually

* "In all their sculptures he is represented as a remarkably high crested, large headed, heavy shouldered animal,—rather long bodied, powerfully limbed, his neck clothed with volumes of shaggy mane,—and his tail coarse and abundant. He therefore had nothing of the modern Arab in his form and character."—"*Horses of America*": *Henry William Herbert.*

"Judging from the Elgin marbles, the next sculptures in antiquity to those of Nineveh, the Greek horse was not above fourteen and a half hands high, and had the short stocky ridged shapes of the galloway or cob. They are all what are vulgarly called cock-thrappled, that is, having the wind-pipe and fore-neck above its insertion in the chest projected like the same parts of a game cock when crowing; and with their hagged manes, short round barrels, heavy joints, short stiff pasterns, look like what they doubtless were, a large breed of clever active galloways."—*Ib.*

† "On my first arrival in America, I was particularly struck by the fact that the American horse, as compared with the English, was remarkable for what is called the goose rump, the American racer standing very much higher behind and lower before than his English compeer, and this difference still more conspicuous in roadsters."—*Ib.*

considered the best mark of pure blood. (See "*Field*" newspaper, October 17, 1863, p. 383.) Thus the tendency to low croups, and ill set-on tails, is common to America, Africa, and Arabia, and only to be resisted by the most careful and artificial crossings.

We come next to the subject of colour. But in order to comprehend this, we must premise a short account of the different colours extant from remote antiquity.

The *bays*, including the *browns*, all having black manes and tails, and extremities in common, are the first and most numerous colours.

The *chestnuts* light or dark, including the sorrel, all having the extremities of the same colour with the body, and the manes and tails light, are the second variety.

The *duns*, including the mouse colour, or bluish variety, many having dark stripes down the back, and some of the Isabella duns, with black stripes about the legs as well as on the withers and line of back, seem to belong to this variety. They are curious as showing remote affinities with the hippotigrine group of zebras and quaggas, in the latter; whilst the blue mouse colour points to the asinine group.

There has always existed from remote antiquity a *black* race, yet of all colours it dies out the soonest.

A pure *white*—the foal, born white, exists still in a wild state, and has always been of the highest consideration from remote ages, and may be considered a true variety.

Not so the *greys*, including the dapple, the iron-grey, the flea-bitten, and the roan. All these are born dark, become lighter in adult life, and pure white in old age; and scarce can be called a true colour.

Lastly, we have the *piebald*, or black and white, or red and white. These have existed in all ages, are said even still to exist in a wild state on the confines of China—are depicted on the most ancient coins of that kingdom,—were cotemporary with the siege of Troy, being ridden by Turnus, king of the Retulians,—are still to be seen in a feral state in northern Italy, have appeared in America, at Patagonia, and as the paint horses of the North American Indian.

In observing the Sable Island horses for colour, I found the bays to be the most numerous, including the brown with them, and next the chestnuts. Of black there were few. Of greys, none. A peculiarly wild mare, seemed to be of a red roan, but I never got near enough to determine. There was one pure white young horse that must have been foaled white, from his age. Of piebald, they had so run into the colour that means had to be taken to lessen them, by destroying them, and by sending them off the island; and lastly, the bluish mouse colour, often with a black stripe along the back, seemed to be nearly as numerous as the chestnut. This last colour, uncommon among our artificial breeds, perhaps because of its soiled look and want of show, is very asinine in its colour, especially in the long winter livery, the inside of the ear being then fawn, and the list down the back very conspicuous. Many of the chestnuts seemed running into Isabella and light duns; but I saw none with black lines around the legs, and but few with the black list along the spine.

To sum up then what we read from this narrow page in natural history, opened to our view, and in which my sole assumption is their origin from two or three individuals, we find that, left to themselves, following the laws of natural selection, their descendants in one hundred and fifty years, have returned to the habits and manners of the tarpany, or only stock of wild horses now existing in the world. That, in regard to their form they differ in some respects from the tarpany, though agreeing with them in size, hairy head, and thick coat: but, although differing from these, they have wonderfully reproduced forms, of whose existence we only know from the sculptures of Nineveh and the friezes of the Parthenon, where we find the low stature contrasted by the tall rider, the abundant tail and mane either cropped or tied and plaited, to prevent its encumbering the rider, the hairy jowl and horizontal head, and the short and cock-thrappled neck, and in some figures the short croup and low tail. In the immense manes, one of which (I have the authority of the late Mr. Edw. Wallace in asserting,) measured three yards; we find also their type in the feral breed of the Ukraine, a stuffed specimen of which breed, now at Dresden, measures the incredible length of 24 feet on its mane.

We find, too, in comparing them with the feral breeds of other lands, of hot sun, and rich bottoms on warm sandy plains, with the feral breeds of America, with the domesticated races of Asia and Africa—that in reproducing those forms, though left entirely to natural selection, they but obey a law general to all. The Mustang, the Shetland poney, the African barb, and the pure Arabian, all equally obey it still, as did the stud-mares of that great Assyrian, who came down upon Israel, "like the wolf on the fold," thousands of years gone by.

We are forced to the inevitable conclusion, that had Childers,—who about the time these animals were placed upon their surf-fringed sand bank, was doing his mile a minute at Newmarket,—with his pure-blooded and fiery mates, been deported to this island, his descendants would have been a race of miserable ponies, instead of Herod and Eclipse, Harkaway, and Caractacus, with their thin necks and deer-like heads, high withers, noble standard borne tails and inimitable speed and staying.

As regards colour we find that the original stock carried with them the germ of all colours known from ages, not only the bays and browns which we consider the natural colours, but the more startling varieties of pure white, and piebald,—piebalds known from ages, on old China coin, upon the ancient Thracian hills, from whose back Attila ravished worlds, and the mark of whose foot, it was his boast, that neither nature nor man could efface. We find, too, the chestnuts prevailing with their extremities coloured like their bodies, their tails and manes growing ever lighter, and a tendency to a dark streak on the back and withers; lastly, the blue greys or mouse or tans, with the same dark streak. Here, too, there is nothing new; the ancient Assyrian dun, and the Phrygian cerulean breeds of the time of Homer, are all prototypes, though the latter is scarcely known among our domestic breeds.

Thus left to natural selection they have produced nothing new, but have reproduced old colours and forms. Content with noting facts we will leave it to others to speculate how far this reproduction of Isabella colour, the proper mule colour, points to some remote affinity with the Hippotigrine group; or the blue grey with its black stripe, so asinine in colour points to affinities with the wild ass, to which fond fable has attributed this crucial mark, since he bore our Lord on his lowly back. But we may add that in his rat tail, thin mane and largely developed ear, the modern thorough bred also points to the same direction.

Again, it is curious to observe that the blue duns, and Isabella, chestnuts, of Mexico, Tartary and Sable Island, are only the sub-colours of all horses; for in clipping horses of all colours, they are reduced—the bays, blacks and browns to the blue dun, whilst the chestnuts, except the very dark, become Isabella; even some white have become dark blue, or have a blue skin, the greys alone seeming unchanged. One may also speculate, if the black races, the first to die out, do not disappear insensibly into the blue tan: this colour being only kept up by grooming and condition, a few days of sun-tan turning the blackest, rusty.

Whether our domestic horse is descended from one original stock, or from several kindred species so nearly allied as to breed together, is a question towards solving which our few remarks, in so limited a period as 150 years, and so small a number as 400, may perhaps do a little; at all events the facts are worth preserving, and as such I have offered them to your attention.

ART. VIII. NOTES ON THE WEATHER AT HALIFAX, N. S., DURING 1863, WITH COMPARISONS OF THE TEMPERATURE OF THAT PLACE WITH SOME OTHER PARTS OF BRITISH NORTH AMERICA. BY COLONEL MYERS.

[*Read March* 7, 1864.]

MY knowledge of Meteorology is so slight, and not possessing the instruments employed in making the various delicate observations, which would have been required to enable me to treat the subject scientifically, the few remarks I have been prevailed upon to offer on this occasion, must necessarily be of the simplest character. They will consist for the most part of the results of a rough record of the weather, kept by me during the past year, and some comparisons of the temperature of this place with that of other parts of British North America.

I cannot vouch for the absolute correctness of my observations, nor claim for them any greater merit than that they have been taken regularly, and without intermission, three times a day. Intending them only for my private use, as a means of comparing the seasons of one year with those of another, as they passed, I have not been particularly exact in noting them; and my instruments, comprising only a common barometer, and day and night self-registering thermometers, are not sufficiently good to ensure the accuracy requisite to make their indications available for any higher purpose than that I had in view.

Desiring, by this preliminary explanation, to avert from my crude and unpretending contribution to the papers of this Institute, the test of a rigid scrutiny, which it is ill adapted to bear, I proceed to state, that, according to my register, the highest temperature in the shade recorded during the past year, was on the 7th July and 3rd August, having on each of those days reached 86°; the lowest on 4th February, when it was 10° below zero; giving a yearly range of 96°. The highest monthly range was in February, 53°, the lowest in August 34°. The mean temperature of the year was 44°. The hottest month was July; the coldest February.

The highest reading of the barometer during the year was on 5th February, 30°.55; the lowest on 7th January, 28°.80; giving a yearly range of 1°.75.—The highest monthly range was in January, 1°.60; the lowest in July, 60°. The mean barometric pressure for the year was 29°.71.

The most prevalent wind during the year was S. W.; the least prevalent E. N. E. Rain fell on 113 days; snow on 32 days; and there was fog on 41 days.

Aurora Borealis was visible on 62 nights; there were 44 solar, and 14 lunar halos observed.

Thunder and lightning occurred on 15th, 24th and 25th June, on 29th July, 22nd August, and 21st September—lightning was seen without thunder being heard on 21st May, 6th July, and 6th August—thunder was heard without lightning being seen on 8th November.

For most of the following periodic phenomena I am indebted to our President J. M. Jones, Esq.:—

On the 18th March a robin was seen; on 23rd the snow bunting were observed on the common.

On the 14th April butterflies first seen; 15th grass (Timothy) sprouting; 22nd Mayflower in bloom; 25th croak of frog first heard; 28th whirling beetle observed on brooks and ponds, and swallows seen; 30th leaves of moosewood well developed; on the 3rd May beech trees in bud; leaves of the elder opening; spawn of frogs in ponds; on the 9th the red maple, and on the 11th the hacmatac were bursting into leaf, and blue violet in bloom; 16th dandelion in flower, and black flies first seen; 20th the wild strawberry in blossom; Star of Bethlehem in flower, and white throated sparrow first heard; 21st a humming bird seen; 23rd fire-flies first observed.

On 7th June yellow orchis in flower; 21st lilac in bloom; 22nd the ash in leaf.

On the 24th August, plover arrived, leaves of some trees began to turn colour; on the night of 22nd and 23rd there was a heavy gale from S. E., veering at midnight to W., accompanied with thunder and lightning.

On the 6th September red maple turned colour in moist places.

On the 13th October leaves of the ash falling; on the 23rd the birch and balsam poplar, and on the 30th the ash were stripped of leaves.

On the 1st November white butterflies still about; on 6th leaves of the hacmatac turning colour; 12th leaves of apple trees falling.

On the 2nd December there was a heavy gale from W. S. W. veering to N. W., which caused much damage on shore and at sea; 9th a silver-thaw; on the night of 21st a meteor of remarkable size and brilliancy was seen in several parts of the Province; on 26th a double lunar halo was observed. High winds prevailed this month, weather mild, and winter late in its approach, attributed by some to the Gulf stream taking a more northerly direction than it has hitherto done. And this theory would seem to obtain support from the circumstance of seaweed, peculiar to the Gulf-stream, having been found on this coast and at Sable Island; of the severity of the winter at places to the westward, and even to the southward of us, where the stream could have no influence; and of an unusual current in this part of the Atlantic Ocean, which, in thick weather, when no observations could be taken, has swept vessels far out of their course to the northward, causing, as in the lamentable instances of the steamers "Anglo Saxon" and "Africa," disaster and loss of life.

It may not be uninteresting now to compare, as I proposed, the temperature of this place with that of other parts of British North America; and in the first place I will refer to a paper by Dr. Smallwood, Professor of Meteorology in the University of McGill College, published in the November number of the "*Canadian Naturalist*," 1857, in which it is stated, "that the temperature of the air in the vicinity of Montreal for the previous seven years, exhibited a yearly mean of 41°.56; that the highest temperature in the shade on record there was 100°.1, and the lowest 36°.2 below zero, giving a climatic range of 136°.3; the hottest month is July, and the coldest February. * * The song sparrow, the harbinger of the Canadian spring, generally makes its appearance the first week in April; frogs are first heard about the 23rd of April; shad are caught the last week in May; fire-flies are first seen about 24th June, and the snow-bird generally makes its first appearance about 20th November; swallows about 18th April; winter generally sets in about the latter week of November, or the first week of December, and is ushered in by a fall of snow from N. E. by E. and this is the point from which the Canadian winter storms come. Rain generally comes accompanied with a wind from S. S. W. or S. E. and also from N. E. by E. There are generally a few days of that poetic season, the Indian Summer, in November—

"The year's last lovely smile,
That comes to fill with hope the human heart;
And strengthen it to bear the storms awhile,
Till winter's days depart."

The months of April, May and June, bring returning summer; the nights of July and part of August are generally oppressive, the temperature often remains at 70° during the night; but the Canadian autumn is very pleasant."

Comparing these periodic phenomena with our own, it would seem that the winters in Montreal set in, and break up, rather earlier than with us.

Meteorological registers which I have had an opportunity of examining, shew that the mean annual temperature at Halifax for 1860 was 43°.5; 1861—42°.7; 1862—43.°9; and 1863—44°.5. At Newfoundland for 1855 it was 40°.9; 1856—41°.5; and 1858—40°. At Kingston, Canada West, for 1856 it was 41°.5; 1857—43°.7, and 1858—43°.1. At Montreal for 1857 it was 40°.58; 1858—40°.06; 1860—43°.42; and 1861—41°.72.

It may here be observed that in the yearly mean at these several places, there is a very remarkable uniformity of temperature; the difference between any of them extending to only about 4° in all the years we have been noticing; but, on examining the yearly range, it will be found to vary considerably.

We have seen that at Montreal during a septennial period it is noted at 136°.3, at the same place in 1859 it was 141°.3. At Kingston C. W. the range in one of the above named years reached 117°.5.; at Newfoundland 101°; while at Halifax it has not exceeded 100°

As the registers from which these data have been gathered are not (with one or two exceptions), for the same years, nor in complete succession, a perfectly accurate result from the comparison of these places cannot perhaps be arrived at; but I think it may fairly be assumed that the temperature of Halifax is the most equable among them; and indeed it would not be difficult to prove, from statistics, carefully compiled for the information of the authorities at the War Office, and from other sources, that Nova Scotia enjoys a climate, equal, if not superior to that not only of the other British Provinces on this continent, but of any of our colonies. Our winters are not too severe, our summers not too hot; and though we cannot boast much of our springs, the loveliness of our autumnal weather is not, I believe, to be surpassed in any part of the world.

The fine specimens of our fruit and other productions of the soil, which have been exhibited in England, have convinced people there that Nova Scotia is not the hyperborean region they had long supposed it to be; and the more the excellence of the climate of this country, and its other advantages are understood abroad, the greater will be the inducement to the emigrant to bend his steps to our shores. No means for making them better known ought to be neglected, and I look forward sanguinely to the time, when this Institute may essentially promote this desirable and important object by sending forth, at stated intervals, a series of Meteorological observations from an establishment of its own, furnished completely with accurate standard instruments.

The hope that others more competent than myself, might follow it up, was my chief inducement to take this feeble step towards awakening an interest here in a branch of science so useful to almost every class of people. An acquaintance with it is, in some measure, a necessity to the physician, the traveller, the mariner, and the farmer. To the observer of nature it opens a field of unbounded delight, where, in the fierce storm, the appalling lightning, and awful thunder, he may contemplate the Almighty power of the Creator, and in all the complicated arrangements constituting what is termed climate, he may trace beauty of design, carried out with infinite wisdom and benevolence. The philosopher too, will find much to engage his attention in the examination of phenomena connected with Meteorology, as yet very imperfectly understood: and, to bring the difficulties surrounding them to a satisfactory solution, may baffle the utmost exertion of his intellect and ingenuity. In this as in other sciences great strides have been made of late years, and among the philanthropic efforts to render it beneficial to mankind, Admiral Fitzroy's system of storm signals, now so well organised in England, stands conspicuous. All who feel an interest in our fishermen and sailors, would hail with joy the establishment of such a system along our coasts, by which these hardy men, "who go down to the sea in ships and occupy their business in great waters," might be warned of approaching storms, and saved from disaster and loss.

In a paper on Meteorology, by Professor Henry of the Smithsonian Institute, published in the *Canadian Naturalist* of August 1859, is shown what is being done in this branch of science in the neighbouring States. We learn from it, that the Institute had distributed several hundred meteorological instruments over the country; that there are 350 observers in the United States, who make observations three times a day, and that it was expected these observations would be carried on at sea also, to arrive at satisfactory results. He gives the following account of the method of observation pursued each day at the Smithsonian Institute.—"They have a map of the United States hung upon a board, with pins stuck through it at the points where the observers of the Institute are stationed. The Institute has daily reports by telegraph from many of these points. Each morning an assistant hangs a cord on the pins, to indicate the state of the weather—black, if raining; green, if snowing; brown, if cloudy; and white, if fair. All storms travel east, and thus they are enabled to predict with great certainty the condition of the weather twelve hours in advance."

Mr. Glaisher and other æronauts, by observations during their perilous ascents, of electrical phenomena, formation of clouds, &c., are making valuable additions to the stock of meteorological information; and an extract, from an article in "*Orr's Circle of the Sciences*," gives some idea of what is expected to be accomplished through the agency of meteorology:—"Professor C. P. Smith, the astronomer royal of Scotland, has caused the electric telegraph to work in meteorology. A wind dial, at the one extremity of a wire, is made to turn another simultaneously at the other extremity. The time will come when all large towns will have buildings devoted to these observations, and in which dials will be seen in every direction, some labelled Edinburgh, others Liverpool, Dublin, London, Paris, York, &c., and where the public will be enabled to see the direction of the wind, at the same instant, at most remote places. The benefit to the farmer and the navigator will be great from such an arrangement. Were such stations to be thickly scattered throughout the country, every change of wind, and every shower, could be traced and recorded, and a knowledge imparted, the benefit of which could not be sufficiently appreciated * * * * our knowledge of meteorology would then make rapid advances; laws of the weather would be unfolded; and predictions of coming changes, which are now mere guesses, as often wrong as right, would be based upon truth."

Yet when all this and much more shall have been attained, how far will man still be from an adequate and perfect conception of the works of the Almighty, or of their wonderful adaptation to supply the wants, and promote the happiness of his creatures,—the beneficent purposes for which he intended them. The laborious enquirer may toil up the ladder of knowledge, but, climb as high as he can, there will be still a step above him, and the more he becomes sensible of his inability, with his finite capacities, to reach the crowning summit in this world, the more firmly will he be convinced, (to use the appropriate words of one of the writers of the *Bridgewater Treatises*,) "that he is destined for a future state of existence, where his nature will be exalted, and his knowledge perfected, and where the great design of his Creator, commenced and left imperfect here below, will be completed."

ART. IX. ON THE FLORA OF CANADA. BY GEORGE LAWSON, PH. D., LL. D., PROFESSOR OF CHEMISTRY IN DALHOUSIE COLLEGE.

[*Read March* 7, 1864.]

THE author laid before the Institute a Synopsis of the Canadian Flora, embracing a list of all the flowering plants and ferns that had been observed in Canada, with habitats in detail, showing the distribution of each species separately. The list, which was too lengthy to be printed here, was prefaced by a few remarks on the general features of the Canadian flora. After a brief discussion of the question of origin of species, with reference to Mr. Darwin's theory, which Dr. LAWSON deemed insufficient to meet the wants of the case, it was observed:—

Humboldt, with his great power of generalization, and true appreciation of the poetry as well as the science of nature, summed up the results of all our botanical statistics when he said, "The carpet of flowers and of verdure spread over the naked crust of our planet is unequally woven; it is thicker where the sun rises high in the ever cloudless heavens, and thinner towards the poles, in the less happy climes where returning frosts often destroy the opening buds of spring or the ripening fruits of autumn. * * * Thus we see variety and grace of form, mixture of colours, and generally the perpetually youthful energy and vigour of organic life increase as we approach the tropics, although everywhere man finds some plants to minister to his support and enjoyment."

The floral carpet depends for its thickness upon physical causes, but its intricate and ever-varying patterns lead us back to the mode of origin and subsequent diffusion of species. In Canada we have examples of the thinning of this carpet to the northward. In the south-western peninsula of Canada, there is a luxuriant vegetation, composed largely of species which have their head quarters farther south in the adjoining States. Here are magnificent tulip trees and black walnuts, the occidental plane, and such little southern plants as Jeffersonia diphylla, azolla Caroliniana, and Erigenia bulbosa. This is the peach country of Canada, and the part peculiarly adapted for the grape-vine, tobacco (now extensively cultivated,) and Indian corn, all of which require in Canadian latitudes a maximum of summer heat. Gooseberries do not thrive, and although the soil is peculiarly adapted for turnip culture, the climate is too warm and dry. In like manner, oats, broad beans and cabbages give way before wheat, potatoes, kidney beans and pumpkins, all of which enter largely into field culture.

In the south-western peninsula of Canada there are other plants that have a rather wider range northward and eastward; such are lupinus perennis (normal form), ranunculus rhomboideus, the painted cup, castilleja coccinea, asplenium rhizophyllum, the beautiful walking-leaf fern, Woodwardia, &c. Viola sagittata is common about Toronto, but rather a local than a southern or western plant, and podophyllum peltatum extends sparingly to Lower Canada.

The prevailing and characteristic trees of Upper Canada are the beech, maples, several species of oak, ash and birch, hickories, ironwood, bluebark, butternut, pines, hackmatack, cedars (white and red), hemlock, balsam fir, poplars and wild cherries; spruces increase to the eastward. Of essentially American species, which form the great mass of the Canadian flora, the solidagoes, asters, and other showy compositæ, are conspicuous. It is along the southern and south-western frontier of Canada that there exist the greatest numbers of plants of the true American flora, which is a continental flora, developed chiefly inland, and decreasing toward the Atlantic seaboard. We have many examples of it in Nova Scotia, but here the preponderance of *northern* species is much greater than in corresponding latitudes in Canada, and many of our common plants are in western Canada, either entirely northern or strictly confined to the great swamps, whose cool waters and dense shade form a shelter for northern species. This effect of the swamps in modifying the distribution of species seems to have been hitherto overlooked.

The great numbers of aquatic plants furnished by the Lakes, were then referred to, as well as the numerous examples of the arctic or Scandinavian flora prevailing in the northern and eastern parts of Canada, and still further developed in the Hudson's Bay territory; and the means by which the various floras were brought together, so as to form the present composite flora of Canada, were discussed with reference to the views of Lyell, Watson, E. Forbes, J. Hooker, Dawson and Darwin.

Alluding to the circumstance that there was a remarkable sameness in the plants associated with boulders in different parts of the country, incidental reference was made to a very remarkable boulder, in the Trent valley, in Upper Canada, which was visited by Dr. LAWSON, in company with the Rev. W. Bleasdell, M. A., rector of Trenton, on 6th June, 1862, and which Dr. L. proposed to name the Bleasdell boulder. Mr. Bleasdell has kindly furnished the following measurements :—

Length, 44 feet; breadth, 24 do.; height, west end, 19 do.; height, east end, 22 do.; greatest width of base, 21 do.; longitudinal circumference, 114 do.; lateral do., 77 do.

It lies due east and west, and is surrounded by a grove of ironwood, overtopped by maple and beech. The following plants were found growing upon this huge stone :—

Rubus strigosus, ribes cynosbati, ribes rotundifolium, Silene Pennsylvanica, fragaria vesca, mitella diphylla, solidago Canadensis, abies balsamea, abies alba, lastrea marginalis, polypodium vulgare, adiantium pedatum, Hedwigia ciliata, leptobryum pyriforme, bryum roseum, scyphophorus pyxidatus, peltidia polydactyla.

The most characteristic boulder plants in Canada are Parmelia conspersa, P. cyanea, schistidium apocarpum, polypodium vulgare, Hedwigia ciliata and scyphophorus pyxidatus.

Art. X. Notes on the Economic Mineralogy of Nova Scotia. (Part I.) By Prof. How, D.C.L., University of King's College, Windsor.

[*Read April* 4, 1864.]

It is unquestionably desirable, that as complete an account of the Minerals of Nova Scotia as can be obtained should exist in the Province, and that the Institute of Natural Science should possess in its archives all the information that can be laid before those seeking to know the mineral resources of the country. In the absence of a Provincial geological survey, the reports of which would, of course, contain everything of importance relating to the subject, and would, in all probability, be found upon the shelves of such an Institute as ours, the labours of individual members must be looked to for the acquisition of all that can be expected from private sources.

The latest book treating of the Mineralogy of the Province, is *Dawson's Acadian Geology* (1855), of which a supplementary chapter was issued in 1860. Since the publication of the body of this work, various additions have been made to the number of minerals known to exist in the Province, while new localities have been found for those previously recognized here, and in some of these commercial operations have been undertaken. Since the issue of the supplementary chapter gold has become an object of extensive enterprise, and a tolerably complete collection of the minerals of Nova Scotia has been exhibited to the world, in the International Exhibition of 1862, a catalogue of them being at the same time distributed, containing their names and localities, and the briefest possible statement of some of the most important facts relating to a few of them. As regards gold, the reports of the Chief Gold Commissioner give the statistics of this branch of industry, and with respect to the quantities of other useful minerals raised, there are also official sources of information in the Provincial records. It is very obvious, however, that there are facts relating to minerals, the knowledge of which is desirable for scientific purposes and interesting to the general public, not mentioned in catalogues or in statistical statements, and these it is an object of our Institute to acquire. Many such facts have been given in original papers, by myself and others, published almost exclusively out of the Province, during the last few years, and are scattered through the pages of various periodicals, Dawson's supplementary chapter touching on a few of them only: various others I have become acquainted with by my own researches, and by communications from gentlemen engaged in mining or in operations connected with mining, some being collected when I was preparing the minerals for the Exhibition of 1862; and I propose, now that an Institute of Science exists in the Province which has a prospect of permanence, and an established system of publication of its transactions, to offer for the consideration of its members from time to time, such notes on the Minerals of Nova Scotia, as I hope will be acceptable and useful. And, in the first place speaking only of the useful minerals, these being most generally interesting, I offer the following as my first contribution to the Economic Mineralogy of this Province.

Iron Ores and Iron Manufacture.—There is an excellent description of the iron ores of the Province in *Dawson's Acadian Geology*, where particular attention is paid to those which were being worked at the time of writing. No large deposit of ordinary ores has been, I think, found since this account was published; but titaniferous iron ores have been met with, and these I intend describing in the present notes.

In the International Exhibition of 1862, a fine representation was made of these ores, and of iron manufactured from some of them in the Province, viz. at the Acadia Iron Works at Londonderry. Ores were exhibited from sixteen localities: the majority of the specimens were valuable hematites, and a large proportion consisted of massive samples which remain distributed through museums in Britain, as evidence of the nature of this portion of Nova Scotian Mineralogy. The most important contribution was made by E. Jones, Esq., Manager of the Acadia Iron works, who furnished nine large remarkably fine samples of hematite ores, with four specimens of pig iron, and some bars of iron produced at the works from such ores. Having had the pleasure of visiting this establishment in 1861, in company with R. G. Haliburton, Esq. Secretary to the Exhibition Commissioners, and of observing the admirable arrangements under which a large amount of work was being done in mining the ores, smelting them and converting the metal produced into bars, I requested Mr. JONES to favour me with a description of the works, and a statement of the amount and quality of iron made, feeling confident that if published these would be found very interesting to numbers of persons in the Province. This gentleman having been kind enough to comply with my request, and to supplement his first account with a few additional details last month, I am sure I do the members of the Institute an acceptable service, in laying before them the brief statistics of an industry so interesting, and happily so important and flourishing as it proves to be :—

"The Acadia Iron Works were commenced in 1849, and the first iron was made by the Catalan forge in 1850. In 1852-3 a blast furnace was erected for the manufacture of pig iron, the Catalan forge being then abandoned. Up to the time of my arriving in the Province, in the summer of 1857, there had been manufactured altogether about 1000 tons of iron, from about 4000 tons of ore. Since that time to the present (1861) we have made about 4000 tons of iron, using about 9000 tons of ore. Our present make of bar iron is at the rate of 1200 tons, of an economical value of about £24,000 per annum. The ores we use are a hematite, yielding about forty-eight, and a brown and red oxide yielding about forty per cent. of iron. The ores are somewhat refractory: this arises mainly from the presence of a stone mechanically mixed through the ore, and which is very difficult to act upon in the blast furnace. It requires about a hundred and sixty bushels imperial of charcoal, and two hundred bushels of limestone (this is found in the neighbourhood) used as a flux, to smelt one ton of pig iron, and about three cords and a half of wood to convert the pig iron into bars. The wood used is required to be perfectly dry; for drying it we use artificial means, and also house a large quantity in sheds for winter use—as much this year as a thousand cords. We have one blast furnace, and three puddling furnaces, with one re-heating furnace; the pressure of blast used is about four ounces to the square inch, and the quantity of air about two thousand cubic feet in a minute. We employ now about two hundred and thirty men, and our expenditure for wages, &c., at the works will average about £1200 per month." The blast, I may insert here, is obtained by the improved noiseless fan, which, with the heavy hammer used in the puddling process, and the rolling mills for making the bars, is worked by a powerful steam-engine.

"The iron made," Mr. JONES told me, "compares very favourably with the best metal brought to market from any part of the world for the same purpose, which is the manufacture of steel. Thus the Swedish iron, of which there are many varieties, varies in price from £12 to £25 sterling, one brand bringing as much as £30 to £34 per ton in the Sheffield market. The Acadia iron is worth about £16 sterling per ton, so that it compares with the average of the Swedish metal. It should be added that at Londonderry a less expensive mode of manufacture is adopted, than that usually pursued in Sweden, on account of the high price of labour in this country."

Writing on 25th January, 1864, in answer to some additional questions of mine, Mr. JONES further states, "I have little to add to the account I gave you some time ago of our works, and excepting in the increased production there is no change; we shipped in 1863, 900 tons of bars and 402 tons of pig iron, of the aggregate value of $85,000. We are now driving an adit into the mountain at the head of the river, which will enable us to ascertain the nature of the deposit of ore at about one hundred yards under the surface.

"The value of our iron as compared with English of the best quality, is best estimated from the selling price:

English Pig Iron (Staffordshire) average....	£4	0	0	stg.	per	ton.
Acadian "	"	7	0	0	"	"	"
English Bar Iron (Staffordshire)	"	9	0	0	"	"	"
Acadian "	"	15	10	0	"	"	"

"As compared with Swedish iron, our bars rank with the best qualities, there being *but one* iron which is considered superior for *steel;* our bars are all used for this purpose, and the demand is steadily increasing. The pig iron is used principally for the manufacture of railway wheel tires, for which purpose it is well suited, being, when converted into malleable iron, very compact, and not liable to wear by attrition.

"This year we have for the first time shipped to the United States, where the bars are coming into demand for making steel.

"Dr. Percy has found titanium in our iron in considerable quantities.

"I may add that we have purchased a neighbouring property on the same mineral range, with a view to extending our manufacture."

It would appear that the Silurian rocks at Londonderry abound in iron to their very base, for a specimen of ore coming from the intersection of the lower carboniferous with the slates on the south side of the Cobequids, put into my hands by Mr. JONES for examination, proved to be amorphous carbonate of iron converted externally into hematite; as Mr. JONES thought the deposit might possibly prove of economic value, there must have been indications of its being extensive. I find it stated that, since the Exhibition of 1851, this amorphous carbonate of iron has become one of the most valuable ores of Great Britain. It is scarcely fifteen years since it was first proved to be worth smelting, and yet, in 1860 one district produced 248,665 tons of pig iron. (*C. News*, VI. 88.)

The iron formerly made at Nictaux was inferior to the Londonderry metal, one reason being that it contained phosphorus; the character of that produced at Clementsport, where operations were recommenced two or three years ago, I am not acquainted with.

Titaniferous Iron Ores.—These exist at three localities in the Province; of which one is Sable Island, where there occurs a magnetic iron-sand, in which I found titanium; according to Dr. Percy, the ferruginous portion (the rest being quartz sand) is chiefly magnetic iron with a little titanium and a trace of chromium. This information was obtained from G. HANDLEY, Esq. of Halifax, who exhibited the ore. The other localities are in western counties, and one affords an ore containing a considerable quantity of titanium. A sample of this ore was procured by R. G. HALIBURTON, Esq., and exhibited by him as of average quality; the deposit was said to be large. It was, like that of Sable Island, in the form of sand; it consisted of grains of quartz sand and small crystals of two distinct minerals, one strongly magnetic (Iserine), the other not affected by the magnet (Ilmenite). The relative proportions of these three ingredients I found to be, in round numbers, in the hundred parts:—

Magnetic Iserine Sand	30
Non-magnetic Ilmenite Sand	56
Quartz Sand	14
	100

I found titanium in both the forms of ferruginous sand, and contented myself with proving its presence in large quantities in the whole mixture, without making a complete separation of it from the iron and magnesia. The published analyses of these ores show a very great difference in their relative richness in titanium; thus, iserine contains:*

Oxide of iron	91
Oxide of titanium	9
	100

While ilmenite is represented† as consisting of, exclusive of unessential matters:

Oxide of iron from	91.5	to 46.4
Oxide of titanium from	8.5	to 53.6
	100.0	100.0

This latter ore, it will be observed, I find to form about fifty-six per cent of the Digby deposit as exhibited.

The third locality of titaniferous ore is at Sable River, Shelburne County, where a vein has been found on the Atlantic coast. This information I obtained from Mr. HALIBURTON in 1861; no specimen of the deposit was shown me.‡

The value of titaniferous iron ore for steel making, has been of late years much insisted on in England. It was mentioned in Mr. JONES' last letter above quoted, that Dr. PERCY had found titanium in considerable quantity in the Acadia iron; this fact was brought out by a question of mine directly on this point, my object being to ascertain how far this excellent steel-making iron agreed in this respect with Swedish and other irons noted for the same application. With regard to some of these, Mr. Mushet states in a long and most interesting letter to the *Engineer*, quoted in part in the *Chemi-*

* Dana's Mineralogy, 4th Ed., p. 102. † Loc. cit. p. 116.

‡ I have learned since this paper was read, that titaniferous iron sand is also found in Cape Breton.

cal News of April 21, 1860,* that, "If any chemist will be at the pains of analyzing the steel irons used in Sheffield, and seek especially for their per centage of titanium, he will find that their market value is in exact proportion to the per centage of titanium they respectively contain;" also, "that the magnetic iron ore from which the Dannemora iron is prepared contains a larger per centage of titanic acid than any other ores from which the inferior brands of Swedish iron are obtained, and the bar iron is therefore more largely alloyed with titanium," and "the celebrated Damascus blades are made from iron reduced from a highly titaniferous iron ore. The Wootz ore of India is more titaniferous than that of Dannemora. The Elba iron ore is moderately titaniferous. Iron alloyed with titanium possesses a degree of body and durability unknown in ordinary bar iron of good quality. First rate steel can only be made from iron containing titanium."

The durability of Acadia iron railway wheel tires, was especially mentioned by Mr. JONES. Further, Mr. Mushet says, even one half per cent of titanium may possibly constitute the excellence of steel, and that as all magnetic ores contain titanium, the most impure ores of this class yield superior iron. This should be of interest to the owners of magnetic iron ores in Annapolis County, where I have been shown, on the North Mountain, the outcrop of a bed of this ore.

That faith is placed by Mr. Mushet in considerable proportions of titanium constituting generally the excellence of irons, is shown by another statement of his,† viz., that "whoever wishes to make the best iron must add the largest proportion of titanium ore to the burden of his blast furnace, being careful, however, to introduce nothing which tends to counteract the effect of the titanium alloy, such as materials containing phosphorus, sulphur, and an excess of lime." He is not singular in this opinion, for Mr. Struson, another English ironmaster, after describing the difficulties met with in working titaniferous ores, says,‡ "the remedy was obvious, and by adding more carbonate of lime and other reducing fluxes, success was so far obtained that iron of various qualities could be produced at will, a soft malleable iron resulting from one assay, and from another

* Vol. I. p. 231. † Quoted in *Chemical News*. I. 276. ‡ *C. News* I. 274.

a fine grained silvery steel, which when made into a chisel could cut any other steel in our possession. "These experiments, and some of Mr. Mushet's, were made on titaniferous iron sand from Taranaki in New Zealand, an ore which, from the accounts given of it, appears to resemble the Digby mineral described in these notes: it is found in enormous quantities: it is said that more than 185 millions of tons are ascertained to exist, enough to supply all the furnaces in England for twenty-five years.

The publication of the letters from which I have quoted drew from Dr. Sterry Hunt, of Canada, a communication* on the titaniferous ores of that country, which he shewed to be numerous and of vast extent; the supply of them in fact was stated to be inexhaustible.

In 1861 Mr. Mushet secured two patents for improvements in the manufacture of iron alloys by the addition of ores of titanium to other ores of iron, (*C. News*, VII. 35,) and was no doubt convinced that the metals really contained the titanium existing in the ores from which they were made. It is remarkable, however, that, while no difference of opinion seems to exist about the titaniferous ores producing excellent iron and steel, the titanium does not always pass into these products. In a paper read at the last meeting of the British Association, and given in the *Chemical News* for Nov. 7 and 14, 1863, Mr. Riley states that up to the end of 1862 he could find no distinct evidence of titanium except in occasional traces, either in pig iron or in Mr. Mushet's steel, and that Dr. Perry also said he could never find it. It will be remembered that this chemist is this year mentioned by Mr. JONES as having found it in the Acadia iron in considerable quantities. Mr. Riley also afterward detected it in several pig irons, in one to the amount of more than one and a half per cent.; and he states in the paper referred to, that "it must be admitted that when titanic acid is present in iron ores, it appears to impart a steely nature to the iron reduced from them, somewhat similar to that obtained by the use of manganese; and fluxes that have been used with advantage at Sheffield, have, on analysis, been proved to contain a high per centage of titanic acid. The pig iron made with seven and a

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* *C. News* II. 41.

half per cent of titaniferous iron ore, proved also to be an iron of very great strength and excellent quality both for castings and for the Bessemer process."

It follows that if the deposits of titaniferous iron ores in this Province should prove to be extensive, the discovery ought to be of great service. As there is abundance of such ores in Norway, whence they can be taken to England for about £10 a ton, the only apparent market for export would be the United States; in proximity to which Nova Scotia would have the advantage of Canada. The obvious use of them, however, would be the improvement and developement of the home manufacture of iron and steel.

As it is already shown that the Acadia iron, so excellent in the respects described, contains titanium, and as it is admitted on all sides that titaniferous ores are very beneficial additions to other ores of iron, though the reason of their being so is not clearly made out, it becomes important to enquire fully into the extent of such deposits in the Province, where there are so many other iron ores (some of which, those of Nictaux certainly, do not afford iron equal in quality to that of Londonderry), upon which to try the effect of the addition of such ores as the Digby titaniferous sand, in making them yield irons equal to those of first repute abroad.

Art. XI. On the Pearl. By J. Hunter Duvar.

[*Read May* 2, 1864.]

[Mr. Hunter Duvar read a preliminary paper on North American Pearls. The author promises to pursue the subject.]

Attention was first drawn to an abundance of Pearls in the rivers of Nova Scotia, in 1861. Upwards of fifteen hundred specimens were sent from King's county to the London Exhibition of 1863. None of these were of large size,—none larger than one submitted on this occasion to the Institute, and which weighed three and a half carats. The colour of most of those yet found in Nova Scotia is a silvery white or opaline, and generally pellucid, although sometimes marred by being clouded; form usually spherical. The writer had not seen any collected within the Province, of the more delicate and highly prized tints.

The best Pearls hitherto found have been in the waters flowing westward into the Bay of Fundy, comparatively little search having been made, and but few found in the rivers emptying eastward, into the Atlantic.

In the United States Pearls of price are stated to have been taken from the *Alasmodonta margaretifera;* and the *Unio ochraceus, complanatus* and *radiatus*,—but as yet in Nova Scotia, only from the *Alasm. margaretifera*. Small and seed Pearls of no remunerative value are, however, plentiful in the *Mytilus edulis* on all the coasts.

The writer's observations went to indicate that the Pearl is an excretion from the first nacreous layer,—is a disease of age, but age does not necessarily produce pearl;—that it is of rapid growth, with vitality throughout its substance until maturity, which is when it has attained a spherical shape. It then separates from the neck or base which connected it with the shell, and is voided. If this be true—

> "Full many a gem of purest ray serene,
> The dark unfathomed caves of ocean bear."

The attention of chemists was invited to the scales of the smelt, as a material for the manufacture of pearl paste, such as is now made from the scales of the bleak.

Art. XII. List of Butterflies observed in the neighbourhood of Halifax, Nova Scotia. By Thomas Belt.

[*Read May* 2, 1864.]

No catalogue of the Nova Scotian Butterflies having been published, I have been requested to draw up, a list of those observed by me in the vicinity of Halifax during the years 1862 and 1863. My observations were confined almost entirely to the neighbourhood of Halifax, were extended over only two seasons, and my time was otherwise much engaged, so that the list can only be considered as a contribution towards a catalogue of the Nova Scotian species. There is no good accessible work on North American Butterflies, and I have thought it might be useful to append a few notes on the different species, and have given their times of appearance, their distribution, &c.

The day is now past when the study of any branch of Natural History might be considered trivial or unimportant, and an eminent naturalist has lately remarked, that "Butterflies offer great facilities for the study of the variation of species, from the ease with which suites of specimens may be obtained and preserved." It may be added that both the advocates and the opponents of the Darwinian hypothesis may find arguments in support of their respective opinions; the one may shew as Mr. Bates has done, that two species occurring in the same locality and presenting apparently very distinct characteristics, are in other places connected by intermediate varieties —the other may point to the great persistency of form and colouring of species that range over both the old and the new worlds, and from the northern edge of the temperate zone to the tropics, with all the consequent variation of conditions as to food, climate, the enemies against whom they have to guard, and the rivals amongst whom they have to struggle for existence. These considerations invest the study with great interest, so that even the mere collector may by the specimens he brings together, assist in elucidating some of the most important problems in Natural History: for the laws that govern the variations of Butterflies must rule throughout the organic kingdom.

Here I may urge the great value of collections of the varieties of species, which may be more instructive than typical specimens. It is probable that many of the North American Butterflies instead of being representative species (as they have been called) of European insects, are in reality geographical varieties: thus the American *Colias philodice* is probably only a variety of the European *C. europome*, and the American *grapta*, *J— album* of the European *G. V— album*. It has often been considered that animals and plants presenting slight differences are more likely to be distinct when they inhabit far separated countries; whereas the reverse seems to me more likely to be the case, that the different geographical conditions have caused the same species to vary.

In the names of the genera I have followed DOUBLEDAY, WESTWOOD and HEWITSON in their *Diurnal Lepidoptera*.

Papilio turnus, Linn. Abundant. The Butterfly appears about the first of June, having passed the winter in the pupa stage. After the middle of the month specimens are more or less faded and injured, and by the end of June they have deposited their eggs, and only a few stragglers are to be seen, presenting in their short lives a great contrast to species of the more robust genus *Vanessa*. The caterpillar changes to a chrysalis about the beginning of September, from which it does not issue until the following June, so that its active existence only extends over three months. It is probable that its congeners, *P. troilus* and *P. asterias*, will be found in the Province; but they do not occur near Halifax.—*Distribution:* Hudson's Bay, Canada, United States to East Florida.

Pieris oleracea, Harris. Common. The first brood appears at the end of May; the second in July. — *Distribution:* Canada, United States.

Colias philodice, Godt. Abundant. There are two if not three broods; the first appears in May; the second in July; and I have seen numbers on the wing in fine weather in November. — *Distribution:* Canada, United States.

Danais archippus, Fabr. *D. erippus*, Cramer. Rare near Halifax. In the autumn of 1863 a few specimens were taken on Citadel Hill, and in the neighbourhood of Ashbourne.—*Distribution:* Canada, United States, Bermudas.

Argynnis cybele, Godt. *A. aphrodite*, Fabr. Very abundant in July and August. Many writers consider the two forms distinct species; but they pass into each other by insensible gradations. —*Distribution:* Hudson's Bay, Canada, Northern States.

Argynnis myrina, Cramer. Common. There are two broods: the first in May and June; the second in August and September. —*Distribution:* Hudson's Bay, Canada, United States.

Nelitæa ismeria, Boisd. Scarce. Near Lake Loon and Lake Thomas, in July.—*Distribution:* Canada, Southern States.

Melitæa tharos, Cramer. Common in June, July and August.—*Distribution:* Hudson's Bay, Canada, Northern States.

Grapta interrogationis, Godt. Scarce. Horticultural Gardens, August, 1863.—*Distrib.:* Canada, Northern and Southern States.

Grapta progne, Cramer. Abundant. It issues from the chrysalis in July and August; hybernates during the winter, appears again in April, and faded specimens may be seen up to the end of June. It is distinguished from the next two species, by wanting the black mark in the centre of the upper surface of the hind wings; and on the under surface by its darker colour, and by the white mark being a simple right angle in shape, and not curved like the letter C.—*Distribution:* Hudson's Bay, Canada, United States.

Grapta comma, Harris. We have two very distinct forms in the neighbourhood of Halifax, which have been confounded under the above name. They occur in the same localities, and as I have examined a great number of specimens without detecting the slightest symptom of the one merging into the other, I must, pending further information, treat them as distinct. HARRIS in his description does not mention the points that distinguish the two forms, and I therefore append a description, taking HARRIS's name for that which comes nearest his definition:

DESCRIPTION. — *G. Comma*, Harris. *Upper surface, fore wings:* orange tawny, spotted and barred with black, and bordered by a dark brown band. *Hind wings*, orange tawny, two black marks near the base, which in some specimens coalesce. A black mark in the centre of the wing, just below the median nerve. Border brown with a transverse row of obscure light tawny lunules. *Under surface, fore wings:* mottled with dark and light *reddish brown;* next the margin a connected row of *grey* lunules edged with black, within which is an interrupted line of *black* points. *Hind wings:* mottled with light and dark *reddish brown;* a grey lunule edged with black near the centre of the margin, and a line of nearly obsolete black points; the white mark in the centre is large, silvery, curved, and at each end thickened.

Rare near Halifax, though it appears to be common in the Northern States and in Canada. I have taken specimens near Waverley.

Grapta C–argenteum. I propose to revive KIRBY's name for this species. HARRIS states that it is his *G. Comma*, but neither KIRBY's figure nor description agrees with that species, and the authors of *Diurnal Lepidoptera* have with more reason placed the name as a synonym of *C. progne;* but I think it very probable that he intended the present species:

DESCRIPTION.—*G. C–argenteum*, Kirby? *Upper surface, fore wings:* tawny orange at the base, orange towards the apex, spotted, barred and bordered with black. *Hind wings:* tawny orange, two black marks near the base and one in the centre of the wing; border broad, dark brown or black, and including a transverse row of orange lunules; border edged with grey in perfect specimens. *Under surface, fore wings:* mottled with *black, brown and cinereous;* a connected row of *green* lunules next the border, inside of which is a row of *green* spots. *Hind wings:* mottled with black, brown and cinereous; a row of conspicuous green lunules next the border, and then a row of green spots; white mark smaller than in the last species, but variable, generally thickened at the lower end and hooked at the upper. This species is easily distinguished from *G. progne*, by the conspicuous black mark in the centre of the upper surface of the hind wings; and from *G. comma* by the green markings on the lower surface; these are sometimes olive green, but always distinct. The mottlings are also different, and the wings more deeply angulated. In this last character and in the green markings of the under surface it comes very near *G. C–album* of Europe.

Much more abundant than the last. Near the Dartmouth Lakes and Lake Loon, in spring and autumn.

Vanessa J–album, Boisd. Rather scarce. I have noticed it near the Dartmouth Lakes and at Lawrencetown. — *Distribution:* Canada, United States.

Vanessa milberti, Godt. *V. furcillata*, Say. I have specimens from Windsor and from Truro, but have not noticed it near Halifax. It appears in July and August.—*Distribution:* Hudson's Bay, Canada, United States.

Vanessa antiopa, Linn. Common everywhere. Like most species of *Vanessa*, it is very long lived. It appears at the end of July, is plentiful all the autumn, hybernates during the winter, and appears again in spring, and faded specimens may be seen late in June. It is a very robust butterfly, and widely distributed, ranging over Europe and Northern Asia, and in America from Hudson's Bay to Mexico.

Pyrameis atalanta, Linn. Not common. It appears in August and hybernates during the winter. Horticultural Gardens, Lawrencetown, and Lake Loon.—*Distribution:* Europe, America from Hudson's Bay to Mexico, Bermudas, Hayti.

Pyrameis cardui, Linn. Common in August and September.—*Distribution:* Europe, Asia, Africa, Australia, America from Hudson's Bay to Venezuela.

Pyrameis huntera, Smith. Common on Citadel Hill and near Dartmouth, September and October.—*Distribution:* Canada, United States, Hayti.

Limenitis arthemis, Drury. Not uncommon, but scattered. It appears about the first of July and lasts until the second week in August.—*Distribution:* Hudson's Bay, Canada, United States.

Limenitis disippas, Godt. Rare near Halifax. I have seen it at Waverley and near Elmsdale. It appears in July and August.—*Distribution:* Canada, United States, Guiana.

Debis portlandia, Fabr. Rare. I have two specimens from near Elmsdale. It appears in August.—*Distribution:* Canada, Northern and Southern States.

Erebia nephele, Kirby. I have not seen this butterfly near Halifax. It is not uncommon near Windsor, in August.—*Distribution:* Canada, Northern States.

Thecla niphon, Hubner. Not uncommon in dry shrubby places in May.—*Distribution:* Canada, United States.

Thecla augustinus, Westwood. *T. augustus*, Kirby, *(non Fabricius.)* Common on dry shrubby banks; when pursued it falls amongst the herbage. It appears in May.—*Distribution:* Hudson's Bay, Canada.

I have another species of *Thecla* in my collection, which appears to be undescribed, but as I have not seen descriptions of the new Canadian species *(T. laeta* and *T. acadica)* I hesitate to describe it as new.

Lycæna pseudargiolus, Boisd. Abundant in May and June, and again in July and August.—*Distribution:* Canada, United States.

Chrysophanus phlæas, Linn. *Polyommatus P.* Abundant. There are two broods,—the first in June, the second in August and September.—*Distribution:* Europe, Himalayas, Canada, United States.

Chrysophanus catægi, Boisd. *Melitæa tarquinius*, Fabr. I have taken specimens of this rare butterfly near Portobello, and the Rev. Mr. Frere, of Bermuda, took one near Ashbourne.

Nisoniades brizo, Boisd. *Thanaos b.* Common. It appears in May, and again in the autumn.—*Distribution:* Canada, United States.

Pamphila zabulon, Boisd. Common in June and July.—*Distribution:* Canada, United States.

Pamphila peckius, Kirby. Common in June and July.—*Distribution:* Canada, United States.

Newcastle-on-Tyne, *April* 12, 1864.

APPENDIX.

ABSTRACT OF METEOROLOGICAL REGISTER, HALIFAX, NOVA SCOTIA, LAT. 44° 39′ 26″ N., LONG. 63° 33′ 48″ W., KEPT BY COLONEL MYERS, MORRIS STREET, HALIFAX.

1863.	Thermometer. Max.	Thermometer. Mean.	Thermometer. Min.	Thermometer. Range.	Barometer. Max.	Barometer. Mean.	Barometer. Min.	Barometer. Range.	Winds. Most prevalent	Winds. Least prevalent	Weather, &c. Rain fell on	Weather, &c. Snow fell on	Weather, &c. Fog on	Weather, &c. Aurora Borealis.	Weather, &c. Solar halo on	Weather, &c. Lunar halo on	Weather, &c. Lightn'g.	Weather, &c. Thunder.
											Days	Days	Days	Nights	Days	Nights		
January	52	30	10	42	30·40	29·60	28·80	1·60	N. W.	E.	8	2	3	2	3	2	..	..
February	43	23	—10	53	30·55	29·80	29·00	1·55	N. W.	E.	5	9	1	6	2	2	..	..
March	42	25	— 3	45	30·27	29·66	29·10	1·17	N. W.	E.	4	7	1	6	3	1	..	..
April	66	38	25	41	30·16	29·66	28·92	1·24	E.	W.	11	5	5	4	7	..	..	..
May	78	47	32	46	30·04	29·66	29·36	·68	N. E.	N. W.	13	..	3	5	8	..	1	..
June	73	54	37	36	29·93	29·64	29·22	·71	W.	N.	10	..	3	4	7	..	3	3
July	86	65	51	35	30·04	29·79	29·44	·60	S. W.	E.	10	..	6	5	1	1	2	1
August	86	64	52	34	30·03	29·75	29·06	·97	S. W.	E.	11	..	6	6	1	2	2	1
September	82	58	40	42	30 30	29·81	29·34	·96	S. W.	E.	11	..	4	7	2	..	1	1
October	70	51	34	36	30·20	29·84	29·36	·84	N. E.	S.	11	..	3	6	5	1	..	..
November	60	40	13	47	30·08	29·64	29·09	·99	W.	E.	14	3	4	9	2	2	..	1
December	47	26	11	36	30·24	29·70	29·12	1·12	N. E.	S.	5	6	2	2	4	3	..	..
Yearly....	..	44	..	96	....	29·71	....	1·75	....	....	..	..	..	..	..	..	..	..

In the readings of Thermometer and Barometer the fractional parts of degrees have not been noted.

On the Occurrence of the *Kjockkenmoedding*, on the Shores of Nova Scotia.

At the January meeting, 1864, of the Nova Scotian Institute of Natural Science, held in Halifax, an interesting paper was read by the Rev. John Ambrose, Rector of St. Margaret's Bay, upon certain mounds, formed by a race of men of whose habits and general mode of life no record at present exists,—and with a view to revelations which would help to identify the period of their formation, and also throw considerable light upon the character of the fauna of the Province in times of remote antiquity, a subscription list was opened among the members to defray the expense of excavation, &c.

Accordingly, on Saturday, the 11th June, a number of the Members of the Institute, and their friends, proceeded to St. Margaret's Bay, for the purposes named, and after a pleasant ride of 22 miles, arrived at the French Village, so called, and proceeded to Mr. Garrison's, on whose land are some of the mounds referred to, who very kindly placed at their disposal all the facilities in his power for the prosecution of their design.

The mound examined is at the foot of a rising ground, not twenty-five feet from the salt water. The situation proved that the people by whom it was accumulated had a fine eye for the picturesque, and a good judgment in the selection of a sheltered spot for habitation. The place, although on the shores of the Bay, appears completely land-locked, and at the time of their sojourn must have been covered, like all the land around, with a luxuriant growth of spruce, fir, birch, beech, and other woods, down to the water's edge. A beach composed of granitic debris runs along the shore for a considerable distance, where canoes could lie in safety. It was, likewise, an aid to cleanliness, and must have made an excellent bathing place for the juveniles of the tribe, where they might disport themselves in the tide, as the juvenile Indians of the present day are so fond of doing. Granite boulders crop out here and there on the land in the vicinity—but their position is evidently accidental—an indication that the race who made this place their habitation had no idea of making metes and bounds to their encampment by such land marks. Some of the boulders were in the mound itself, covered up, which also seemed to prove that no excavation had been made wherein to throw the debris of the camp, a feature of their life that corresponds with the habits of the Nova Scotian Indians of the present day.

The mound is but little elevated above the surrounding soil. It must be recollected, however, that the plough had passed over the land, and the periodical rains had greatly denuded it. It may therefore, at a previous period, have been much higher above the general level than it is now. Its length is over 100 feet, breadth about 25 feet, and it lies N. W., and S. E. On pulling up the turf shells were immediately visible—the common clam (*Mya arenaria*) embedded in a black, cindery soil. At a depth of two or three inches these became quite numerous, intermingled with bones of birds, beasts, and fishes—the latter unfrequent, and apparently of small species, as though they may have been caught near the shore, and not in deep water. A loose, friable black substance was disseminated throughout the mass, and occasionally pieces of charcoal, which seemed to indicate that the mollusks had been roasted or baked rather than boiled. The clam shells formed the chief deposit, but frequently large shells of the quhog *(venus mercenaria)* were found, and there was one scallop shell *(pecten islandicus)* gathered. The quhog, as we understood from the owner of the soil, is not now found in any part of St. Margaret's Bay—so that a secret must have died with the tribe, or they may have been transported from some other and distant quarter. They are found at Prospect, an adjacent harbour, and are common at many places on the coast in deep water.

At about six inches beneath the surface, a loose layer of clam shells, quhog and mussel shells *(Mytilus-edulis)* three inches deep, was reached. The quhogs were few, and the mussels very much decomposed, so that the latter could be easily squeezed to a fine pearly powder between the fingers, and two small white pearls, which had suffered no decay, were found in some of this powder. Occasionally, throughout this substance, the bones of animals occurred, chiefly of the smaller species. It was somewhat significant that the remains of larger animals, (large molar teeth and bones) and also two very perfect stone arrow-heads, and two sharpened pieces of bone, between two and three inches long, which may have served for needles, with a stone chisel, highly sharpened, and attempts at arrow-head making out of pieces of jasper or agates, which must have been brought from some other place, were found at a much greater depth in the mound. It would thus appear that at the time of the first visit or encampment the larger game were plenty, and had been gradually driven away, leaving the smaller species of animals to the hunters—a circumstance, perhaps, that may at length have induced the abandonment of the site. Pieces of broken pottery of very rude manufacture, but with some attempt at ornament, were also collected and preserved. The bones were all cracked and broken lengthwise to extract the marrow.

The intermixture of bones and shells continued to a depth of eighteen inches from the surface, and in one place several large rounded stones about six inches long by three or four in their longest diameter were dug out, which to use the language of the land owner, may have been their fire-place. At this depth, and beneath these stones, there was a layer of white sand, similar to that of the beach, and about three inches thick, which at some distant period may have formed part of the beach itself. At a greater depth the soil became harder, was of a brownish yellow colour, sandy, and exhibited no further traces of animal or vegetable remains.

The bones found were conjectured to belong to the elk or moose, the bear, the carriboo, the fox, or dog, the porcupine and the beaver,—to the crane, the gull and the partridge among the birds,—and to the smaller species of cod or haddock among the fishes. None of the remains were supposed to be human, and no instruments of iron, or brass, or bronze, or copper, or wood, or horn, were found.

It will be perceived that with little exception the foregoing description may be read for the description by Sir C. Lyell, of the Danish kitchen middens. There appears therefore to have been little variation in savage life between the old world and the new; and that the more frequently tribes and families divided, and the further they roamed from the centres of civilization, the more degenerate they became, until as mere hunters and fishers they lost all trace and remembrance of the arts of civilization. The early part of the stone age of Europe, 4000 years ago, according to Sir C. Lyell, differed but little from the stone age as brought almost within the memory of the civilized emigration of Nova Scotia. True, we have not yet correctly estimated the time when the mound was in process of formation; or how long the dwellers around it may have remained there; or at what successive periods it may have been added to or revisited by the ancient people: but from the fact that the remains occur just beneath the sod, and that the shells (those of the mussel excepted) are very little decomposed: and that although many of the bones are decayed, and in one instance apparently fossilized, others are comparatively fresh, the fractures still sharp and well defined,—we do not feel disposed to attribute a very high antiquity to the race that dwelt there. The layer of sand at the bottom of the mound, eighteen inches from the surface, may indicate that the tide had once flowed to the spot, but it is not probable that such was the case when the shells were deposited. The thick layer of shells, six inches from the surface, seems also to confirm an idea that these people were erratics, remaining in one place just so long as it supplied their wants, or having their summer and winter resorts,—and in so far their habits would agree with those of the Micmacs. Their food while on the coast must have consisted largely of shell fish, which could be procured with less labour and appliances than that obtained by hunting the wild denizens of the forest. The question therefore, of their being a different race to the Micmacs, and supplanted by them, does not seem to be answered in the affirmative by the examination just recorded—which after all, however, was but a superficial one—and can scarcely be fully depended on as affording conclusive data. Yet if five or six hundred years be allowed as the remotest antiquity of the oldest portion of this mound, and fifty years before the country was settled by Europeans may be supposed as the last visit to this locality, it may, probably, be near the truth, and at the same time approximate to the advent of the Indian tribe to Nova Scotia. So much may be hazarded without absolute proof; but the whole subject at the present time is specially interesting, and deserves a greater amount of scientific research than has been hitherto bestowed upon it.

W. G.

A SECOND attempt on the part of the Institute to prosecute this enquiry, took place on the 21st of September, 1864, when a Field Day was devoted to a visit to Cole Harbour, an inlet of the Atlantic some ten miles to the eastward of Halifax.

Some deposits along the shore at a short distance below Mr. Robinson's house were first examined, where a quantity of shells, very much decomposed, were found just below the surface of the soil. The ground here had been so frequently ploughed, and the shells so incorporated with it, that no definite character could be attached to the site, except that it had been undoubtedly an Indian encampment and refuse heap of great age. Mr. Robinson pointed out some remarkable geological features at this spot, which go far to prove that a fresh water lake had existed where now was dry land.

The next place visited was Cranberry Cove, so called. Its present appearance is a hollow in shore, surrounded by broken metamorphic rocks, which slope upward more or less gradually, to a height of 20 to 30 feet, and are covered with a growth of young trees—birch, maple, spruce, oak, sumach. The bottom of this hollow is fringed with a scanty growth of alder, and exposes a flat surface of swampy peat and moss, about six yards wide near the salt water, but gradually expanding towards the upper boundary, where it approaches a circular form, and is from 20 to 30 yards in diameter. The thickness of peat could not be satisfactorily ascertained. A drain about a foot in depth and width had been cut through it. The surface was covered with cranberry vines, which yield in some seasons a plentiful crop—from which circumstance the cove takes its name. The place appeared to be much frequented by hares, which perhaps find the cranberry and other tender plants desirable food.

At 20 or 30 yards from the salt water up the cove, on the right slope, there appeared to have been an Indian encampment—not, however, within the memory or tradition of the inhabitants of Cole Harbour. On digging near the foot of the slope, it was discovered that for a length of 21 and a breadth of 10 feet, there were a bed of shells and black loose soil, of an average depth of 18 inches. Amongst this stuff were intertwined the roots of trees and shrubs that had grown around since its deposition. The shells were chiefly clam *(mya arenaria)*, mussel *(mytilus edulis)*, a few *purpura lapillus* and remains of an oyster shell *(ostræa virginiana.)* The only mammalian remain found was a sharply angular piece of bone about two inches long, which may have belonged to a porcupine. The clam shells presented much the same appearance as those at St. Margaret's Bay—the mussels were more perfect, having in many instances, the outer coat of shell of the usual bluish color, but were easily reduced to powder by squeezing between the fingers. The *purpuræ* were quite perfect and hard; the oyster shell was only a fragment. There were no well defined pieces of charcoal, or burnt wood, as in the mound at St. Margaret's Bay. The mixture also of mould with the shells was softer than at that site, which may have occurred from the ground being wet at this season, a good deal of rain having fallen within the previous two or three weeks. No arrow-heads or implements were found.

The facts as detailed connected with the Cole Harbour deposits, seem to bear out the following inferences. They may be more recent than those at St. Margaret's Bay—the shells being better preserved. This hollow may at one time, perhaps during the visits of the Indians, have been a small lake, draining the higher lands around. During some extraordinary rainy season, it may have made a breach at its lower extremity seaward, and as a lake been drained and left swampy, a thick growth of peat succeeding the water. The place was admirably adapted for seclusion or concealment, for either or both of which it may have been used. Cole Harbour may once have been a lake into which the salt water flowed, and may owe its present character to gradual encroachment of the ocean—but it must have been a harbour when this place was inhabited by the Indians. This was probably the summer residence of a family—the squaws and papooses may have been left here to feed on shell fish, and other marine provision, while the Indian master was abroad at the chase—an inference which the absence of bones, arrow-heads and implements, remarkable as compared with the St. Margaret's Bay deposits, seems to favour. The oyster shell would imply a great age to the deposit if it represented a live mollusk of the period, as none are so found at present in Cole Harbour. This was attributed by our guide to the rapid filling up of the harbour, which is becoming very shallow from the great influx of sand, which has covered up and killed the oysters. He informed us that oysters must at one time have been in great plenty, as numbers of shells, often of very large size, are dislodged and brought up whenever an anchor is heaved.

The peat of Cranberry Cove rests on the metamorphic rock, but its depth was not ascertained. On top it is a thick green moss, full of cranberry vines. The peat itself has a strong sulphureous smell, owing perhaps to the decomposition of iron pyrites in the strata on which it rests, or a sulphur spring may be indicated. The exploration of some of the peaty growths in this Province would be of much scientific interest, and might throw additional light upon the history and antiquity of extinct mammalia. There may be no remains of the kind in the peat at Cranberry Cove, which however seems a likely spot wherein to discover the fossilized relics of some bog foundered animal, which would supply a link in the chain of animal creation.

W. G.

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PROCEEDINGS

OF THE

Nova-Scotian Institute of Natural Science.

VOLUME ~~II~~ 1. PART 3.

ANNIVERSARY MEETING, OCT. 12. 1864.

IN accordance with the Rules of the Institute, the Anniversary Meeting, of which due notice had been previously given to all the members, was held on Wednesday, Oct. 12, 1864, when the following gentlemen were elected by ballot, to fill the various offices for the ensuing year :—

President.—J. M. JONES, F. L. S.

Vice-Presidents.—Capt. HARDY, R. A., Dr. B. GILPIN, M. D.

Treasurer.—Capt. LYTTLETON.

Secretary.—WM. GOSSIP.

Assistant Secretary.—A. S. FINNIE.

Council.—Dr. DEWOLF, Professor LAWSON, Dalhousie College, Colonel MYERS, W. C. SILVER, J. H. DUVAR, P. S. HAMILTON, JOS. BELL, Lieut. DEANE, 17th Regiment.

Mr. C. E. BROWN, proposed at a previous meeting, was duly elected a member of the Institute.

It was *Resolved,*—That any gentleman duly elected a member of the Institute, and desirous of becoming a Life Member, may be admitted as such on payment of ————.

[At a meeting of Council, Oct. 24, it was *Resolved,*—That the blank be filled with *Five Pounds.*]

ORDINARY MEETING, NOV. 7, 1864.

Capt. KING, R. A., proposed at a previous meeting, was duly elected a member of the Institute.

Dr. B. GILPIN read a paper on a species of *Salmo*, found in some of the Lakes of this Province. *(See Transactions.)*

Conversation ensued relative to the habits of the *Salmo* family. It was stated that they assume, in a greater or less degree, the prevailing colour of the locality they frequent. The difference in colour between the fish of warm climates and those of northern or temperate waters, was noted—the tints of the former being warm and bright—the latter generally sombre and subdued; it was also remarked that the colours of southern fish become modified when, as is sometimes the case, they travel northward. The species described by Dr. GILPIN were stated to weigh about 3 lbs. full grown, but they have been taken weighing 6 lbs. The opinion of the meeting was in favour of the fish being considered a new species. [This opinion has not been sustained on further enquiry and research.]

Dr. GILPIN read a paper—"On some of the Mammals of Nova Scotia"—being a continuation of papers under his name, in the published Transactions of the Institute. The paper described the *Condylura cristata;* also the only two species of Bat known to exist in Nova Scotia—*Vespertilio subulatus*, and *V. pruinosus. (See Transactions.)*

In the conversation on these subjects, some doubts were expressed as to the *Condylura cristata* being the only species of mole in Nova Scotia. It was stated that *V. pruinosus* was found occasionally, but rarely, in Canada,—that one had been taken in Bermuda, brought from other parts in the sail of a ship,—that a similar instance had occured, of one being found in the sail of a ship belonging to Mr. West, lying at his wharf in this city, which had just arrived from the West Indies.

The President read some notes on the Great Auk, *(Alca impennis,)* a very perfect skeleton of which was produced. It had been procured through the kindness of the Bishop of Newfoundland, (the Right Rev. Dr. FIELD,) from the Funk Islands off that coast, and was one of the only two specimens that remained of the bird, which like the Dodo had become extinct. *(See Appendix.)*

Various speculations were hazarded on the causes which may have led to the extinction of the Great Auk, once so numerous on the coast of Newfoundland and adjacent islands—the principal of which was supposed to be the destructive agency of man. Some doubt was also expressed as to the total extinction of the species.

ORDINARY MEETING, DEC. 5, 1864.

A note was received from His Excellency the Lieut. Governor, PATRON of the Institute, regretting his inability to be present, owing to previous engagements.

Professor JOHNSON, of Dalhousie College, proposed at a previous meeting, was duly elected a member of the Institute.

Lieut. WEBBER, R. A., proposed at a previous meeting, was duly elected a member of the Institute.

Dr. B. GILPIN read a communication from the Essex Institute, Mass., calling attention to a proposal to publish a Naturalist's Directory. It was accompanied by a blank form to be filled up with Naturalists' names, and their special departments of study. [The publication has since been received, and is a very useful book of reference.]

Dr. B. Gilpin read the following letter from Dr. Dawson, Principal of McGill College, Montreal:—

Note *on a Species of Gemellaria from Sable Island.*

Among some specimens from the above locality collected by Mr. J. R. Willis, and kindly sent to me by that gentleman, is a large tuft of a *Gemellaria*, which I regard as new. In Busk's Catalogue of the Polyzoa in the British Museum, only one species is noticed, *G. loriculata*. Dr. Stimpson* has described a second from the Bay of Fundy, under the name *G. dumosa*; but Mr. Willis's specimen differs from both. I have therefore prepared a detailed description of it, and desire to dedicate it to Mr. Willis, its discoverer, as a testimony of my appreciation of his services in the investigation of the Marine Zoology of Nova Scotia.

Gemellaria Willisii, S. N.

General Appearance.—Cœnæcium branching in dense tufts from a stout stem (attached to a sea-weed). Height of largest specimen, 2½ inches. Fibres flexible, but somewhat brittle; membranous in texture, but effervescing strongly with an acid and leaving a very delicate membranous skeleton. Colour brownish white or light fawn.

Microscopic Characters.—Pairs of cells seen in profile have at top and bottom a breadth of about one-fifth their length. From the top they increase in width to the base of the aperture, which is a little above the middle of the cells, where the breadth is equal to about one-third of the length, decreasing regularly toward the base. Single cells seen in front are broadest at the top, where the aperture occupies nearly the whole breadth. Aperture oval-ovate, covered with a flat membrane having a semicircular slit at top. In branching, the highest pair of cells give off from their sides a pair of branches, and usually also one or two stems from their upper ends. This gives to the Cœnæcium a densely tufted character.

The species differs from *G. loriculata* of Britain in its narrower and less inflated cells and longer apertures, and in its more dense habit of growth, arising from the mode of branching above indicated. It differs from *G. dumosa* of the Bay of Fundy, in so far as can be ascertained from the short description of that species, in the form of the aperture.

In my collections from Nova Scotia I have only the following additional species of *Polyzoa*, all of them found also in the Gulf of St. Lawrence:—

Membrampora pilosa,	Lepratia pertura,
Lepratia armulosa,	L. variolosa.
L. trispinosa,	

This very short list might no doubt be largely increased by a little attention to the subject, and these curious and beautiful little organisms are well worthy of the notice of collectors, especially of those who take an interest in microscopic objects.

J. W. Dawson.

Capt. Hardy read a paper on Provincial Acclimatization. *(See Transactions.)*

Professor Lawson read a paper entitled—"Notice of the Occurrence of Heather *(Calluna vulgaris)* at St. Ann's, Cape Breton Island. *(See Transactions.)*

In the after conversation it was stated by a gentleman present, that *native* heather had been found on the Halifax peninsula,—[which however is not sufficiently substantiated.] It is frequent in gardens as an exotic. Evidence was adduced to prove that it had been known in Newfoundland for a long period, and is generally supposed to be an indigenous plant. An opinion seemed to prevail however, that the instances remarked upon, of its being found in Massachusetts, Cape Breton, or on the Halifax peninsula,

* Marine Invertebrata of Grand Manan.

may have been propagations from plants brought to those countries by emigrants.

Dr. LAWSON also made some observations on Lemania, an aquatic plant found in the United States, and more recently in Canada; and which he had also met with, adhering to stones, in the Sackville River, at the head of Bedford Basin. *(See Transactions.)*

ORDINARY MEETING, JAN. 9, 1865.

The President noticed the receipt of several donations since the last ordinary meeting, viz.:—

1. By Capt. HARDY. Vol. V. of the Natural History of the State of New York.

2. By Miss WILLIS. A Collection of Nova Scotia Ferns.

The President noticed the receipt of Letters, Transactions and Publications, as follows:—

1. A letter from the Smithsonian Institute, informing that the Nova Scotian Institute of Natural Science had been placed upon their List for exchange of publications.

2. From the Essex Institute, Salem, Mass., acknowledging receipt of Vols. I. and II. of Transactions of the Nova Scotian Institute, and sending their Proceedings in return.

3. From the Academy of Science, of St. Louis, Missouri, with Part I. Vol. II. of their Transactions, and notifying that the Nova Scotian Institute had been placed upon their exchange List.

4. From Sir W. Jardine. The Address of the President of the Dumfries and Galloway Natural History Society. Also.—The Transactions and Journal of the Proceedings of the Dumfriesshire and Galloway Natural History and Antiquarian Society.

5. From Dr. Dawson, Principal of McGill College, Montreal. A paper "On the Fossils of the genus Rusophycus."

6. From Thomas Belt, Esq. A paper on Lake Basins, and the evidence of glacial action in their excavation.

Mr. A. DOWNS read a paper on the Land Birds of Nova Scotia, describing sixty-one species, of which sixteen were warblers. He purposes a continuation of the subject. *(See Transactions.)*

Rev. J. AMBROSE, of St. Margaret's Bay, read a paper on the Natural History of St. Margaret's Bay—with especial reference to the Sea Birds that frequent its waters. *(See Transactions.)*

The President read a letter from Professor OWEN, relative to remains found in the Kitchen Midden at St. Margaret's Bay, explored by the Institute on one of their Field Excursions last summer, and described in the Appendix of Vol. II. P. II. of their Transactions. (*See Appendix.*)

Colonel SINCLAIR, proposed at a previous meeting, was duly elected a member of the Institute.

Mr. SANDFORD FLEMING, proposed at a previous meeting, was duly elected a member of the Institute.

Ordinary Meeting, Feb. 6, 1865.

Mr. Duvar read a paper entitled—"Contributions to the Game of Nova Scotia." (*See Transactions.*)

In the conversation the necessity was recognized that measures should be taken to preserve the Game of the country, all varieties of which were fast decreasing, owing to the wanton destruction of species on the one hand, and the absence of precautionary measures, especially with reference to the river fisheries, on the other. The introduction of foreign species likely to thrive in this climate, was also strongly advocated—of the feathered tribe especially, which would enliven our forests and farm yards with their presence and melody.

The Secretary read a paper sent by Mr. Belt, "On the Formation of Lake Basins by Ice action." (*See Transactions.*)

It was urged in after conversation on the subject, that the conformation of a country, independent of other causes, would be sufficient to account for the formation and direction of lakes and rivers; but that there was good evidence, especially on the Atlantic coast of Nova Scotia, that glacial action must have powerfully assisted their excavation there. The metamorphosed rocks at the bottom and on the shores of many of them, were worn smooth and covered with striæ, not by the action of the present waters or wintry ice, but by those of perhaps thousands of ages in the past; and the course of these Atlantic streams was generally in the direction of the glacial drift. Bedford Basin, at the head of Halifax Harbour, was instanced as perhaps partially formed by glacial erosion; and as probably a lake ere the icy pressure at the Narrows forced the barrier, and opened a communication with the sea. In connection with the subject, and in the course of explanation of lake phenomena, a centre of dispersion of erratics, commencing at the heights around Major's Lake, a few miles from Dartmouth, and spreading in a southerly direction towards Cole Harbour, was noticed.

Ordinary Meeting, March 6, 1865.

The President acknowledged a donation to the Institute by Lieutenant Webber, R. A., of a Geological Cabinet, containing specimens of minerals and fossils, including those of all formations from the Primary to the Tertiary inclusive.

The President read a paper sent by Professor How, of King's College, Windsor—"On some of the Brine Springs of Nova Scotia." (*See Transactions.*

In the discussion that ensued, evidence was adduced of the occurrence of other mineral springs in various parts of the Province, and it was stated that the waters were used by the inhabitants in their neighbourhood for the purpose of curing various complaints. A sulphur spring at Cranberry Cove, Cole Harbour, was mentioned as situated near the site of a Kjoekkenmoedding.

The Secretary read a paper "On the Antiquity of Man." (*See Transactions.*)

After the conclusion of the paper, some interesting remarks were made concerning the aboriginal inhabitants of Nova Scotia, who formed the Kjoekkenmoeddings of the coast, by which it appeared that the race was almost identical in their mode of life with those of the European coasts,—similar material being found in both; only the rude pottery of Europe differed somewhat in the colour of the clay of which it was made, from that found in Nova Scotia.

The President read a letter from Admiral Sir ALEXANDER MILNE, recently Naval Commander-in-Chief on this Station, communicating interesting information, the result of many years experience, on the extension of the Gulf Stream. (*See Appendix.*)

The Secretary reported, that in accordance with a Resolution of the Council of the Institute, he had forwarded to the Honble. the President of the Legislative Council, and to His Honor the Speaker of the House of Assembly, respectively, the invitation of the Institute to the members of both Branches of the Legislature to attend their ordinary meetings during the Legislative Session.

ORDINARY MEETING, APRIL 6, 1865.

Colonel MYERS read a paper entitled—"Notes on the Weather at Halifax, Nova Scotia, during 1864." (*See Transactions.*)

During the discussion which followed the reading of this paper, the President read a letter from Professor HENRY, Secretary of the Smithsonian Institute, stating that the Institution would be glad to receive a daily telegram giving an account of the state of the weather, direction of wind, &c., at Halifax. It was the opinion of the meeting that such a request should be complied with, and the military authorities memorialized to allow such observations to be delivered to the Institute for transmission to the Smithsonian.

Dr. B. GILPIN read a paper—"On the Gaspereau" (*Alosa tyrannus*). (*See Transactions.*)

After the reading of Dr. Gilpin's paper, some of the members made remarks upon the habits of this fish; and its rare custom of rising to a fly was placed beyond doubt by a gentleman present stating that he had caught one while trout fishing, with an artificial fly, last summer, on the Nine Mile River.

The Secretary read the following extract from a letter he had received from E. MARET, Esq., of St. John's, Newfoundland, an Associate Member of the Institute:—

"ST. JOHN'S, March 21.

"I have not been able to do much in the way of investigation, but previous to leaving the west coast an arrow head of *flint* was given me by Mr. LeGallois, which he had just found in the course of one of his journeys. I have also obtained some handsome comb shells, as well as a very fine specimen of cockle.

"We have had a most extraordinary winter, exceedingly mild with occasional severe frosts. At present (March 21) there is scarcely any snow on the ground, an unusual thing for Newfoundland.

"Contrary to my former experience, I find that Frogs do exist in Newfoundland, and several colonies of them inhabit the ponds and lakes about St. John's, though whether introduced or indigenous, or whether the same as those of Nova Scotia, I cannot say. At all events they are not numerous.

"I also find that snails, similar to the common English snail, exist in certain localities."

Ordinary Meeting, May 1, 1865.

The President read a paper—"On the Reptiles of Nova Scotia"—illustrated by preserved specimens. (*See Transactions.*)

In the conversation that ensued, a doubt having been expressed with reference to the young of snakes passing for safety into the mouth of the mother, which had been stated of the *Coluber sirtalis*, a gentleman present (Mr. Nash) said that he had been a witness of the fact on more than one occasion, in the vicinity of Truro. He could not ascertain whether it was owing to inducement on the part of the parent, or instinct on that of the young. Nor had he ever seen the young snakes return from such a place of concealment or safety. [This statement by a gentleman of unquestionable veracity, may help to resolve the doubts of naturalists on the subject.]

The Secretary read a paper sent by Professor How, of King's College, Windsor, entitled—"Notes on the Economic Mineralogy of Nova Scotia." It treats upon the Ores of Manganese and their uses. (*See Transactions.*)

An interesting conversation succeeded the reading of this paper. Mr. Nash, who is interested in the Teny Cape Manganese Mines, in Hants County, assented to the general correctness of the details which had been read, relative to that enterprise. He mentioned the occurrence of Manganese at other places,—at Wellington Mountain, Cape Breton,—also, at Falmouth, Hants County. He had been informed by Dr. Johnson that it occurred on or near to his land in Pictou. Mr. Nash stated that some hundreds of tons had been sold in Liverpool, England; and some also in Boston, where it is used for a particular purpose. The working had so far paid very well. He had in his possession Bog Manganese from Antigonishe, and some had been sent to him from Ship Harbour. He was firmly persuaded that the best Manganese the world could produce, was to be found in Nova Scotia.

The President made some appropriate observations upon the progress of the Institute, and its prospects for the future, and closed the ordinary meetings for the season. He also announced that a Field Meeting of the Institute would take place in each of the Summer and Autumn months until October next, when the Ordinary Meetings would be again resumed.

WILLIAM GOSSIP,
Secretary.

TRANSACTIONS

OF THE

Nova-Scotian Institute of Natural Science.

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

NO. II.

[*Read November* 6, 1864.]

Having in my first number given the members of the Soricinæ family inhabiting this Province, as identified by myself, I now proceed with the Mammalia, at least those that I have identified myself.

Genus, Condylura.

Condylura cristata.—A rather large specimen from alcohol, taken at Annapolis Royal, 1862, during summer, measured—extreme length, 8¼ ins.; length of tail, 3½ ins.; diameter of tail, ¼ in. Colour—dark blue-black above and below, nails flesh colour, the tail covered with scales that are concealed by stiff hairs, compressed at base, swelling out suddenly about two-thirds of an inch from base and then narrowing to a fine pencil at point, at its largest part at least a quarter of an inch in diameter; the nose with twenty-two points or rays; the fore feet very broad, oval shaped, fringed with stiff hair and covered above and below with fine scales or scale-like points, the base of each finger excepting the outside one with a pointed peculiar fringe of two or three points like a cock's comb, the nails each ¼ of an inch long, the hind feet longer and narrower than the fore, and covered above by the same scales, the soles with three or four irregular tubercles; the star-like rays of the nose, and the fringe at the base of the forefingers, seem peculiar to this animal. It is rather common in the Province, and seems to represent the true moles to which it is allied, and which I have never identified here. All specimens that I have had belonged to one species. I think the tail swells during the sexual period, and when the animal is fat, at other times diminishes.

Genus, Lasiurus.

Having neglected to describe the Bats, in their usual place, before the Soricinæ, I place them here. I have identified but two species myself, but I have little doubt that several more species inhabit the Province.

Lasiurus, cinereus, (Hoary Bat.)—I have seen but two specimens of this bat taken here. One from Sambro, the other taken from the foretopsail of a brigantine in Halifax harbour, and therefore I consider it rare. These specimens answered in every respect *V. pruinosus* of Richardson, DeKay and Say. This latter naturalist, supposing himself the discoverer of it, gave it the specific "*pruinosus*,"—but Dr. Allen in his monograph of North American bats, quotes a catalogue of Peale's Museum, 1796, by M. Palisot de Beauvois, who describes it under the name *cinereus*.

Vespertilio subulatus.—Two specimens measured—total length, 3ins.; total spread, 9ins.; they both agreed with DeKay's description of northern specimens, their colour being darker and ears longer than those of New York. Dark about head; dark brown olive on back; yellow mixed white beneath; yellow down extending a little way under rib of each wing; the ears not so hairy as DeKay's. They are very common.

Genus, Lynx.

Lynx, Canadensis, (Loupcervier.)—A very handsome but not large skin in winter pelage, from Mr. Coleman's, Halifax, measured —length to tip of tail, 3ft. 2in.; length of tail, 3½ins.; of pencil to ears, 1½ins. Colour, dusky brindle on the back, an indistinct but decided dark line down the centre of the back, end of tail deep black, sides and belly yellowish rusty, inside of legs yellowish white, no spots, but three indistinct dusky bars inside fore leg, black tips and pencils to the ears, and a large collar yellowish white alternating with black stripes beneath the throat—a general hoary tint over all. The fur was very long and loose. The legs and feet very robust and well furred, with thick yellowish white fur, and the pads covered. This true boreal species, reminding us of the alpine hare, the ptarmigan, the spruce grouse, and the snow owl, in his well-furred limbs, is abundant in the Province He loves the thick covers and dense spruce-pine woods of the midland counties of King's and Annapolis, in which he hunts the varying hare, and surprises the dusky grouse, and from which he descends at night to the barns and sheepfolds in the cleared land. He is very destructive to sheep. He rarely is found near the seaboard, or amongst the scanty cover of the granite hills where the red cat abounds, and never like the latter comes out in the open, or into the town in daylight. When pursued, he runs in a high awkward gallop, with an arched back, leaving a very broad trail upon the snow, and soon takes refuge in a tree. About twenty-five years ago the country about Annapolis Royal was infested with them, when Mr. George Hardwicke, a young farmer, with a love for hunting, introduced hunting them with a foxhound. Mounting his horse by day-break of a winter morning, he would ride ten or twelve miles into the forest, dismount, and beat the woods for game. In half an hour the hound would find, and in about twenty minutes more have treed the Lynx in the fork of a spruce-pine tree. Following at his leisure the track on the snow, he easily tumbled her out of the tree by a charge of buckshot, as she hissed and glared at him like an angry cat, with erect fur and arched back. He took twenty during the winter, sometimes two in a day, and a right pleasant sight it was to see him return home, at the close of a short winter's day, with one, if not two, hanging across his croup, as he rode his mare into the settlement, his snowshoes, axe and gun crossing his broad shoulders, all making a pretty woodland scene with the white snow and dark firs beyond. Though cowardly and skulking when opposed to man, one who has witnessed his sudden pounce upon his prey can readily understand his ravages among sheep.

Lynx, rufus, (Wild Cat).—A very large male, shot by Mr. Stayner as he was prowling about the environs of Halifax in 1861, measured—from tip of nose to end of tail, 3ft. 4ins.; to end of hind leg, 4ft. 4in.; from tip to tip of ear, over forehead, 10ins.; tail, 7ins.; the colour above rusty, with a general hoary tint; inside of fore legs, belly, and beneath tail whitish; obscurely spotted with red on flanks and outside paws, and two or three black bars inside fore leg; ear black, with a peculiar half-moon white patch on the back, and a very small pencil to the tip; some very obscure dusky lines along the top of back, and a few dark lines diverging from the inner corner of each eye to the forehead, and each side of the nose; the soles of fore and hind feet nearly black, the pads naked, and the tail with several obscure dusky annular marks around it, the tip black above, white beneath. A small summer skin from Mr. Thomas, Halifax, now before me, is bright reddish brown on back and sides, a deep brown mark down centre of back, outside of fore and hind legs light reddish; belly, throat and inside of leg whitish, with black bars; the same markings on ears and forehead as in winter skin; scarcely a pencil to tip of ear; the fur short and stiff, except on the belly, where it is fine and loose. This animal is finer and more handsome in its figure and slenderer in its legs than the Loupcervier; its head is finer and bolder, and altogether it has less of the stealthy, awkward gait of the latter. It loves the seaboard and the sterile granite hills. Where it abounds few or no Loupcerviers are seen. Its food is the same, and it is equally destructive to sheep. Its bolder nature brings it down into the open country, and often into the small towns and villages. Perhaps forced by hunger it then prowls about yards, seizing poultry in open day, and is soon shot by a crowd of men and boys.

In studying and comparing our Lynxes, we find that one, the Loupcervier, is a true boreal animal with a limited range. Its short tail, large collar, long pencil to the ear, and furred foot, its large pale yellow eye, (the onyx eye of the ancients,) are all typical of the Lynx of the Old World. On the other hand, the Wild or Red Cat has become indigenous at a far later period. Its naked foot, pencil disappearing in summer from the ear, finer fur, smaller collar, and its ringed and longer tail, all give it a more southern centre of origin, as they also approximate it to the genus "*Felis*." Baird and Audubon both give it a range from Mexico to the Rocky Mountains, where they are smaller and redder and the pencil disappears on the ear, yet all preserve the peculiar half-moon white patch on the ear, which Baird justly considers typical. It is curious, too, that the less boreal animal is the more abundant—the Wild Cat skin being exported at the rate of five hundred and fifty or more and still abundant, whilst the Loupcervier is becoming scarce and is exported at the rate of about two hundred and fifty.

It is to be hoped they will long be spared as fit denizens of our northern hills and pine forests.

Genus, Canis.

Canis occidentalis, (the Wolf).—I have identified this destructive animal as existing in Nova Scotia. A very large specimen, taken at Windsor, was exhibited in Halifax. I can only mention it to observe how very difficult it appears for some large species to find new habitations. In Nova Scotia the cover and the game are alike and equally abundant as in New Brunswick or Newfoundland, yet twice within this century a voluntary migration of Wolves has been made and both failed. About seventy years ago Wolves made their appearance, but were soon lost sight of. About twenty-years ago they again appeared simultaneously in every part of the Province. The mail courier had scarcely reported one crouching before his off leader in the gorge of the Cobequid hills, before one was trapped at Yarmouth. They seem to have trotted through the whole Province from north to the extreme south, and to have retreated on their tracks with equal stealth; since for twenty years no word has been heard of them. Their instinct taught them that it was no place to found a race in.

Genus, Vulpes.

Vulpes fulvus, (Red Fox).—I have identified but one species of Fox, though subject to varieties, as we will see, by a proneness to nigritism, on studying their skins.

A fine skin, in perfect winter condition before me, has the chin, throat, line down the breast and belly, narrow line along hind legs and tip of tail, white; back of ears, stripe in front of each leg, black; the tail with more or less sooty tips to the hair, inclining to black; a dusky spot on each side of the nose from where the moustachial hairs spring; all the rest of the body a rich lustrous fulvus red, with a slight dash of hoar upon the flanks.

Another skin before me has nose, face, backs of ears, chin, throat, belly, entire legs and tail (except white tip) generally black; shoulders and stripe down the back decided black; forehead, and part of shoulders and flanks, hoary grey, mixed with yellow; the rest of the skin pale yellow. This is the Cross Fox.

In another skin before me, the yellow has entirely disappeared;

belly and under parts, legs and tail (white tip excepted) black; the upper parts black with more or less white hair intermixed in a general hoary tint. This marks the Silver Grey Fox.

In another skin, with the exception of a few grey hairs on either flank, one lustrous jetty black relieved by the snowy tip of the tail, pervades the whole. This is the priceless Black Fox.

The hunter and the fur dealer make seven distinct varieties,—the red, the brander, the cross, the patch, the silver and the black. These are so many stages in the Red Fox becoming black.

In a red skin of the finest colour there are always a few scattering grey hairs upon the flanks, some sooty hairs upon the tail, and a tendency to black upon the belly. Whilst the grey hairs of the flanks are overrunning the whole body, the tail, (tip excepted,) the belly, chin, breast and legs become black. This is the brander,—a red grey fox, black beneath. When the black of the tail invades the back and shoulders, he becomes the cross-fox, or a red grey with a cross on his back. A little red still lingering about the back makes him a patch. When that has entirely disappeared, he becomes silver grey, and when one entire nigritism has pervaded the whole skin, except the snowy tip of the tail, he then becomes the peerless black fox, so seldom seen that he is almost a myth. Though I have seen one at least, which had as few as a dozen white hairs on the flanks. This description is based upon a series of skins, spread out and varying from red to black. Although I do not mean to assert that these changes take place in every one living specimen, yet it seems probable that as the cubs are born dusky, this tendency to nigritism exists, with more or less intensity in each individual at the birth, and prevents the red colour from appearing. At least we must accept this as a reason until we get more certain knowledge. All I mean to advance is that there is a general principle and order in the changes, and that in the reddest skin we find the germ of the blackest. This tendency to nigritism shared by the wolves, and in a less degree by the squirrels, seems to increase in northern latitudes—the proportion of silver and cross foxes in the Hudson Bay Company's list, being about one-third, whilst in Nova Scotia the proportion runs one in ten. I saw two that were taken when cubs at Annapolis. They were kept in confinement for several years, the female greyer than the male, but they never bred. They seemed slenderer than the red foxes, with longer legs, but I have never seen any specific difference between them and the rest. They are found in the same litter. The white traces on the flank and white tip of tail are common to all, and had they power to found a race it would have been more numerous. The hunters tell you he is a solitary animal, ranging by himself, of a different manner and habit. But carrying twenty pounds on his back he is invested with a romantic interest; he is like a criminal, with blood money on him; he scarcely shows his brush but there is a general commotion; traps are set on his beat, poison, dogs and men beset his path. The fortunate captor carries his spoils to Halifax, and sometimes secures twenty-five pounds for a skin. Absorbed in the stock of the London dealers, it reappears at the great Leipsic fairs to be contended for by a Russian prince, Hungarian noble, or a Chinese mandarin, where they have reached the incredible price of forty or fifty pounds. The London public were amazed at the large prices attached to these skins at the Great Exhibition. With their proneness to nigritism the red fox abounds in our Province; they keep cover by day, hunting at night. When seen on the open by daylight, he exhibits every mark of caution, stopping, snuffing the air, crouching down, glancing on every side, then advancing, waving his tail from side to side. By-times again he allows an approach without the slightest fear. A young girl coming down the Granville Mountain captured a fox on the road, tied its legs with her garters, put it into her basket and fetched it home. I know another to have been stalked in open day and shot, without the slightest precaution. Doubtless it was this habit in the fox that caused the ancients to say he was affected by epilepsy.

He is a bitter and untiring thief, taking the goose from her nest one night and returning for the eggs the next. He is accused of killing lambs, and justly, as I have known him to have been seen pursuing sheep with full cry and breast erect like a hound. When these imported dainties are not within his reach he contents himself with wild eggs, small birds, hares, mice, and even shell fish and fresh water clams, as the margins of our inland streams quartered up in every direction by his tracks attest. Between two or three thousand skins are annually exported still, though their numbers are sadly diminishing. The red fox skins of Prince Edward Island, compare favourably with those of Digby County. The beauty and lustre of their skins, either red or black, with their noble brush, relieved by its snowy tip, must be our apology for hoping, notwithstanding he is the prince of vermin thieves, that the day is far off when he will be extinct in our pine-fir covers, or that a mandarin may not expend his fifty guineas to gratify his semi-barbarous tastes.

NOTE.—As this article is passing through the press, Capt. HARDY has given me a bat which from its inter-femoral membrane I think may be V. *evotis*. This will then give us three species.

ART. II. ON PROVINCIAL ACCLIMATIZATION. BY CAPT. HARDY, R. A.

[*Read December* 5, 1864.]

THE very recent and ambiguous term, Acclimatization, implying the subjugation and domestication of wild races of animals; the transplanting of the useful or ornamental amongst nature's gifts in the animal or vegetable kingdoms, between various portions of the globe, for man's benefit; and the hybridization of species,—means but a continuation of the ceaseless efforts of civilized man to utilise and improve all things that were in the beginning created for his use, and placed under his dominion for that express purpose.

Accordingly we find that, in the most important branch of this wide field of experimental research—the domestication of animals,—nearly all the useful beasts, either of burden or for food, and in the various spheres most suitable to their existence in such a subordinate condition, have been thus turned to account from the remotest antiquity. In this branch, mediæval and even modern ages have witnessed no important additions to the classes of animals referred to, although the transplanting and interchange of species has taken place from time to time, and various breeds improved by crossing with foreign varieties. And so for a long time the civilized world rested on the successful, perhaps long-continued efforts of past ages, apparently content with its beasts of burden, its easily reared and fattened cattle, sheep and swine, its domestic poultry of ancient pedigree, and with the indigenous luxuries afforded by the game and fish of its forests and waters. Variety of food has always been a desideratum on sanitary principles, but sufficient variety appears to have been attained in the well-known animals of the modern farm yard.*

On the other hand, when we turn to the vegetable world, we find that the efforts to domesticate wild species, either for food or ornament, have been continuous and ever-increasing. Forest trees and shrubs, plants with esculent roots, leaves or seeds, those possessing fibres capable of utilisation by manufacture, countless hosts of ornamental and flowering plants, have swelled the lists of modern botanical acclimatizers; and where the all-important condition of suitable climate did not exist, the necessary temperature for the plant's existence was obtained artificially. In accounting for this it will be easily seen how great a difference lies between the cultivation of a new plant and a new animal, thus giving so great a preponderance to the acclimatizers of new species of the vegetable kingdom, when it is remembered that the former demands but two conditions for life and health—the soil and climate of the centre of creation in which it was first placed, or of the natural boundaries to which it has in course of time spontaneously radiated; whilst the new animal does not succeed in any great dissimilarity of these two conditions, and imperatively demands association for the purposes of subsistence, with the same or most similar forms of vegetable life to those of the country where it is found as indigenous. The same argument applies to the transfer of fish to foreign waters, either salt or fresh; and here still greater research is to be inculcated before experimental acclimatization, as their peculiarities of habits and diet are so much less understood.

The recent discovery of the art of artificial hatching of the ova of fish, termed Pisciculture, the increasing frequency and popularity of zoological collections, and the successful experiments made in the

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*Well authenticated modern cases of the transmission of large mammals from one country to another occur in the following instances: "The Reindeer was successfully introduced into Iceland about a century ago, while similar attempts failed, about the same time, in Scotland. The Cashmere or Thibet goat was brought to France a generation since, and succeeds well. The same or an allied species, and the Asiatic buffalo, were carried to South Carolina about the year 1850, and the former at least is thought likely to prove of permanent value in the United States. The Yak, or Tartar ox, seems to thrive in France, and success has attended the recent efforts to introduce the S. American Alpaca in Europe."—*Man and Nature; by G. P. Marsh.*

parks of wealthy individuals, in Great Britain and on the Continent, in breeding foreign deer, antelopes, &c., has given rise to extended popular movements in this direction, called Acclimatization Societies, in France, England, Germany, and the Australian colonies. The British Society has offshoots in various parts of the United Kingdom, in New Zealand, and in Palermo. These Societies are supported in some cases by voluntary subscriptions; others are aided by large legislative grants of money; whilst all receive great assistance from government in the free transit of animals, &c., by men-of-war; and in some cases grants of land for experimental parks or farms. The following enunciation of the purposes of the English Society, contained in the Rules, will afford a just conception of the ideas and intentions by which all are animated.

It aims, 1st, at the introduction, acclimatization, and domestication of mammals, birds, fishes, insects and vegetables, whether useful or ornamental.

2. The perfection, propagation, and hybridization, of creatures already domesticated.

3. The spread of indigenous and naturalized animals, &c., from parts of the United Kingdom where they are already known, to other localities where they are not known.

4. The procuring, whether by purchase, gift, or exchange, of animals, &c., from British colonies and foreign countries.

5. The transmission of animals, &c., from England to her colonies and foreign parts, in exchange for others sent from thence to the Society.

6. The holding of periodical meetings, and the publication of Reports and Transactions, for the purpose of spreading knowledge of acclimatization, and of inquiry into the cause of failure.

Without going into minute details of the establishments, their successes and failures, let us here briefly glance at what has been accomplished by these Societies in various portions of the globe during the past three or four years of their infancy. As might be expected, no complete success on so large a scale as to have passed beyond the nursing of the Society, has yet been recorded, whilst failures and disappointments have been numerous and heavy; yet the Societies are satisfied with their progress, and learning to look more to the necessary qualifications for successful acclimatization, are giving greater attention to a few subjects.

I have before me the Fourth Annual Report of the English Society for the year ending May 31, 1864. A most zealous member and promoter of the Society's objects, Lord Powerscourt, has successfully imported from a German forest a number of magnificent red deer, much larger than those at present found in Great Britain, and hopes by crossing to improve the breed of English red deer, which Mr. Frank Buckland says have been sadly degenerating in size, weight, and general appearance. Recently received specimens of the Wapiti, that magnificent American stag, and of large East Indian deer, are thriving in this nobleman's park.

Repeated failure seems to have attended the experiment of introducing the Chinese sheep, (the same as may be seen at Mr. Downs' establishment at the N. W. Arm). These animals have been disseminated through the country in charge of members, who have nearly all reported unfavorably of the pure breed, though where crossing has been tried there seems to have been more hopes of success. Amongst the birds mentioned as having been bred in the Society's care, are the Honduras turkies, bronze-wing pigeons from Queensland, and a variety of crosses between birds of the genus *Phasianidæ* have been obtained. Many other valuable birds from India, South America, and Australia, have been lately received, but have not yet bred. Amongst the latter are a pair of Australian emeus.

The most interesting portion of the Report, however, comes from the Piscicultural branch, under the guidance of the indefatigable Mr. Francis Francis. It appears that the cost of the apparatus and working it for one year has been only £300, and the Society has sent out amongst its members over 50,000 ova and fry. Many of these ova have been transmitted to the distant colonies of Australia and New Zealand, where the trout and salmon of the Old Country are now living, watched by anxious eyes, the hopeful pioneers of the new races which are to colonise the mountain streams of Tasmania and New Zealand. Of all the Societies in operation, those established by our energetic colonists of the southern hemisphere seem to have been actuated by the greatest zeal, and to have achieved the greatest amount of positive success. That of Melbourne appears to be the parent and first importer of the host of new creatures which are being diffused through the neighboring colonies, on the continent across the water to Tasmania, and even to New Zealand. The last Report of this Society is so interesting, that it is scarcely possible, in noticing the achievements therein recorded, to refrain from giving the whole *in extenso*. Certainly, in no country on the face of the globe could acclimatization be more applicable, and hence the earnestness of its colonists in this matter. Australia possesses no indigenous ruminant, and scarcely a game bird beyond a variety of aquatic fowl; and the immense success of the introduction of sheep on its vast pasture lands, where no animal had browsed before from the creation, thereby giving the colony its staple product, wool, is in itself an earnest of the great advantages of acclimatization. After noticing the introduction and successful reproduction of the camel, a herd of which were brought from India at the expense of £120 per head, the llamas and alpacas from South America, Cashmere goats presented by the Paris Society, and various breeds of sheep, the Report goes on to say :—

"While devoting this amount of attention to such animals as the camel, the alpaca, the angora goat, and the sheep, which may be considered as more immediately interesting to the mercantile and pastoral classes, the sportsman has not been forgotten. The fallow deer, the Indian elk, the beautiful spotted axis deer, have been successfully imported, bred from, and turned loose at Wilson's Promontory, the Wummera, the Sugarloaf, and the Bunjip. Numerous specimens of the hog-deer of India, a beautiful deer from Manilla, and another from Formosa, are still in the possession of the Society, with a view to their multiplication and ultimate release; and fresh importations of the deer tribe are almost of weekly occurrence.

"The hare has been sent to the Society by the Zoological Society of London, and has been turned out, and is now breeding freely on Philip Island. Various breeds of pheasants, partridges, grouse, and quail, have been introduced, and some have been liberated. Amongst those may be mentioned the Californian quail, which has bred after being liberated in the Botanical Gardens and Philip Island, and the Algerine sand-grouse, of which a considerable number have been imported, and which, from their hardy nature and the similarity of their original climate, may be considered highly adapted to this country. The English wild duck has been imported, has multiplied very freely, and now visits the lagoon at the botanical gardens in nearly equal numbers to the indigenous water fowl. The Egyptian goose has bred at the Royal Park, and promises to be thoroughly acclimatized. The wild pea fowl of Ceylon has thriven and bred in the charge of the Society, and can soon be set at liberty.—The white swan has been introduced in considerable numbers, has bred in the gardens of the Society, and is now distributed in various localities. Various kinds of foreign doves and pigeons have been introduced and liberated. The curassow has been obtained, and has bred in the aviaries of the botanical gardens."

Then comes an enumeration of the various European pond and river fish, successfully brought over the great intervening wastes of ocean by unremitting care, and including that great desideratum of these enterprising naturalists, the noble salmon, which, however, is expected to thrive and multiply to a far more remunerative extent in the bright cool streams of Tasmania, than in the sluggish rivers of the Australian continent; and lastly, a cheerful notice of the hosts of the common field birds of Old England, now spreading rapidly through the colony by natural means, enlivening the neighborhood of the towns, and doing infinite good to the agriculturists, by attacking the hosts of caterpillars and other insect pests which there prove so destructive to the crops.

As may be supposed, such extended operations could scarcely have been performed without greater assistance than that afforded by even a large assemblage of private subscribers. Indeed, though these have liberally contributed, the Melbourne government, recognizing the vast importance of these efforts to the future prospects of the country, have voted munificent sums to their furtherance. It is stated, that up to the date of the Report no less than £20,000 has been advanced by the government. Foreign Societies of a similar nature, seeing the zeal of the colonists and the aptitude and necessities of the country, have forwarded many new creatures;—indeed, the Report states, that a French man-of-war was at that time engaged in bringing the Society specimens of the yak, the ostrich, and other animals.

There are besides, Societies on the model of that of Victoria, in Sydney, Hobart Town, Adelaide, Brisbane, Auckland, Lyttleton, and Dunedin. So that it may be presumed that in a quarter of a century the strange and sparse fauna of these vast antipodal possessions, will be supplanted by all those beautiful forms of animal life which are so essential to the prosperity and happiness of man in his highest state of civilization, affording variety in food, gratification to the eye, and excitement and health in the chase.

Such then are some of the most important statistics of Acclimatization. That our mother country regards its advantages as far from uncertain or insignificant, may be seen in the fact of her having placed Her Majesty's ships at the disposal of the colonies for transport of specimens. Doubtless the introduction of a new creature in such numbers as to become eventually a common denizen of the country, either wild or in a state of domestication, requires great forethought as regards the aptitude to dwell and thrive in a new home, by comparing the conditions of its past existence with those under which it is expected to live in future. Indeed, without such proper knowledge of the minuter habits and requirements of animals, failure is inevitable; but more than enough has been shown to establish it beyond cavil as a branch of science, a practical offshoot of the interesting science of natural history.*

We now come to consider the proper subject of this paper—the question of Provincial Acclimatization as applicable to Nova Scotia. I have so far drawn attention to the advances made by the antipodal colonists in this direction, to show how the objections of distance, expense and uncertainty of results, have all been put aside for ends thought worthy of such sacrifices. But Australia was a country craving animal immigration, her large and wealthy population demanding many of the absent table luxuries of the old world, and her youth eager for the time when the boundless forests and grassy plains should abound with the stag or roe, in place of the monotonous marsupials which as yet had afforded the only material for the chase. In Atlantic America, on the contrary, instead of having to supplant the indigenous animals, we possess, in a state of nature, some of the noblest forms of animal life, which no longer called upon to supply the aboriginal Indians with their sole means of subsistence, may be called on with that moderation which should always characterize a civilized people, to afford both the invigorating pleasures of sport and luxuries for the markets. Every stream and lake abounds with trout, and there are but few rivers from Cape Sable to the Labrador which the salmon does not annually attempt to ascend.

What then is to be desired? Has not America, receiving from the east all those useful animals which accompany man in his migrations, and which, returning to a state of nature in the plains of Mexico and South America, have multiplied so greatly as to afford a staple product for exportation, given all imaginable luxuries to the new-coming nations in the produce of her forests, prairies, rivers, and sea coasts? Yes, but the gift has been abused. It is sad to contemplate the wanton destruction of game and game fish

* Applied Natural History it has sometimes been termed.

throughout the northern continent since its first settlement by Europeans: many animals, now on the verge of extinction, driven off their still large domains, not primarily by the approach of civilization, but by ruthless, wholesale and wanton modes of destruction. "One invariable peculiarity of the American people," says the author of *The Game Fish of the North*, "is that they attack, overturn, and annihilate, and then laboriously reconstruct. Our first farmers chopped down the forests and shade trees, took crop after crop of the same kind from the land, exhausted the soil, and made bare the country; they hunted and fished, destroying first the wild animals, then the birds, and finally the fish, till in many places these ceased utterly from the face of the earth; and then, when they had finished their work, that race of gentlemen moved west to renew the same course of destruction. After them came the restorers; they manured the land, left it fallow, put in practice the rotation of crops, planted shade and fruit trees, discovered that birds were useful in destroying insects and worms, passed laws to protect them where they were not utterly extinct, as with the pinnated grouse of Pennsylvania and Long Island, and will I predict, ere long re-stock the streams, rivers and ponds, with the best of the fish that once inhabited them."

A home question for our subject would be,—In the hands of which class of men does this Colony now find itself? And I fear the unhesitating answer of the impartial stranger and visitor would be, that in all regarding the preservation of our living natural resources, we were in the hands of the destroyers. The course of destruction so ably depicted by the author quoted, is being prosecuted throughout the length and breadth of Nova Scotia, and the settlers of this Province blind to their own interests, careless of their children, and utterly regardless of restraint imposed by the laws of the country, worse than useless because not carried out, are bringing about the final depopulation of our large wild lands and waters. It really becomes a question as to whether late interference shall arrest the tide of destruction ere the entire extermination of fish and game shall bring the country to a sense of its loss, and finally to a wish for their reproduction.

In such a state of affairs, Provincial Acclimatization would prove an empty speculation, for any new animal or bird introduced into our woodlands requiring freedom from molestation for a term of years, would be quickly hunted down and destroyed.

Leaving, however, these important questions of protection or extinction of already-existing indigenous species in the hands of those who hold the means of ordering these matters, I will now call your attention to what might be done to increase our stock of useful wild or domestic animals, birds or fish, could they be insured the necessary wardship. We will consider first whether our large woodland districts demand and would bear foreign colonization, and for what types their physical conformation seems best adapted.

Even in its most undisturbed and wildest depths the North American forest has always been noted for its solitude ; the meaning being the great disproportion of the animal to the vegetable kingdom. It seems as if nature had exhausted her energies in shading the ground with the dense forest and the rank vegetation which every where seizes on the rough surface beneath. It is impossible to say to what extent animal life might have once existed in the primeval forest; but no one who has taken a day's walk in the woods, either near to or far from the haunts of man, can fail being impressed with the apparent absence of animal life. The European visitor, in a suburban ramble through the bush, wonders at the scarcity of game birds, rabbits, or hares, but is astonished when told that in the deepest recesses of the wild country he will see but little increase of their numbers. A canoe paddled through lake after lake of our great highways of water communication, will see but a few pairs or broods of exceedingly timid waterfowl, where in Europe they would literally swarm. Surely then, here is room for the work of Acclimatization, in a country where so much toil is undergone in the often fruitless pursuit of sport.

The undergrowth of our wild forest lands, the field for Acclimatization which we have under immediate consideration, consists of an immense variety of shrubs, under-shrubs, and herbs, annual or perennial. The under-shrubs generally bear the various descriptions of berries, and with great profusion. There are here and there wild pastures, or intervales, by the edge of sluggish water, but they bear but a small proportion to the woodlands ; the bogs and barrens produce moss in abundance, and of the kind found in every part of the world where the reindeer is indigenous, or has been successfully introduced, as in Iceland.

We find accordingly, that our largest ruminant, the moose-deer, is in the strictest sense of the word a wood-eater; whilst our other animal representing this class, the American reindeer, or carriboo, is found in those portions of the Province where large and seldom disturbed plains and bogs afford him his favorite moss, the lichen (*range ferinus*). As amongst the larger animals, ruminants alone offer a selection for introduction into a forest country with the physical attributes of Nova Scotia, we may ask if there is any other animal of the deer tribe which might be successfully acclimatized here. The answer comes through careful consideration of the fauna and flora of other regions compared with our own. The field naturally presenting itself for this research lies in the forest districts of America further west, and in northern Europe, which, under similar climatic influences, presents a strong analogy to this portion of the globe, especially on its western seaboard; the forest trees and shrubs, the larger animals, the birds and the fish of Norway and Sweden, are almost reproduced in British North America; indeed, distinction of species in many cases is far from established.

*The red deer then, of Maine and the Canadas, and more recently of New Brunswick, by spontaneous acclimatization, or perhaps rather through the instrumentality of the wolf, appears to be perfectly adapted for an existence in the Nova Scotian woods—a graceful species, but little inferior to the red deer of Europe, affording the excellent venison with which the New York and Boston markets are so well supplied. The climate of Nova Scotia, allowing so little snow to accumulate in the woods until the close of the winter, would prove a great safeguard against the wholesale destruction with which it meets in Maine and New Brunswick, where it is continually in a most helpless condition from the depth of snow throughout the winter. Indeed, it is already with us, for a small herd of healthy animals may now be seen at Mr. Downs' gardens, to whom the country is already indebted for many an unassisted attempt at real practical acclimatization.

The only other ruminant on the list of this order indigenous to climates similar to our own, is the hardy little roe-deer or roe-buck, common in the beech woods of northern Europe. I am confident

* Cervus Virginianus.

that this animal would thrive in the hard woods of Cumberland; and as it seems to live and thrive close to civilization, it would find ample room and food in our suburban copses and uncleared barrens. Descending in the scale of animal classification, the next selections for consideration of a future Acclimatization Society in this country, as adapted to live and multiply and become profitable in the woodlands, seem to be offered in the prolific order *Rodentia,* of which many families are already indigenous—the squirrel, beaver, porcupine and American hare, commonly known as the rabbit. The first of these might receive an interesting accession by the introduction of the black and grey squirrels of Canada and the States; the beaver, porcupine and woodchuck, are all prized by the hunter as food, lacking the supply of venison, and the latter, persecuted though it be by human, furred, and feathered foes, is still so prolific and common, as to form a great portion of the winter subsistence of both settlers and the poor of this city. Indeed, when we enumerate its enemies of the animal creation, which almost altogether live upon it, the lynx and wild cat, the foxes, the horned owl, the marten and the weasel, and take into consideration the numbers which are taken by man, by snaring them in their easily discovered paths to and from their feeding grounds in the swamps, it is wonderful that they still remain so plentiful. A great objection to the flesh of the American hare, however, is its insipidity and toughness, except when taken young. Far more delicate and esteemed is that of the Spanish, or domestic, and common wild English rabbit, (*Lepus cuniculus*), whilst it would seem that both are of a sufficiently hardy constitution to stand the rigours of our winter. The former is already an acclimatized inhabitant of the sand banks of Sable Island, according to Dr. Gilpin, having been introduced by the honble. Michael Wallace, and increased amazingly, affording the Islanders many a fresh dinner when salt junk is plenty and fresh beef scarce. No easier experiment could be made in applied Natural History, than the extensive breeding of the common grey rabbit by some resident near town, whose premises bordered on uncleared bush or scrub. To commence, a large bank of loosely piled earth and stone might be made, here and there perforated by a length or so of suitable tubing, such as used for drains, the bank enclosed by wire netting, and a few pairs of rabbits turned in. They would soon tunnel the bank in all directions, and as the families increased they might be allowed to escape into the neighbourhood. A fair warren once established would be the means of a quick colonization of the surrounding country. And the true rabbit living so constantly under ground, would enjoy much greater security from animals and birds of prey than his indigenous congeners.

Still keeping in view the acclimatization of creatures intended to exist in a state of nature and not for domestication, a division of the subject which appears to be most feasible and best adapted to the condition of this Province, let us next turn to the birds.

We have already existing in our woods as game birds, two species of *Tetraonidæ*, or the partridge tribe; the *T. umbellus*, or the ruffed grouse; and the *T. Canadensis*, or spruce partridge—as permanent residents; and as summer visitors the two N. American *Scolopacidæ*, the woodcock and snipe. There is but one representative of the *Phasianidæ*, or pheasant tribe, in North America, the only gift of the new to the old world, whence the domestic race has sprung, and that is the wild turkey. It certainly would appear that our large woodland solitudes offer especial facilities for the introduction of some new members of the grouse family, birds especially formed for existence in cold climates. Formerly common in the Scotch pine forests, now only to be met with in the north of Europe, in Norway, Sweden, and Russia, the magnificent capercaillie or cock of the wood, (*T. urogallus*,) equalling, in the case of the male bird, the turkey in size, presents so tempting an experiment that it should be almost introduced regardless of expense. It appears to feed exclusively on pine shoots. Mr. Bernard, author of a recent work called "Sport in Norway," says it is still common in all large forest districts in that country. I believe this bird loves solitude, and surely he would find it, if essential to his existence, in some of the great expanses of coniferous forest which still prevail in most portions of Nova Scotia. Next in size and beauty might be selected the black game (*T. Tetrix*) of the wilder portions of the British Isles, and numerous in Norway, where it is stated they not unfrequently cross with the capercaillie. This bird is known to subsist on the buds and seeds of the alder, on the berries of the whortleberry, and on the bog cranberry, all of which are so abundant in our woods, and of almost identical species. A successful introduction of this bold, handsome grouse, would add great interest to the wild sports on the open barrens. The hazel hen of northern Europe, (*T. bonasia*), reported to be the best fleshed bird of the grouse tribe, is another association of a country in which spruce woods abound. It is exceedingly like our birch partridge in appearance—a little smaller and wanting the ruff; like the latter, also, its flesh is white. There are many other northern grouse in both the old and new worlds, but none that I should import as so likely to succeed, and as such valuable acquisitions, as the capercaillie and the black cock.

With the fact of the introduction and breeding of the English and gold and silver pheasants at Mr. Downs' establishment we are all acquainted; and the most interesting fact is the well-ascertained capability of the English pheasant to live and find its own subsistence in our woods through a rigorous winter. Why should not this experiment be continued?

It is to be feared that those troops of little songsters with which the fields of England abound, and which have been carefully acclimatized in Australia for old association sake, would die on the first near approach of the mercury to zero. Those that are imported are closely kept within doors. Mr. Downs has two pairs of the European jackdaw, which he hopes will increase in his neighbourhood. These interesting and garrulous little members of the family *Corvidæ*, whose young every English boy covets to obtain and educate to the acquisition of rudimentary speech, would find but few ivy-mantled towers or venerable steeples in which to build their nests; but when Gilbert White informs that for want of church steeples they will build under ground in rabbit burrows, the new-comers would not be long in devising a remedy for the defect.

As a second consideration in connection with this wide subject, let us enquire whether any good purpose could be answered by an attempt at domestication or semi-domestication of our indigenous ruminants, the moose and the carriboo. When we consider that these two species are found throughout the old world, under the same conditions of climate and vegetation which attend them in the new, it appears unaccountable that we have no historic records of the subjugation of the carriboo for domestic purposes by the primitive Indians of the northern coasts of America, as this animal has been applied from time immemorial by the Lapps.

An eminent naturalist, Dr. Gray, in delivering his address in the Nat. Hist. Section at the late meeting of the British Association at Bath, thus alludes to the latter fact: "The inhabitants of the arctic or sub-arctic regions of Europe and Asia have partially domesticated the reindeer; and either Asiatics have peculiar aptitude for domesticating animals, or the ruminants of that part of the world are peculiarly adapted for domestication;" and he then instances a variety of exemplifications, in their having domesticated the yak in the mountain regions of Thibet and Siberia, the camel and dromedary in central Asia, in southern Asia the zebra, and in the Malayan archipelago various species of buffalo and wild cattle. It may be stated, that modern geological discovery has placed the original home of the reindeer in the high Alps of central Asia, whence these animals, followed by their ever-accompanying human associates, the Lapps, migrated to the northwest of Europe. As a beast of burden, however, to traverse those treeless wastes answering to the snow-covered barrens of Lapland, the dog seems to have answered all the purposes of the Esquimaux and other arctic-American tribes, whilst in more southerly and wooded regions, a sledge-drawing animal would have no scope or sphere of employment. And viewing the animals in this light, the horse and the ox which have accompanied Europeans, have left no desideratum that could be supplied by either the moose or the carriboo. There are, however, several undoubted instances of the applicability of the moose to draught. A few years since a settler on the Guysboro' road, named Carr, possessed a two-year old bull moose, which was perfectly tractable in harness. For a wager, he has been known to overtake and quickly distance the fastest trotting horse on the road, drawing his master in a sleigh, the guiding reins being fastened to a muzzle bound round the animal's nose. Another instance was that of a very large moose kept by a doctor in Cape Breton, which he would invariably employ in preference to his horse when wishing to make a distant visit to a patient, and in the shortest time. It is very certain that in its youth the moose is one of the most tractable of animals; but it is in the rutting season of the third year that the males become unmanageable and dangerous.*

The point, however, on which I wish to engage attention, is not the domestication of either of these animals in the state in which the ordinary domesticated animals are associated with us, but a possible state of semi-domestication, by which the moose might be caused to multiply on uncleared land, and regularly bred, fattened, and turned to profit without the smallest cost to the owner, except the expense of maintaining his enclosures in an efficient state of security. My attention was first drawn to this by reading an account of the successful breeding of the American elk (*C. Wapiti*) by an American gentleman, a Mr. Stratton, of New York State. I quote from a letter dated January 12, 1859:

"My desire to keep and breed them, without their becoming a tax upon me, led to diligent enquiry in relation to what had been done in the way of their domestication. I procured, as far as possible, every paper, book, and document, which could give any light upon the subject. I wrote to every part of the country whence any information could be obtained, and opened a correspondence with those who had undertaken such an enterprise. The result of my efforts was simply this: nearly every one who had owned an elk was a gentleman amateur, and had left the care and direction to servants;—that the bucks, not having been castrated at the proper age, had become unmanageable:—and when the novelty of the attempt was over, the domestication in most cases was abandoned. But from my own inquiries, and a close personal observation of the habits of the animal, I believed that a different course would produce a more favorable result. The first requisite was a place to keep them in. Now, they had always lived in the woods, summer and winter: why not live in the forest again? Acting on this principle, I immediately set to work and fenced in about 150 acres of hill land, which was steep and stony, covered with brushwood and entirely useless for agricultural purposes. In this lot I turned my elks, where they have been six years. In the mean time I purchased two more does, and have reared eight fawns. Having emasculated the older bucks as fast as the younger ones became adults, I have now a herd so gentle, that a visitor at my farm would hardly imagine that their ancestors, only three generations back, were wild animals. And this has been done simply by visiting the park two or three times a week, and always carrying them an ear of corn, some little delicacy, or salt, and treating them with unvarying kindness.

"The facility for extending this business may easily be conceived. New York alone might support 100,000 elks on land where our domestic cattle could not subsist, furnishing an amount of venison almost

* Formerly the elk of Europe was used in Sweden to draw sledges, but his use for this purpose was finally prohibited by government, as criminals used it as a means of escape.

incredible; while the adjoining State of Pennsylvania, to say nothing of others, might sustain a still larger number without encroaching upon an acre of land now used for stock-rearing, or any other purpose connected with agriculture."*

Here, then, we have a modern precedent for an experiment which I am convinced would answer in the case of the moose, a still larger and more profitable animal than the wapiti. What an admirable opportunity for utilizing those barren wastes which surround us! Take for example that large triangular piece of waste country commencing at Dartmouth, extending along the shores of the Basin on one side, bounded by the Dartmouth lakes on the other, and skirted by the railroad from Bedford to Grand Lake as its base. With the exception of a few clearings on the shores of the Basin, the whole of this is a wilderness, containing some 13,000 acres of wild, undulating land, with here and there thick spruce swamps, mossy bogs, and barrens covered with a young growth of birch, poplar, and all the food on which the moose delights to subsist. That they have an especial liking for this small district may be gathered from the fact that I have never known it as not containing two or three of these animals. There is no reason why an experimental farm, conducted on the principle followed by Mr. Stratton, should not be able to breed and turn out into this district a very large number of moose, and in such a state of tameness that they would be induced to remain within enclosed portions of the wilderness, furnishing, in proper season, a profitable supply of flesh for the market.

To the carriboo, on the other hand, these suggestions will not be applicable, as this animal requires, as a primary condition of its existence, a large and uninterrupted field for periodical migration.

Art. III. Notice of the occurrence of Heather (*Calluna vulgaris*) at St. Ann's Bay, Cape Breton Island. By Geo. Lawson, Ph. D., L. L. D., *Professor of Chemistry, Dalhousie College.*

[*Read December* 5, 1864]

It gives me much pleasure to bring under the notice of members of the Institute, information and specimens which will, I trust,

*In 1862, Mr. Stratton states that he had succeeded in raising thirty-seven elk. He had trained a pair to harness, and had sold them for $1,000. Whilst, as an article of food he can now raise elk cheaper than sheep.

be sufficient to show that *Calluna vulgaris*, the common heather of Scotland, is a genuine native of our Province of Nova Scotia. When in Cape Breton Island in August last, I obtained information from L. Robertson, Esq., of North Sydney, which led me to make special enquiry at St. Ann's, in the County of Victoria. On reaching that place I found that the *Calluna* was growing in a bit of boggy land among stumps of spruce trees, on an uncleared part of Ulston Farm, belonging to John Robertson, Esq., President of the St. Ann's Agricultural Society, who proceeded with me to the spot, and informed me that he had known the plant to have existed there for about ten years. It was originally noticed by a highlander when mowing, who immediately ran to his master, exclaiming: "I have found heather!" Full enquiry was made on the spot as to the whole circumstances, and I could not ascertain any fact tending in the slightest degree to indicate that the *Calluna* had been planted at St. Ann's. On the contrary, I believe it to be a genuine native. There was only a small patch of it, not more than a yard across, and it had been pretty well eaten down by cattle. Mr. Robertson kindly promised to have a fence put round it to preserve it from farther injury. The "surroundings" of the heather at St. Ann's are most appropriate. Both the scenery and vegetation resemble those of the Scottish Highlands. The cloudberry *(Rubus chamæmorus)*, sundew, and many other highland plants, were abundant on the neighbouring hills. The *Calluna* station is probably not more than one hundred feet above the sea level.

Within the last few years an animated controversy has been going on among both European and American botanists as to whether the *Calluna* is really indigenous to the American Continent or to adjacent Islands. This is in reality a matter of great interest in a strictly scientific point of view, for it has important bearings on the questions of distribution, age and origin of species, and therefore, a reference to the opinions expressed and facts adduced by others, may not be unacceptable as an appendix to my own observations.

The *Calluna* is very general throughout Europe, spreading over extensive tracts of land in Britain, to which it gives the name of "heaths," and over the Continent generally, (not by any means confined to the North,)* and eastward to the Ural Mountains. That is its eastern limit, for it is not known in Siberia, has been only erroneously reported from the interior of Northern Asia, and is not found in North West America. Humboldt,† after detailing the distribution of heaths and the relations of the North and South African species to those of Europe, remarks, in reference to *Calluna vulgaris:*

> "The accurate knowledge which we now possess of the mean temperature of several parts of Northern Asia, as well as of the distribution of the annual temperature into the different seasons of the year, affords no sort of explanation of the cessation of heather to the east of the Ural Mountains. Joseph Hooker, in a note to his Flora Antarctica, has treated and contrasted with great sagacity and clearness two very different phenomena which the distribution of plants presents to us: on the one hand, 'uniformity of surface accompanied by a similarity of vegetation;' and on the other hand, 'instances of a sudden change in the vegetation unaccompanied by any diversity of geological or other features.' * * * * No less striking is the absence of *Calluna vulgaris*, and of all the species of *Erica* throughout all parts of the Continent of America, while the *Calluna* is found in the Azores and in Iceland. It has not hitherto been seen in Greenland, but was discovered a few years ago in Newfoundland."

According to Professor Asa Gray, the earliest published announcement of *Calluna vulgaris* as an American plant, is that by Sir William Hooker, in the Index to his Flora Boreali-Americana (vol. ii. p. 280), issued in 1840, where it is stated that: "This should have been inserted at page 39, as an inhabitant of Newfoundland, on the authority of De la Pylaie." Accordingly, in the seventh volume of De Candolle's Prodromus, to the European habitat is added, "Etiam in Islandia et in Terra Nova Americæ Borealis." But Dr. Joseph Hooker, in his valuable paper on the Distribution of Arctic Plants,‡ observes, "*Calluna vulgaris*, L. is mentioned in De Candolle's 'Prodromus,' on the authority of a specimen gathered by La Pylaie, as a native of Newfoundland; but I find no confirmation of this habitat, nor is it found in any part of the American Continent."

Mr. Bentham had never seen an American specimen, and, remarks Prof. Gray, "he also overlooked the fact (to which Dr. Seemann has recently called attention) that Gisecke, in Brewster's

* I have specimens from Italy.

† Aspects of Nature. Sabine's Translation. Vol. ii. pp. 144–147.

‡ Linn. Trans. vol. 23.

Encyclopædia, records it as a native of Greenland. No mention of it is made by Dr. Lang, in his enumeration of the known plants of Greenland, appended to Rink's Geographical and Statistical account of Greenland, published in 1857,—from which we may infer that the plant is perhaps as rare and local in Greenland as in Newfoundland, or even in Massachusetts!" In the American *Journal of Science* for September, 1861, Professor Gray announced the unexpected discovery, by Mr. Jackson Dawson, of a patch of heath in Tewksbury, Massachusetts; adding the remark, that: "It may have been introduced, unlikely as it seems; or we may have to rank this heath with *Scolopendrium officinarum*, *Subularia aquatica*, and *Marsilea quadrifolia*, as species of the Old World so sparingly represented in the New, that they are known only at single stations,—perhaps late-lingerers rather than new-comers." Mr. Rand, after exploring the locality, gave a detailed account of the case, and of the probabilities that the plant might be truly native, Professor Gray adding a note to say that the probability very much depended upon the confirmation of the Newfoundland habitat. As to that, Dr. Gray had been verbally informed, in January 1839, by the late David Don, that he possessed specimens of *Calluna* collected in Newfoundland by an explorer of that Island. The Tewksbury habitat was fully described to me and interesting details afforded by Professor Hitchcock, junr., with whom I was a fellow-passenger through Massachusetts in November of last year. Mr. C. J. Sprague took up the subject, and after searching in vain for any publication of Pylaie's containing mention of this heath in Newfoundland, and finding that no specimen was extant in Pylaie's herbarium, or elsewhere that he could trace, he took a sceptical view, and in the Proceedings of the Boston Natural History Society for February and for May, 1862, he argued plausibly from negative evidence, against the idea that any native heath had ever been found in Newfoundland or on the American Continent. However, in the *Natural History Review* for April, 1864, Mr. Hewett C. Watson supplied the following additional evidence of the existence of *Calluna* in Newfoundland:—

"Specimens of *Calluna vulgaris* from Newfoundland have very recently come into my hands under circumstances which seem to warrant its reception henceforth as a true native of that Island. At the late sale of the Linnæan

Society's Collections in London, in November, 1863, I bought a parcel of specimens, which was endorsed outside, 'A collection of dried plants from Newfoundland, collected by — McCormack, Esq., and presented to Mr. David Don.' The specimens were old, and greatly damaged by insects. Apparently, they had been left in the rough, as originally received from the collector; being in mingled layers between a scanty supply of paper, and almost all of them unlabelled. Among these specimens were two flowerless branches of the true *Calluna vulgaris*, about six inches long, quite identical with the common heath of our British moors. Fortunately, a label did accompany these two specimens, which runs thus: 'Head of St. Mary's Bay—Trepassey Bay, also very abundant. S. E. of Newfoundland considerable tracts of it.' The name *Erica vulgaris* has been added on the label in a different handwriting. All the other species in the parcel (or nearly all) have been recorded from Newfoundland, so that there appeared no cause for doubt respecting the *Calluna* itself. And, moreover, the collector had seemingly some idea that an especial interest would attach to the *Calluna*, since in this instance he gave its special locality, and also added two other localities on the label. But there is very likely some mistake in the name of the donor to Mr. Don. It is believed by Sir William Hooker that he was the same Mr. W. E. Cormack, whose name is frequently cited for Newfoundland plants in the *Flora Boreali-Americana*. This gentleman was a merchant in Newfoundland, to which he made several voyages. We should recollect that the *Calluna* advances to the extreme western limits (or out-liers) of Europe, in Iceland, Ireland, and the Azores. The step thence to Newfoundland and Massachusetts, though wide, is not an incredible one."

I hope that some gentleman in Newfoundland will be induced to take the trouble of instituting the necessary inquiries to elicit some more definite information as to the Newfoundland habitat. So many other shrubs have been mistaken for heather in Nova Scotia and other parts of the world, that it is necessary to accompany any observations with specimens from the locality.

The occurrence of this common European plant in such small quantities in isolated localities on the American Continent, is very instructive, and obviously points to a period when the heath was a widely-spread social plant in North America as it still is in Europe, where oft-recurring fires are yearly lessening its range. The late Professor Edward Forbes, Dr. Joseph Hooker and Mr. Darwin, all agree in advocating a southern migration of northern types "due to the cold epochs preceding and during the glacial," and since Dr. Hooker has shown that the Arctic flora is essentially a Scandinavian one, there is no difficulty in finding in this theory an explanation of the way in which *Calluna* might have reached the eastern coast of America. There are, however, other explanations. At last meeting of the Institute, our President ever active in the cause of science, showed us an extremely interesting specimen of a bird that is apparently fast following the Dodo, and may soon become extinct, if not so already. In *Calluna* we have probably an example of a species on the verge of extinction as an American species, while maintaining a vigorous and abundant growth in Europe. If so, may not Europe be indebted to America for *Calluna*, and not America to Europe? But I must not open up so important a question as the origin and history of our species, while so little is known of the botany of the Maritime Provinces of British America.

In a letter from Professor Asa Gray, of Harvard, October 4, 1864, to whom I had sent a specimen of the *Calluna* from St. Ann's, he remarks: "I am much interested in the smallness of the amount of the plant in your station,—just as in that in this State,—confirming my view that it is now a mere remnant of what was once more diffused."

ART. IV. NOTE ON LEMANIA VARIEGATA OF AGARDH. BY GEORGE LAWSON, L.L.D., Ph. D., *Professor of Chemistry and Natural History in the Queen's University of Canada.*

[Read December 5, 1864.]

THE correction of errors in science is a very slow process. In the first part of the second volume of Bishop Agardh's "Species Algarum," published in 1828, an alga said to have been found "in *fluviis Americæ borealis*," was described under the name of *Lemania variegata*. Agardh's original description of the plant appears, however, to have been published in the Stockholm Transactions in 1814, to which I have no means of access at the present time. The specimen upon which the species was founded had been given to Agardh by Olaf Swartz, his first master in Algology, who obtained it from the collector, the Rev. Dr. Muhlenberg, of Lancaster, in Pennsylvania. Not having been met with by subsequent observers, *Lemania variegata* has been looked upon as a long-lost plant.

In a parcel of specimens of cryptogamic plants sent to me in August 1862, by Mr. John Macoun, of Belleville, Canada West, a

*Read before the Botanical Society of Edinburgh, 9th April, 1863.

most zealous and successful explorer, I at once recognized a *Lemania*, remarkable for its extremely rigid, prominently monoliform, curved filaments, attenuated towards the base and apex, and regularly marked throughout by alternate bands, dark and white,—agreeing, in fact, very well with Agardh's description of *L. variegata.* I doubted not that the Belleville plant was conspecific with that of Agardh, and probably the identical form described in the "Species Algarum." Accordingly, I gave a description of the plant in the Edin. New Phil. Jour., N. S., vol. xviii. No. 1, July 1863. My description was scarcely published when an opportunity presented itself of my personally visiting the habitat for the Lemania, River Trent, along with its discoverer Mr. Macoun, and a careful examination led to a modification of my views. The plant is indeed apparently the same as that described by Agardh, but it is certainly not different specifically from *Lemania torulosa*, with which Harvey had indicated the probable identity of Agardh's plant (*in Nereis.*)

Lemania, Bory.

Generic character.—Fronds bristle-like, rising in clusters from a common adherent base, cartilaginous or corneous, continuously tubular, more or less nodose (brown, dull green, blackish or particoloured), the tube membrane composed of two distinct closely adherent strata of cells, those of the outer stratum minute, irregularly polygonal, closely united pavement-wise in radiating groups, those of the inner stratum rounded and not conformable, much larger than the others. Spores (so called by authors) in seriated stalked tufts, inside the swollen joints of the tube, and arising either from a central axis (according to Dr. W. J. Thomson), or from the inner peripheral layer of cells, or from both.

This genus, named *Lemania* by Bory, in honour of M. Lemain of Paris, "a modest naturalist not less learned in botany than in the other branches of science," embraces three species of aquatic algæ of very remarkable aspect and structure, which grow attached to stones, rocks, wood, &c., in the bottoms of shallow, rapid, fresh-water streams. Unlike most fresh-water algæ, they have dense, compact tissue, giving them firm consistence; they are rich in nitrogen, and when burned yield ammoniacal vapors. The plant usually consists of a little tuft of stiff erect or curved bristle-like fronds, which adhere by a common discoid root to submerged objects. The minute structure of these plants has been illustrated very fully by authors at different times, from Vaillant (1727) downwards, with singularly conflicting results. The most recent and perhaps most valuable contribution that has been made to the history of *Lemaniæ*, is the remarkably lucid description of Dr. W. J. Thomson, in the Transactions of the Botanical Society of Edinburgh, vol. vi. page 243, to which I would refer observers as an excellent basis for further inquiry, although I have been unable (probably from my specimens being too matured) to confirm some of Dr. Thomson's results. Mr. Thwaites of Ceylon has carefully studied the early developement of the frond, and states that the spores at first vegetate into slender confervoid filaments, with long joints containing spirally arranged endochroms. The filaments constitute a sort of prothallus or pro-embryo, the initial state of the plant. After a time thick branchlets, the germs of the perfect and permanent frond, spring from the cells of the confervoid filament; they are at first wholly dependent upon the cell from which they rise, but soon acquire rootlets at their base, and, rapidly elongating, grow into the densely cellular, opaque, cartilaginous bristle-like tubes, so characteristic of the mature plant in this genus.

1. *L. fluviatilis*, internodes longer than nodes=(Conferva fluviatilis lubrica setosa, Equiseti facie, Horse-tail River Conferva, *Dillenius*, Hist. Musc., tab. vii. fig. 47. Conferva fluviatilis, *Linn.*, *Mohr*, *Roth.*, &c. Polysperma fluviatilis, *Vauch.* Chantransia fluviatilis, *DC.* Lemania corollina, *Bory.* Nodularia fluviatilis, *Lyngb.*) This is the more common British species which I gathered in quantity in a stream on the Ochil Hills, near Stirling, in 1857. It has also been recorded as growing near Bangor (*Dillenius*), in Winterbourne Stream, Lewes (*W. Borrer*); at Hamsell, and at the waterfall at Harrison's rocks (*E. Jenner*); Aberdeen, abundant (*Professor Dickie, M.D.*); Ireland, frequent (*D. Moore*); Scandinavia, Germany, France, Corsica; Sackville river, Nova Scotia, adhering to stones.
2. **β. *tuberculosa* = (Nodularia fluviatilis ramosa, *Lyngb.*) Denmark.**
3. **γ. *media* = (Conferva fluviatilis, *Dillw.*, E.B., t. 1763). England.**
4. **δ. *fucina* = (Lemania fucina, *Bory.* Chantransia dichotoma, DC.) France, chiefly in Bretagne.**
5. **ε. *subtilis* = (Lemania subtilis, *Agardh*, in Act. Holm. 1814, t. 2, f. 4, Kutzing.) Sweden, &c.**

6. *L. torulosa*, internodes equalling the nodes = (Conferva fluviatilis nodosa Fucum æmulans, Sea Horse-tail-like Conferva, *Dill.* Hist. Musc. tab. vii. fig. 48. Conferva torulosa, *Roth.*, *Mohr.*, *Dillw.*, &c. Lemania incurvata, *Bory.*) Recorded as occurring in mountain streams near Ludlow, Salop (*Dillenius*), Anglesea (*Rev. H. Davies*); also in France, Germany, Kentucky, United States (*Dr. Short* in Harvey, Nereis).
7. *β. usneoides* = (Conferva usneoides, *Wallr.*) Saxony.
8. *L. variegata* = (Hippuris fluviatilis petræa nuda Virginiensis, *Pluk.*) Belleville, Canada West (*J. Macoun.*) United States, Pennsylvania? (Muhlenberg).

Probably *L. fluv*, *ε. subtilis*, and *L. torulosa*, *β. usneoides*, may be found, on investigation, to be well-marked species. The various forms deserve a careful examination, and I would beg to direct the attention of British botanists to the subject.

Art. V. On the Land Birds of Nova Scotia. By A. Downs.

[*Read Jan.* 9, 1865.]

To the casual visitor, Nova Scotia would appear to be very deficient in bird life, and to a certain extent this condition is apparent even to the settler, for in certain seasons of the year and in winter, the interior districts seem altogether deserted by members of the feathered tribe. The lumberer will tell you that his monotonous life in the woods at the latter season, is rarely cheered by the presence of birds, and save and except the peeping cry of the black cap, and Hudson's Bay tit, and the brown creeper, with an occasional harsh note from the Canada jay, or a "chip" from the red squirrel, no sound beside the creaking branches of the maple, or the melancholy sough of the pine, is heard to break the death-like silence which reigns around. An English settler will not fail to notice the difference which exists between the scarcity of birds around his country house here and in the old country. Here a few blue birds or titmice are the only specimens seen about dwellings, while in England flocks of vociferous sparrows are feeding in the yard, and many a black bird, thrush, hedge-sparrow, and green linnet, haunt the garden and orchard, taking their toll from the gooseberry and currant bushes.

This scarcity of birds renders a residence in British North America by no means so pleasing as it otherwise would be, if the hours of early morning were enlivened by the merry chirpings of our feathered favourites; and although some may be inclined to think that the presence or absence of birds has little to do with our happiness so long as prosperity attends our worldly condition, they will surely acknowledge that the song of birds, attached as it always is to the season of summer, when the flowers exhale their perfume and the bursting leaves give fragrance to the breeze, tends to elevate our feelings, and make us realize the full benefit we enjoy in the contemplation of these pleasing scenes of nature.

It may not be out of place here to consider for a moment whether we should not derive benefit from the acclimatization of some of these household birds of England. Take the common sparrow for instance. What a treat it would be to see these saucy fellows preening their feathers on our roofs, and collecting in dozens round our doors to pick up the scraps, and I would even go so far as to say, gobbling up the cherries in our gardens; for who would not make a sacrifice of some kind, to colonize his domain with such a family of merry friends. It is often said that the cold of a Nova Scotian winter would soon kill the English bird; but how is it, I ask, that many of these birds are found in Germany and all parts of Northern Europe, where the cold is often as great as we have it here. Then the birds I speak of are more of a domestic type, keeping near dwellings, and apparently preferring the society of man. If, therefore, during the hardest weather we took care to feed them daily, as we do the poultry, our barns and outhouses and spruce thickets would afford them sufficient shelter at night. I think it is worth a trial.

In the following list it will be observed that no less than eighteen different species of true warblers visit us in summer. Some of these are remarkable for the beauty of their plumage, and even more so for their song.

To him who is blest with a desire to retire from the busy hum of men, and amid the seclusion of the forest to study in nature's school, a bright sunny morning at the end of May, when the hard woods are expanding their newly-formed leaves, presents a scene which no pen could properly describe. Flitting about from tree to tree, these gaudy plumaged little songsters sing their melodious song, while the sunbeams dance in the shadowy glades, or flash upon the varnished leaves which rustle to the balmy western breeze. Up and down, round and round, chasing each other, darting from thicket to thicket, these merry little migrants from sunnier climes pursue in wanton playfulness their mates, or catch their insect prey; while at intervals they mount the topmost branches of birch or maple, and with distended throat and excited look pour forth their dulcet strains. Hard must be the heart of that man who is not moved at the scene around him, or as my worthy master in ornithology, Mr. Waterton, truly says in his ever memorable "'Wanderings in the South American forests'—heedless and bankrupt in all curiosity must he be, who cannot pause to look upon the towering mora tree, or listen to the distant bell note of the snow-white campanero."

But I fear my prefatory remarks are becoming too long and tedious. I will therefore pass on to my notes upon sixty-one different species of land birds, which will occupy my first paper upon the "Birds of Nova Scotia;" and should the present list prove interesting to the members of our Institute, I shall have great pleasure in following it up with others, and complete, if life and health be spared me, a perfect catalogue of all the birds that have been observed in the Province to the present time.

The Golden Eagle—(*Aquila chrysaetos*).—A specimen of this rare bird was taken in a fox trap uninjured, at Newport, in the winter of 1856. I first became acquainted with this bird in a garret, and he was so pugnacious, attacking Dr. Buskirk and myself with such fury, that I had to seize a broomstick to keep him off. Mr. Scarfe kept him for a year or more in a back yard opposite Mr. John Esson's, but at last he made his escape.

Bald-headed Eagle—(*Haliaetus leucocephalus*).—This bird is pretty common on the eastern coast of this Province. At Tangier their nests occur on the topmost branches of blasted pines and other trees. The nests are of large size and formed of sticks, and are always placed in an almost inaccessible position. This powerful bird when wounded throws itself upon its back on the approach of the sportsman, and with glaring eyes dashes out its huge talons with the utmost fury, rendering its capture by no means easy.

Some years ago, when I lived in town, I kept a pair of these eagles tame in my yard. One day Capt. Sir Richard Grant, R. N., came rushing in, in a great hurry, calling out—"Downs, your eagles are on the house and will get away," as he didn't know it was a common resting place for them. I afterwards gave these eagles to Capt. Dickson, the son of Sir Jeremiah Dickson, who many of you will recollect, and he took them to England with him. The female is extremely savage, for one in my collection when first taken at Tangier seized a child, and had killed several cats belonging to the miners. There is a dispute among naturalists as to whether there be two distinct varieties of this bird. The fact is, that the young birds do not assume the perfect plumage of white head and tail until the third year, and this immature state has no doubt given rise to the supposition. I am quite certain of the fact of the plumage requiring three years to mature, having one in my possession at the present time, which is just assuming the white head. In the month of June, some years ago, when that ardent naturalist the Rev. Mr. Torre, Secretary to Lord Falkland, was here, in company with him I visited the Shubenacadie, collecting specimens. We came upon the nesting place of these birds, situate on the precipitous cliffs beyond the Grand Lake. The young were sitting on the ledges of the rock high up, and screaming vociferously for food, which rendered the solitude of the place doubly felt. Thousands of night hawks were dashing over the river in chase of their insect prey as the sun was setting behind the dense mass of forest in the west, and as the wild notes of the birds echoed from the surrounding rocks, we stayed our paddles to rest for a while, and listen to this charming music of the wilderness.

Osprey—(*Pandion haliaetus*).—This bird is very common on our Atlantic coast, breeding in the vicinity of most harbours. I do not think that he ever troubles the settlers by making raids upon the poultry yards, as he appears to be a worthy inhabitant of Nova Scotia—a pure fisherman. Poising himself for a while in mid-air, he is suddenly seen to dash headlong to the water, and rise immediately with a large fish in his talons. This he carries to his eyrie, generally situated on the topmost branches of a storm-bleached rampike. If I were to state the quantity of sticks of which the nests of this bird is composed, you would surely think me guilty of exaggeration, for an ordinary cart would hardly hold it. He sets a good example to commissariat officials in looking far ahead in the furnishing of his larder, so much so that it sometimes becomes offensive from the effluvia arising from the superabundant food left unconsumed. I kept a nest of the young of this species in my collection last year.

Ice Falcon—(*Falco Icelandicus*).—I only know of one instance of this bird occurring in Nova Scotia. This was taken at the mouth of the harbour here in an exhausted condition on board a ship, and died shortly after it came into my possession. This is more properly a European bird.

Goshawk—(*Astur Atricapillus*).—This bird is far too common—a perfect villain among poultry. Even a few days ago he carried off a beautiful little call duck belonging to my neighbour, Mr. Drillio; a pet pigeon from Capt. Hugonin, and also a call duck from me. I lost many fancy pigeons of great value last year by one of these birds; in fact every one, more or less, on the peninsula and about the head of the Arm, suffers annually from his depredations. I cannot invent a name bad enough for him. The young of this bird for the first year is so different from the adult, that many persons not well acquainted with the bird would consider these varieties as distinct species.

Rough-Legged Buzzard—(*Buteo lagopus.*).—Very rare, and only occasionally shot on his migrations to the north. It is a handsome bird, feathered to the toes. I once possessed a splendid specimen, which I stuffed.

Red-tailed Buzzard—(*B. borealis*).—I have a living specimen of this bird in my possession now. He was taken in the garden at the Ordnance Yard, in the act of seizing a pet crow belonging to Mr. Pengelley. A soldier caught him in his hands. One day the Chief Justice brought Mr. Livesey out to my place, and on my telling the former that I had tried and condemned my specimen for attempted murder, Mr. Livesey said "he has evidently made a bad use of his talents (talons)."

Red-shouldered Buzzard—(*B. lineatus*).—This bird is of rare occurrence. I have only seen two specimens.

Hen, or Marsh Harrier—(*Circus Hudsonicus*).—This bird appears to have the widest range of any hawk known, being found in all parts of Europe, Asia, Africa, and America, even to the Equator. It is always known by the white rump, which occurs in all changes of its plumage from youth to maturity. In habit it is cruel, though cowardly, searching everywhere for victims, but selecting them only from weak and helpless objects. It preys upon moles, mice, young birds, and is very destructive to young game: nor does it spare fish, snakes, or even worms. I once took two green snakes from the crop of one of these birds. The slender body and elegant shape distinguish this species from others of the genus.

Pigeon Hawk—(*Falco columbarius.*)—This species is common in Nova Scotia, breeding in all the wooded parts of the colony. It is not troublesome to the farmer, only feeding upon the smaller birds. On my recent visit to Boston, while on my passage about half way across the Bay of Fundy, while I lay sick in my berth on board the "Delta," I was suddenly hailed by Mr. Cunard, who said a live bird had just come on board. Refreshed by the intelligence, I jumped up on deck, and found a sailor with a beautiful little pigeon-hawk in his hand, which had been taken in the rigging; General Doyle called for some meat, a portion of which he consumed. Unfortunately, after my putting him into a box, a steward, while feeding him, pulled one of the laths off, and just as we made Cape Ann, our little friend flew up the gangway and hasted ashore—thus getting his passage free, all found.

Sharp-shinned Hawk — (*Astur fuscus*). — Common. Breeds all over the Province. Like the pigeon hawk, it does not molest the poultry yards, being too weak and puerile to attack large prey.

Sparrow Hawk — (*Falco sparverius*). — Savage and bold in habit, this little bird, swift of flight, attacks even a canary at the cottage window. It is happily not very common. I once raised a nest of young ones, four in number, which afterwards died. Its plumage is very rich—black, brown, and white, deeply marked and distinct.

Hawk Owl—(*Strix funerea*). — This bird is in some years very abundant in winter time, but may not be seen again for four or five years. It is common in Newfoundland, where it breeds in the cariboo districts. I have often kept living specimens in confinement, taken sometimes on board the Cunard steamers off the coast.

Great-horned Owl—*(Bubo Virginianus)*.—I have now in my collection two of these birds, which I have had for several years. The female is a very fierce bird, and has a certificate of bad character nailed on her cage. She murdered her husband, and ate him, and from her dignified deportment has been named by visitors "The Lord Chancellor." She is black with murder, treason, sacrilege, and crime, and was presented to me by Mr. J. M. Jones.

Snowy Owl—(*S. nyctea*).—This bird is common here in winter, and breeds in Newfoundland. It appears that in some winters these birds traverse the North American continent in flocks. Last winter they made their appearance in great numbers in different parts of Canada.

Barred Owl—(*Syrnium nebulosum*).—This bird is a resident, never migrating from the colony. It breeds in the woods in all parts. It feeds on hares and ruffed and spruce grouse. The eye of this species is round and bluish-black in colour, while all the other owls have yellow eyes. This is the bird that disturbs the midnight slumber of the moose hunter and lumberer, coming near the camp fire and peering into the glare, which gives it a demoniacal appearance. Distending its throat and pushing its head forward, it gives vent to an unearthly sound, which to the superstitious is all but overcoming. While moose hunting some years ago, a colored man of kindred taste, by name Cornelius Toliver, one evening at the camp fire while listening to the hooting of this owl, related a superstitious tale regarding the appearance of his brother's wife after death, a circumstance of which he seemed greatly in dread.

Long-eared Owl—(*S. otus*).—Very rare in the colony, but is flushed occasionally when sportsmen are woodcock shooting.

Short-eared Owl—*(S. brachyotos)*.—Occurs here but rarely. I have a specimen which was taken alive on board the R. M. S. *Canada*, off Cork, Ireland, about two years ago.

Tengmalmi's Owl—(*Noctua Tengmalmi*).—Not common here, but abundant in Newfoundland. I stuffed two of these pretty little birds for a passenger in the "Osprey," who brought them to me alive, having captured them on board that ship off Cape Ray.

Acadian Owl.—This bird is known to the Indians and settlers as the "saw-weet," from its emitting a cry somewhat like that word. Capt. Bland, R. E., and Mr. George Piers had a living specimen of this bird which they put into a room with a live rat. He immediately attacked and killed the rat, but died shortly afterwards, having apparently overtaxed his strength in his efforts, which will not be wondered at when we consider that the weight of this little assassin is but two ounces and a copper.

WHIP-POOR-WILL—(*Caprimulgus vociferus*).—This bird used to breed here regularly near Hosterman's mill at the head of the Arm. I once heard one crying by my pond close to the house at midnight; but alas! from causes unknown, we no longer hear the plaintiff cry of the Whip-poor-Will. Waterton, speaking of this bird in the forests of Demerara, under the name of "goatsucker," thus proceeds—"The harmless, unoffending goatsucker, from the time of Aristotle down to the present day, has been in disgrace with man. Father has handed down to son, and author to author, that this nocturnal thief subsists by milking the flocks. Poor injured little bird of night, how sadly hast thou suffered, and how foul a stain has inattention to fact, put upon thy character! Thou hast never robbed man of any part of his property, nor deprived the kid of a drop of milk." When the moon shines bright, you may have a fair opportunity of examining the goatsucker. You will see it close by the cows, goats, and sheep, jumping up every now and then under their bellies. Approach a little nearer,—he is not shy, "he fears no danger, for he knows no sin." See how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them as fast as they alight on the belly, legs, and udder of the animals. Observe how quiet they stand, and how sensible they seem of his good offices. Were you to dissect him and inspect his stomach, you would find no milk there. It is full of the flies which have been annoying the herd.

NIGHT HAWK—(*C. Virginianus*).—This very common bird breeds on all blueberry barrens throughout the colony. It rarely visits us until the warm weather of June arrives, and departs for the south before the first frosts of autumn arrive. They lay two pretty mottled eggs on the bare ground.

SPINE-TAILED CHIMNEY SWALLOW—(*Hirundo pelasgia*).—Very common, building its nest in a chimney formed of little sticks, glued together with a glutinous substance, somewhat like the edible bird nests of China.

PURPLE MARTIN—(*H. purpurea*).—This bird visits us every summer, but does not appear to like the place, as we are perhaps too near the sea coast. I have offered it every opportunity for breeding, to no purpose. When our Institute visited Windsor, at its first field meeting in the summer of 1863, I saw some of these birds looking for a convenient place to nest in about the Clifton House; and I am sure they would breed there if suitable boxes were provided for them, as they appear to delight to breed about inland hotels in the United States, where they are always provided with martin houses. In the western States, the Indians put up hollow gourds on poles for their accommodation.

WHITE-BELLIED MARTIN—(*H. bicolæ*).—Breeds freely in boxes at my house and Halifax. It is the earliest swallow we have, arriving here about St. George's day. It is not gregarious in habit.

CLIFF SWALLOW—(*H. fulvus*).—This bird is very different in its habits from the latter species, building its nest of mud, while the other uses straw and feathers. It also likes the society of its fellows, always building in company in positions like the Dockyard, old Barracks, Province Building, and Dartmouth church, from which latter place I am sorry to say it has been driven away by having its nesting places built up. What would Waterton say to such inhospitality? I saw this bird breeding about the cliffs of the rocks overhanging the Shubenacadie, in numbers.

BANK SWALLOW—(*H. riparia*).—Not found about Halifax, but is plentiful about the shores of the Basin of Minas, where it builds in the banks. Mr. Torre shot one for a specimen when entering its hole to feed its young. We counted about two hundred flies in its mouth and throat.

BARN SWALLOW—(*H. rustica*).—Is very common, breeding in most of the barns of the country. It is a good architect, like the cliff swallow, building a mud house for its young.

BELTED KINGFISHER—(*Alcedo alcyon*).—This is a very common bird all over the Province. It builds its nest in a bank, high above the water at the end of a tunnel about two feet long. It lays six fine pearly white eggs. It pays frequent visits to my pond, sitting upon the dead branch of a tree, from which it occasionally makes a plunge for a fish. I think this bird might be kept in confinement, like the Laughing Jackass of Australia, another member of the genus. The note of this bird is very similar to the "whir" of a watchman's rattle, and is more frequently emitted during the breeding season.

Tyrant Fly-catcher, or King-bird—(*Muscicapa tyrannus*).—Inland, but rare on the sea coast. At Londonderry, Windsor, &c., it is by no means a scarce bird. They are very useful on farms as watch-birds, driving away hawks from the poultry yards. This bird ought undoubtedly to be carefully preserved by all farmers, for he may well be termed "the farmer's friend." He also feeds on noxious insects. Poor Alexander Wilson paid a tribute to his worth in a poem, the language of which is so touchingly beautiful, that apart from all his other publications it is sufficient to raise him in the estimation of all kind-hearted people.

Green-crested Fly-catcher—(*M. Acadica*).—Frequents the woods, and is generally seen in company with the warblers. It builds a little hanging nest, usually suspended between the fork of a small branch, and lays four white eggs.

American Redstart—(*M. ruticilla*).—This beautiful bird is very common, arriving generally about the 10th of May. It is called by the settlers "gold-finch." By no means shy, this little fly-catcher presents a showy appearance in our woods. Several pairs breed every year near my house, forming nests similar to those of the green-crested fly-catcher. Waterton found this species in the winter season in Demerara, but never knew where it bred.

Red-eyed Vireo—(*Vireo olivaceous*).—Very common. It used to breed plentifully in the hardwood groves at Purcell's Cove, but I grieve to say that the fishermen living there have cut down nearly all the trees for fuel, and the poor Vireo has to seek for another home. His note sounds like "Whip Tom Kelly," constantly repeated all day long.

Canada Fly-catcher—(*Myiodioctes Canadensis*).—This species usually arrives about the 10th of May. Its colour is olive green with a black cap. It is always found with the warblers, and appears to be a connecting link between the warbler and fly-catcher.

Note.—There is another large species of fly-catcher which I cannot make out. It frequents the barrens about Grand Lake and Lawson's Mill. It is very solitary in habit, and does not make its appearance until the summer is well advanced. The coloured man Toliver, mentioned before, was generally hailed by his children when the first note of this bird was heard, with—"Daddy, here summer's come."

Great American Shrike — (*Lanius borealis*). — This bird is common in winter time, and is very daring, attacking even canaries in cages at a window. I think it breeds north, as it is not observed here in summer.

Robin, or Migratory Thrush—(*Turdus migratorius*).—Of this bird I need say but little, as all people, old and young, are cheered by his presence and song in spring. It also enlivens the homes of the Newfoundlanders at the same season. Arrives here about St. Patrick's day; a few stop with us all winter.

Hermit Thrush — (*T. solitarius*). — Common, although not generally observed. Its sweet yet melancholy note, given from the top of a spruce, late in the evening, induces the settlers to name it "*the nightingale.*" It lays four eggs of a blue colour in a nest on the ground, formed of dry grass and small roots, and is generally placed under the shade of the ground juniper.

Olivaceous Thrush — (*T. olivaceous*). — This species may be readily taken for the last. It makes a far different nest however, building in trees; the egg is also very different in colour. Its plumage is more of an olive green, while the former is of a rich brown.

Cat Bird—(*T. felivox*).—This is a common bird, but does not arrive until the summer is well advanced. It breeds in the alder swamps about the Dutch Village, and lays four blue eggs. Some of my neighbours have several of these birds in cages at the present time. It is the best song bird we have.

Golden-crowned Thrush—(*T. aurocapillus*).—Very common in the wooded districts, but hardly ever seen in the open. It builds an oven-shaped nest, and lays four eggs. Its note is loud and rapid and makes the woods ring with its echoes. In habit it is shy and solitary.

Water Thrush—(*Cinclus Americanus*).—This species is found about the margins of solitary lakes in the woods, and appears to delight in running in the shallows, searching for water beetles and other insects. It has long and slender white legs well suited to its habits, which are somewhat similar to those of the water wagtails of England.

American Pipit—(*Anthus Ludovicianus*).—This bird generally arrives here on its way to the south about the 20th September, and only stays a week or ten days. It may frequently be observed about that date on the stone walls around "the common," constantly wagging its tail up and down. It feeds upon insects and small seeds.

SHORE LARK—*(Alauda alpestris)*.—Generally arrives here from the south about the end of March, on its way to the north. It breeds in Newfoundland.

RED-POLL WARBLER—(*Sylvicola petechia*).—This is the pioneer of the genus *sylvicola*, arriving here about St. George's Day, even while the snow remains upon the ground. It makes its nest in a little mossy hillock in swampy places in the woods.

YELLOW RUMP WARBLER—(*S. coronata*).—This is the next visitor, arriving about the 1st of May. It builds its nest at the top of a pine tree, and lays four little blotched eggs. It is very common; handsomely marked with lemon yellow on the head, buts of the wings, and rump. Many people call it a goldfinch.

BLACK-POLL WARBLER—(*S. striata*).—Rare. I have shot but few specimens, and know nothing of its habits.

BAY-BREASTED WARBLER—(*S. castanea*).—This species is not very common, and frequents pine woods.

CHESNUT-SIDED WARBLER—(*S. ictero-cephala*).—This gay little warbler is very common in the birch groves, flitting from tree to tree, pouring forth its love song in the breeding season.

HEMLOCK WARBLER—*(S. parus.)*.—Only one specimen of this rare visitor has fallen under my notice, which I shot near the "rocking stone" at Kidston's.

BLACK-THROATED GREEN WARBLER—(*S. virens.*)—Abundant in pine woods. Its note sounds like "a little bit of bread and no cheese." Have never found the nest of this bird.

CAPE MAY WARBLER.—(*S. maritima*).—Very rare. I have only seen one specimen, which I shot at Dartmouth some thirty years ago. I still have it in my collection.

BLACKBURNIAN WARBLER—(*S. Blackburnia*).—Observed on the hardwood hills about Grand Lake, but never about the sea-coast district. It is one of the handsomest of the warblers which visit us.

YELLOW-POLL WARBLER—(*S. æstiva*).—I have shot a few specimens of this bird about Kidston's, but know little of its habits.

YELLOW-BACKED WARBLER—*(S. Americana)*.—This is another rare species, occurring inland in hardwood districts. I have shot several specimens; always perched on the tops of the highest maples and other hardwood trees, over brooks of running water.

Black-throated Blue Warbler—(*S. Canadensis*).—Occurs rarely about Grand Lake. Have never shot more than two specimens.

Black and Yellow Warbler—(*S. maculosa*).—Abundant in all the wooded districts; arriving about the 10th of May.

Blue-eyed Yellow Warbler.—This familiar little warbler breeds in the vicinity of dwellings, generally in a gooseberry or lilac bush. It is of great service to the garden, consuming vast quantities of green caterpillars and insects. It is very fond of willow trees, and generally observed in such positions.

Blue-green Warbler.—This species is very rare.

Mourning Warbler—(*Trichas Philadelphica*).—Of this species I have only obtained one specimen, which I shot at the "rocking stone," near Kidston's, four years ago.

Maryland Yellow-throat—(*T. Marilandica*).—This pert little fellow has a good deal of the habit of the "Jenny Wren" of England, dodging in and out of a faggot heap. During the breeding season it has a habit of rising in the air singing, and drops down again like a stone. It generally builds at the foot of an alder bush, and successfully raises a large family.

Nashville Warbler—(*Sylvicola rubricapilla*).—I have always observed this species singing on the very topmost branches of trees. It is very wild and difficult to shoot, and is not very common.

Having now arrived, gentlemen, at the end of my present list, I must state that all the facts I have given may be safely relied upon, as they are the result of forty years' experience in bird life. And I would here, as it is the very first time I have ever appeared as a reader in public, take the opportunity of counselling the young men of Halifax to take more interest than they do in the natural history of their country. Many an hour now passed in walking up and down Granville Street in tight boots, might be devoted far more profitably to studying the quiet scenes of nature. If I had listened to the advice given me by the young men of my time, I do not think I should have had the pleasure of appearing here this evening; and instead of being happy, as I now am, in the presence of my brother naturalists, and possessed of a cheerful home to which I can retire, surrounded by my feathered favorites, I should most probably either have descended to an early grave, or been the habitual frequenter of the tobacco and dram shops. No; the country for me, before all the grandeur and pleasure of the town. Old Waterton once said to me, he would sooner be in the woods than in the finest palace in Europe.

Art. VI. Observations on the Sea-birds frequenting the coast of St. Margaret's Bay, N. S. By Rev. John Ambrose.

[*Read Jan'y* 9, 1865.]

For the convenience of persons wishing to make enquiries of our fishermen, or desirous of obtaining specimens from them, I give the names by which they distinguish the sea-birds with which they are familiar, together with the scientific equivalents of those names, so far as I have been able to identify them :—

Loon—(*Colymbus glacialis.*)
Sea-duck—Eider—(*Anas mollissima.*)
Bottle-nose Drake—King eider—(*Fuligula spectabilis.*)
Coot, black—Common Scoter—(*Anas nigra.*)
Coot, bottle-nose—Surf Scoter—(*A. perspicillata.*)
Parrot—Puffin—(*Mormon fratercula.*)
Murr.
Turr.
Lord or Imp—Harlequin duck—(*Anas histrionica.*)
Cockawee—Long-tailed Duck—(*A. glacialis.*)
Hag-down—Manx Shearwater—(*Procellaria Puffinus.*)
Shell-Drake—(*Anas tadorna.*)
Red-breasted Merganser—(*Mergus serrator.*)
Grey Dipper.
White Dipper.
Black Duck—(*Anas boschas.*)
Common Teal—(*Anas Crecca.*)
Sea Pigeon.
Little Auk—Rotche—(*Uria minor.*)
Storm Petrel—(*Thalassidroma pelagica*).
Canada Goose—(*Anser Canadensis.*)

Brent Goose—(*Anser brenta.*)
Common Gannet—(*Sula Alba.*)
Shag—Cormorant—(*Phalacrocorax cristatus.*)
Saddle-back Gull—(*Larus Marinus.*)
Large grey Gull.
Mackerel Gull—(*L. argentatus.*)
Winter Gull—(*L. leucopterus.*)
Sea Goose.

This list is by no means complete, as there are many birds less frequently seen on the coast, of which I have not yet obtained specimens or reliable accounts.

The main body of these birds spend the winter far to the westward of these shores; but a large number of stragglers of almost the whole list (of the duck and gull species) remain over winter, and furnish an agreeable variety to the larder, and a luxurious substratum as well as covering to the beds of our fishermen. On every fine day towards spring, especially if slightly hazy, as before a thaw, when the sea is smooth, from daylight till dusk, a continual popping is heard all around the Bay, and the far-off dot-like boats with their puffs of smoke add an enlivening effect to our winter landscape. Then the murr shooter is busy, for murrs at this season of the year seldom fly, but strive to escape by diving. The fowler, provided with one or two old militia muskets, an ox-horn full of cannon powder, and a bag of duck shot, sits amidships in his skiff, facing the bow. Pushing the oars, he quietly approaches the murr within thirty or forty yards, and fires. If the shot fails, the bird dives and comes up a hundred yards or so further off, is again approached as before, and so on until finally secured.

Our sea-birds begin to return eastwardly to the breeding places in the following order:—eiders about the middle of March; young coots and young eiders (*i. e.* birds not a year old), puffins, murrs, turrs, long-tailed ducks, harlequin ducks, loons, sea-pigeons, and shell-birds, about the last of March. Old coots a week or so later than the foregoing. By the last of June all birds of the duck species have passed.

They mostly fly with a fair wind, though not a day passes without some travellers during the migrating season. The largest numbers keep off at distances varying from four to eight miles from the ordinary coast line, so that the largest flocks are clear of danger, and only the smaller ones pass close by the outside capes and headlands. Consequently, Green Island affords the best shooting, Iron-bound Island, off Chester Bay, the next best, then the outside ledges at the west side of the mouth of this Bay, where many birds stop to feed on shell-fish. The inside flocks then make a straight course for Peggy's Point, thence fly directly to Betty's Island, off Prospect,—a very few passing within shot of the islands off Dover.

The young birds, both of the eider and scoter species, viz., such as are about pairing for the first time, do not as a general rule fly with their seniors, but prefer going in flocks by themselves. Whether this arrangement is dictated by prudence on the part of the old birds, or impatience of controul and a desire for congenial society among the young, its consequences prove that the largest liberty is not always the best thing for youth and inexperience. Urged by the instinct of reproduction towards the sunny islands of the north, the young birds take the shortest routes, pass within reach of the fowlers' shot, and many pay for their impatience with their lives. "*Festina lente*" is a lesson towards housekeeping most frequently learned by painful experience, by men as well as birds on our shores. Early marriages among the thriftless and unprovided lead to much misery among our fishing population.

The food of most of the duck species seems to consist mainly of shell-fish, principally mussels, which they obtain from the various outlying ledges. I say most of the duck species, because some—such as "shell-birds," murrs, and turrs,—like the gulls, live mostly on fish. And here we observe the provident care of Him who openeth His hand and filleth all things living with plenteousness. Birds living on shellfish and weeds are furnished with a broad, flat, strong bill, suitable for detaching and crushing their food. Others, such as shell-birds, which live on both small shells and fish, have the bill narrower and stronger, as well as sharper in the curved edges at the sides. Others still, such as turrs, and gulls, &c., which feed on fish alone, have the bill narrow, sharp at the sides, and generally with a downward curve at the point, for the better seizing and securing the slippery and struggling prey.

Sea-birds, much more than land-birds, are inclined to straggle from the main flocks and deviate from general rules. The migratory thrush is almost the only straggler among our land birds that I have observed remaining behind the main body in their autumnal migrations. But, as I before observed, almost our whole list of sea-birds are given to straggling habits in autumn. And in spring, whilst the main body go far north-east to breed, a few grey gulls, murrs and puffins, breed on our shores. Tradition would show, however, that the majority are reformers, whilst the minority are such as hate vulgar innovations, are content to "let well-enough alone," and stick to old systems, regardless of danger. Old settlers affirm that these shores formerly abounded with sea-birds, and that our outlying islands were the breeding places, not only of almost all the existing species, but also of one which, by the description given me by the late Michael Publicover, of Blandford, I take to have been the great auk (*Alca impennis*). But as men and guns began to multiply, the birds found it necessary to resort to less frequented places to the north-east. So it has been also with the fish of these waters. Danger has altered their habits, and it is only those which "learn nothing and forget nothing," that among our birds and fishes retain unaltered the institutions of more ancient times and safer circumstances.

The names given to our sea-birds by the fishermen are mostly descriptive, as indeed all names of distinction should be. The puffin is called the parrot, because of the similarity of its bill to that of the latter bird. The cock-a-wee is so named from its gabbling note, which sounds like this name. In some parts of the Province it is called the old squaw, from the ludicrous similarity between the gabbling of a flock of these birds and an animated discussion of a piece of scandal in the Micmac language, between a number of antiquated ladies of that interesting tribe. The harlequin duck is called a lord, on account of the gay plumage of the drake. It is also known as the imp, because of the difficulty of shooting it. The little auk is called the bull bird, from the shape of its head and neck. It frequents our coves in the dead of winter and towards spring, and rarely flies, but endeavours to escape pursuit by diving. It is the favourite game of boys, more eager for the pleasure of a shot than solicitous as to the cost of ammunition.

The boatswain is always found in company with his betters, the larger kind of gulls, who by no means relish his society, but vote him an intolerable bore. His habit is to pursue the gulls through the air until they drop their excrement, which he catches and devours ere it reaches the ground. He is consequently looked upon with much contempt by our fowlers, but enjoys the usual immunity of meanness, for the gulls are shot and eaten, whilst he is suffered to escape.

The hag-down is seldom found near the shores, but like the sea-goose keeps off at a distance of not less than six or eight miles. In dark and foggy weather both kinds come in occasionally, the sea-goose particularly, about the end of June. Hag-downs, like petrels, are very fond of scraps of fish or meat thrown overboard by the fishermen, who thus lure the birds to their destruction, the hag-down flying so close to the boat as to be easily knocked down with a sprit or oar. They are very tenacious of life, and like Irishmen may be "kilt" many times by the blow of a stick, and yet recover. They are killed mostly for the sake of their feathers. The bodies are generally thrown to the pigs, though some persons manage to eat them, as they eat gulls and cormorants, by skinning before cooking them.

The birds most highly prized for food are eiders and coots, or scoters. These are shot in large numbers at Iron-bound and Green Island by the help of decoys. The ingenuity displayed in the manufacture of these decoys is very creditable to our fishermen. They are made of pine or spruce, neatly shaped, and not unfrequently covered with the skins and plumage of the birds they represent. They are attached to each other by pieces of codline of various lengths, so that on the water they are distributed by the winds and currents, exactly in the manner and at the relative distances of their living prototypes when swimming at their leisure. The two families on Iron-bound place these decoys in good positions for shooting, immediately before the arrival of the first flocks of birds. For some days not a gun is fired on the island, nor a loud sound heard. The birds, arriving and finding everything still, and flocks seemingly of their own kind already in possession of quiet and desirable places for food and rest, exchange caution for emulation, call a halt, and at once settle down. Then begins the work of destruction. The decoys are quietly drawn in towards the shore by the fowlers, who with muskets and large water dogs are carefully concealed behind the rocks nearest the shore. The ducks follow by degrees, until a large number are well in, and then, sitting and rising, receive the deadly welcome. The water is stained with blood, and covered with the bodies of the slain, and the air is rent with the flapping and quacking of the survivors, and the barking of dogs ere they muster courage to rush into the half-frozen water and secure the floating, swimming, and sprawling game. In this manner, during the easterly passage of the birds, hundreds are secured by the people on Iron-bound alone. I am credibly informed that during the vernal and autumnal flights something over two thousand birds were shot on this island in 1863. The greater part of the game is sent to Halifax, Lunenburg, and the neighboring places for sale, whilst the feathers bring from thirty to thirty-five cents a pound.

The people of Peggy's Cove shoot from their boats, lying off in a line extending seaward from Peggy's Point. I have seen in a morning in spring as many as fourteen or fifteen boats thus lying off, at the distance of a little more than a gunshot apart, tossing on a sharp "lop," or slowly rising and falling on a southerly swell. Two men go in each boat, one to fire and the other to keep the boat in position by short strokes of the oar, which is called "drumming." The wind is south-west, or west, the weather is hazy, and the birds, seizing the opportunity of a fair wind and obscurity, fly from headland to headland in large flocks. To our unpractised eye, as we stand on the cliff, no bird is visible; but the urchins around suddenly exclaim "there's a bunch comin'!" They come straight on; but presently discovering the nearest boat, sheer slightly, rise much higher, and pass between two other boats. Bang! bang! is the salute, and you see the disabled suddenly tumble with hanging wing; others reel on their course, try for a moment to keep up with the increased rapidity of their companions, but fall here and there at short distances from the boats.

From daylight until eight or nine o'clock in the morning the firing continues, and in the height of the flying season, at intervals throughout the day.

Sometimes these excursions are attended with excitement of a different kind. Two of our fishermen, tempted by the abundance of game, remained so long outside one squally morning, that at length a heavy sea filled the boat, sweeping the men overboard.

They were rescued by another boat's crew with much difficulty, having lost everything in their own boat.

Two others were coming in, on another occasion, after a morning's shooting, when they saw a heavy sea approaching. "Hold on!" said one, "and we shall get a runner." But the sea, instead of running them in towards the shore, broke upon their boat, and washed one overboard. The other threw him an oar, leaving himself but one, by which the boat was unmanageable. Another boat, however, rescued both men from their perilous situation.

A boat's crew on these shooting excursions will generally bring in from two or three to twenty or thirty birds, according to the position of the boat and the skill of the fowler. But at points further out along the coast, such as Green Island, Horse-shoe Ledge or Betty's Island, as many as forty or fifty birds are not unfrequently brought home by one boat in a morning.

At the first settlement of the shore, birds were much more numerous than at present. As the population increased, the number of birds fell off rapidly; but this decline was at length discovered to proceed more from the club than the gun. For many years vessels had been allowed to load with sea-birds' eggs at the various breeding islands between Nova Scotia and Labrador, through the entire period of incubation, and this egg-gathering was too frequently attended by the wanton and wholesale destruction of the parent birds. From the beginning of the breeding season to the end of it, these islands and rocks were continually visited, all fresh eggs were taken away, and all stale ones broken. At length some wholesome and necessary restrictions on the egg trade were put in force by the Canadian legislature, since which time the birds, though more wary, are not decreasing in numbers so rapidly as formerly. A future generation will see the necessity of reasonable protection for the reproduction of birds and fish, and necessity may inspire the firmness requisite for the impartial execution of such protective edicts.

The shooting of sea-birds is not only a source of profit to our fishermen, and a means of providing them with an agreeable variety at their frugal board, but it also relieves a great deal of the tedium of their winter season of inactivity. It is surprising, however, that accidents do not more frequently happen from their mode of charging their guns. Three fingers of powder and two of shot is the smallest load for their old militia muskets—the approved gun here,—and in the hurry of loading in a boat much more powder is frequently poured in. Black eyes and bloody noses are the not uncommon penalties of a morning's sport, and I know one fisherman whose nose has been knocked permanently out of shape by the frequent kicking of his gun. In several instances the gun has gone clear overboard out of the fowler's hands, by the recoil. But nothing can daunt these men, or induce them to load with a lighter hand. There is one living at Nor'-west Cove, who has had his right eye destroyed by his gun, but who is now as great a duck-shooter as ever, firing, however, from the left shoulder.

Many of these people have a strong belief in the potency of charms and incantations, in connection with shooting, and consequently would lose all confidence in themselves, and all ability to take aim, with a "charmed gun." A man formerly lived at La-Have, who enjoyed the reputation of being able, with a glance, to pervert for a time the shooting qualities of any gun. Not unfrequently did this fear of his evil eye induce other sportsmen to withdraw, leaving him all the shooting of the occasion. The same superstition exists among the African tribes, so far proving that the negro is "a man and a brother."

A singular proof of the adaptation of instinct to necessity, is found in the manner in which sea-birds of the duck species attempt to escape when on the water and unable to fly. They will swim for long distances just so much below the surface of the water that the end of the bill as far as the nostrils is the only part of the body exposed to the air. Many in this way escape the most careful pursuit. It seems to me more than probable that this art has been acquired since their acquaintance with man, the only foe whose "far-darting" destructive power, and inability to see the operation from above, makes such a mode of escape at once necessary and practicable.

Crippled birds resort to retired coves and out-of-the-way nooks, where they remain until fully recovered. Some are wing-broken and unable to fly, others are maimed in the leg or foot and can not dive, but He who careth for the fowls of the air is their provider, and very many of them get the better of their wounds. There is a favourite resort for wounded birds between Peggy's Cove and Dover, which is thence called the "hospital." There is also a well-known "hospital" for sick and wounded fish about a quarter of a mile outside of Peggy's Point. It is a narrow gulch or ravine with a muddy bottom, thirty fathoms deep, bounded on each side by a sort of rocky cliff fifteen fathoms from the surface. Healthy fish, observing ordinary rules, are found on the rocky bottom at each side of this ravine, but in the muddy valley itself none but the sick and wounded are taken. There they are caught of large size, but what are called "logy fish"—many of them wounded with deep gashes, not such as are generally made with any of man's contrivances, and all wretchedly thin. On either side of this hospital hake will not take bait in day time, but in the "sick bay" itself—"*necessitas nullas habet leges*,"—they will bite at all times. They are hungry, and therefore likely convalescent, but not sufficiently strong to defend themselves or take their ordinary prey at proper seasons outside.

ART. VII.—SOME ADDITIONS TO THE GAME OF NOVA SCOTIA. BY J. H. DUVAR.

(*Read Feb.* 6, 1865.)

"NATURAL HISTORY in the olden time" would be an excellent subject for the pen of any member of this Institute, who combines with his knowledge of Natural History a taste for dipping into history proper. In following his liking for the latter pursuit, the naturalist would stumble on records that would astonish the scientific men of the present day. While it is impossible to withhold our meed of admiration from the early travellers and missionaries who, led by the spirit of adventure, or zeal for their order, made their way into the most savage lands, and brought back not unfaithful accounts of manners and customs, it is yet astonishing how credulous they were in all that pertained to natural history. I have in my possession a tracing of a Jesuit map of Lake Superior, made in 1670, which agrees in almost every detail with the modern chart, yet of the same date, when their topography was so reliable, the reports of the good fathers on animated nature were not such as have been confirmed by later investigations. In these days of minute and exact research, it may not be uninteresting, from the stand point to which the waves of progress have wafted us, to pause and look back to the landmarks that indicate the ebb and flow of the great ocean of Truth, on the shores of which this generation and those past have alike been picking up shells.

Navarette, for instance, describes, in the empire of China, an alligator, three fathoms thick, in which were found three men's heads, with some daggers and bracelets. Nevertheless there was an herb which enabled the possessor to ride this formidable creature with safety, as Waterton rode the cayman. The unicorn is described, among other qualities, as being "a merciful beast." The mermaids of the Gambia are reputed, when fried, to resemble pork. A singular efficacy against falling sickness resides in the leg of the elk, *which* leg is discovered by knocking the animal down, and observing with which foot he scratches his ear. There is a variety of goat in Nankin, that has ears and nose, but no mouth, and lives upon the air. A still more extraordinary animal must be described in the author's own words. "There are two other strange and remarkable creatures in China. The one is called *Lang;* its forefeet are very long, and the hinder ones short. The other beast is named *Poei*, or *Poi*, whose hind feet are long and the fore feet short, whence it follows that they cannot go singly apart from one another. Their Maker taught them how they should go from place to place to feed and seek their sustenance. Two of them join, and one helps the other, so that one sets down the long fore feet, and the other hind feet, so they make one body that can walk: thus they get their food and live. The Chineses call miserable poor wretches that cannot live by themselves *lang poi*, to signify that they want some assistance to get a living. This is not unlike a lame and a blind man, one finds eyes and the other feet, and then they help one another and walk." The same or another observer met with a fowl the size of a chicken, which laid, a yard deep in the sand, eggs "bigger than the bird itself, so that no man living would judge that the eggs could be contained within it." In the vegetable kingdom, the curate of Labaun saw a tree whose leaves falling to the ground turned into mice. And in Lower Germany are found on the sea shore trees whose leaves, dropping into the water, are converted into ducks.

These examples may suffice to mark the distinction between the natural observers of two centuries since and those of even this little Institute,—being, as it is, an outlying post, or rather vidette, on the extreme edge of the intellectual field of the century.

Coming down from these worthy travellers who trustingly accepted the most incongruous appearances as merely so many manifestations of the Creator's power, through the later periods of close observance and accurate classification, we find that the studies of the naturalist in the present day are mainly given to utilize the mass of facts which he and his predecessors have garnered up; hence acclimatization, fish-culture, improvement of domestic stock, and search for animals and plants that may contribute either to man's wants or luxury.

The geographical distribution of animal life does not strictly follow the isothermic lines of the globe. Hence there is an increased range for stocking the temperate zone with the products of other zones, especially of the warmer belts, which are more prolific of varieties than the colder, and, moreover, it is well recognized that animals adapt themselves better to change of climate when removed from a higher to a lower degree of temperature, than from a lower to a higher. This fact indicates to us more than one inhabitant of southern latitudes, which, by a little attention, might be induced to naturalize in our colder air;—the alpaca, for instance, which, already imported into Spain, finds on the slopes of the Pyrenees the summer and winter climate of Nova Scotia. M. Saint Hilaire* very learnedly shows that man, who calls himself the lord of creation, is really lord of only forty-seven specimens, all told, of beasts, birds, fishes and insects. His list is interesting. Here it is, omitting the dates of domestication :—

Mammalia: The Ox, Buffalo, two varieties of Camels, Goat, Sheep, Zebu, Yak, Lama, Alpaca, Reindeer, Arnu, Joyal, Horse, Ass, Dog, Pig, Cat, Guinea Pig, Rabbit, Ferret,—total, twenty mammals.

Birds: The Pigeon, Poultry Fowl, common Pheasant, Peacock, Game Fowl, common Duck, Swan, Ring Turtle-Dove, Chinese Goose, Canary, Turkey, Muscovy Duck, Golden Pheasant, Silver Pheasant, Ring Pheasant, Canada Goose,—sixteen Birds.

Insects: The Mulberry Silkworm, Bee of southern Europe,

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* Acclimatation et Domestication des Animaux Utiles.

common Bee, Egyptian Bee, Cochineal, Almond Silkworm, Ailanthus Silkworm,—seven insects.

FISHES: The Carp, Goldfish,—two fishes.

REPTILES: None.

Total, 21 mammals, 16 birds, 7 insects, 2 fishes—46 in all, instead of 47.* Of these 47, M. St. Hilaire says fifteen are wanting in France and thirteen in Europe;† and he adds, "is this a sufficient conquest of nature? Is it enough to have in our court yards only three species so valuable as that of the gallinaceæ?—or only one of the rodentiæ, so remarkable for its fecundity, the precocity of its development, and the excellence of its flesh? Among the large herbivorous mammalia, is it enough to possess only four alimentary species?" I would add, is it enough for our sportsmen to possess, in a Province such as Nova Scotia, of which so large a portion must ever remain in lake, moorland and forest, so few varieties of swimming, flying, and running game?

It will be noticed that M. St. Hilaire's catalogue of domesticated animals is more than arbitrary, and somewhat less than complete. Some of the animals mentioned can only, by a latitude of language, be said to be domesticated, while others, equally under the subjugation of man, are omitted from the list. The immediate business of this paper is not, however, with the domestic animals of man, but with the semi-domesticated or "GAME," which, living untended in our wilds, supply the sportsman at once with amusement and food. Not to trespass on time, I will do little more than indicate such as might find in Nova Scotia the conditions of climate, covert, and food, and by reproduction increase the number and varieties of our objects of the chase. Of course, it would be a mistake to introduce any new game until the legislature and the people at large have found the way to preserve what we have. The Inland Fisheries and Game Protection Society, recently organized, have taken the initiatory step, and it is to be hoped that their endeavours will be seconded by the influential in the community, until the public

* The one omitted is probably the tench, introduced into Britain with the pond carp and goldfish. It may be the Pike, according to the old rhyme:

"Turkeys, carps, hoppes, piccarel and beer,
Came into England all in one year."

† Fourteen are wanting in Nova Scotia. The others, including the gold and silver pheasant and the common English pheasant, adapt themselves well to the climate. In lieu of the silkworm the cecrops is abundant.

mind is educated up to a proper pride in the maintenance of our forest life.

Taking the sportsman's definition of "fish, fur, and feathers," it is only among the Ruminants and Rodents that we can look for additions to our running game. Of the wolf we have but a rare visitor from the adjoining province of New Brunswick—and he, gaunt, solitary, and cowardly. Our hunters always know where to find a bear, or a loup-cervier (vulgar: *lucifee*). Moose and cariboo, if let alone, and especially if the Legislature would prohibit their being hunted for the next four years, would largely increase. But other furs are few. Naturalists, rather than sportsmen, must determine whether the white hare of Newfoundland, found also in this Province, is identical with the prolific Scottish mountain hare, or wherein either may differ from the bold and agile Irish hare *(lepus Hibernicus)*. Should they be of different species there yet appears no reason why all should not thrive here. The common English hare (*lepus timidus*), would manage to maintain itself in the highly cultivated western portions of the Province, but as the thrifty farmers of that region would not care to burden themselves with its feed, there is not much hope of seeing it domesticated among them. Besides, the hare, as an object of pursuit, belongs to what may be called the advanced stage of sporting, and would serve, mainly, as an inducement for the breeding of the greyhound, "the regent of dogs,"—a title which, whether applied to his sagacity, courage, docility, and susceptibility of instruction, extending even (contrary to general opinion) to the education of his nose, experience of the animal amply verifies. Here let me mention, incidentally, that where the hare will find a form the English skylark will live, to cheer the sportsman's heart with its song. There is probably not one acclimation that could be more easily made in the agricultural districts of Nova Scotia than the songlark. The geographical range of the bird is extensive—from Southern Europe to Siberia. Larks can be bought in quantity in either England or Germany at trifling cost, and would survive the voyage hither. The grey rabbit or burrowing hare (*lepus cuniculus*), is another introduction that would naturalize itself, and would, doubtless, increase in a more rapid ratio than its enemies. Specimens of the house or domesticated rabbit, have escaped from confinement near Halifax, and have been afterwards seen, earning apparently a honest livelihood.

Suffering as our country is from the want of protection for its game, it may be too sanguine to hope for any increase in the variety of our deer. In wooded, sheltered and enclosed parks the fallow deer might be reared as an ornament to grounds, although unfitted to range for itself in the woodland. But the ordinary American or Virginia deer (*Cervus Virginianus*) has its range from the Gulf of Mexico to the borders of New Brunswick, increasing in size and beauty as it approaches the north. There can, therefore, be no possible hindrance to the introduction of this really valuable game into our coverts, where, according to the opinion of our best sportsmen and most practical naturalists, it would multiply and increase. The beautiful and hardy little roedeer of the Scottish highlands (*Capreolus capræ*) is another most desirable accession, nor do I think it would object to make itself a habitat in the fir copses of our secluded forests. A year or two of experimental acclimatization within enclosures would prove its adaptability for the woods.* Another of the deer family which would, probably, naturalize more kindly, is the "wapiti," or Canadian elk (*Elaphus Canadensis*—Ray,) of which Sir John Richardson gives the northern range as the 56th or 57th parallel of north latitude. Previous to the late unhappy war in the States, the Wapiti was semi-domesticated in many parks in Virginia. The king of Italy has imported a herd which are reported here to have taken kindly to the hills of Lombardy. Beyond the ruminants named, the chances of increase to our deer are unlikely. Attempts have been made in the United States to extend the range of the pronghorn antelope and Pacific blacktail deer, under climatic conditions more favorable than ours, but without success.

In birds, there are a few likely to prove additions to our game, all being of the sub-family of the *Tetraoninæ* or grouse. Commencing with the true ptarmigan—the *lagopus albus* of Linnæus—there could be little difficulty in introducing this fine although rather sluggish bird on our higher barren grounds. A member of the Institute states that it does exist (rare) on our hills. Indeed

*I have lain out, in Scotland, on the watch for these pretty creatures in weather quite as cold as it is in Nova Scotia in ordinary winters.

it ranges on the mountains from Iceland to the Alps.* Everywhere in Nova Scotia are to be found those rugged granite wilds such as are its haunts in Scotland and Norway. The severity of our climate is not greater than its European experience. In summer, it would find varied sustenance on the moors, and in winter the birds, like other winged game, would sustain themselves with their proper food of buds, berries and leaves of trees. As they associate in flocks and may be taken in snares, there would be but slight difficulty in importing a sufficient number to experiment upon. A yet finer bird than the ptarmigan is the capercailzie (*Tetrao urogallus*), the very king of feathered game. This splendid fowl is still common in Sweden and Russia, and could be, and ought to be, a splendid addition to our birds of the chase. As it lays from eight to a dozen eggs, and the young are hardy as well as active in foraging for themselves, three or four years' protection should suffice to form the nucleus of a preserve, especially as man would be the chief enemy so large a bird would have to fear. An importation from Norway could be made without extraordinary expense. Should we ever have an acclimatization society in this Province, or should it fall within the scope of the Society for the Protection of Game, the capercailzie would probably be the first importation to which they would turn their attention with hopes of success. The black grouse (*Tetrao tetrix*) is another pleasing game bird, susceptible of naturalization here. The black grouse could live on the edge of our swamps and cranberry or blueberry barrens, and would put through the winter on juniper and beech buds and mast. For most part of the year they are wary, and afford capital sport. The principal British bird of game has yet to be noticed—the grouse proper (*lagopus scoticus*), the red grouse, locally called the muirfowl or gorcock. There are great doubts whether it would be possible to stock our barrens, even were its haunts as rigorously preserved as are the moors at home. True grouse seem to thrive nowhere but among the Scotch heather, the bells of which form their principal food,—although I have shot these birds when they were pilfering oats from late reaped fields on the edge of the moorland. Considering the almost impossibility of protecting them in a wild state, at the same time that they are quite susceptible of

*It is also found in Newfoundland.

domestication, they will not likely be ever found to multiply in Nova Scotia except as denizens of the aviary, or among the fancies of the poultry yard. Here let me contradict an error that is still going the rounds of English sporting works. In the "Field Book of the Sports and Pastimes of the British Islands," by the author of "Wild Sports of the West," (a recent edition,) it is stated, under the head of "American game," "The American grouse is precisely like the Scotch grouse. There is only here and there a place where they are found; but they are in those places killed in vast quantities in the fall of the year."* Every body on this side the water knows that the American grouse—or partridge so called —are the birch† (*Tetrao umbellus*) or ruffed grouse, and the spruce spotted, or Canada grouse, both different from the red grouse of the British Isles.‡

As regards the family of pheasants, much may be said in their favour. The English pheasant (*phasianus colchicus*) has escaped from confinement and survived the winter in Nova Scotia. Golden and silver pheasants, now kept for luxury, have proved themselves capable of enduring the severest frosts. Indeed there are many varieties of pheasants, which, with the spread of agriculture in the future, may become the game of the country, and supersede, in the hedgerows and coppices, the now wilder winged ones of the woods.

One more splendid variety of game must be mentioned, which would multiply and flourish exceedingly, but the hope to see it in our woods is too utopian for this century. This bird is no other than the turkey; the half-bred bronzed being probably the best. We read that a flock of 2,000 were kept in Richmond Park in the time of George II., for the especial shooting of that monarch, but as the public surreptitiously joined in the sport, they were destroyed. The only drawback to their being naturalized as wild game in this Province is, that while one could be found, none of our backwoodsmen would want for a dinner.

Proceeding to the finny tribe:—

From the greater capacity of fish for bearing extreme variations of temperature, and from their adapting themselves so easily to

*See Field Book, &c., page 9: London.

†It is the birch partridge (male only) that "drums."

‡The willow grouse of Newfoundland, and the prairie hen, or pinnated grouse, have also been suggested to me, but I cannot speak of them from personal knowledge.

variations in the state of their natural element, whether it be rapid, sluggish, clear, or turbid, we should probably succeed with fish more surely than with any other game. Perhaps it is treason to hint that Nova Scotia is not so good a fishing country as many others. Several new varieties of fish have to be reared as stock on our aquatic farm before we can boast of much variety for *maigre* days. Omitting such of the game fishes of Europe and elsewhere as are manifestly unsuited to the Nova Scotian element, there are several of the *salmonidæ* that deserve passing enquiry. Thus the *salmo hucho* of the Danube, attaining the length of two feet, has attracted the attention of English fish-breeders. It can live wholly in fresh water; but as it is the most predatory of the tribe, the wisdom of introducing it here into our limited range of lakes may be questioned. The *salmo ferox*, or great lake trout—not to be confounded with the *salmo eriox*, or bull trout—is well adapted to our larger lakes, such as Rossignol, Grand Lake, &c, as it reaches nearly the weight of the true salmon (*salmo salar*), but does not migrate to salt water.* It is found in all the mountain lakes of Scotland, Switzerland and Norway, and even in ponds without running water. It is decidedly ferocious. I am unable to say what relation the European fish bears to the great American lake trout, found in lakes Huron and Erie, but not in Ontario. Richardson, an American naturalist, calls the cis-Atlantic fish the *salmo Naymagush* (an Indian appellation), and describes its average weight as double that of the true salmon. Another of the tribe is named by the same authority, as the lesser lake trout, or *salmo adirondacus*, of four to six pounds weight, which does not rise, but is taken by trolling in deep water—therein differing from the Irish gizzard trout, or *gillaroo* (which answers its description), but which *does* rise to the fly, although its main food is small shell-fish. Yet another American member of the *salmonidæ* is found in New Brunswick, and is called the Schoodic trout; in appearance like a "grilse," origin doubtful, being supposed by some to be a hybrid between the salmon and salmon trout.† It is permanent in the fresh water of the St. Croix River, and in the Schoodic lakes. It is called by Girard the *salmo Gloveri*. The delicate vendise or ven-

*Col. Sinclair, A. G. M., captured a specimen which seems identical with the *salmo ferox*.

†A very unlikely circumstance.

gis (*salmo marenula*) known as the fresh-water herring in Scotland, Switzerland and Silesia, would doubtless thrive here, as there, in deep shaded lakes. So would the char, which inhabit the lakes of the Tyrol. Mr. Astley Baldwin,* a pleasing writer on fish and fishing, recently remarks: "a new species of salmon trout has lately been brought to perfection on the continent (Europe). It does not grow to a considerable size; it is, however, very palatable, and commands a good price. The name bestowed on it is *salmo salvelinus*. This fish is being introduced into the Danube, one of the best rivers for fish of all kinds in the whole of Europe."

The Danube is at present a source from which many fine varieties of fish are being drawn for propagation, among others, the huge *siluris glanis*, which reminds me that forty years since Sir Humphrey Davy, in his "Salmonia, or Days of Fly-fishing," speaking of that river, says:—

"The four kinds of perch, the *spiegil carpfen* and *siluris glanis*, all good fish, and which I am sorry we have not in England, where I doubt not they might be easily naturalized, and where they would form an admirable addition to the table in inland counties. Since England has become Protestant, the cultivation of fresh water fish has been much neglected. The *barbot* or *lotte*, which already exists in some of the streams tributary to the Trent, and which is a most admirable fish, might be diffused without much difficulty, and nothing could be more easy than to naturalize the *spiegel carpfen* and *silurus*; and I see no reason why the *perca lucio perca* and *zingil* should not succeed in some of our clear lakes and ponds, which abound in coarse fish. The new Zoological Society, I hope, will attempt something of this kind; and it will be a better object than introducing birds and beasts of prey."

After this extract from Sir Humphrey, time need not be wasted in particularizing other less important varieties of fish desirable for our waters, such as varieties of the bass, tench, and carp, and the most recent English suggestion of the mountain mullet from Jamaica.‡ Suffice it to say that none of the above suggested additions to our game would be subjected to any new climatic or physical conditions were they imported into Nova Scotia. The main objections are the expense and the difficulty of protection.

With permission let me conclude this paper by reference to a

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* Once-a-week, Decr. 24, 1854.

† Salmonia, page 258, Lond. 1828.

‡ The yellow perch (*perca flavescens*) will live every where in Nova Scotia, and wherever that useless fish is now found, the black bass (*centopristens nigricans*) would flourish, as also the striped bass, which although a sea-fish is said to thrive and even to improve by being cut off from the salt water. The loch bass, another variety, has found its way from Lake Champlain, through the canal, into the Hudson, and plentifully stocked that river.

desirable importation, (a crustacean,) which though not game itself, is nevertheless a capital addition to a game supper, the *cancer pagurus*, or large edible crab so abundant on the shores of Britain, especially along the east coast of Scotland. Nothing could be easier than to stock our seaboard with this excellent shell-fish. The writer chanced about three years ago to be the fellow-passenger to Europe of some tubs of live lobsters, which were sent from the shores of Maine, *via* Halifax, to the emperor of France; and thought at the time it would be a good thing were the tubs returned to the governor of Nova Scotia, filled with live crayfish and edible crabs, in return for the lobster salads the French savans have doubtless ere this enjoyed from lobsters native to the coast of Acadia.

By the way, there is one other fish which ought to abound in every brook and rivulet, viz., *Leuciscus phoxinus*, or true minnow. They have only to be thrown into any suitable water to increase and multiply for the angler's use. They may be drawn from several of the streams near Halifax to stock other breeding places.

In a pleasing book by an American sportsman occurs the following passage, not inappropriate to the subject of this paper:—*

"There is a very erroneous impression, encouraged too, shame to say, that the wild creatures of the woods and waters must, in the nature of things, disappear before man. Now, although this is a lamentable fact, it is not a necessary consequence, and there is nothing in man's capturing fish and killing game, properly and reasonably, that will seriously diminish their numbers. Fish and birds prey on one another: for every large trout a man takes he saves a hundred small ones; for every hawk he catches hovering over his barnyard and hills, he saves a hundred quail, and thus, although he kills them himself, he preserves them from vermin, from one another, and from birds of prey. If he will add to this a very little care and protection of the young, he will increase the supply a thousand fold."

In conclusion, I have only to add, that an increase in the number and variety of our game must be an object of interest to every one who takes pleasure in out-of-door life, and, I think and hope, is alike within the province of the sportsman and the naturalist.

Let me hope that these imperfect notes may lead to more practical investigation, and tend, in a slight degree, to show the value, as preserves, of our forests and rivers, in which the game at present is so mischievously and wantonly wasted.

* Game Fish of the North: New York, 1862.

ART. VIII. THE PRODUCTION AND PRESERVATION OF LAKES BY ICE ACTION. BY THOMAS BELT.*

[*Read Feb.* 6, 1865.]

DURING a residence of two years in the Province of Nova Scotia, my attention was directed to the multitude of lakes, great and small, that are spread over the country, sometimes in connected chains, sometimes isolated on the tops and sides of hills, &c. These lakes form a common feature in the northern parts of America, and increase in number as we proceed northwards. The larger lakes are shown in maps of the Provinces, but it requires a visit to impress on the mind the number of small lakes and ponds that abound in every direction. Mr. Perley, speaking of Newfoundland, says :—

"The most remarkable feature of Newfoundland is the immense and scarcely to be credited abundance of lakes of all sizes. * * These are found universally over the whole country, not only in the valleys but on the highest lands, even on the hollows of the summits of the ridges and on the tops of the highest hills. These ponds vary in size from pools of fifty yards in diameter, to lakes of upwards of thirty miles long and four or five miles in width. The number of ponds which exceed a couple of miles in extent must on the whole amount to several hundreds; those of smaller size are absolutely countless."

My duties in connection with the management of some mineral properties in Nova Scotia, took me almost daily along the line of an important chain of lakes, which, stretching almost across the Province, had been taken advantage of by the Shubenacadie Canal Company to form a water communication from the Atlantic coast to Cobequid Bay, by connecting the different lakes with short canals. The works of the canal company exposed in many places the structure of the enclosing strata, and showed that most of the lakes were in true rock basins; and I had opportunities whilst mining operations were being carried on on the banks of one of the lakes, of studying the disposition of the heaps of boulder clay and gravel piled up on its sides.

The rocks in which the lake basins lie are chiefly extremely hard quartzites and metamorphosed schists, supposed to be of lower silurian age, although as yet no fossils have been discovered in them. They are irregularly covered with heaps of boulder clay, mostly unstratified. Wherever the surface of the rock is exposed, it is found to be scratched, grooved and polished; and other marks

* Read before the Geological Society, June 22, 1864.

of intense glaciation, such as the rounding of protuberant bosses of rock, and the transportation of huge boulders, are of frequent occurrence. The course of the main lines of scratchings varies from N.N.E. to N. N. W., and the lines of the major axes of the lakes and of the chains of lakes, have the same bearings. The Shubenacadie lakes commence at Dartmouth, near Halifax harbour, and stretch in an irregular northerly direction to the head of the Shubenacadie river, a distance of twenty-two miles, and with the river they occupy a great depression or valley, running from Cobequid Bay to Halifax harbour, a distance of fifty miles.

The largest of the chain, the Grand Lake, is eight miles long, and in its deepest part its bottom lies seventy-four feet below the mean level of the sea. The coast is indented with long, narrow, deep bays or fiords, running in the same direction as the chains of lakes. The glaciation of the rocks and the transportation of boulders point to the agency of ice, and the only question undecided is, whether we shall ascribe them to the action of glaciers or of icebergs. Icebergs, laden with rocks and clay, and ploughing up the bottom of the sea where they grounded, might be sufficient to account for the scratchings and for the transportation of boulders; but they do not furnish us with the power requisite to scoop out deep channels and gorges, often continuous for scores of miles, in hard rocks, which are as characteristic of a glaciated country as the minor scratchings and groovings. In Nova Scotia, the whole country has been hugely grooved and furrowed, and heaps, or rather hills of gravel, piled up on the sides and in the courses of the channels excavated. This configuration of the country is best explained, as it has been by Agassiz and others, by supposing that it was covered by a vast accumulation of continental ice, moving southward from the Arctic regions, which, when at its greatest development scooped out the larger vallies and deep fiords, and modelled the grander features of the country; and during its retrogression, when continental ice enveloping the hills had wasted into glaciers down the principal valleys, they, during their slow retreat, left terminal moraines in their courses, and heaps of gravel and angular blocks on their flanks.

It is readily admitted that such lakes as are formed by the damming up of channels with heaps of clay and gravel, may have been formed by glaciers leaving terminal moraines in their retreat, and the scooping out of long deep channels is easily understood; but the production of deep rock-basins is not so easily explained, and their glacial origin has been disputed by eminent geologists. We owe the theory of the production of rock basins by ice action to Professor Ramsay, who in 1859 showed that there was an intimate connection between mountain lakes and the evidences of glacial action, and argued that the rock basins had been ground or scooped out by ice, either in soft rocks surrounded by harder, or more generally, in places where a greater height of ice had accumulated and exerted a greater grinding pressure on the rocks beneath. In 1862 he extended his theory to account for the production of the great lakes of Switzerland, and even those of North America, contending that there is such a gradation of size from the least to the greatest that we cannot apply the theory to the one and not to the other.

The Lake of Geneva is 984 feet deep, the Lake of Zug 1279 feet, and the Lake of Brienz more than 2000 feet, and its bottom about 200 feet below the level of the sea. In Italy even these depths are exceeded, and we have the Lake of Como 1929 feet deep, and the Lake of Maggiore 2625 feet, and its bottom 1940 feet lower than the sea level. With regard to these great depths it has been urged by Sir Charles Lyell and others, that though the passage of prodigious masses of ice for ages over the surface would doubtless produce depressions where the hardness of the rocks beneath was not uniform, yet a depth would soon be reached where the movement of the ice in the basins would be arrested, and the discharge of the glaciers would be over and not through the ice-filled hollows. In a glacier as in a river, the lower strata move much more slowly than those at the surface, being impeded by the friction on the bed of what we may call the ice river—and as in the Lake of Maggiore the ice, on Professor Ramsay's theory, would have in its exit to ascend a slope of five degrees from its deepest part. It is contended that in such a case it would be simply dammed up, the glacier passing over it. It is true that in Australia there are deep hollows in the courses of the streams, in which water is stored up during the dry season, but this is a peculiarity of intermittent rivers and dependent upon the intermittent action. Again, in British North America, great holes are gradually worn during winter in the sleigh tracks, commencing at first with slight depressions in the hardened snow, and increased by the passage of every sleigh, until the holes become so deep as greatly to inconvenience travellers; but here again the action is very different from the steady continuous flow of glacier ice, the scooping out power depending on the sudden descent of the sleighs into the hollows, which, in the case of glaciers would be filled with ice.

Sir Charles Lyell considers that the great lake basins of Switzerland have not been scooped out, but that they are all due to unequal movements of upheaval and subsidence during the great oscillations of level since the commencement of the glacial period.* But whether or not this theory is sufficient to explain the formation of the great lakes of Switzerland and Italy, it does not apply to those of British North America, nor of northern Europe, where we have lakes of all sizes, increasing in number as we proceed northward, and found everywhere along with and evidently part of the glaciation of the land. It does not explain this palpable connection of rock basins with glacial action, and in seeking for another solution we naturally turn our attention, first of all, to that agent whose power has been so conspicuously displayed in the erosion of the deep valleys and fiords of glaciated countries.

These considerations have lead me to endeavour to solve the main difficulty in accepting Professor Ramsay's theory, viz.: the immense depths of some of the basins; and I think it may be shown that even if the ice were dammed up at moderate depths, it would still possess great grinding powers, which would be augmented instead of being diminished by increased depth. In the first place I must draw attention to a feature of all glaciers, the streams that issue from beneath them. In Switzerland, from the bottom of every glacier, rushes a torrent densely charged with mud. It is the same with the great glaciers of the Himalayas—the Ganges, the Pindur, the Kuphinee and the Thlonok, rise from beneath glaciers. The flow of water diminishes in winter, but never entirely ceases in glaciers of the first class. In Greenland, Dr. Rink says, that "in some places mighty springs are seen to come forth from under the outer edge of the ice, pouring out clayey water in continued quan-

* Antiquity of Man, p. 316.

tity throughout the winter." * Most of the water issuing from the bottom of glaciers proceeds from the melting of the ice at the upper surface of the glacier, finding its way to the bottom through crevices and channels in the ice; but a not inconsiderable portion is produced by the melting of the lower surface next the earth. Professor Forbes made some careful observations on this point, and found that in summer the glacier wasted away by melting at the surface 3.62 inches daily, and by subsidence or wasting at the bottom 1.63 inches daily. The water that issues from beneath the ice in Greenland throughout the long and severe winter, can only proceed from land springs and from the melting of the ice next the earth. The only example of glaciers that do not give off water during the winter that I have been able to find, are some of those small ones on the higher parts of the Alps that have been called "glaciers of the second class," on which, from their altitude, the effect of the earth's heat must be very small.

Let us apply these facts to the consideration of the question of a depression in the pathway of a glacier, which has reached such a depth that the ice is not bodily discharged from it, but simply fills it, the glacier passing over the choked up hollow. We have seen that at the bottom and sides of the hollow, the ice would be slowly melted by the earth's heat, increasing with the depth of the basin; as the ice at the *lower end* of the basin melted the whole mass would be pushed along by the thrust of the moving glacier above it. Into the crevice at the upper end would pour the water coming down the bottom of the glacier from above the basin, which would pass underneath and be forced out at the lower end, carrying with it the mud produced by the crushing down of the ice as it melted at the bottom, and by the grinding along its floor as it melted at the lower end of the basin. The water coming from above would assist in melting the ice, especially in summer, but its most important effect would be the scouring out of the bottom of the basin, so that an ever clean face of rock would be presented to the huge tool operating upon it. That such an action, or a somewhat similar one, would take place at the bottom of an ice filled basin, with a glacier passing over it, and that it would be effective in deepening it, I cannot doubt. It would in some measure resemble the action of a

* Jour. Geographical Soc. Vol. 23, p. 153.

hollow drill that has been proposed for boring holes in rock through which a current of water is forced to carry off the ground stone, and still more, the production of pot holes on our coasts and in the hard beds of many rivers, by the moving water turning a stone in a hollow and so gradually deepening it, until through time a cylindrical and deep cavity is formed. A lake basin is an immense pot hole, in which the mass of ice that filled it took the place of the moving stone, its grinding power vastly increased, and in great part due to the moving glacier above it. The eroding action would be slow, but it would be continuous, and the only limit in depth to its power would be when the hydrostatic pressure of the water equalled the weight of the superincumbent ice, a limit far beyond anything with which we have to deal. The rock basins of Nova Scotia are much shallower than those of Italy and Switzerland, because in the one case the rocks operated on have been hard metamorphosed schists and quartzites, in the other soft molasse, easily eroded; the work done being proportional to the hardness of the material.

Art. IX. On some Brine Springs of Nova Scotia. By Henry How, D. C. L., Professor of Chemistry and Nat. Hist., University of King's College, Windsor, N. S.

[*Read March* 6, 1865.]

In a former communication to the Institute,* and in another paper,† read before the Natural History Society of Montreal, I have given the composition of some of the mineral waters of the Province, known or reported to possess medicinal properties. Nearly all those analysed had for their leading ingredient sulphate of lime, or plaster, as it is called, the exceptions being a brine from the neighborhood of the Renfrew gold diggings, and that interesting water from Bras d'Or, of which the chief constituents were common salt and nearly as much chloride of calcium. In the discussion which followed the reading of my paper at the Institute, several springs were mentioned as locally famous, viz., those of Earltown, Shubenacadie, and a place a mile and a half east of Shelburne; but I believe no facts bearing on the composition of

*Trans. N. S. Inst., Vol. 1. †Canadian Naturalist, Oct. 1863.

their waters were made known. As regards the waters yet examined, those adverted to above contain so much sulphate of lime, and so little of other substances, that they might almost be made to form a distinct group; and the Bras d'Or water is one of a very remarkable class,* called strongly saline, differing from brines in holding an amount of earthy chlorides equal or superior to that of common salt, which in true brines is of course the characteristic and exceedingly preponderating ingredient. It is well known that many of these true brines exist in the Province, but no analysis has yet been made, or at any rate published, of any of their waters. In the present paper, I give the results of my analysis of the waters of two brine springs (one of which I have made the subject of a communication to the Chemical Society of London), with information respecting the localities in which they rise, and place also upon record some notices of other brine springs with which I have been favored.

Brine Springs, Walton, Hants Co. My attention was drawn to one of these springs last May, when I was on a prospecting expedition in the neighborhood, by Mr. Joseph W. Stephens, who assisted me in collecting some of the water, and who subsequently kindly furnished me with interesting details of information. The spring issues on the west bank of the Petite River, a short distance from Walton bridge. It always has a considerable flow of water, which is clear and has no odour. The water has never been known to freeze; its temperature was 44° Fah. on a warm day in winter when the air was 46°. At all times in winter, even in the very coldest weather, there is about an eighth of an acre of the ice in the river quite soft and rotten, into which the spring water flows, and where the water actually enters the river it is never frozen. Mr. Stephens threw a piece of ice into the spring in January, and was astonished to see how rapidly it melted. The water is evidently somewhat thermal. It appears not to have been put to any medicinal use. The water collected by myself, having been kept in a well-corked bottle, was analysed in December, when it gave the following results: the imperial gallon contains—

* Geology of Canada, p. 563, and C. News, x, 181.

	Grains.
Carbonate of Lime	14.73
Carbonate of Magnesia (very small)	undet.
Carbonate of Iron	traces.
Phosphoric acid, decided	traces.
Chloride of Magnesium	4.48
Sulphate of Lime	161.16
Chloride of Sodium	787.11
	967.48

There is probably a small amount of chloride of potassium contained in the common salt, and it is quite possible also that there are traces of other constituents, which were not sought for in the small quantity of water at my command. A very interesting feature in this brine, illustrating the differences which obtain between the composition of waters as they issue from the earth, and that of the ocean which exhibits the results of numerous chemical changes, is the very large quantity of sulphate of lime present along with the salt, which, however, is still by so much the principal ingredient that the water is a true brine. In sea water, according to the elaborate researches of Forchhammer, extending to several hundreds of analyses,* the maximum ratio of chlorine to sulphuric acid and to lime *in the open ocean*, is—

100 chlorine to 12.09 sulphuric acid, and
100 chlorine to 3.16 lime;

in the Walton brine we have

100 chlorine to 19.7 sulphuric acid, and
100 chlorine to 15.4 lime.

This water in fact contains almost exactly as much sulphate of lime (161 grains) as pure water would dissolve (viz., 163 grains) if saturated. Since some of the waters of the Province, viz., those of Wilmot and Spa Spring, Windsor, to which curative properties are attributed, contain this substance as by far the most abundant ingredient, experience may yet show the Walton brine to be also valuable to invalids, although sulphate of lime has not, I believe, as yet been recognized as a useful medicinal agent.†

Brine Spring, Salt Springs, Pictou Co. For a quantity of water from this spring I am indebted to the Rev. A. McKay, who occu-

* Proceedings of the Royal Society, C. News, x, 293.

† Mr. Stephens informs me that on the other side of a ridge of land rising just above the Walton Spring just described, at a distance of two miles and a half, and on the descent of the ridge, a second brine spring is said to exist.

pies the Manse at the locality, and who kindly furnished me with the following information:—

"Last spring there was a great freshet, and the river made its way into the principal spring. I waited, expecting to have the river turned into its wonted channel, but being from home on a mission to Cape Breton at the time the river was lowest I did not succeed. There has been a hole dug in the end (?) of a low bank about nine yards from this main spring, by a company, about twenty years ago, who made salt from the water which came up there. This hole is ten or twelve feet deep. The water does not overflow here. From this spring I took the water sent to you. I also sent a piece of the rock jutting out between this hole and the main spring. There are several small springs about this low bank, over the length of about 150 yards. The salt water oozes out in many places along this course, and salt is deposited in some places.

"The water is used for rheumatism, and in so far as used I believe it has proved an effective cure. It is applied externally."

On examining the water, I found that there was a very large quantity of salt present, along with much sulphate of lime. When received (September 9th) the water was without odour, but on standing for some time it smelt strongly of sulphuretted hydrogen, from the reduction of the sulphate by organic matter. Under these circumstances, in order to obviate considerable error, the principal ingredients were estimated at short intervals, but of course, since an accurate analysis could not be made of a liquid constantly changing, I can only offer the following results as exhibiting the approximate composition of the brine. An imperial gallon contained—

	Grains.
Carbonate of Lime	3.775
Carbonate of Magnesia	2.932
Carbonate of Iron	.181
Silica	.560
Sulphate of Lime	154.730
Chloride of Magnesium	27.330
Chloride of Calcium	51.910
Chloride of Sodium	4133.500
Phosphoric Acid, Boracic Acid, Bromine, Organic matter,	undetermined.
	4374.918

Specific Gravity at 53° Fah........1046.69

There was probably a small amount of chloride of potassium contained in the common salt. With regard to the bromine, the evidence of its presence was very decided, the quantity was quite large enough to admit of determination, but the trouble involved in the exact estimation of this element is really so considerable that I contented myself with qualitative results. No doubt this valuable substance exists in other brines of the Province, but it has not before been proved to be present. It is from brines that most if not all the bromine of commerce is obtained. Boracic acid was found by evaporating somewhat less than a third of a gallon of the water, when it was perceived to exist in distinct traces. The presence of this acid is particularly interesting; it is probable or at least possible, that if due search were made most if not all the brine springs of this Province which rise in the lower carboniferous rocks would be found to contain it. I have already shown* the existence of boracic acid (in two minerals), and also of a small quantity of rock salt, in the gypsum of Windsor, and now we have the same association observed in water from rocks (most probably) of the same formation at a distance of some 60 miles. When I detected the borate in gypsum, the late Dr. Robb, of Fredericton, strongly advised me to search waters issuing directly from the plaster rocks for boracic acid: the interest attaching to such an enquiry is increased by the result now brought forward. Gypsum is often associated with rock salt in other countries, and it is found with boracic acid (in the mineral boracite) in Germany.

Brine Spring, Sutherland's River, Pictou Co. For information respecting this spring, I am indebted to Rev. Dr. Honeyman; the water issues in the bed of the river, so that it can only be got at in the dry season; the outlet is situated a little above the falls due to disturbance of rocks which are probably lower carboniferous. The spring was discovered by persons observing cattle to drink at it, and it is now much resorted to and its waters are drunk for a variety of diseases.

Salt Pond, Antigonish. Dr. Honeyman informs me that salt was formerly made from this pond, and that a bathing house exists here: the region is lower carboniferous.

Brine Springs at Whycogomagh, Cape Breton. Of these, Dr. Honeyman tells me there are two, of which one is medicinal and the other is employed in the manufacture of salt. They rise in

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* Silliman's Journal, Sept. 1857, and July 1861.

lower carboniferous rocks, and at about a mile from the medicinal spring is situated the "salt mountain," supposed to be so called from a salt spring which issues from it. H. Gesner, Esq., informs me that this spring is not strongly saline. I learn from Dr. Honeyman that there is in this district another spring of a highly gaseous character, which is continually sending off bubbles of gas, carrying up a fine sand; its water is not saline but sweet to the taste.

Brine Spring, 12 miles from Bedeque. H. Gesner, Esq., informs me that a very strong brine, affording one bushel of salt to the hundred gallons of water, or six per cent. of salt, is found on the north side of the St. Patrick's Channel.

From what we see of the number and distribution of the brine springs of the Province, mentioned in this paper and elsewhere, the manufacture of salt may be expected to become a considerable branch of industry. The composition of the brines issuing from the lower carboniferous rocks is favourable to the manufacture, if, as may be supposed, they all resemble those of which the analysis has just been given, in containing sulphate of lime as the most abundant ingredient next to salt. As this is a substance not readily dissolved by water, it will separate almost entirely from the brine on boiling down to a certain stage, and the deposit on further evaporation will be table salt of considerable purity. Bromine of course, if present, will be found in the fluid from which the salt has deposited.

Art. IX. Enquiry into the Antiquity of Man. By Wm. Gossip.

[*Read March* 6, 1865.]

The evidence relied on by geologists who endeavor to carry back the antiquity of man to an era far beyond the historic, is gathered from strata of the tertiary period, in which, associated with remains of extinct animals, are flint implements and weapons, similar to those which are known to be of the recent period; and from cavern deposits, in which the remains of man are found, mingled with those of other animals, the species of which it is supposed did not come down to the chronologic or historic age.

Geology, however, reveals no data to establish positive conclusions on this subject. There is ample room for speculation, and time and verge for almost every deduction that may be hazarded, and many of these are practically mischievous. It has already become a vexed question whether man was really created, or progressively developed from inferior forms of animal existence. Some philosophers evidently deem the record of his creation a fable. Others, among whom we may quote Sir Charles Lyell, attempt to show that man went back to, if I may so speak, or was coeval with the extinct animals, instead of their coming down to what we believe to have been his era; or they would lead us far beyond the sacred chronology to a period anterior to the glacial, and showing us vegetation similar to that which now prevails in temperate regions of the earth, and remains of quadrupeds which once lived and flourished upon it, bid us seek there, as if seeking we should find, for evidence of man's existence also. None, however, has been or is likely to be discovered. Nor does it seem probable, as the result of investigation, that the truth of the sacred record will ever be successfully disturbed.

It is to a few of these speculations, and the alleged proofs, which may be found at large in Sir Chas. Lyell's book "*On the Antiquity of Man*," that I would this evening direct your attention. I shall endeavour to show that the facts stated as evidence of human existence are not referable to the remoter period, but may all have been consummated in the chronologic era.

It is something gained in a cause like this, when the bias with which an author approaches his subject can be clearly demonstrated. If he truly believe that he can achieve a result, however distant it may seem, he will seldom hesitate to adopt every possible inference which he thinks may lead to it. Sir Charles Lyell has largely, whether justifiably or not, drawn upon the material at his command, for the purpose of making a nearer approach to his object. It would occupy too much of our time were I to allude to every instance; but I will quote one, which if it open up an extensive field of investigation, is well calculated to strengthen scepticism, and to lead astray from the legitimate area of enquiry, which as yet is far from being thoroughly explored.

There are in England two sets of strata, of marine formation, which seem to form a connecting link of the tertiary with the post-tertiary periods. One of these belongs to the older pliocene, and is divisible into the coralline and the red crag—the coralline being the older of the two. The other belongs to the newer pliocene, more advanced in time as the term indicates, and is commonly called the Norwich, and sometimes the mammaliferous crag. I need not go into a lengthy and particular description of these formations, any one who desires that will find it in Sir Charles Lyell's "*Antiquity of Man*," and other works on Geology. It will suffice to state, that in them are a number of shells of recent species, the proportion of the recent to the extinct being greater in the newer beds. Thus, in the coralline or oldest crag, there is found fifty-one per cent of recent, in the red crag fifty-seven, and in the Norwich crag eighty-seven. These shells prove a progressive change in the climate. That of the coralline must have been warm, for twenty-seven southern shells are found, of species which now inhabit the Mediterranean and West Indies, and but two closely related to arctic fauna. Only thirteen of these southern shells occur in the red crag, together with three new southern species, but eight northern species are found, showing that the climate was less fitted to support some of the testacea that lived in the previous period, and becoming more suitable for the northern species. All the foregoing southern species disappear from the Norwich crag, but all the eight northern species remain, and four arctic shells are added. Thus is represented the increasing cold, the gradual approach to the glacial period of depression, although, in the time of the Norwich crag, probably there was no season in which the cold was intense.

Connected with the marine deposit of the Norwich crag, at a place called Cromer Jetty, where it thins out, is a submerged forest, which has been traced for more than forty miles, and which at one time must have had a considerable elevation above the sea. The Scotch fir, spruce fir, yew, alder and oak, are among the trees that are known to have grown in that region, and various extinct mammalia flourished there, of which numerous bones have been collected.

There is no doubt about the age of these respective formations. They belong most certainly to the older and newer pliocene strata, and the associated fauna are those which previously and probably then existed, and roamed the forest now buried beneath the waters. But had remains of man been found there, the chronological record would not have been true. They have not been found, therefore positive evidence against that record is wanting, and so far the negative evidence proves its truth. Yet Sir Charles Lyell writes, with reference to the time of the Norwich crag:—

> "Neither need we *despair** of one day meeting with the signs of man's existence in the forest bed, or in the next overlying strata, on the ground of any uncongeniality in the climate, or incongruity in the state of the animate creation with the well-being of our species. For the present we must be *content to wait*, and consider that we have made no investigations which entitle us to wonder that the bones or stone weapons *of the era of the elephas meridionalis* have failed to come to light. If any such lie hid in those strata, and should hereafter be revealed to us, *they would carry back the antiquity of man to a distance of time probably more than twice as great as that which separates our era from that of the most ancient of the tool-bearing gravels yet discovered in Picardy or elsewhere*. But even then the reader will perceive that the age of man, though pre-glacial, would be so modern in the great geological calender, that he would scarcely date so far back as the commencement of the post-pliocene period."

From this instance, which will show the scepticism, or if you will the positive belief, of the talented new school of geologic philosophy, you will gather the fact, that there are no evidences of man's existence upon the earth, in any formation or deposit, previous to the glacial period, nor have any traces of his existence that may be depended on been discovered in Europe until a long time after its close.

When scepticism is carried beyond the historical, chronological, and geological evidence, it need not surprise, that conclusions based on such scepticism are disputed. Sir Charles Lyell states in his book, that M. Desnoyers, an observer equally well versed in geology and archæology, had disputed the conclusion arrived at by other geologists (M. Tournal and Christol), that the fossil rhinoceros, hyena, bear, and other lost species, had once been inhabitants of France contemporaneously with man. "The flint hatchets and arrow-heads," he said, "and the pointed bones and coarse pottery of many French and English caves, agree precisely in character with those found in the tumuli and under the dolmens (rude altars of unhewn stone) of the primitive inhabitants of Gaul, Britain, and Germany. The human bones, therefore, in the caves, which are

* The italics are mine.—W. G.

associated with such fabricated objects, must belong, not to antediluvian periods, but to a people in the same stage of civilization as those who constructed the tumuli and altars." "In the Gaulish monuments," he added, "we find, together with the objects of industry above mentioned, the bones of wild and domestic animals, of species now inhabiting Europe, particularly of deer, sheep, wild boars, dogs, horses and oxen. This fact has been ascertained in Quercy and other provinces, and it is supposed by antiquarians that the animals in question were placed beneath the Celtic altars in memory of the sacrifices offered to the Gaulish divinity Hæsus, and in the tombs to commemorate funeral repasts, and also from a superstition prevalent among savage nations, which induces them to lay up provisions for the *manes* of the dead in a future life. But in none of these ancient monuments have any bones been found of the elephant, rhinoceros, hyena, tiger, and other quadrupeds, such as are found in caves, which might certainly have been expected had these species continued to flourish at the time that this part of Gaul was inhabited by man."

I quote this, not only to show that there is a wide difference of opinion among geologists of eminence upon the antiquity of human remains, but that Sir Charles himself, as he states further on, became of opinion, from the arguments of M. Desnoyers and the writings of Dr. Buckland on the same subject, and by visiting several caves in Germany, that the human bones mixed with those of extinct animals in osseous breccias and cavern mud in different parts of Europe, were probably not coeval.

This opinion, however, he limits, for he again states, "But of late years we have obtained *convincing proofs*, as we shall see in the sequel, that the mammoth, and many other extinct mammalian species very common in caves, occur also in undisturbed alluvium, imbedded in such a manner with works of art, as to leave no room to doubt that man and the mammoth coexisted." I am not inclined to dispute their coexistence, but I wish to offer my reasons for believing that it took place in the chronologic era, and not in time so far beyond it as to make the Bible a fable, and to scatter the foundation of our religious belief to the winds.

In the way that I am able to understand the geological evidence on the subject, it does not conflict with the sacred chronology, and may be readily made to prove its truth; while all the argument adduced in favor of the remoter antiquity of man, if valid, must prove that chronology to be a falsehood. My ideas upon the subject tally more with those of M. Desnoyers than with Sir Charles Lyell's, although distinct from either. I acknowledge the truth as advanced in part by the former, but dissent altogether from the conclusions of the latter. At the same time, my solicitude is not on account of my own views, but lest those of Sir Charles Lyell should have more importance than they deserve. You know what he means —that he thinks he has good evidence in strata in which the remains of man are found with those of extinct species of animals, to prove not only the age of such strata, but also the coeval existence of man and the extinctions with which he there seems to be associated, and that man's proper time on this planet will thus be tens of thousands of years (it does not matter how many) further back than his first appearance in the Garden of Eden. I believe that in all this he is mistaken—that he takes things too much as he finds them, for the purpose of establishing a foregone conclusion, and attaches too little importance to the changes that have taken place on the earth during the past six thousand years. He ignores altogether such an event as the Noachian deluge, and the phenomena which must have accompanied and followed it. He does not allude to it, and his silence is more eloquent than words to show that he does not believe in it. I do believe in it, and depend upon it as strong evidence in disproof, and to uphold my own views, although I bring these forward with diffidence and great humility. They may or may not be entitled to examination. It is, however, an attempt in a safe direction, and it does not follow that some more efficient explorer of the arcana of nature, may not be privileged to reconcile the discrepancy if any, that prevails between the conflicting testimony of geology, as held by some, and what is generally termed revealed religion.

In the early period of man's history, there was doubtless the same migratory disposition as at the present day. We find it recorded that the eldest son of the first human pair, was the first emigrant. For the period of sixteen or seventeen hundred years between the creation and the Noachian deluge, we may suppose that offshoots were continually transplanting themselves, not only from the parent stock, but from each other. As men separated from their fellows, they must have become divided into families, groups and tribes, just such as peopled the northern parts of America when discovered by Europeans—wanderers who had lost all trace of their origin and of the primitive civilization,—hunters and fishers—dependant upon the prolific sea, and upon the wild beasts of the forest for food and clothing. It is quite possible and probable, that before that event the northern portions of Europe, in the order of creation, had been peopled with animals of forms and species largely developed, fitted for a previous condition of the earth, but becoming gradually extinct under the operations of altered nature. These fading species would have been contemporary with man, have lived and died around him for ages, until he and they were suddenly removed from the scene by destructive agencies. It is to this buried world that I would direct your attention. If the Noachian deluge erased from the earth by a signal catastrophe all human traces from certain latitudes, and all traces of other animals that existed there, you will see that ages must have elapsed ere traces of man would again become visible, and that then they would be found with a greatly changed contemporary fauna, and a condition of the earth different from that which preceded it. I believe that much of the cave phenomena and of the alluvial deposits in Europe, may be attributed to the Noachian deluge, or catastrophes of the like nature that previously occurred, of which there is no tradition, and that other instances quoted are as truly antediluvian, but after the creation.

There are some remarkable facts in Sir Charles Lyell's work, in connection with deposits in which the remains of man occur associated with those of the extinct animals. 1st.—These deposits are not simple strata—limestones or other rock formations, but are made up of the erosion of such formations including the glacial drift and later accumulations, a loose incoherent mass of chalky marl, sand, gravel and clay—none of which are native of the place where they are found—but brought there by streams from a distance, and from higher grounds. 2ndly.—The remains are not in the relative positions in which we might expect to find those of man, still an inhabitant of the earth, and those of wild animals of such huge forms and assumed fierce dispositions as were the extinct species. They are just in such proximity or association, as though the extinct monsters had held the same relation to man as the domesticated cattle of the present day—as though it were a millenial period—the teeth of a mammoth being found by the skull of a young person—another skull in a breccia in which was the tooth of a rhinoceros—another in which a perfect flint tool was in close proximity to the leg of a cave bear; and numerous other instances of fraternal position between these and other extinctions and the human race. You of course cannot believe in this harmony of nature, and therefore it is necessary to account for the position of these remains in some other way. It may puzzle you to think how it could have occurred at all, judging from any progressive changes that come under observation at the present day.

But there is another fact to which, in the third place, I beg to advert, and which seems to me to be still more strange when properly considered; but which is relied upon as the strongest evidence of the coeval existence of man with the extinct species. It is the finding of the remains of man and his tools and implements, in the *lowest* part of the *lowest strata* of sand, gravel, &c., both in the cave deposits and river alluvium. I will recite some of these instances:—

Cave Deposits:—

1. The cavern of Pondres, in which human bones occurred in the same mud with the bones of an extinct hyena and rhinoceros. The cavern was in this instance filled up to the roof with mud and gravel in which fragments of two kinds of pottery were detected—the lowest and rudest at the *bottom* of the cave, *below the level of the extinct mammalia*.

2. In the caverns of Engis and Engihoul, on the Meuse.—"Speaking generally, it may be said that human bones, where any were met with, occurred at all depths in the cave mud and gravel, sometimes above, and sometimes *below* those of the bear, elephant, rhinoceros, hyena," &c.

3. Lyell's exploration in the Engihoul cavern.—"Bones and teeth of the cave bear were *soon* found, and several other extinct quadrupeds. * * My companion continuing the work perseveringly *for weeks* after my departure, succeeded *at length* in extracting from the same deposit, at the depth of two feet *below*

the crust of stalagmite, three fragments of a human skull, and two perfect lower jaws with teeth, all *associated* in such a manner with the bones of bears, large pachyderms and ruminants, and so precisely resembling these in colour and state of preservation, as to leave no doubt in his mind that man was contemporary with the extinct animals."

4. The Neanderthal cave.—A human skeleton found near the *bottom* of loam which covered the floor of the cave, and the skull near the entrance, as though it had gone into the cave head foremost through some communication with the surface, amongst the *first* matter washed in.

5. The skull of an adult individual found in the Engis cave near Liege, associated with the elephant, rhinoceros, bear, tiger, hyena—all of extinct species, but nevertheless accompanied by a bear, stag, wolf, fox, beaver, and many other quadrupeds of species still living—a fact which has considerable bearing on this question, and which it is as well to keep in remembrance in connection therewith.

6. Caves of Gower in Glamorganshire, South Wales. — "But the discovery of most importance, as bearing on the subject of the present work, is the occurrence in a newly discovered cave, called Long Hole, by Colonel Wood, in 1861, of the remains of two species of rhinoceros, *R. tichorinus* and *R. hemitæchus* (Falconer), in an undisturbed deposit, *in the lower part of which* were some well-shaped flint knives, evidently of human workmanship. It is clear *from their position* that man was coeval with these two species. We have elsewhere independent proofs of his coexistence with every other species of the cave fauna of Glamorganshire ; but this is the first well-authenticated example of the occurrence of *R. hemitæchus* in connection with human implements."

River Alluvium :—

7. M. Boucher de Perthes in the first vol. of his "*Antiquites Celtiques*," published in 1847—states that he found flint implements in the *lowest* beds of a series of ancient alluvial strata bordering the valley of the Somme,—the tools were stated to occur at various depths, often twenty or thirty feet from the surface, in sand and gravel, especially in those strata which were nearly in contact with the subjacent white chalk.

8. Dr. Rigollot, having inspected the collection of M. Boucher

de Perthes, returned home, resolved to look for himself for flint tools in the gravel pits near Amiens. There he immediately found abundance of similar flint implements, precisely the same in their make and geological position, some of them in gravel nearly on a level with the Somme, others in similar deposits *resting on chalk*, at a height of about ninety feet above the river.

I need not multiply *unconscious* instances. These are remarkable arrangements of strata. We have man resting on the chalk, or nearly so, along with river and land shells of *living* species. Then come remains of contemporary animals of species which still exist. Then are found mollusca, of species not now living in Northern Europe, and others of living species. Then the cave hyenas, bears, and lions. Then the hippopotamus, rhinoceros, *elephas antiquus E. primigenius*, &c.,—the *last* first and the *first* last. Judging from the composition of the strata, which is a mixture and mingling of all the formations from the lowest eocene to the superficial surface accumulations, we certainly might expect to find, here and there, a representative of each of the extinct mammalia. The strange fact is, that they are in reversed order, or in such a position as would imply that a reversion was going on when they were deposited. But if this order of superposition is relied upon as proof that man was coeval in time with all these extinct animals, it ought to be held equally as proof that man existed before them, seeing that his remains are often found, almost as a rule, *beneath* them. While, therefore, it is not improbable that some of the now extinct animals may have come down to his era, we get a much more intelligent glimpse of his true position and time in creation, by finding his remains more intimately associated with species which now exist, which must have been contemporary with him, although created before him.

The geological record may, however, be read in another way—by placing man at the *head* of the creations of the Tertiary period instead of at its *foot;* and then following down from the recent to the eocene, we shall have the *received* order of superposition so far as the strata of the embraced periods are concerned. Man would then be found in his proper place, the associate of all existing species, and probably of some of the extinctions, and with all living species of land and marine mollusca, and would not be found in *simple* strata later than the recent, although it would not be extraordinary if his remains should be discovered in mingled strata—that upon which he was created with that upon which the extinct animals roamed and existed. This order does no violence to chronology, but rather sustains it. It makes man the last created mammal, and the cattle preceding him, and the wild beasts later still; and still preceding them extinctions of species for which the earth had become gradually unfitted. It goes further. It settles the point with reference to cave deposits and river alluviums, which are simply the mud of the erosions of surface and lower strata, burdened with the contents of each as the floods have reached them consecutively, sometimes mingled in their passage, or embedded successively at lower levels than the sites from which they had been washed. And this is the reason why we sometimes find flint implements in the lowest beds, or mingled with animal remains in the strata next imposed.

I have thus come shortly, with due reference to the time which reading this paper will occupy, to that stage of progress when exemplifications are necessary to verify the positions I have assumed. I find these, to my own satisfaction at least, in the book to which I have so frequently referred.

Sir Charles Lyell alludes to the investigations made by M. Tournal, an eminent archæologist, in 1828, in the cavern of Bize, in the department of the Aude, South of France. M. Tournal states that in this cavern he had found human bones and teeth, together *with fragments of rude pottery* in the same mud and breccia, cemented by stalagmite, *in which land shells of living species* were imbedded, and the bones of mammalia, some of extinct, *others of recent species*. The human bones were declared by his fellow labourer, M. Marcel de Serres, to be in the same chemical condition as those of the accompanying quadrupeds. Five years later M. Tournal, speaking of these fossils, states that—"they could not be referred to a diluvial catastrophe, but must have been introduced gradually, together with the enveloping sand and gravel *at successive periods*."

If the pottery described here was in a similar position to that described by M. Christol in the cavern of Pondres, to which I have previously alluded, we may suppose the relics of man in the cavern of Bize were *near* the bottom also, *below* the extinct mammalia, and this taken with M. Tournal's assertion that they were introduced *at successive periods*, enables me to draw the following inference in support of my views :—

We have no data to determine in what condition this part of the earth may have been at the period assigned as that of man's creation. We know of but one spot that is said to have been altogether pleasant. That previous to that event various species of animals roamed here, died, and became embedded, is exceedingly probable. Man at length came upon the scene, lived and died also. Consequently his remains and his works, with those of recent species, and those of extinctions, if some of them came down to his era, lay at the surface. Ages elapse, oscillations occur, and there are signs of approaching submergence of the land. Floods are frequent, sweeping the surface of its contents, and precipitating them into rents, communicating with systems of subterranean channels and caves. They form the undermost deposits in all such caves. Oscillations continue, *lower strata* are exposed and eroded, and bones of quadrupeds, extinct even then, are washed out, and they too are precipitated into caverns and channels, and form a superimposed secondary deposit. The grand submergence takes place—the Noachian deluge prevails in these latitudes—the quick upheaval follows, and animal relics, bones clothed with flesh, but rent and dismembered by conflicting elements, are introduced. In process of time stalactite drips through the roof, and stalagmite covers the floor of the caverns, which remain in that condition until developed by scientific research, a subject of speculation in the nineteenth century of the Christian era.

Time will not permit me to discuss this portion of the subject at much greater length. It may however be observed that there will be various modifications of cave deposits; and that although the proper place of human remains, washed from the surface and higher levels, is underneath other remains, when so found, it may have been that caverns were filled with relics long before man appeared; and in these the extinct animals and perhaps existing species may have mingled, and the remains of man, if any, washed in at a future period, would then be in the upper stratum. There ought to be no mistaking the geological age of caverns like these. It may have been also, and the case seems proved, that bones and implements of man have been washed out from the surface, and rolled in the beds or channels of rivers or torrents; and that lower strata, in which reposed the remains of older animals being reached, that both may have been mingled and further rolled and triturated in the same streams for a long time, before communication with the interior was made—and thus these remains would be identical "in appearance, colour, and chemical condition,"—then they may have gone in a mingled mass into the cavernous passages and fissures, and would be found, as Schmerling found his deposits in the Enjis and Engihoul caverns before referred to—*at all depths*, and their respective ages undistinguishable.

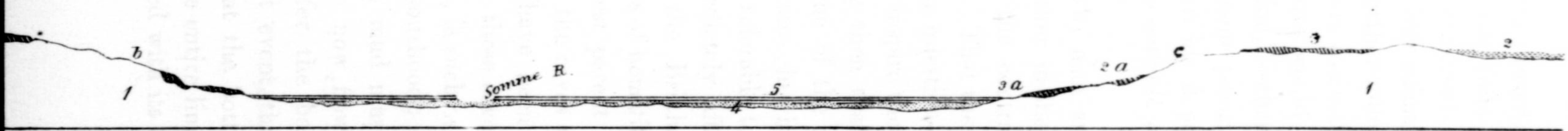
I cannot discover any good reason why man and many animals now extinct, may not have existed together in the chronologic era, from the creation to the deluge. On the contrary, the evidence appears to me to favour their coexistence. That the Noachian deluge was partial or otherwise, is not now the question—that there was such an event universal tradition would inspire the conviction, even though the record were lost. Allowing then that it extended to northern regions inhabited by man, some of the caverns near the sea, those at Brixham, in Devon, for instance, in which animal bones and flint implements are found, may be referable to such a disturbance, and others to the period immediately after. There are several circumstances connected with the Brixham caves which favour this opinion. Some worn pebbles of hematite found in them, could only have come from their nearest parent rock at a period when the valleys immediately adjoining the caves were much shallower than they now are. This may have been the time of the deposition of the gravel and stones in these caves. The reddish loam in which the bones are imbedded, is such as may be seen on the surface of limestone in the neighbourhood; but the currents which were formerly charged with such mud must have run at a level 78 feet above that of the stream now flowing in the same valley—and to this time we may refer the bone deposits. It accords also with the phenomena of that event, that there is good evidence in the discovery in the mud at the bottom of the bone earth and close to the flint knives, of the entire limb of a cave bear, which must have been introduced clothed with its flesh, or with the [illegible] bound together by their natural [illegible] of the coexistence [illegible] with mammals now extinct. It further appears that the [illegible] at first must have been deposited through these channels [illegible] great force, and thus accumulated the stony fragments—that [illegible] this stratum there was a regular current, and that then [illegible] sand and bones accumulated—and that when this ceased, the [illegible] and gradually formed.

[illegible] might point to other instances of cavern deposits which seem [illegible] the received chronology with reference to the age of [illegible] I find no valid reason for carrying back to remote [illegible]. I shall however rest this part of the case with the facts [illegible], and proceed to examine the theory by the evidence afforded [illegible] deposits, containing bones of extinct mammals and flint [illegible] similar to those of the caves.

It must be borne in mind that these alluvial deposits in valleys [illegible] made up of erosions and denudations of the surface strata, and [illegible] similar to those which are found in caverns. We ought there- [illegible] have the same phenomena—or with slight modifications—and [illegible] it is so. The same inverted strata ought to have openly, [illegible] as in the underground passages and caves communicating [illegible] the surface. In the diagram* before you, which is a section [illegible] valley of the Somme in Picardy, you will find the regu- [illegible] of superposition of strata—first the chalk (1), next the [illegible] strata (2), then the loam, or drift, or brick earth (3). Next [illegible] find the upper and lower level gravels made up of these [illegible] which I have marked—upper (4) and lower (5 a); then [illegible] of both (6), the peat (7), and the river Somme, with new [illegible]. I will read the description (with these figures) from Sir [illegible] Lyell's book, and afterwards make a short commentary [illegible] in accordance with my own views:—

"The valley of the Somme in Picardy is situated [illegible] of white chalk, with flints, the strata of which are nearly horizontal. The chalk hills which bound the valley are [illegible] between 200 and 300 feet in height. On ascending to [illegible] we find ourselves on an extensive table-land, in which [illegible] slight elevations and depressions. The white chalk itself [illegible] ever exposed at the surface on this plateau, although

* This is copied from the section in Sir Charles Lyell's book, and is [illegible] will give an idea of the position of the various deposits. [illegible]



Relative position of the Deposits &c in the Valley of the Somme.

(See p. 93)

C. & A. Gorle Lith. Halifax N. S.

bones bound together by their natural ligaments, of the co-existence of man with mammals since extinct. It further appears that the waters at first must have been propelled through these channels with great force, and thus accumulated the stony fragments—that succeeding this torrent there was a regular current, and that then fine mud and bones accumulated—and that when this stayed the stalagmite floor was gradually formed.

I might point to other instances of cavern deposits, which seem to corroborate the received chronology with reference to the age of man, which I find no valid reason for carrying back to remoter periods. I shall however rest this part of the case with the facts quoted, and proceed to examine my theory by the evidence afforded by river deposits, containing bones of extinct mammalia and flint implements similar to those of the caves.

It must be borne in mind that these alluvial deposits in valleys, are made up of erosions and denudations of the surface strata, and are similar to those which are found in caverns. We ought therefore to have the *same* phenomena—or with slight modifications—in both; and it is so. The same inverted strata meet us here openly, which met us in the underground passages and caves communicating with the surface. In the diagram* before you, which is a section across the valley of the Somme in Picardy, you will find the regular order of superposition of strata—first the chalk (1), next the eocene strata (2), then the loam, or drift, or brick earth (3). Next you will find the upper and lower level gravels made up of denudations, which I have marked—upper (2 *a*), and lower (3 *a*); then the gravel bed (4), the peat (5), and the river Somme, as it now runs, (6). I will read the description (with these figures) from Sir Charles Lyell's book, and afterwards make a short commentary upon it, in accordance with my own views.—

"The valley of the Somme in Picardy is situated geologically in a region of white chalk with flints, the strata of which are nearly horizontal. The chalk hills which bound the valley are almost everywhere between 200 and 300 feet in height. On ascending to that elevation we find ourselves on an extensive table land, in which there are slight elevations and depressions. The white chalk itself is scarcely ever exposed at the surface on this plateau, although

* This is copied from the section in Sir Charles Lyell's book, and is not correct, but will give an idea of the position of the various deposits. (See section.)

seen on the slopes of the hills, as at *b* and *c*. The general surface of the upland region is covered continuously for miles in every direction by loam or brick earth (3) about five feet thick, devoid of fossils. To the wide extent of this loam the soil of Picardy chiefly owes its great fertility. Here and there we also observe on the chalk outlying patches of tertiary sand and clay, with eocene fossils (2), the remnants of a formation once more extensive, and which probably once spread in one continuous mass over the chalk, before the present system of valleys had begun to be shaped out. It is necessary to allude to these relics of tertiary strata, of which the larger part is missing, because their denudation has contributed largely to furnish the materials of gravels in which the flint implements and bones of extinct mammalia are entombed. From this source have been derived not only regular formed egg shaped pebbles, so common in the old fluviatile alluvium at all levels, but huge masses of sandstone several feet in diameter. The upland loam also (3) has often, in no slight degree, been formed at the expense of the same tertiary sands and clays, as is attested by its becoming more or less sandy or argillaceous, according to the nature of the nearest eocene outlier in the neighbourhood. The average width of the valley of the Somme between Amiens and Abbeville is one mile.

"It will be seen by the description given of the section, that (3 *a*) indicates the lower level gravels, and (2 *a*) the higher ones, or those rising to elevations of eighty or a hundred feet above the river. Newer than these is the peat (5), which is from ten to thirty feet in thickness, and which is not only of later date than the alluvium (3 *a*) and (2 *a*), but is also posterior to the denudation of those gravels, or to the time when the valley was excavated through them. Underneath the peat is a bed of gravel (4), from three to fourteen feet thick, which rests on undisturbed chalk. This gravel was probably formed, in part at least, when the valley was scooped out to its present depth, since which time no geological change has taken place except the growth of the peat, and certain oscillations in the general level of the country. A thin layer of impervious clay separates the gravel (4) from the peat (5), and seems to have been a necessary preliminary to the growth of the peat."

I may sum up the substance of this description in a few words. If my theory of inversion be sufficient to account for the finding of the remains of man in mixed strata—no violence will be done either to the scriptural or geological record. They will fall into their proper place in the order of creation. So also will those of the recent animals cotemporary with man: and so also will those of the extinct mammalia.

The valley of the Somme and the hills by which it is bounded, must at one time have been the bottom of a large cretaceous lake, which communicated with the sea. When the elevation of this basin into dry land occurred, the chalk arose covered continuously with a loose and incoherent eocene formation of sand and gravel containing contemporary mollusca. There is no evidence to show that this eocene strata, lying directly on the chalk, was ever inhabited, except by fresh water or land shells, up to the glacial period. As this came on and continued, there may have been great depression and submergence of the land—the loam and clay being then deposited that cover the country, much thicker than they now are, and destitute of fossils. There was a corresponding re-elevation and denudation—the surface of the country rose slowly above the reach of the water, but the configuration of the land caused a broad, deep, and rapid stream, perhaps ice laden, to run where the valley of the Somme now is, sweeping away what remained there of the superficial deposit, eroding the eocene strata, excavating the valley down to the chalk, and also eroding its sides. This stream, as oscillations occurred, may have run at a higher or lower level, but remained for a long time at the upper level (2 *a*) where its eddies accumulated the upper level gravels, which extended on either side the valley towards its centre. The higher dry land would have been overspread with herbage, and have nourished and sustained living creatures—*elephas primigenius*, *rhinoceros tichorinus*, *equus fossilis*, and other extinctions which then had roamed from more southern latitudes subsequent to the glacial era, and their remains became embedded. Long previous to the time of man's appearance on this scene, and before his creation, some of these races became extinct.

At length man in his continued migration, from the cradle of the human race, arrived at and roamed over the country, as wild as civilized man found the aborigines of this continent—wearing the skins of beasts—using stone implements and flint weapons, and possessed of the useful art of making rude pottery. He too peopled the country for ages—hunted, and lived and died there. Suppose now that the Noachian deluge affected these latitudes—that another great depression took place, and all the high hills were quietly covered by the waters—and shortly afterwards a corresponding re-elevation. What then would have been the effect upon the surface deposits of the lands bounding the valley of the Somme? The broad waters would have been charged, first, with the uppermost stratum, the remains of man and his works, and those of contemporary fauna. Secondly, with remains of other and older mammalia—all which would have been deposited in their order on the chalky shelf (2 *a*) in the eddies of the swift stream that ran at that height, and have formed part of the alluvium (2 *a*) mingled with eocene strata (2) and extending into the valley. Thirdly, with part of the remaining unfossiliferous loam and drift which cap these gravels. As the waters decreased, the stream, cutting through (2 *a*) would have swept it nearly all away, depositing its sediment charged with its material and other debris, at (3 *a*), which would then have been the bottom of the valley, and in its turn would have succumbed to the still decreasing downward impetuous flood; and all the finer particles having now disappeared, would have left the rough gravel (4) resting upon the chalk—the newest deposit except the peat, of the valley of the Somme—and then the waters having subsided the river would have formed its present channel or something very like it, and the peat would have begun to grow.

This is my comment upon the geological deposits of the valley of the Somme. If just, it rescues them from the long past ages to which Sir Charles Lyell and other geologists have consigned man and his works, and so far as these last are concerned, brings them down to a period between the creation and the Noachian deluge. It does not, however, necessarily implicate this last event as the sole agent by which these deposits were made, for oscillations of the land and changes of level in this region, may have caused inundations which would have produced the same results. But it does show that the antiquity of man, judged by the received chronology, need no longer be a subject of dispute, or doubt, especially by the believers of Divine revelation.

The generations immediately after the Noachian deluge, buried their dead out of their sight. We have a record of this in the life of Abraham, who purchased the cave and the field of Machpelah from Ephron the Hittite, the children of Heth being witnesses; and such burial places were held sacred, sometimes visited by survivors, and occasionally opened to admit another tenant to the narrow house. We do not for a moment suppose that Abraham originated this custom—but it may have been an *antediluvian* one,—and we therefore have a warranty to search for an antediluvian cave or grotto set apart for the sacred rite of burial. Sir Charles Lyell has found one, which he says "seems clearly to have been a sepulchral vault of the *post-pliocene!* period," near Aurignac, not far from the foot of the Pyrenees, thus carrying back its age tens of thousands of years probably before the assumed period of man's creation.

It is a grotto in the side of the hill of Fajoles, near the town of Aurignac, in the department of the Haute-Garonne, near a spur of the Pyrenees. The discovery was made by a workman (Bonnemaison), who observed that rabbits when chased ran to this spot to burrow. On reaching into the hole, he laid hold of, and drew out, much to his surprise, one of the long bones of a human skeleton. Digging into the talus he came to a large stone slab, which formed the closure of a grotto, the inside of which was almost filled with bones, among which were two human skulls. He communicated the circumstance to M. Amiel, the mayor of Aurignac, and the discovery made a great sensation. The bones were all re-interred in the parish cemetery, but not before M. Amiel, who was a medical man, and had a knowledge of anatomy, ascertained that they must have formed part of seventeen skeletons of both sexes and all ages, some so young that the ossification of the bones was incomplete. He also remarked that they must have been a race of small stature. Unfortunately the skulls were injured in the transfer, and after the lapse of eight years, when M. Lartet visited Aurignac, and a further investigation was about to be made, the sexton was unable to tell where the remains had been buried, and they have not been re-discovered to this day.

Outside this cave, among ashes and some overlying earthy layers, separating the ashes from the talus, were a great variety of bones and implements—a stone of a circular form flattened on two sides, arrows without barbs, other tools made of reindeers' horns, and a bodkin formed out of the more compact horn of a roe deer. Among the cinders outside the vault were fragments of fissile sandstone reddened by heat, which were observed to rest on a level surface of nummulitic limestone, and to have formed a hearth. There were no human bones on the outside of the grotto, and of the various species of animals there were extinct and living species—among the former—ursus spelæus, felis spelæa, and hyena spelæa, *carnivora*,—elephas primigenius, rhinoceros tichorinus, megaceros Hibernicus, *herbivora;* and of the latter—badger, polecat, wildcat, wolf, and fox, *carnivora*,—and the pig, stag, roebuck, reindeer, and aurochs, *herbivora*.

This is a short summary of the history of the Aurignac relics. It is, to say the least, a singular instance of human remains, not enveloped in a preserving matrix, remaining for *so long* a period undecomposed. If we give them the age assumed for them by Sir Charles Lyell, they may have lain there hundreds of thousands of years, a long time for traditions or customs of burial to have been retained which descended to Abraham. But if we allow that the extinct mammalia may have peopled this region between the creation and the deluge, the fact of cave burial and the post-diluvian custom or tradition will be much more intelligible. The fossilization of the young bones in process of growth, is another marvel. And almost equally so, after the sensation excited by the discovery, is the total oblivion that fell upon the Aurignac sexton, of the spot where the remains were re-interred.

The only good reason I can discover for attributing so great an age to these human remains, is their association with those of many extinct animals, which are known to have existed and roamed the earth long ages previous to the period assigned for the creation of man. If, however, these extinctions came down to the date of the Adamic chronology, and I believe that most of them did so, equally with those which are still living species, this reason would not apply—for we might expect to find them here, the natural enemies and the food of man. We might then suppose this cave to be a burial place of some small emigrant tribe of antediluvians, who in a few generations after the first man, had found their way to this region from the centre of the race, and had hunted, and lived and feasted upon the animals of the chase, such as the remains are described to be. Against this supposition is the stated fact, that *no change* in the physical configuration of the district, such as a flood would have made, has taken place since the grotto was a place of sepulture. But if the Noachian deluge were a partial one, which is a tenet of the modern school of philosophy, if they admit it at all, a good deal may be made out of Sir Charles Lyell's own argument in support of this theory of the age of the remains in the Aurignac grotto. Thus he says—"It is the normal state of the earth's surface to be undergoing great alterations in one place, while other areas, often in close proximity, remain for ages without any modification. In one region, rivers are deepening and widening their channels, or the waves of the sea are undermining cliffs, or the land is sinking beneath or rising above the waters, century after century, or the volcano is pouring forth torrents of lava, or showers of ashes; while in tracts *hard by*, the ancient forest, or extensive heath, or the splendid city, continue scatheless and motionless." There may then have been elevations here, and depressions at no great distance. The floods which covered the face of the country in other parts, and filled caves with the bones of men, and animals now extinct, whether Noachian, or a consequence of them, or otherwise, may have spared the region in which the Aurignac grotto is situated, while they fulfilled their mission upon the fauna at a distance, nigh or afar. The Aurignac grotto, therefore, while it shows that man may have existed with animals now extinct, affords no proof that he was as old in time as they; or even that all the monstrous existences that peopled the world at his advent, became extinct at the great catastrophe which preserved a large proportion of the species that now remain.

Our own country affords some remarkable instances of the presence of man and his works on the scene, long previous to its discovery by Europeans, and the introduction of civilization and refinement. It is easily ascertained at the present day, that the aboriginal race in this part of the continent, lived by hunting and fishing, and used stone and bone weapons of offence and defence, and implements of industry or domestic economy, precisely similar in form and fashion to those that stretch beyond the historic period in Europe. There has been no intervening bronze age in this part of the American continent. The remains and relics are the veritable weapons, utensils and pottery, in type and material, as were used by the remotest Gaul, Briton, and Scandinavian, long before a bronze implement was introduced among them. We are thus pointed to an interesting fact. That the ancient people of Europe had become isolated from the centre of civilization, and had lost all tradition of it, except of one event; and were to it as unknown as was America, (to which the human family had also gradually spread), until the days of Columbus. The wonderful tales of the heathen mythology may therefore be no longer myths when taken in connection with the subject of the antiquity of man, and the discovery, in the north of Europe, of a new country and a strange people, and the reclamation of their millions to a state of half civilization, and an exchange of stone for the more useful and ornamental bronze and gold and silver. The time is too far distant to enable us to judge correctly whether the intruders supplanted, as on this continent they are gradually doing, or amalgamated with, the aboriginal race. The Fin, the Lap, and the Esquimaux, in the extreme north, in their lineaments and stature, their customs and usages, seem to favour the idea of a people retreating beyond the influence of manners and modes of life which they could not appreciate, and were powerless to withstand; and the ancient painted Briton, clothed in the skins of beasts, with his fishing corracle, so like the Indian, contrasted with the war chariots and splendour of his chiefs, and the power of the Druidical priesthood, leads us to believe that the advent of a superior race was attended with consequences to the aborigines of the old world, very similar to those which have been produced in the new. That advent was certainly post-diluvian, although no authentic record remains that can be depended on, of the settlement or conquest by which it was made.

One great cause of scepticism is the readiness with which mankind yield their belief to theories put forth with show of reason, by those whom they regard as superior intelligences, and in whom they repose implicit confidence. Let a man do some great thing which will bear the test of enquiry in every possible shape, and become famous thereby, and he may afterwards commit a thousand vagaries, and find multitudes to uphold him. A Lyell, a Darwin, or a Huxley, may go a long way in the path of human knowledge, make important discoveries, and satisfy the world that all they do is right and just and proper—and that therefore their theories, equally with their facts, may be received with faith equal to that which should follow plain demonstration. But there is no reason why we should respect their speculations as we do their truths, seeing that, although in their own hands, they lead to nothing, and are nothing. Such an impotent conclusion has met Lyell, who expects to find remains of man in the submerged forest at Cromer, where they are not to be found. Such also has met Darwin, who has let go his belief in creation, and adopts variation of species instead; and such also meets Huxley, who traces back organized being to molecules, so much alike in every species, that all his philosophy cannot distinguish one from another, and who is yet compelled to acknowledge that the molecule of a horse prodnces a horse, that of a bear a bear, that of a camel a camel, and that of a man—although exactly like the others—a man. We must, therefore, be careful while giving due credit for the truths that such men teach, not to be led away by speculation which is not truth, and to which the test of truth cannot be applied with any satisfactory results.

But it is time that I should bring these observations to a close. We are all searching after truth—whether we look to find it in the past, of the beginning and progress of which we know so little, and which seems to our finite capacities an eternity of duration,—or in the present, in which we have an interest for three score years and ten, to mould it for the future,—or forward to that future, whose duration will be infinite, and in which we expect to be partakers of another form of existence that shall not change. We glean here and there, with the depths of the wisdom so dearly purchased for us by the first man with the penalty of a short life, a few startling facts, which create in us wonder and awe at the stupendous work of creation. We reason upon them with the aid of science, and make a little progress in unravelling their history, and are then brought to a stand still, or are lost in endless and unprofitable speculation. Looking backward or forward, and investigating as we may, we find no theory so stable as the recorded order of creation—none with which our geological facts so well agree;—and as this has not been written in detail, and therefore not so much for our learning as the exercise of our faith and for our edification, we may rest assured that our faculties are given us, less on account of what has been done, than for what there is to do; and that the exploration of the earth for the past history of man is of little consequence as it concerns his present happiness, to say nothing of the future, while it only tends to perplex hi[s] ideas and unsettle his reason. Taking this view of the subjec[t], I am quite content in my belief that man was the last mammal created. That he had his time and place assigned to him in that sublime expression of the Will of the Almighty Creator, with whom to will is to execute, Who said—"Let us make man in Our image, after Our likeness—and let them have dominion over the fish of the sea—and over the fowl of the air—and over the cattle—and over all the earth—and over every creeping thing that creepeth upon the earth."

Art. X. Notes on the Weather at Halifax, Nova Scotia, during 1864. By Colonel Myers.

[*Read Monday Evening, April* 6, 1865.]

The year 1864 began with a gale of wind from S. E., and snow, which latter, however, soon turned to rain. The remainder of the month of January was generally fine, and, with the exception of two days, when the mercury stood a few degrees below zero, the weather was mild for the season. The mean temperature was 23°, being 7° lower than it was in 1863.

The weather in February was unsettled; the mean temperature 26°, being 3° higher than in 1863.

March was stormy and unsettled; mean temperature 28°, being 3° higher than 1863.

April weather variable, with high winds; mean temperature 36°, being 2° lower than in 1863.

May generally fine, though fogs were frequent; mean temperature 48°, being 10° higher than 1863.

June fine, but season backward, in consequence of the want of rain and prevalence of cold sea fogs; mean temperature 57°, being 3° higher than in 1863.

July very fine and dry; mean temperature 62°, being 3° lower than 1863.

August, though generally fine was characterized by occasional heavy rains; mean temperature 64°, being exactly the same as last year.

September very fine, with the exception of a few days of heavy rain; mean temperature 56°, being 2° lower than 1863.

October for the most part lowering and rainy. Frosts occurred towards the end of the month; mean temperature 46°, being 5°, lower than 1863.

November generally unsettled; mean temperature 39°, being 1° lower than in 1863.

December weather variable and stormy; mean temperature 27°, being 1° higher than in 1863. The year closed with some severe weather.

The highest temperature in the shade recorded by me during 1864, was 92°, on the 15th June; the lowest—5° during the nights of 23rd and 24th of December. The highest monthly range, 55°, in June; the lowest 33°, in July and September.

Yearly range 97°; the hottest month was August; the coldest January; the mean temperature of the year was 43°, being 1° lower than that of 1863.

The highest reading of the barometer was 30°.26 on the 10th December; the lowest, 28°.48 on 22nd December. The highest monthly range, 1°.78 in December; the lowest, .54 in July. Yearly range, 1°.78. The mean for the year, 29°.65.

The most prevalent winds during the year were N.W. and S.W. The least prevalent S. and E.

Rain fell on 118 days; snow on 49; hail on 8; and fog was present on 56 days.

Aurora Boreales were visible on 54 nights; there were 16 solar, and 17 lunar halos.

Thunder storms occurred on 12th March at 8 o'clock, A. M., and at 1 o'clock, P. M.; on 31st May; 27th June, and 12th July; on the 2nd, 11th, and 26th August; on 12th and 13th September, and on 14th and 17th October. Lightning was seen, but thunder not heard, on 3rd and 12th July; on 25th September, and on 8th October. Thunder was heard, but lightning not seen, on 13th, 20th, and 23rd June.

The latest fall of snow in the Spring was on the 20th April, and in the Autumn a few flakes were observed as early as the 20th October. Fine weather predominated during the year, and the summer was remarkable for its dryness. In some places the want of rain was much felt, and, even in our abundantly supplied city, apprehensions were entertained of a failure of water, the lakes having fallen below their usual level. There were but few heavy gales, and I may here mention that the late Judge STEWART favored me with a communication, only a few months before his death, in which he stated that he had frequently noticed that storms, which from time to time prevailed in the northern parts of this continent, extending as far south as New York, and approaching as near as Truro and Windsor in this Province, did not reach Halifax, where, while New York, Boston, St. John, and the circumjacent country were devastated, calm and fine weather prevailed. The Judge had hence assumed the hypothesis that Halifax is the centre of a storm circle, and he thought, if the attention of the government were called to the subject by this Institute, it might be induced to regard it as worthy of notice, and grant a small sum annually to be expended in obtaining from the telegraph company such daily information as would enable us to ascertain whether this view is a correct one; which, if established, would be of some importance to disabuse the world of the idea, so universally entertained, that this is pre-eminently the land of fog and storms. If an interchange of weather signals between the Smithsonian Institute at Washington and Halifax, which is now under consideration, can be accomplished, it will do much in furtherance of this object, and should the assistance of the government be required in carrying out any arrangement of this kind, it will no doubt be freely accorded.

Among several fine displays of aurora borealis, for which the past year was distinguished, one, on the night of 7th—8th of June, surpassed in magnificent beauty, extensive diffusion, and length of duration, anything of the kind I had ever before witnessed. At eight o'clock, P. M., of the 7th, a violent squall of wind from the N. W., with heavy rain, passed over the city, after which the weather became calm and cloudless. At about nine o'clock bright undulating sheets of light were first observed in the whole northern part of the sky, extending upwards beyond the zenith, and, by degrees, overspreading the heavens in the form of an immense tent, making the night as light as day. At midnight its appearance was peculiarly beautiful. Iridescent rays, darting rapidly upwards from the north, mingled together beneath the apex of this vast canopy, forming large luminous masses, which, with a rolling motion, at one time gradually faded away, only shortly to re-appear with additional splendour. Thus it continued until about one, A. M., of the 8th, when the whole began to subside towards the north, forming an arch, which extended from east to west about fifteen degrees above the northern horizon. The arch was depressed at the centre, and luminous streamers occasionally shot up from it, till it entirely disappeared soon afterwards. The weather of the preceding week had been calm and fair, with the exception of the squall on the same evening, and two days on which there had been rain and fog. The atmospheric pressure was 29°.73; the temperature 45°. Two days afterwards stormy southerly weather prevailed, which I have often observed to follow the appearance of Aurora Borealis. I have been led to notice this phenomenon more particularly from having read in the Proceedings of the British Meteorological Society of November, 1864, an interesting description, by F. Abbott, Esq., of a rich and rare Aurora Australis he had observed at Hobart Town, on the evening of the 8th June, 1864. The occurrence of two such unusual appearances, at nearly the same time, in the northern and southern hemispheres, and their resemblance to each other in some of their features, struck me as being very remarkable.

On the 22nd of April a fine Parhelion was visible between five and six o'clock, P. M.

At midnight, 24th June, a bright stream of light was observed to rise vertically from the eastern horizon, gradually spreading out in its progress upwards, like the vast tail of a comet; a similar appearance occurred on the 27th September, at 7 P. M.

The following periodic phenomena will not probably be uninteresting:—

January—16th, smelts taken in Porter's Lake full of spawn.

February—7th, black and white birch bear catkins owing to the very mild weather; red maple and currant bushes in bud; 8th, moose bush buds bursting into leaf.

March—3rd, migratory thrush seen; 5th, a silver thaw; 8th, gnats and small flies appear in houses; 10th, blue jays seen; 11th, wild geese going north, and pine grosbeak about; 21st, migratory thrushes in fields; 31st, Mayflower plucked near North West Arm.

April—1st, song sparrow and blue bird seen; 2nd, white throated sparrow first heard; 5th, North West Arm frozen over again slightly, after having been free of ice for some days; 7th, water spider on brooks; 22nd, "Camberwell beauty" butterfly flying about; gnats dancing in the air; swallows first seen; migratory thrush sings; 24th, hermit thrush first seen; 25th, frogs heard; meadows getting green, and rhubarb sprouting; 26th, poplar (*P. tremuloides*) in blossom; 30th, frog spawn in ponds; pine in new leaf.

May—2nd, red maple buds in forward state; 3rd, birch and hacmatac in bud; blue violet in blossom; 4th, brown snake first seen; 5th, wild gooseberry in leaf; 6th, gray hunting spider on stone walls; 22nd, frost occurred; 29th, apple trees in full leaf; blueberry in blossom.

June—4th, clouded yellow butterfly about; 5th, birch and red maple in full leaf; balsam poplar in leaf; dandelion in seed; 6th, pigeon-berry in blossom; buttercup in flower; 8th, Bermudiana in blossom; 9th, ash in young leaf; 11th, red spruce in flower; apple in blossom; large tiger swallow-tail butterfly about; 12th, ground juniper in flower; withrod flowers just forming; 13th, timothy grass in flower; 14th, yellow potentella in blossom; 17th, lilac in full bloom; 18th, white weed in full bloom; 19th, ash in blossom; 21st, firefly first seen; 29th, ash in full leaf; lilac blossoms fading.

July—6th, blackberry in full bloom; withrod in blossom; 9th, timothy grass ripe; 10th, white acacia in bloom; 15th, strawberries abundant; wild rose in blossom; gad-fly abound and troublesome to cattle; 19th, brooks and watercourses dried up; cattle suffer for want of rain; 25th, cracking locust first heard; 30th, black and red spruce bear cones in abundance. During this and the succeeding month vast quantities of *medusæ* were observed floating about the harbour.

August—7th, blueberries abundant; 21st, red maple leaves turning crimson in wet places; 28th, golden rod in flower.

September—5th, Michaelmas daisy in full bloom; 9th, field cricket sings in pastures; 21st, mackerel abundant in the harbour; 22nd, maples, birch, and poplar turning colour rapidly in the forests; 23rd, blueberry leaves changing colour; pigeon-berry still in flower.

October—2nd, pine sheds its leaves; 7th, grasshoppers still about.

December—2nd, snow bunting first seen on the common; 10th, witch hazel in blossom.

By the kindness of Judge Wilkins I have had an opportunity of inspecting a register, in his possession, of observations, regularly noted three times a day, of the temperature at Halifax during the months of December and January in three successive years, from December 1809 to January 1812. With the assistance of this interesting document, I have been enabled to compare the mean temperature of these winter months, upwards of fifty years ago, with that of the same months in 1863, 1864, and 1865, and the result is as follows:—

Date.	Mean temp.	Date.	Mean temp.	Date.	Mean temp.
Dec. 1809	33°	1810	27°	1811	36°
		1863	26°	1864	27°
Jany. 1810	21°	1811	27°	1812	25°
" 1863	30°	1864	23°	1865	22°

This tends rather to invalidate the supposition, so generally admitted, that the winters of the present time are milder than those of former years: but it would be premature to form a decided opinion upon this point without a more extended investigation, the means for pursuing which may possibly yet be found.

ART. XI. ON THE GASPEREAUX. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

[*Read April* 6, 1865.]

Alosa Tyrannus { Gasperot (Mons. Deny, 1675,) Gaspereau.
Spring herring........... Blue back.
Alewife.................. Kiack.

SHOULD any one on a warm evening of the last of April or beginning of May, stand at the mouth of any of our rocky streams, pouring their snow-swollen torrents down to join the sea, he may see, as the last of the flood tide sweeps up to meet their turbulent waters, on every jutting point, on every isolated rock, a figure with a bag net on the end of a ten or fifteen foot pole, casting his net again and again, into every little pool or whirling eddy at his feet, and returning it as often filled with one, two, or more glittering fish, which with a dexterous toss he throws upon a silvery heap, tossing and flapping their lives away on the warm grass hard by. The warm setting sun is throwing his beams, athwart rock and tree, and little fires lighted to drive away the black flies, are wreathing the tree boles with scanty smoke. As we pass figure after figure we find them mostly young men or boys, negroes, here and there an old settler with a known love for sport, and at the day which we write of, numerous Indians. The game is not enough to lure the strong man from his farm or his mill; he leaves it for his boys and his poorer neighbours. We pass the rogue who stole our last year's best bough apples; we pass Peter Prince's ragged, and white-teethed progeny, but pause, attracted, as we all are, by the man of the forest, the man of no house, or no key to his front door. He stands before us casting back-handed throws of his bag-net, with true Asiatic grace, so different from the direct Anglo-Saxon plunge of his neighbours, so resembling round hand bowling, the last nobby dodge of the cricketer. In the days of which we speak, he stood bare head and neck, a scarlet-seamed blue hunting frock girt about his loins by a gay girdle, holding his knife and tobacco pouch, scarlet edged leggings shewed fairly his clean curved limbs, and mocassins of his own make covered his firm foot. "Brother," we say, "is the sport good?" "Too much water, all get up before the lakes fall;" and as he speaks he lands two or three glittering fish at our feet. As they roll and toss on the warm grass, their large lidless eyes filled with dust, the sun for the first time glinting their sides of molten silver, we handle and examine them. Fresh from the cool water they are covered with slime; the scales readily come off in our hands. When the scales are entire their colour is silvery from the belly nearly to the back; along the back there runs a dusky greenish line, a thousand reflections of green and violet break the surface; the head and cheeks have a yellowish tinge with a little violet; the fins so lately waving in water transparent are already darkening and stiffening. As in his restless struggles the scales come off, we find the colours of his back deepening, and a black spot showing near his gills. His description in our notes reads:—

Length from 10 to 12½ inches, colour, when fresh from the water and covered with scales, silvery, greenish dusky on back and about an inch down the side, green and violet reflections casting everywhere; opercles yellowish with violet reflections; about ten or less faint bands, by turning the fish to the light may be observed, passing longitudinally from gills to tail; a black spot immediately behind the opercle, lips dusky, fins yellowish or greenish dusky, the points, and first rays darker than the others; the same colour in the caudal fins. The scales are so deciduous that they fall off in handling; and then we find the colour of the back more decided, the longitudinal bands showing as rows of distinct spots, and the black spot behind the opercle very distinct. In general appearance the fish is rounder and shorter than the herring—greatest width anterior to dorsal fin—and about one fifth the length, eye half an inch in diameter, irides silvery, a little more than its diameter from tip of upper lip, lip notched to receive the lower lip in; nostrils open half way between tip of nose, and eye; the head shorter and smaller than the herring; the belly strongly serrated, about 35 points from gill-ray to anus.

Fins—dorsal fin, 15 rays, the first very short, and joining the second which is the highest—irregularly rhomboidal, pectoral 16 rays, second and third the longest, ventral 9, anal 17; caudal deeply cleft almost to the scales, having two half rays, then seven entire rays, then several more half rays, then seven entire ones and ending with two short ones, the caudal fin often split and fringed, the gill ray seven of a side, the last one square pointed—no teeth.

D. 15, P. 16. V. 9, A. 17, C. 14 entire, 8 or 10 half rays.

Our specimen is now dead, and we note how fleeting the colours of the fins are, which almost should be described when floating in water, and covered as the whole body is with nacre, doubtless to keep the water from penetrating the joints of the scales. We are now aware that our fish is a true *alosa*, allied to the shad, the menhaden, and many others, and that the stream before us is crowded with a multitudinous marine army, coming up with the last of the flood, and running the rivers to reach the lakes to spawn. A little further up the stream, the river becomes deep and smooth, and is crossed by the high road. Lying at our length on the log bridge, we watch a continuous stream passing slowly up and up, two or three inches apart. Farther up, and the river breaks over a smooth plane of slate stones too shallow for his depth. Arrived at this plane, he throws himself as far up as he can, and then commences a series of spasmodic flaps with his tail.

Slowly and painfully he passes over and drops exhausted into the tranquil pool above. Utterly exhausted, they lie heads and tails in a confused mass. Presently recruiting, their heads all pointing up stream, they again commence their march.

In countless hordes they sweep through lonely still waters, the home of the trout, cool and pellucid enough to tempt a weary way wanderer, but on and on his irresistible instinct drives him. A natural dam, some two or three feet elevation, and over which the waters fall with a perpendicular rush, now arrests his progress. He throws himself (no doubt with a vigorous sweep of tail) directly at it. That about two and a half to three feet is his utmost range, the many failures he makes before he drops into the pool above attest.

He has now gained his lake, often a very small one in the heart of the forest, and perhaps six hundred feet elevation from high water mark. And now commences his brief courtship, for, unlike the lordly salmon who dallies until November, our fish has but little time for delay. Camping on the lake-side of a moonlight night, you hear a swash in the water. "What fish is that?" you ask your Indian; "Gaspereaux," is his answer. The trout-fisher by day sees the surface of the lake ruffled by a hundred fins, then the trout break all around him. "See the Gaspereaux hunting the trout," he says. But these are only his harmless gambols, coloured by the resistless instinct of reproduction. He has even been known to rise at a fly, and to take a bait on these waters. Although the salmon and trout are often seen spawning, I never met any one who has seen the Gaspereaux in the act. So I suppose he spawns in deep water, as we know he loves the deep lakes with clear sandy margins.

As hatching is a much shorter process than with the salmonidæ, there seems to be less need of a current of aerated water constantly floating over the eggs, and thus the deep still waters of the lake may be chosen. No doubt the moment spawning is over, his instinct teaches him to return to salt water; but there seems some difficulty in determining the exact time. This must be measured by the power of either parent fish to retain the spawn within their bodies. Some observers put it at twenty-one days, in which time, from leaving the sea, the Gaspereaux has spawned and commenced his return, allowing that he has met with no obstruction. On the other hand, sportsmen assure me that they have met them during July on the lakes, and others, whose powers of observation I cannot doubt, have seen them passing down in August. But they all agree that the young fry go down into the sea in September and October, at which time they are over four inches in length. Messrs. Treat & Sons' gaspereaux spawned about the first of June. The date of placing them in fresh water is not given, but as they would scarcely have been obtained before the first of May, it gives them three weeks for their spawning period.*

From all these we learn that in three or four weeks after leaving the salt water, his brief holiday over, our fish commences his return. Unnerved by the exhausting toil of reproduction, by the absence of food (their stomachs are found empty on the lakes), and perchance by the warming summer waters, he addresses himself to the perils and dangers of descent. Too poor for an object of capture, he slips down unnoticed, save by the idle or curious, where, a few weeks before, a whole population watched his ascent. It is said those marine wolves, the eels, follow the advancing and retreating armies in their rear, gobbling up many a weak fish, or unlucky little one on the march. A dry summer has emptied the lakes and turned the foaming torrents of the spring into dusty rills. He often gets caught in these lukewarm shallows and dies. Not unfrequently the hunter finds them in bushels in the fords; quite as often the bear secures a rich feast—dipping his hairy paws into the shallow pools. He may be seen approaching nervously and timidly a rapid, then striking up stream, and returning pass down tail first. Those which are seen in July, or passing down in August, we must consider fish that have left the sea late in May, or that are caught by

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* Messrs. U. S. Treat & Sons, of Eastport, Maine, placed Gaspereaux in fresh water ponds during the spring of 1857; on the first of June they spawned, in six weeks the eggs were hatched, in four months they were let down to the sea from three to five inches in length.—*Patent Office Report*, 1857, *page* 230.

A gentleman who allows me to use his experience, but not his name, and who is entitled by his position and practical knowledge to the highest consideration says, "My observation has led me to note that the gaspereaux having free access to their spawning grounds, remain exactly twenty-one days in fresh water, and during the twenty-four hours, only journey downwards to the salt water between the hours of three and five P. M. The fry of gaspereaux leave the lake in which they spawned on the dark nights of September, together with the eels. Any one can notice this that choses to watch an eel weir placed upon a stream. When gaspereaux are heard and seen at night breaking the water about the sandy margins of a lake, in my opinion they are spawning and act in a precisely like manner to salt water herring when they seek shoal-water in salt water for that purpose. I have never observed a gaspereau to rise at a fly; but I know of many instances of their being hooked by fishermen, but it was what I call a foul hook—the angler having thrown over them when the school arose to the surface of the water. The instances that I have witnessed have invariably taken place when a multitude of gaspereaux have been detained on their ascent by a dam."

the dry season, and go down during the August freshets. Finally, October seems to be the last date for even the fry to be seen in fresh water.

We have thus received the Gaspereaux from the moment he left salt water, conducted him through all his perils, and had him as it were under our eye till we have returned him to deep water again, three months out of the twelve. The other nine months he is hid from us. They are taken in small numbers, generally with herring, sometimes with the mackerel, as late as 24th November, on our coast, but they are evidently only stragglers, the great body that swarmed our rivers must leave our coast, to return in spring. They return either to deep soundings or to the south. And now a change takes place in the colour of a few individuals, that is, so far, unaccountable to us. After gaining the salt water the lean weak fish rapidly recruits, becomes silvery, very fat, and a few individuals have a deep blue band of one inch and a quarter extending along the back. In all other respects—of fins and fin rays—they are identical with the rest. Our fishermen call them blue-backs, readily distinguish them, and maintain them to be a separate fish. Whilst differing from them, I must accord my obligation to their intelligence and exact appreciation of minute differences, in the form and habits of fish. On the 15th November, 1864, Martin Harrigan gave me two blue-backs; 27th November, two more specimens.

Colour.—Very brilliant; silvery, with deep blue backs extending one inch and a quarter down the side. Covered with nacre, and scales entire, the longitudinal bands extending from gills to tail difficult to see,—the black spot behind the opercle showing,—by turning them in various lights they become apparent; the colour of all the fins yellowish white; the extremities dusky, in pectoral first ray dusky; the caudal light-dusky, frayed and split on its extremities; opercles yellowish, with reflections, and lips yellowish-dusky. In comparing them with a gaspereaux taken at the same date, I find fins, fin-rays identical; the blue-back is rather shorter, but much rounder and thicker through the sides, the scales appearing larger.

A gaspereau seen at this late date being very thin, "slinky" as the fishermen call it, his scales loose, and his colour yellowish silvery, and green dusky on the back. A very fat fish swells out the scales, making them larger; as he thins they slide in upon each other. Whilst concluding that they are of one species, I still think that the salt water is the cause of the change; but why it only affects individuals is still unknown. Blue-backs are often seen ascending the rivers, but I have no evidence of any being found descending them. Their more valuable congener, the shad,* is subject to the same change.

Of the food of gaspereaux, one would suppose from the toothless jaws and wide extensive gape, so unlike the recurved teeth and armed tongue of the genus salmo, evidently formed for seizing living and struggling food, that he was fed by gelatinous masses sucked into a wide mouth. Of his rising to a fly, and taking bait in the lakes, we have proof, and Dekay asserts, the stomach of one he examined was filled with shrimps. Dekay's descriptions refer to a smaller and longer proportioned fish than ours, with the eye further from the end of nose, but otherwise it tallies with ours, and his plate is good. From him, too, we learn that its southern range is the Chesapeake, where he appears in April. From Perley we find his northern range, Miramichi, which river he ascends to spawn in the lakes from which it has its source. Though doubtless it was known from the earliest discoveries of the province,† yet Latrobe, in the Philosophical Transactions of America, was the first to describe it, and give it the specific name, "*tyrannus*," preceding Peck, who calls it "*serratus*," in Belknap's History of New Hampshire, I have not the exact date to refer to, but somewhere about 1780. As an article of food, when eaten fresh, it is not held in great estimation in our markets. When slightly struck with salt and smoke-dried it is called a "Kiack," and is very palatable. Many are cured in this way about Lunenburg and the Atlantic seaboard. The Indians dry them in the sun about their wigwams, but the usual way is to salt them in barrels like herring, and use them in each family for home consumption. Their leanness makes them a good export for the West Indies, as the fat herring becomes completely decomposed into oil by the climate. As is the case with all fish which perform annual migrations to spawn in fresh water, they gradually desert cultivated countries. The various obstructions to

* The Rev. Ferdinand Gauvreau, P. P., Memremcook, N. B., says of the shad, "the first run are green on the back, the second a pale green, and the third run have blue backs, and are the best fish."—*Perley's Report*, p. 144.

† Beamish Murdoch, Esq., was kind enough to point out to me, in Mons. Deny's History of Acady, 1675, the word "Gasperot." This gentleman, who describes what he saw with the liveliness of an eye witness, says of them truly enough, "they are not equal to the herring for eating."

the streams, caused by mill-dams, and accumulations of saw dust, and the passing of boats, are doubtless the reason. Their numbers have very much diminished along our coast, and doubtless will continue so to do. By the government returns for 1861, the total number cured is put down at 12,565 barrels, but this does not include all used for family consumption,—the eastern portion of the province giving by far the greater quantity. Since that date they are not returned separately, but classed with herring. I have not mentioned one power attributed to it, because I think it needs further corroboration,—the power of climbing up perpendicular heights, as mill-dams, by holding on by its sharp serrated belly. The instinct of all fish is to lie flat in shallow places; the climbing fish having a different apparatus. However, I mention it as a very common belief. I would rather hazard the suggestion that their saw points are used in spawning, as the trout uses his lower jaw, in furrowing up the sand.

Note.—Since this article went to press, I have the most undoubted authority that trout possess the power of running up perpendicular sheets of water at least six feet high, and I cannot but accord the same power to the gaspereaux; in both instances by muscular action, and not by the serrated belly. On 2nd August, 1865, the mill dam at nine mile river was filled by young and old gaspereaux, returning to the sea, caught there by the dry summer. LEWIS KIRBY, Esq. gave me this fact.

In both these facts, I feel pleased to corroborate the statements of our fishermen, which I have always found correct and exact, though doubted by some.

ART. XII. CONTRIBUTIONS TO THE NATURAL HISTORY OF NOVA SCOTIA. REPTILIA. BY J. M. JONES, F. L. S.

(*Read May* 2, 1865.)

THE class REPTILIA forms no unimportant part of the animal kingdom, and in the present advanced state of zoological knowledge the species known to naturalists are annually becoming more numerous. In the early days of science, when natural history had few students, and even down to a comparatively recent period, the study of reptiles was almost totally neglected; and in the museums of divers countries a few stray bottles full of snakes and lizards, unnamed and uncared for, lying in some obscure corner, and deemed too disgusting for the eyes of visiters, were the only representatives of this singular race of creatures. It is far different, however, now, for in our splendid national museum we possess a collection which for interest can hardly be surpassed by other zoological departments, while, both in Europe and America, the study of Herpetology has become a prominent branch of scientific research.

In taking a survey of the geographical distribution of reptiles over the surface of the globe, we at once perceive that under the influence of the greatest continued heat they appear to thrive in the greatest abundance, and attain the largest size. The tropical parts of this continent possess more reptiles than those of Asia or Africa according to late returns; but probably when the interior of the latter country becomes better known to naturalists, its forests and morasses may prove the habitats of many species now unknown. As we proceed from the equator to the poles, we find reptile life gradually decreasing until we arrive at the borders of arctic Europe, Asia, and America, beyond which barrier no species have, as yet, been found. Very few reptiles reach the north boundary of the temperate zone, taking the isotherm of 30° for its limit, the frogs and salamanders appearing to go the farthest north. In regard to reptile life in elevated districts, we find that on the European continent the common frog (Rana temporaria) has been found 8,000 feet above the sea level in the alpine districts, in the vicinity of the snow limit; the viper (Pelias berus) five thousand three hundred feet; the mountain lizard (Lacerta montana) at four thousand five hundred feet; and the slow-worm (Anguis fragilis) at six thousand feet; while on this continent, the alligator (Alligator lucius) has been observed in the Andes, about the latitude of the equator, at an elevation of three thousand feet, where the temperature ranges from 63° to 73°.

With this brief introduction, I will now pass on to the reptiles of our own Colony.

In considering the habits of our Nova Scotian reptiles, we can not fail to observe that the ophidians are much influenced by the temperature of the seasons; and from other causes also, which I have not yet been able to account for, they are found some seasons in great abundance, while during others hardly a dozen specimens are observed in the same district. I have had ample scope for observation during the past four years of my residence here, in the forest and cultivated land about my home, and have paid particular attention to the habits of this order, collecting specimens of all sizes, from the embryo taken from the egg to the perfect example of the largest size. I have had similar opportunities of studying the habits of the batrachians, but with the members of the order *Testudinata* it has been otherwise. Nevertheless, through the kindness of one of our members, I am enabled to fill this blank, and present to you a fair account of the reptiles of our Province.

The first order in the class *Reptilia* is that of the *Testudinata* or tortoise tribe, and of this Nova Scotia possesses three species—the alligator terrapin, or snapping turtle (Chelydra serpentina), painted tortoise (Emys picta), and the wood terrapin (Emys insculpta). The second order *Loricata*, comprising the crocodiles and alligators, has happily no representative in this northern clime. The third order *Sauria*, including the lizards, has also no representative. The fourth order *Ophidia*, to which all the serpents belong, has five well ascertained species—the black snake (Coluber constrictor), the striped or spotted snake (C. sirtalis), the green snake (C. vernalis), the ringed snake (C. punctatus), and the spotted neck snake (C. occipito-maculatus). We come now to the sub-class *Amphibia*, which contains in the first order *Anoura*, the frogs and toads. Of these Nova Scotia possesses seven recognized species—the bull-frog (Rana pipiens), the spring frog (R. fontinalis), the leopard frog (R. halecina), the wood frog (R. silvatica), the American toad (Bufo Americanus), Pickering's hylodes (Hylodes Pickeringii), and the northern tree toad (Hyla versicolor). The second order of amphibians *Urodela*, contains the salamanders, of which we have four species—the violet coloured salamander (Salamandra sub-violacea), the red-backed salamander (S. erythronota), the salmon coloured salamander (S. salmonea), and the crimson spotted triton (Triton mille-punctatus. These comprise the whole of our Nova Scotian reptiles, at least as far as I have been able to ascertain.

Order—TESTUDINATA.

Genus—CHELONURA, Flem.

Chelonura serpentina, DeKay......... Snapping Turtle.

Testudo serpentina—Linn. Syst., p. 354.

Chelydra lacertina—Sch. Monog.

Emys serpentina—Gray, Synops. Rept. apud Griff. Cuvier, vol. 9, p. 14.

Emysaurus serpentina—Dumeril & Bibson, vol. 2, p. 350.

I am indebted to Dr. Gilpin for the following information regarding this species:—"The snapping turtle is found in the larger lakes of the colony, being aquatic in its habits. It has often been observed beneath the ice during winter. It is occasionally taken on land, while travelling from one lake to another, or when depositing its eggs. One caught in the latter position was about two feet long, and boys of twelve years old easily rode on its back by standing on it. The shell scarcely encases the head, legs, and tail. The tail has four or five sharp points on its upper side; the under shell very small, a mere breast plate. In 1833, while with some Indians in a canoe on Lake Rosignol, we came upon a snapping turtle basking on a log. With the greatest caution we floated with a light breeze to within twenty yards of it, when, with a heavy splash it disappeared. Marking the exact spot, in a moment the canoe was swept over it, and an Indian held the turtle to the bottom of the lake by pressing the paddle upon his back, while another Indian drove a stake through its body and lifted the turtle into the canoe. After decapitation the body crawled about for some twenty-four hours or more, and the severed head snapped at wood, and held so tight that force was used to disengage it.

Genus—EMYS, Brong.

Emys picta—De Kay........... The Painted Tortoise.
Testudo picta—Gm. Schneid, Schildk, p. 348.
T. cinerea—Schœpff, Hist. Test., p. 23, pl. 4.
Emys bellii—Gray, Synops., p. 12.

This pretty little tortoise is found in abundance about the small lakes, ponds and ditches of the colony, where a dozen may be seen together basking on an old log, and when surprised going off with an awkward yet swift plunge. It may easily be kept in confinement in a tub of water, and will, when domesticated, rise to the surface, and take a worm from the hand. In such a position it has been known to lay an egg, which was hard and about an inch and a half long. The young of this species, about the size of a penny piece, may be seen in the lakes resting on the point of a water lily leaf.

Emys insculpta—DeKay .... The Wood Terrapin.

Emys pulchella—Schweig, 303.

E. scabra—Say, Journ. Acad. Nat. Sc. Phil. iv., 204.

E. speciosa—Gray, Syn. 26.

E. inscripta—Mus. Par.

This species is generally found at a distance from water in the forest, but goes into the lakes and burrows beneath the mud during winter.

Order—OPHIDIA.

Genus—COLUBER, Linn.

Coluber constrictor—Linn .... Black Snake.

C. constrictor—Shaw, Zool., p. 464.

C. flaviventris—Say, Exp. Rock. Mount., pp. 167, 337.

Bascanion constrictor—Baird & Girard, Cat. of Serp., p. 93.

Coryphodon constrictor—Dunn & Bibr. vii. p. 183.

C. constrictor—Gunth. Cat. of Col. Snakes, p. 108.

Although this species is very rare in the neighbourhood of Halifax, I imagine it is common in the interior of the colony, from information I have received. A coloured man some time ago informed me, that one of these snakes had chased him when a boy the whole length of a field. I thought at the time that his account was much exaggerated, but I find from the best authorities that this habit of chasing an enemy is fully established, and that its force on such occasions is very great.

This snake appears to be widely distributed on this continent, being known from Canada to Mexico. It is also found in St. Domingo, and, according to Stedman, in Surinam.

Coluber punctatus—Linn .... Ring-necked Snake.

C. punctatus—Lacep., ii. p. 257.

C. torquatus—Shaw, Zool. iii. p. 553.

Homalosoma punctatum—Wagl. Syst. Amph., p. 191.

Spilotes punctatus—Swain's Nat. Hist., p. 364.

Calamaria punctata—Schleg. En. ii. p. 39.

Ablabes punctatus—Dum. & Bibr. p. 310.

Diadophis punctatus—Baird & Girard, Cat. Serp. p. 112.

A specimen of this prettily marked species given to me by Dr. Gilpin was taken at Annapolis. Another, given me by Mr. Downs, captured by some men working at a drain in his grounds on the 7th September, 1863, was marked with a bright orange band round the neck, and the abdomen bright lemon colour. From it I made the following description :—

Length, 11½ inches. Extreme breadth of head at broadest part across base of large occipital plates, 2½lines. Breadth of body 2½lines at a distance of 3in.4lines from frontal extreme, which is not exceeded at any other part. Head, flat. Breadth of yellow collar ¾ of a line. Tail 2in.7½lines.

Colour—Head, above, very dark steel blue; nasal scales brownish. Irides, above, reddish. Immediately behind the head a collar of orange yellow, margined with black, separates the head from the body. Upper jaw edged with yellow; deeper posteriorly. Upper parts, olive brown, fading into light steel blue at the sides. Beneath, bright yellow from neck to base of horny tip of tail. Chin and throat very light yellow. On either side of the yellow belly run a series of dark spots at the posterior angle of each abdominal plate, very obscure and almost absent for a space of 3½ lines from the collar. Under the lens the dorsal scales appear mottled and the occipital plates of pearly lustre. Abdominal plates 156.

This snake is by no means common about Halifax, and may be considered our rarest snake.

Coluber vernalis—De Kay.............. Green Snake.
C. vernalis—Hall, N. Am. Herpet. iii., pl. 17.
C. cyaneus—Shaw, Zool., p. 506.
Chlorosoma vernalis—Baird & Girard, Cat. N. Am. Serpents, p. 108.

This delicate little snake is very common about the grass fields and cultivated spots. Specimens vary in colour, some being of a much lighter green than others. It is very agile in its movements, gliding through the grass when disturbed, with rapidity. According to Baird this snake is northern in its distribution, extending from Maine to Wisconsin in the United States, but no further south than Virginia on the Atlantic coast. I have observed it about as early as the 6th May. Cats appear to delight to catch these snakes as they run through the grass.

Dr. Gunther in his British Museum Catalogue of Colubrine Snakes, appears to object to this species being included in the genus *Chlorosoma*, as Baird & Girard have done; for he states that that genus was established by Wagler for *Philodryas viridissimus*, and that the snakes differ too much from one another.

Coluber sirtalis—Linn................ Spotted Snake.
Tropidonotus tænia—DeKay, p. 43, pl. xiii., fig. 27.
" *sirtalis*—Holb., N. Am. Herp., vol. iv.,
Eutœnia sirtalis—Baird & Girard, N. Am. Serp., p. 30.
Eutœnia sirtalis—Baird, Serpents of N. York, p. 15, pl. i., fig. 5.

This is by far the most common snake in Nova Scotia, being abundant in all parts of the colony. Although continually observed in the dryest positions in the forest, it nevertheless appears to prefer the neighbourhood of swamps, brooks, and damp places, where it leads a partially amphibious life during the hot season. The largest specimens I have seen were in such places, and one which I killed during the latter part of the summer of 1863, resting on a log in a swampy hollow, measured two feet eight inches in extent. It generally makes its appearance in the forest about the first week in May, but is much more numerous some seasons than others. During the months of June, July, and August, 1864, scarcely one of these snakes was to be seen in my district, but in September of that year they appeared in abundance. A sudden spell of cold weather appears to have a great effect upon them, as they all disappear at once until returning heat brings them forth again. They shed their skins among ground juniper (Juniperus communis) and other shelter in June, and retire to winter quarters after the first cold days of autumn. I have observed them as early as the 4th of May, and as late as the 7th of October. The young, some four inches long, are seen about the beginning of September. The full grown specimens may frequently be seen by the sides of brooks in the forest, greatly distended with recently swallowed prey, the common toad (Bufo Americanus), probably from its sluggish habits, forming their principal food. On the 1st September, 1864, I witnessed the process of deglutition. A spotted snake, about twenty inches long, had just seized a good sized toad by the right hind leg, which it gradually drew into its maw. Then turning its head sideways, after some difficulty, it secured the foot of the left hind leg, and gradually got this down, when it gave a sudden shake and took a firm hold of the hinder parts. Now, moving its head with the jaws greatly distended, first to one side and then to the other, the toad meanwhile holding with all its might by the two fore feet to the ground, and the snake getting more and more into his maw, the toad's back covered with blood and froth, and the poor captive panting hard. The snake then gradually drew in the distended body of the toad until it reached the head, when, with much apparent trouble, it managed to draw in the fore legs and head. The whole scene occupied about twenty minutes, and was extremely disgusting to witness. The most curious part of the affair occurred at the last, when the poor toad with open eyes gradually receded from view down the throat of the snake.

It is apparently a good swimmer, for the Rev. JOHN AMBROSE informs me that it has been observed a mile or more from the shore at the entrance to St. Margaret's Bay, making for the islands outside.

When greatly irritated by stopping its course repeatedly with a stick, this snake will turn about and show fight, making rapid and repeated bites. It is however perfectly harmless, and its bite would entail no greater suffering upon any healthy person than that of a kitten. It is said that this snake has repeatedly been seen to swallow its young in time of danger, and from evidence received from reliable authority, I have hardly a doubt but that it possesses this curious habit.

This snake appears to be distributed over the greater portion of the North American continent east of the Mississippi, and has been found at an altitude of two thousand feet above the sea in the State of New York. It occurs abundantly in Canada, where it is said to be particularly common in the rocky limestone districts. In Massachusetts it is the most common snake, and it has been observed as far north as Lake Winnipeg by Sir John Richardson.

Coluber occipito-maculatus—Storer.... Spotted-neck Snake.

Ischnognathus occipito-maculatus—Gunther, Cat. of Col. Snakes, p. 81.

I. DeKayii—Dunn & Bibr. vii., p. 509.

Coluber venustus—Hallon, Proc. Acad. Nat. Sc. Philad. iii., p. 274.

Storeria occipito-maculata—Baird & Girard, Cat. p. 137.

It appears that this small species was entirely overlooked by North American collectors until within a comparatively recent period. Storer was the first to bring it to notice. That author states that it has three spots on the neck, but I find a smaller spot below the two side ones, joining with the mottled margin of the underside. I think these spots on the neck are liable to alteration, sometimes being partially absent, and at other times confluent, while in some cases there are no traces of the marks at all. It is liable to considerable change of colour—for two specimens which I took from a heap of weeds were of a bright cinnamon above and brick red beneath. These light coloured specimens may belong to different species, for the scales appear to me to be much wider and shorter, and possess blunter points, than those of the true *occipito-maculatus*. They resemble in some respects the red snake (*C. amaenus*) of DeKay, but the scales instead of being smooth, as in that serpent, are carinated.

They are fond of lying under pieces of wood or stones, where they can feel the sun's warmth, and are common in old heaps of refuse, roots, &c.

This snake is not uncommon near Halifax.

Order—ANOURA.

Genus—RANA, Linn.

Rana pipiens—Harl .... Bull-frog.

R. pipiens—Holb. N. Amer. Herpet. iv., p. 77, pl. 18.

R. catesbiana—Shaw, Zool. iii., p. 106.

R. mugiens—Gunth. Cat. Bat. Lal., p. 15.

I have had no opportunity of studying the habits of this species, as it is unknown in the neighbourhood of Halifax, and the only examples I have seen were those exhibited by Captain Hardy at our conversazione last summer in the hall of the Horticultural Society. Captain Hardy informs me that they are common at Grand Lake; and the Rev. John Ambrose states that they have been known to swallow young ducks.

Rana fontinalis—Le Conte ....The Spring Frog.

R. fontinalis—Holb. N. Amer. Herpet. vol. iii., p. 85 pl. 16.

R. flavi-viridis—Harl. Am. Journ., vol. x.

This species occurs abundantly in Nova Scotia, and may be styled the "common frog" of the country. It frequents the swampy districts, lakes, and ponds, where its peculiar note, like a half broken croak, is heard all day long. Sitting at the edge of a pond, with its head only exposed, it expands its throat at intervals and gives vent to the well known sound. If suddenly disturbed it instantly dives beneath the surface, and if the water be shallow buries itself beneath the mud and leaves at the bottom. It delights to spend the warm days of summer in company with its fellows, partially immersed in the water, but in the hottest and dryest weather disappears entirely during the day time. I have no doubt but that these hottest days are spent beneath the mud, for I have seen one of my Newfoundland dogs when diving in play bring one up alive to the surface on such a day. I observe that this frog croaks oftener and louder in close wet weather, and that a slight frost has the effect of making it silent. It is rarely seen at any distance from water, and immediately makes for that element when disturbed. It is pretty regular in its appearance in spring, but moves from its winter retreat sooner or later, according to the temperature of the season. In 1862 I heard the first croak of this species in my pond on April 27th; in 1863, on April 25th; in 1864, on April 25th; and this year, 1865, on April 6th, and these first croaks were invariably heard at night. I observed the first spawn in the pond in 1863, on May 3d; in 1864, on April 30th; and this year, 1865, on April 10th. Their early appearance and deposition of spawn this year has been owing to the extreme forwardness of the season, vegetation being fourteen to twenty days earlier than during the four previous years. It attaches its spawn to small twigs or sticks at a moderate depth beneath the surface of the water, and I have reason to believe that the act of deposition occurs only during the hours of night. The tadpoles of this species hibernate in the mud like the parent, and appear about the same time in the spring of the year, some of them full grown, but with the umbilical cord attached.

Rana halecina, Kalm .... Leopard Frog.

R. halecina—Holb., N. Amer. Herpet, iv., 9, 91, t. 22.

R. Virginiana—Lawr. Syn. Rept., p. 31.

This is by far the handsomest species of frog seen in Nova Scotia. It is generally found in moist places, although I have occasionally taken specimens some distance from water among standing grain.

it is extremely agile and difficult to capture, taking amazing leaps in its endeavours to escape. The half grown young are plentiful on the sides of ponds during the summer, but they have not the brilliant colours of the mature specimens. I have rarely seen them resting in the water like *R. fontinalis*. I have observed them as early as the 29th of April, sitting on the pond side, and as late as the 4th of October in other places. The first specimens seen are of a darker green on the back than those observed later in the season.

The species is common in most parts of North America, and is known from the Hudson Bay Territory as far south as Mexico.

Rana silvatica—Leconte .... Wood Frog.
R. silvatica—Holb., N. Amer. Herpet, iv., pl. 24.
R. Pennsylvanica—Harl. l. c. p. 60.

The habits of this species are unknown to me, as the only specimen I have captured was a young one during our field excursion at Windsor, in the summer of 1863. I am indebted to Dr. GILPIN for a fine specimen procured.

Dr. Gunther in his catalogue of Batrachians gives this as merely a variety of the European *Rana temporaria*, the tympanum being generally but not always rather larger in the European specimens.

This species has been observed as far north as the Great Bear Lake in the Hudson Bay Territory.

Genus—BUFO, Linn.

Bufo Americanus—Harlan .... American Toad.
B. Americanus—Holb., N. Amer. Herpet, v. t. 4.
B. musicus—Harl. Ac. Nat. Sc., vol. v., p. 344.

This poor, despised, yet useful creature, looked upon with horror by most people, is one of the farmer's and gardener's best friends. Sallying forth from his mid-day retreat at eventide, he searches the paths and other likely spots where slugs and worms are wont to move, and revels in the gardens where this welcome food is most abundant. Although nocturnal in habit it is by no means exclusively so, for I have often taken them in the day time, both in the forest and clearing. It is not, however, so active in the day time as at night, and I imagine its appearance in broad daylight is more owing to disturbance than a natural desire to seek for food at that time. It appears to frequent the cultivated districts more than the forest, although the largest specimen I ever obtained was found in the day time in an uncleared spot in a hard-wood grove. This specimen measured four inches and a half in length, including the head, which was one inch and four lines, and three and a quarter inches in breadth of body. About the end of May the young, about an inch long, are often seen hopping about, and then gradually increasing in growth, as the summer advances, continue about until the first sharp frosts of October and November compel them to seek their winter retreats. I have never observed them about later than the first week of November.

It appears to be common in all parts of the North American continent, extending from Great Bear Lake in the Hudson Bay Territory to Mexico.

Genus—HYLODES, Fitz.

Hylodes Pickeringii—Holb. . . . . Pickering's Hylodes.
H. Pickeringii—Holb. N. Am, Herpet, pl. 34.
Acris Pickeringii—Gunth. Cat. Bat. Sal., p. 71.

For three years I laboured under a great mistake in regard to the note of this little frog. Often had I listened at all hours of night to its shrill piping noise, and always gave the common frog (R. fontinalis) credit for the strange nocturnal sound; but Capt. Hardy informed me that the musician was no other than Hylodes Pickeringii, several specimens of which he exhibited at our conversazione last summer. It is by no means easy to collect specimens of this species, for although I have searched and searched again with a bright lantern on summer nights, when they piped loudest, I have never yet been able to procure one. Capt. Hardy states that they are seen attached to the reeds and stems of aquatic plants a few inches above the water, and that the first object which attracts the collector to their resting place is the movement of the throat as each little frog continues its piping noise. The curious cruciform rhomboid of dark lines on the back, and the triangular patch on the occiput at once prove it to be distinct from the young of other species frequenting the same places. In 1863, I heard its first pipe in my pond on the 28th of April; in 1864, on the 25th of April; and this year, 1865, as early as April 7th. I have generally heard the first pipe of this frog one night later than the first croak of *R. fontinalis*. It is like that species very silent during drought.

Genus—HYLA, Laur.

Hyla versicolor—Leconte. . . . . Northern Tree Toad.
H. versicolor—Holb. N. Am. Herpet. iv., pl. 28.
H. verrucosa—Dand. Rain., p. 33, pl. 4, fig. 1.
Dendrohyas versicolor—Tschudi, Batr., p. 75.

I am enabled to add this species to the list of Nova Scotian reptiles, through the kindness of Capt. HARDY, R. A., who informs me that although he has never been fortunate enough to secure a specimen, yet from the description given him by a young Indian who collects for him, he has not the slightest doubt as to the species. His informant states that he has found it snugly ensconced in clefts of maple trees, where, from its grey colour harmonizing with the lichens growing on the bark of the tree, it was difficult to observe. Capt. HARDY tells me that the pipe of this tree toad is similar to that of Pickering's Hylodes, although much louder, and that it is more vociferous during damp foggy weather.

It is found throughout the whole extent of the North American continent, from the Hudson Bay Territory to Mexico.

Order—URODELA.

Genus—SALAMANDRA, Brong.

Salamandra subviolacea—Harl. . . . . . . Violet-coloured Salamander.
S. subviolacea—Holb. N. Am. Herpet, vol. iii., p. 105, pl. 24.
S. venemosa—Barton, apud Dand. Hist. Rept., vol. viii. p. 229.

This is a common species, and is found under large stones, in old walls, roots of trees, &c. It is very sluggish in its habits, and scarcely moves when handled.

It appears to be extensively distributed over this continent, being found in the Western States, all along the Atlantic coast, and as far south as Maryland.

Salamandra erythronota—Holb. . . . . Red-backed Salamander.
S. erythronota—Harl. Med. and Phys. Researches, p. 95.
S. cinerea—Id.
Plethodon erythronota—Baird, l. c. 285.

This species is by no means common in the neighbourhood of Halifax. It frequents damp places where it rests concealed beneath stones and other shelter. It is known on this continent as far south as South Carolina.

DR. GILPIN'S *Red-bellied Salamander.*

DR. GILPIN informs me there is yet another salamander, having the under parts red. This may be the Salmon-coloured Salamander (S. salmonea) which has its sides salmon-coloured. It is known in Massachusetts, and may therefore occur in this Province.

Genus—TRITON, Laur.

Triton millepunctatus—DeKay..... Crimson Spotted Triton.

Salamander dorsalis—Harl. Jour. Acad. Nat. Sc., vol. vi., p. 101.

Notophthalmus viridescens—Baird, Batr. Amer., p. 284.

This species is rare in the neighbourhood of Halifax. The only specimen I have seen being the one in my collection for which I am indebted to Captain HARDY, who obtained it from Mr. J. R. WILLIS.

Storer, in his Reptiles of Massachusetts, complains that Harlan, in the Journal of the Academy of Natural Sciences, Philadelphia, describes this species as having "a row of whitish coloured oblong spots on each side of the dorsal line." Now, in my specimen, although the white spots cannot be called oblong, they are certainly clearly defined dots of the colour Harlan mentions. It is true, as Storer says, that preservation in spirits may make this alteration, but nevertheless we frequently find descriptions, given even by the best authorities, from specimens of all kinds so preserved, although I think it would be well for every describer to state the condition of the specimen, whether long immersed in spirits or not. The specimen I possess has been in alcohol for about two years.

In concluding this brief account of the reptiles of this colony, I cannot help remarking how thankful we ought to feel that no poisonous snake is found within our borders. Even England, with all her advantages, has a drawback in this respect, for in many parts of that country, on the heathery moors of the north, and in the fertile valleys of the south, the bite of the venomous adder is too well known. Often have I started back with a shudder, when in searching for birds' nests, in some wild spot, I have suddenly come upon an adder basking in the sun, and one half the pleasure of a day's wanderings in search of specimens was always sacrificed to the fear of this serpent's bite. In the northern States of America, the dreaded rattlesnake swarms in some parts, the bite of which is frequently fatal in twenty minutes; while here, in our little half-island home, our children may ramble wherever they list, and meet with nothing more formidable than the bite of the common striped snake, which at the worst can only inflict a slight wound in no way dangerous to a healthy frame. Therefore, while in other climes which boast of the grandeur of their scenery, the beauty of their vegetation, or the vast area of their fertile lands, deadly foes are ever ready to spring upon the incautious, here in our northern home we may roam through the forests, scale our boulder ridges, or bathe in the limpid lake, without hindrance from any reptile form. Surely we ought, therefore, to consider how blessed we are in this respect, and while considering the blessing let us not forget the beneficent hand that has so blessed us; and as we roam in security amid Nature's pleasantest scenes, let us lift our eyes in gratitude to Him who has spared us the horrors of the serpent's fang.

Art. XIII. Notes on the Economic Mineralogy of Nova Scotia; Part II. The Ores of Manganese and their Uses. By Henry How, D. C. L., *Professor of Chemistry and Natural History, University of King's College, Windsor.*

(*Read May* 2, 1865.)

A very interesting, and to all present appearances, valuable addition to the mining industry of the Province, has been made within the last three years by the working of the ores of manganese. Having been engaged in examining and reporting on the quality of these ores for those originally concerned, and having visited the scenes of operation, I requested and obtained permission to include such information I had gathered by these means in a general account of the manganese ores of the Province at present known to me. Having been, moreover, kindly furnished with sundry details of interest from various sources, I propose now to continue, on this subject, my Notes on the Economic Mineralogy of Nova Scotia, of which the first part was published in the last volume of the Transactions of the Institute.

The only deposits of manganese mentioned in Dawson's Acadian Geology are an impure bed near Cornwallis bridge, that at Musquodoboit, and those in the iron veins of Shubenacadie and in the limestones of Walton and Cheverie, of which latter it is said (p. 239) "small quantities have been exported. I have no doubt that if the limestones can be profitably quarried on a large scale, the manganese might be separated and form a considerable additional source of revenue; but it seems doubtful whether mining operations for the manganese alone can be carried on without loss."

The ores of manganese found here in quantity are Wad or bog ore; Manganite, which may be called hard grey ore, and Pyrolusite, which may be distinguished as soft black lustrous ore, and is often mixed with psilomelane, a hard black ore not so lustrous as the last named.

Wad.—The first of these is a black earthy substance, which is found in rounded lumps and grains. It has been sent to me from Parrsborough, and from another locality, I believe to the east of Halifax, where it is found in lumps mixed with stones; the sample I examined contained a great deal of water, and, when dried, 56 per cent. of binoxide of manganese, with the traces of cobalt which are usually found in this species. Neither of these would be valuable as ores of manganese, but they would probably serve as paints. Bog manganese is often mixed with bog iron ore, and then forms deposits of a brown or chocolate colour, called ochres or mineral paints. The paints of Bridgewater and Chester furnish examples. In the first of these I found only 11 per cent., and in the second about 20 per cent. of binoxide of manganese. It is said to be useless to send to (the English) market ores containing less than 65 per cent. binoxide.

Manganite.—This is a very hard ore which is found in compact lumps of a steel grey colour and sub-metallic lustre, giving a reddish brown streak to a file. It is often found in the neighbourhood of the next mentioned; it occurs abundantly at Walton and Cheverie, and is met with at Douglas and Rawdon. At Walton I have picked it out of the stoneheaps in fields near the river, and was told that a bed of it crops out on the bank of the river near the bridge. It is found at Cheverie in nodules on the beach about twenty rods above high water mark, and has been dug on the upland less than two miles from the beach; it was formerly shipped, but to what extent does not appear to be known. As it is very hard, and contains in its purest form only about 49 per cent. *binoxide*, this ore is not useful for the ordinary applications of manganese; but I was informed by a gentleman from Boston, dealing in these ores, that it answers for a certain secret process better than the rich soft ore, and that something like fifty tons were sold in the United States in 1863, and that it was hoped the demand would increase.

Pyrolusite.—This is the ordinary marketable ore, and is entirely composed of binoxide of manganese. It is so soft as to be easily scratched with a knife to a black powder, and is found in masses which are more or less glistening, and often very beautifully crystallized in black lustrous needles and prisms. It is met with near Kentville, King's County; near Pictou, Pictou County; near Amherst, Cumberland County; at Musquodoboit, Halifax County; and at Walton, and other places, especially at Teny Cape in the township of Kempt, in Hants County. These two latter are the only localities at which mining operations have been carried on, small quantities of ore having formerly been shipped from Walton, where, on one occasion, seven barrels were got out in cultivating a garden, and considerable returns, as will presently appear, having been made at Teny Cape. In 1861 Nicholas Mosher, Esq. junr., of Avondale, brought me samples from Teny Cape which I examined for him, and when he learned what the substance was he sought for it diligently and procured several fine specimens, some of which he sent to the International Exhibition of 1862. He found the ore to occur about a foot below the surface, in a bed of earth about a foot thick, in separate loose masses, generally flattened in shape, of all sizes, from that of a bean up to that of the lump of twenty-four pounds weight, which, as being the largest then met with, was sent to the Exhibition. In this mode of occurrence it was traced some fifty rods; subsequently it was found in thin veins in the rock under this earth, the rock being "brick-like" and easily detached with a pick, so as to leave sheets of the ore. In one place four veins were found in ten feet, the largest vein being about one and half inch thick. Diggings were made to the depth of four or five feet, and the ore became more plentiful, but was so variable in amount that while on one occasion two and a half barrels were got by a man in one day, the average quantity obtained was about half a barrel per day per man. This variation arises from the ore occurring not in regular veins but in separate masses, often lenticular, in pockets of various sizes. The first considerable collection of ore sent from the mines was landed at Windsor in June 1863, for transmission to England. It consisted of thirty-three barrels, equal to about seven and a half tons English; it was picked ore and looked very rich and uniform in quality; the highest percentage of binoxide I know of from Teny Cape was found in a sample I put in the hands of Mr. D. Brown, a pupil of mine, who obtained 95 per cent., and when this lot of ore was sent to England, it averaged on analysis in Liverpool 91·5 per cent. binoxide, and gave less than half a per cent. iron: it sold there half for £8 10s., half for £9 sterling per ton, being disposed of to different buyers. Messrs. Tennant of Glasgow, great consumers of manganese, are reported to have said they had never seen ore so fine. In April 1864, what appeared to be a vein of five feet two inches thick was struck; I visited the mine in June, and saw many tons of ore piled up, and one huge mass of perhaps three tons weight laid bare *in situ*. Mr. John Browne, the manager of the mines, has obligingly furnished me with a report, dated February 16th, 1865, from which I give some extracts: after narrating the facts I had learned from Mr. Mosher, given above, he says: "On the south side of the ridge a large open cutting was brought in running nearly north and south, in which was discovered the first large deposit at a depth of only fifteen feet from the surface. It extended some twelve fathoms in length, varying in thickness from fourteen feet to as little as six inches. From this pocket we took from one hundred and twenty to one hundred and thirty tons, leaving nothing in the bottom but a few small veins. Upon these we sank our shaft, and at a depth of fifteen feet, making in all thirty feet from surface, we intersected pocket No. 2 immediately underneath the first deposit, and making in the same direction. The manganese in the second pocket is of far superior quality to that found nearer the surface, and we have returned from it some hundred and eighty tons. Up to the present time we have been opening ground and prospecting. In conclusion, I beg to state that our prospects are daily improving, and I firmly believe that at no distant date the manganese mines of Teny Cape will hold a distinguished position in the list of *bona fide* and profitable mines of Nova Scotia."

I have omitted a number of technical mining details, allowing the extracts to bring out the mode of occurrence, the richness and quantity of the ore yet obtained: it appears that upwards of three hundred tons have been got out. Two hundred tons more have since been taken out, and very fine ore of 93·8 per cent. has been found at 50 feet below the surface. As regards the quality, I believe all that has been sold in England has realized from £8 5s. to £9 stg. per ton*; the beautiful specimens sent to the Dublin Exhibition this year, are, I apprehend, mostly from the second pocket, as I received the majority on February 4th; the large mass, however, of about three cwt., which has so long lain at the door of the Halifax Reading Room, and is, by the liberality of Messrs. Nash and Co., also to be sent to Dublin, I imagine must be from the first pocket.

The second mine in operation at Teny Cape, was opened up by Messrs. Weeks & Co. In the spring of 1864 samples of ore were brought to me by O. Weeks, Esq., and J. W. Ouseley, Esq., which turned out to be sufficiently rich for working, as they gave, just as I received them, from 88 to about 92·5 per cent. binoxide. In June I went with Dr. Weeks, of Brooklyn, and a party, to prospect the locality whence the samples were taken. It consisted of a considerable hill contiguous to the Mosher mine, and the indications of ore in various parts were very promising. Operations were soon after commenced, and during the year about eight tons, English, of ore were sent to Liverpool, where they realized £8 5s. stg. per ton.† One great advantage of this locality is, that the Basin of Minas is only about a mile and a half distant in a direct line, and the intervening country is such that a road can easily be made from the mines to the place of shipment.

Hants County possesses a variety of manganese ores in localities widely separate from each other; it has been mentioned that seven

* About ten or twelve tons fetched £10 per ton.

† A third mine has been opened by Messsrs. Hamilton & Duvar, and a good deal of ore has been raised.

barrels of ore were on one occasion dug up in cultivating a garden at Walton; of the quality of this I know nothing, but that valuable ore is found at Walton I am certain inasmuch as a party of which I was one extracted several pounds at a locality in the woods about seven miles from Teny Cape; one piece of this is sent to the Dublin Exhibition, and is quite as rich to all appearances as that from Teny Cape.* About twelve miles south of these places Mr. Mosher has met with large detached pieces of ore, one weighing thirty-five pounds was sent to the Exhibition of 1862 and remains in England; it consisted of *pyrolusite* and *psilomelane;* it gave to Mr. Poole, one of my pupils, about 84·5 per cent. binoxide; another large mass found in the same region weighed one hundred and eighty-four pounds. I do not know of what kind of ore it consisted. The rock holding the manganese at Teny Cape is a limestone containing a good deal of magnesia, and coloured either grey or red by oxide of iron; it is soft and easily detached from the ore; barytes is frequently seen crystallized through the ore, and carbonate of lime (calcite) is sometimes found beautifully crystallized in various forms encrusting the ore. At Walton the manganese is sometimes associated with iron ore (limonite), and occurs in limestone. Since nearly all the localities mentioned in a previous page as affording manganese are of lower carboniferous age, it is not improbable that many others may yet be found in the Province, where rocks of this age are so abundantly distributed. It is not, however, in such rocks only that manganese may be expected, since it appears by the Report on Mines and Minerals of New Brunswick, by Prof. Bailey, issued in 1864, that the deposits of manganese, with one exception, in that Province, are met with either in lower silurian or cambrian rocks (p. 71); the exception is a bed said to be alluvial (p. 33). As regards the mode of occurrence it is stated (p.72), that manganese is generally found in quartz or barytes, especially the latter, the country-rock being slates; at one locality (p. 45) the slates enclose a bed of limestone, three or four feet thick, which contains the manganese; the alluvial locality is also said to have the manganese in limestone; in all cases the

* Five tons were afterwards taken out here by Mr. J. Browne.

† In a report issued in 1865, and received since this paper was read, I find that Professor Bailey places the manganese localities in New Brunswick at the base of the lower carboniferous series.

geological situation is different from that prevailing here. I may mention that the report gives twelve hundred and fifty tons as the amount of ore taken account of as raised and mostly sold; a large but unknown quantity besides is mentioned as having been raised and shipped, and much must have been used in the Province, since there were at one time large chemical works at the Hopewell manganese mines in Shepody mountain.

Canada, it appears, has not yet been found to possess manganese ores in sufficient purity or abundance to be of economic importance —(*Geology of Canada, p.* 751.) The chief supplies of these ores were till lately derived from Germany, but mines have been opened not only here and in New Brunswick, but in Spain and Vermont; and it was from Spain, according to a Report read before the British Association in 1863, that the richest ores were at that time mostly imported into England. A short extract from this report will probably be interesting as showing that Nova Scotia has richer and more accessible ores than Spain:—

"Manganese is imported from Germany and Spain; but it is chiefly from the latter country that the richest ores are now obtained, which are found in hills consisting of schistose rock, which sometimes rise to a height of eight hundred feet above the level of the plain; but it is also found in "pockets," and, in the latter case, it is quarried by picks, and occasionally gunpowder is used. The quality of the ore varies from 50 to 90 per cent. peroxide, and to obtain the richer ore men and boys are employed to break and sort it, which is then put into sacks and carried a distance of twenty to thirty-five miles, on mules' backs, to the ports of shipment in the Mediterranean. The richest ores are at Calanas, thirty miles north of the ancient Roman fishing town of Huelva. We are indebted to Mr. Gething for this information, who also informs us that he imported to the Tyne, in 1857, the first cargo of Spanish manganese."

As regards Vermont, it appears from Dana's Mineralogy that the ores are abundant at several places; whether they are worked at more than one I have not learned. The locality at which mining is prosecuted is Brandon; and from the following interesting information, communicated to me by Dr. W. H. Weeks, of Dartmouth, it appears that the mode of occurrence of the ore is very different from that at Teny Cape, and by no means so favourable for operations on a large scale:—

"My visit to Brandon, Vermont, was of very short duration; I spent only a few hours at the works, consequently had not time to study the locality. The manganese is taken out of a gravel bank; it exists in very small pieces, varying in size from that of a pea to a small onion; it is compact, very black, and does not show the crystal as ours does. There is iron ore, said to be very pure, taken out of the deposit, and an ochre largely charged with oxide of iron. The process of obtaining and cleaning the manganese is slow and must be expensive; they wash it in pans by a process something similar to that adopted here for the separation of gold from powdered quartz. The quantity of manganese at the Brandon mines is very small in proportion to the amount of material operated on compared with ours. The Brandon manganese is very pure when thoroughly cleansed, but this is a difficult matter as the oxide of iron adheres tenaciously."

Uses of Manganese Ores.—These ores are employed for a variety of purposes in certain manufactures of purely chemical character, or in which the aid of chemistry is necessary, and according to the application to be made of them they are required of different degrees of purity: in most cases a tolerably high percentage of the particular oxide of manganese, called the binoxide, peroxide, or available oxide, is necessary, and for certain uses there must be little else in the ore, and especially iron must be either absent or present in extremely small proportion. The manufactures in which the ores are used are principally those of bleaching powder, glass, pottery, iron, some brown colours used in dyeing, and manganates and permanganates for certain oxidizing processes (as bleaching fats) and for disinfecting. The native oxide is used for making boiled oil, and has also been recommended as a deodorizer and purifier of water, and a cheap agent for extracting gold from quartz.

It is perhaps impossible to learn the total consumption of the ore for these purposes; we know, however, that Great Britain is the great seat of the chemical manufactures, and we have some facts to guide us to an estimate of the amount used there in the processes requiring the largest quantity; these I will now give, together with a rough estimate of the consumption in the United States. The most extensive use of the ore is in the making of bleaching powders (chiefly chloride of lime). According to the report previously quoted, the amount of manganese imported into the Tyne district alone for this purpose was then (1863) given as 11,400 tons per annum, at £4 stg. per ton. Although this district is a very considerable seat of chemical manufactures, there are other parts of the Kingdom where very large quantities of manganese are required, among which, the most important are Liverpool, the seat of Messrs. Muspratt's, and Glasgow, of Messrs. Tennant's works. Accordingly, we find in the "Statistics of the Alkali Trade of the United Kingdom for 1862," that the annual consumption of manganese was then 33,000 tons for the manufactures depending on the products of the alkali trade, viz.: soap, glass, paper, cotton, woollen, linen, colour making, and all chemical manufactures of any magnitude. This estimate, however, takes no account of the ore used in making iron, and the demand for bleaching powder has been increasing of late years, partly owing to the use of grass, and perhaps of other materials, in the making of paper. The quantity of manganese ores used in the United States was, a year ago, estimated by a gentleman dealing in them in Boston, at about 500 tons per annum, by another gentleman, this year, at 1000 tons.

With regard to the quality of the ore required in certain cases, it is found that in making bleaching powder, the ordinary ores, containing perhaps from 65 to 75 per cent. binoxide along with water, oxide of iron, carbonate of lime, barytes, etc., answer so good a purpose, that the rich pure ores, such as that from Teny Cape, are not bought for this use, unless at a price far below that given by those who require only such ores. One of the firm of Tennant Co. (makers of bleaching powder), said, for example, that he could not afford to use Teny Cape ore, meaning, I suppose, at the high price it would fetch from glass makers, for, as J. Outram, Esq. junr., informed me, the Spanish ore of from 70 to 75 per cent. binoxide, sells for fifty-five to sixty shillings sterling per ton, and therefore the bleaching powder makers will give only about £5 10s. for Teny Cape ore, containing upwards of 90 per cent., while, as we have seen, this actually brought as much as £9 and even £10 stg. per ton. This high price was given by glass and pottery makers who require an ore as free as possible of iron; this at any rate is the case with the former who employ it to remove the stain of iron from the finest kinds of glass. Mr. Outram said that he thought even two or three per cent. of iron would interfere with the sale of ore at 93 per cent. binoxide for this purpose, and it was because the Teny Cape ore gave less than a half per cent. of iron, with 91·5 per cent. binoxide of manganese, that it brought the high prices obtained. The demand for these pure rich ores is comparatively limited, perhaps a few hundred tons a year are fully as much as would find sale at the highest prices named. That there is always a steady demand for ore useful for making bleaching powder, is shown by the efforts made to restore to its original state the oxide employed: patents have been taken out for this purpose, and one is recommended by its owner as restoring the material to 52 per cent. and as being capable of bringing it up to 70 per cent. binoxide, which, as we have seen, is a very moderate percentage in the ores.

With regard to the other applications of manganese, the making of iron and steel is the most important. Manganese renders iron tough and steel better and more durable, in the latter case it acts by removing sulphur and silicon. Although the quantity of manganese actually imparted to the iron and steel is very small, in a manufacture of such enormous proportions the consumption must be large if continued. The making of manganates and per-manganates, which are used as oxidizing agents and in disinfecting, must also be extensive, a prize medal having been given to Mr. Condy in 1862 for the manufacture of such salts on the large scale.

As an illustration of the way in which the ores are sometimes treated in practice, I may mention the mode adopted by Mr. Hobbs, of Boston, who has had a great deal to do with the Upham and Shepody ores of New Brunswick. The ore is washed clean at the mines, boxed up, and sent to Boston, when it is selected into three good qualities and refuse; the three good sorts are ground in three mills till fine as flour, put up in barrels papered inside, and the contents of each barrel are assayed and sold according to assay.

The first quality free (?) of iron and containing about 98 per cent. of peroxide of manganese, is used for making the finest (flint) glass. The second quality (also no doubt pretty free of iron), containing from 75 to 80 per cent. peroxide, is used for making white phials. The third, containing about 70 per cent. peroxide, is employed for making common glass bottles; while the refuse, containing perhaps 25 or 30 per cent. iron, is used either in making clear amber coloured bottles for brandy, etc., or for carboys.

In conclusion I state together the quantities of binoxide of manganese contained in some of the Nova Scotian ores, as found by the experiments of my pupils or myself:—

	per cent. binoxide.
Manganite, from Cheverie, Hants Co., air-dry, gave......	47·73
Wad, from Halifax Co. (?), dried at 212°, gave............	56·00
Pyrolusite and Psilomelane } from Douglas, Hants Co., air-dry, gave...	84·62
Pyrolusite, Teny Cape, Hants Co., No. 1, air-dry, gave...	88·01
" " " No. 2, " "	92·69
" " " No. 3, dried at 212°...	95·00
Pyrolusite, from Cumberland Co., dried at 212°, gave....	97.04

These results relate to the most important character of the ores; in the rich samples the amount of iron was generally very small; other analytical details are omitted, as this paper is perhaps long enough already. It is apparent, I think, that the ores of manganese are likely to prove of considerable importance in the economic mineralogy of the Province.

APPENDIX.

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

1864.	Thermometer. Max.	Thermometer. Mean.	Thermometer. Min.	Thermometer. Range.	Barometer. Max.	Barometer. Mean.	Barometer. Min.	Barometer. Range.	Winds. Most prevalent.	Winds. Least prevalent.	Rain fell on	Snow fell on	Hail fell on	Fog on	Aurora Borealis.	Solar halo on	Lunar halo on	Lightn'g.	Thunder.
											Days	Days	Days	Days	Nights	Days	Nights	Days	Days
January.....	50°	23°	— 4°	54	30·13	29·61	28·96	1·17	N. W.	E.	6	11	...	2	1	...	3	...	...
February ..	49	26	— 2	51	30·18	29·81	28·51	1·67	W.	E.	7	9	...	6	2	1	2	...	...
March.......	49	28	13	36	29·86	29·47	28·67	1·19	W.	S.	6	9	2	2	3	3	2	1	1
April.	61	36	18	43	29·96	29·63	29·10	·86	N. E.	S.	11	5	1	1	8	3	...	...	...
May........	69	48	31	38	30·05	29·64	29·29	·76	S. E.	N.	15	...	...	10	5	2	1	1	1
June...	92	57	37	55	30·06	29·66	29·06	1·00	S. W.	E.	8	...	1	5	3	1	1	1	4
July	83	62	50	33	30·06	29·73	29·52	·54	S. W.	E.	11	...	...	5	1	2	...	3	1
August	82	64	48	34	29·99	29·72	29·28	·71	S. W.	E.	13	...	...	12	7	...	1	3	3
September..	72	56	39	33	30·11	29·72	29·13	·98	S. W.	E.	6	...	1	2	10	1	2	3	2
October... .	63	46	29	34	30·22	29·56	29·18	1.04	N.	E.	15	1	2	3	8	2	1	3	2
November..	58	39	21	37	30·22	29·68	29·17	1.05	S. W.	E.	11	2	1	4	5	1	2	...	...
December ..	45	27	— 5	50	30·26	29·55	28·48	1.78	N. W.	E.	9	12	...	4	1	...	2	...	...
Yearly..	...	43	...	97	...	29·65	...	1·78	.....	......	...	...	...	...	...	...	...	...	...

EXTRACT of a letter from Vice-Admiral Sir ALEXANDER MILNE, K. C. B., to the President, concerning the currents on the N. E. coast of America.

"I am much interested in the question of the currents, and during many years that I navigated the coast of Nova Scotia, and between Halifax and Bermuda, had invariably attended to the set of the Gulf Stream. The best information, however, which has been published of its strength, &c. off the coast of the United States, will be found in Blunt's American Coast Pilot, from the survey and report of the Government Surveyors. My own observations extend more to the north, and give the northern limit, or rather a north west limit, of which I will give you an abstract from my notes. I conceive this limit is caused by the deep current coming in contact with the shoals or soundings in some two or three hundred fathoms water extending from the shore of Nova Scotia, after passing over this limit, or from the line of the warm water into the cold, the currents become uncertain, and this is the case all along the coast of Nova Scotia up to the latitude of Scatterie. The other great current is the one from the Polar Regions, along the east coast of Newfoundland, extending down to the latitude of Cape Race, when a western part of it runs round it into the Bay of St. Mary's; but the eastern part becomes lost; it is probably checked by a northern limit of the Gulf Stream and turns it more into a north east direction. In the admiralty there is no single volume specially devoted to these various currents; but in Bayfield's St. Lawrence, and the Nova Scotia Pilot, Rennells' currents, you will find various extracts from the surveyor's report, but the outer currents, that is, those distant from the shore, are but little known. * * *

"I have no doubt that tropical seeds, fish, crustacea, &c., are carried up to northern latitudes and deposited by the Gulf Stream. Very much to my surprise I saw a shoal of flying fish in Lat. 37° 50′ N. Long. 64° 50′ W., the temperature of the water being 73°, air 71°. I never expected to have seen them so far from a West Indian sea, although some few exist at Bermuda of a small size, but those in the Stream were of a larger description of the West Indian fish. They were very lively and rose in numbers. There is no record of soundings on the north edge of the Gulf Stream, and I cannot find that any sand &c. has ever been brought up by the lead; no doubt it would be an interesting source of investigation, but I see no prospect of its ever being carried out by government, unless a special surveying vessel was employed to trace the line of sounding from the eastward of Sable Island round to the St. George's Shoals."

"P. S.—The mean northern limit of the Gulf Stream between Halifax and Bermuda from fourteen voyages was found to be in Lat. 40° 56′ N., Long. 63° 45′ W."

FIELD EXCURSION, 1865.

The Institute held a Field Day at the Waverly Gold Mines, on Saturday the 1st July.

The members assembled at the Steamboat wharf, Dartmouth, where carriages waited to convey them to the Mines, about twelve miles distant.

The village of Waverly is one of those new places in Nova Scotia, which owe their existence to the discovery of gold. It comprises a cluster of houses at the head of Lake William, which is there connected with Lake Thomas by a drawbridge; there are also a number of scattered dwellings and shanties in the vicinity of the various shafts, and within a circuit of about five miles. The country around is hilly and rocky, wild and desolate, much broken by mining operations, the debris of which is seen on all sides, and especially where shafts have been sunk, or excavations made. The scenery, however, has some redeeming features. It has all the components of natural beauty, and is rich in hill and valley, wood and water. It is also recommended by the charm of novelty; and is besides a prolific study to the geologist and botanist, and to naturalists generally.

The party first visited the "barrel quartz," so called, a few rods east of the village, near the summit of Laidlaw's hill. Let the reader suppose a series of trunks of willow trees some eighteen inches in diameter, unstripped of bark, laid side by side, close to but independent of each other, and he will have some idea of the appearance which the "barrel quartz" formation would present if fairly exposed; but the barrels or trunks are pure quartz, encased in "whin" rock, which is a highly indurated quartzite, and very different in appearance from the clay slate walls which in general enclose the quartz found in other districts. When first worked the "barrels" proved rich in gold, and led to much speculation, the hopes of which have not been realized, and the work is for the present suspended.

Various opinions have been hazarded as to the origin of this curious formation. It has been thought to be the summit of an anticlinal which has been greatly eroded and denuded of the overlying rock. There is ground for the supposition, inasmuch as the rock covering the quartz is plainly marked with glacial striæ which follow the usual N. W. and S. E. course, a fact which proves also, that here as well as every other part of Nova Scotia, there has been no geological change since the glacial era. Others suppose the quartz to have been deposited from super-silicated rocks, acted upon by chemical solvents. The containing rock, named "whin" by the miners, is of a grey colour inclining to light blue, and is usually compact and hard. The igneous theory is also brought to bear upon this peculiar formation; and hypotheses in connection therewith are hazarded, in an excellent paper by Colonel Sinclair, which was read in the afternoon, and will be found in its proper place further on.

Several shafts were visited. At one a ventilator was in use, the air in the pit being impure. The Taylor Company had sunk a shaft 150 feet, from which much valuable quartz had been extracted, and had then driven a considerable distance to Mud Lake, underneath and across which they were preparing to tunnel.

Returning a short distance, and then proceeding onward southward of this small lake, by a road passable with care for a carriage, the shafts sunk by the German Companies, (so called,) and successfully worked, are seen. This part of the village of Waverly has been named Germantown; and some distance further on, the building containing the Crushers, and other processes for extracting the gold, come into view. The superintendent of this establishment, L. BURKNER, Esq., and another gentleman connected therewith, very obligingly accompanied the party, and explained practically the various processes of crushing the quartz and washing it, and amalgamating and retorting the gold. A large quantity of quartz, in lumps weighing from one to thirty pounds, in nearly all of which gold was conspicuous, lay around, ready for the crushers. The quartz then being worked was white, but with a perceptible and peculiar blush tinge. It occurs in veins of six inches thick, more or less, the gold disseminated throughout in small grains, which the miners designate as "sights." Galena frequently occurs in the quartz, and it has been remarked here, that the gold appears to be more plentiful when in contact with it. This was said to be contrary to the experience at Hammond Plains, a few miles west of this locality, where zinc blende is more prevalent, and with reference to the yield of gold appeared to take the place of the galena. Mr. BURKNER, in the most courteous manner, selected a handsome specimen of auriferous quartz from the heap, and presented it to the President for the Museum of the Institute. There were sixteen stampers at work, and more were to be added. The party were hardly prepared for the extensive operations they witnessed, and were deeply impressed with the industrial occupation of gold mining, and its importance as an aid to the progress of the country. It is chiefly from the works of this Company that every now and then an ingot of pure gold, as large and thick as a stock brick, delights the eyes of the people of Halifax, and convinces them that Nova Scotia is able to maintain its place among the gold producing regions of the earth. The last ingot brought into Halifax, was worth $80,000 and was the product of a month's labour of the operatives of the Company.

After resting awhile at the office of the obliging superintendent, the party left the Mines, and were conveyed to Marshall's Inn, where they sat down, in number fourteen, to a substantial repast. When this had been fairly discussed, the President called upon the Members present to communicate the result of their observations, and an interesting desultory conversation ensued. The Secretary then asked permission to read a paper entrusted to him by Colonel SINCLAIR, a member of the Institute, who had been unable to attend, on the subject of the "barrel quartz" formation, before alluded to, which is as follows:—

THE CONTORTED QUARTZ LODE AT LAIDLAW'S "DIGGINS," WAVERLY.

THIS extraordinary quartz lode conclusively proves that it and similar formations were once in a molten and plastic state.

This has been, exceptionally, controverted; it has been held that the mineral seams, variously denominated according to their thickness, were originally cracks, subsequently filled by a process of deposition, for which present experience and hypothetical science fail satisfactorily to account.

The lode in question conclusively prostrates Mr. Evan Hopkin's theory that auriferous quartz *in situ*, and its contained gold, is the result of electrical action, or that in common with magnetic agency.

Remote hypothesis may postulate as an objection, rather than really conceive, that the electrical or magnetic formation of the Laidlaw lode may have been antecedent to its plastic state.

But no one would credit or advocate such a notion unless he were intent on establishing a favourite theory.

Natural philosophers have natural feelings; no one likes to be wrong in a matter to which he is committed in writing.

Quartz is crystalline, sometimes perfectly so, in common with volcanic obsidian, and factitious glass, which it resembles. It is a flux of silica more pure than glass or obsidian, which contain more alkaline fluxes, such as lime, potash and soda; but auriferous quartz, imperfectly crystallized, invariably contains iron, which can be drawn from the pulverized mineral with a magnet.

The arrangement of crystalline particles is an illustration of a certain kind of attraction; but this attraction or affinity resides in the substance itself; it is only analogous to magnetic attraction; it has no peculiar sympathy with external polar influence; it seems to have far more connection with chemical affinity than atmospheric or terrestrial electricity.

Were crystallization more than merely analogous to polar magnetism, in the formation of ice we should observe that the arrangement of successive atoms would follow or pursue some particular direction, but it is not the case; the acicular radiations from the point first congealed shoot out in *all* directions, and by interweaving eventually form a solid uniform mass of equal thickness;—a lake or pond, does not as a rule, freeze from one quarter of the compass to another.

Still less can electricity or magnetism account for the presence of metals in ores; rare specimens of crystallized gold have been produced in nature—in art crystals are produced by allowing substances to take their own form after fusion or solution, and electricity, to produce the same result, must either fuse or solve.

If by this or other means electricity can accelerate the formation of a crystal, it is merely as a local laboratory agent that it acts; its use and action in this respect as a natural agent, has neither been traced nor proved.

An attempt to account for the presence of gold in the lode, seems to be fraught with the same difficulties which would attend a similar investigation with respect to other metals, and the minerals with which they are usually associated.

Most of them have affinities in themselves, and with one another. The peculiar affinity which quartz has with gold has never been displayed or explained

—but until experiment and observation can very clearly establish the contrary, we must be content to assume that there is some affinity between them *in se*,—and if there be any peculiar operative external agency instrumental in associating them, it is rather an agent than a prime cause.

The presence of the metal and the material for its matrix, in a certain degree of proximity, must be pre-supposed as a normal condition — fusion by heat as a prime cause of the arrangement of mineral lodes; at any rate until we are in a position to establish a better theory, we must accept this.

Silica, the base of quartz, pure or impure, is the most universally distributed mineral; it enters into fully two-thirds of the earthy minerals known.

Gold can be extracted by the expert chemist, tending to show that in very minute proportions it is as universally present as iron or the commoner metals —the analysis has been carried to such an extent, that it is alleged to have been found in a flower!

So that in nearly every metamorphic fusion which has taken place, silica and gold must have participated.

Where the subsequent crystalline arrangement on cooling has resulted in the formation of paying lodes, veins or seams of any metal useful in the arts, it is natural to conclude the pre-existence of the metal contained in unusual local proportions.

Notwithstanding the obvious simplicity of this theory, which really more resembles a natural postulate than a hypothesis, the Barrel lode at Laidlaw's is valuable evidence confirmatory of a once controverted question which it is eminently calculated to set at rest, so much so, that it is hardly to be regretted if its bad yield has saved it from entire destruction.

It is evident that when in a true plastic state contortion took place, which could not have resulted had the quartz been in either a solid or a perfectly fluid state.

The lode is, or was, nearly horizontal, had very little dip, its contortions may have been partly attributable to the nature of the ground, but I dont think so; I believe the whole, killas and all, were in a state of fusion flowing against an obstacle at a lower level, the lower portion becoming stiffer from cooling, whilst the succeeding on-flow of a less viscid mass overlapped and cooled in its turn.

The contortions were very singular from their regularity; when the backs were bared they presented an appearance aptly described as resembling trunks of trees laid from two to four feet apart, parallel to one another; the undulations were so remarkable, that it is questionable whether any other mineral lode has ever been found of a similar character, and it is worth notice—perhaps record.

Irrespective of scientific value, a report on this lode may be of practical use, for in shafting to intercept a known lode, in a contorted "country," unless bends be observed, in mining on a large scale calculations may be a very great number of fathoms out on the wrong side of the estimate, causing serious additional expense and delay.

As according to Mr. Campbell's opinion, as I understand it in his first report, the whole metamorphic series of the Province consists of a number of anticlinal axes, caused by the protrusion of granite, with more or less contorted killas, or slate and bluestone, with quartz lodes between the axes, the matter is not unworthy of attention in an economic point of view.

R. B S.

Conversation ensued upon the subject matter, which was all the more interesting, that the formation alluded to had just come under the observation of gentlemen present. The thanks of the meeting were then voted to Colonel Sinclair for his excellent Paper.

The party soon afterward returned to Dartmouth, and crossed to the city, highly pleased with their excursion. W. G.

Letter from the Right Rev. The Bishop of Newfoundland, concerning the Mummy of the Great Auk, (*Alca impennis,*) found on the Funk Islands.

"St. John's, N. F., Aug. 10, 1864.

"*My Dear Sir,*—

"I am much pleased that the mummy arrived in a good state of preservation. How long it has been embalmed or entombed in the ice I cannot of course tell, but I understand the different specimens were found several feet (at least four) below the surface, and under ice which never melts. They were all found on the Funk Islands, but on which side I am not able now to discover, as the person who dug them up is not at present, I believe, in St. John's. He was sent, or went there to gather the guano or bird manure on speculation, with strict injunctions to procure, if possible, the bones, or skeletons, of the extinct bird. In this he succeeded better than in his own business, and probably if he had known the value attached to these specimens by naturalists he might have turned them to better account than the guano. One specimen I sent to Mr. Newton, and you saw by his letter how highly it was prized. Another was sent to Agassiz, and the third I have been enabled through the kindness of our Governor to forward to you. And this is the most perfect of the three, or certainly more perfect than the one I sent to Mr. Newton,—the other I did not see.

"I think it very likely more specimens might be found, as no persons are living on the island, and it is only lately that any attempt has been made to discover and preserve the skeleton.

"Yours faithfully,

"Ed. Newfoundland."

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PROCEEDINGS

OF THE

Nova-Scotian Institute of Natural Science.

VOLUME I. PART 4.

ANNIVERSARY MEETING, OCT. 9, 1865.

IN accordance with the Bye-Laws of the Institute, the Anniversary Meeting, was held on Wednesday, Oct. 9, 1865, at 8 p.m. when the following gentlemen were elected office bearers for the ensuing year :—

President.—J. M. JONES, F. L. S.

Vice-Presidents.—J. B. GILPIN, M.D., Lt. Col. C. HARDY, R. A.

Treasurer.—Capt. LYTTLETON.

Secretary.—WM. GOSSIP.

Council.—Colonel W. J. MYERS, F. R. M. S., J. R. DEWOLFE, M. D., *Edin.*, Professor LAWSON, L. L. D., JOS. BELL, J. H. DUVAR, P. S. HAMILTON, W. C. SILVER, Lt. Col. CLIFFORD, Royal Artillery.

The PRESIDENT in a brief address regretted that the state of the weather had prevented a larger attendance. He entered upon various topics connected with the welfare of the Institute, and alluded especially to the difficulty that had been experienced in carrying out the intentions of the Institute with reference to the summer Field Meetings, which he considered useful, not only in attracting attention to the natural products of the localities visited, but also in engendering a taste for enquiry into matters pertaining to the physical history of the Province. The Chief Commissioner of Railways had very kindly offered free passage over the lines to members attending Field Meetings, and every inducement was therefore offered to those who desired to participate in such meetings ; but he was very sorry to say that but a very small proportion of the members took part in these excursions.

The TREASURER'S account was examined and found correct, showing a balance credit of \$81.87½.

ORDINARY MEETING, NOV. 6, 1865.

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

Dr. J. B. GILPIN read a paper on the Mackerel (*Scomber vernalis*, Mitch.)

illustrated with coloured drawings of two varieties of that species. (*See Transactions.*)

During the conversation that ensued, it was stated that the Mackerel was a much more valuable fish than the herring for commercial purposes. They did not taint so quick when in bulk. The present method of salting was described by Capt. W. T. Townsend. It appeared to differ from that formerly practised, the fish being now packed with the back *upwards*, which prevented the saline sediment sinking into the flesh. A different species or variety of *Scomber*, which came upon the coast about eighteen years ago, none of which had been seen of late years, was alluded to. The upper jaw at the point was curved over the lower, and the fish was much larger and fatter than those now taken. Formerly in the spring the mackerel were all small, and in autumn all large, now they always varied in size at all seasons, large and small ran together.

With reference to the mackerel hybernating in shore mud during winter, the President mentioned a curious circumstance which had come to his knowledge, where a fisherman of Prospect Harbour, had taken one of these fish while eel-spearing through the ice of the harbour, the eyes of which were covered with a thick film. He considered that the supply of the fish on our shores depended very much on that of their particular food, which, if not abundant in the localities generally visited by them, would be sought for and found in other places, causing failure to the fisheries in some parts, while unprecedented luck would be had in others.

Capt. Townsend also stated that the mackerel appeared very regularly on the Atlantic coast, nearly to a day, viz. on the 26th May. They were frequent around the Magdalen Islands all summer, and were found further north, even as far as the north-west coast of Newfoundland, but they had not been seen on the east coast for twenty-one years.

The President read a paper—" On the Geological Features of the Bermudas."—(*See Transactions.*)

In the discussion which ensued, the probability of those Islands having been once connected with the mainland, was mentioned by a member.

Extraordinary Meeting, Nov. 16, 1865.

The members met pursuant to notice, in the room at the Province Building, and proceeded to Government House to wait upon His Excellency Sir F. W. Williams, Bart., (of Kars,) the Lieut. Governor, who had graciously assented to the request of the Council of the Institute that he would become its Patron, vice Sir R. G. Mac Donnell, the late Governor.

On being received by His Excellency, the President stated that owing to a rule of the Bye-Laws, all Lieut. Governors of the Province were to be requested to become Patrons of the Institute during their tenure of office, and that the Society would gladly enrol His Excellency's name in the place of his predecessor, expressing a hope that His Excellency would give his countenance and encouragement to their proceedings for the advancement of science and the benefit of the country.

His EXCELLENCY in reply said it would give him great pleasure to become the Patron of an Institution that was doing so much good in the Province, and that he would endeavour to further its objects as far as lay in his power.

ORDINARY MEETING, DEC. 4, 1866.

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

RIGBY WASON, Esq., 16th Regt., and Lieut. ANDERSON, Royal Artillery, were elected members at the previous Council Meeting.

The SECRETARY read a paper by Lieut. Col. R. B. SINCLAIR, A.G.M. "*On Pisciculture*," (*See Transactions.*)

The PRESIDENT read a paper by Mr. ELIAS MARETT, Associate Member, of St. John's, Newfoundland, "*On Bone and other Implements found in a Cairn of stones which covered the remains of a Bœothick or Red Indian, on an island of the Lower Burgeo group, Newfoundland.*" (*See Appendix.*)

The paper was illustrated by carefully drawn *fac similes* of the relics, from which it appeared that the aborigines who possessed them must have had some knowledge of the christian religion, or of its observance, and also of modern weapons of warfare, for on some of the implements were depicted rude crosses and cutlasses.

From the remarks made by several members it appeared that the Red or Copper Indians of Newfoundland, were sometimes met with as late as the year 1819. On March 5th, of that year, a Mr. Peyton, who carried on considerable salmon fisheries at the north of the island, having for some years been greatly annoyed and having suffered extensive injury at the hands of these natives, determined to go into the interior to have a meeting with the tribe, to endeavour to commence their civilization; but the expedition ended disastrously, for one of the Indians, at the first meeting having seized Mr. Peyton's father with the intention of killing him, was shot, and the rest ran away, with the exception of a woman who was brought back to St. John's, and became civilized, but her death occurred soon after on Jan. 8, 1820. In the spring of 1823, a fur hunter and his companions fell in with an Indian man and an old woman. The former fled, but the other approached and joined the party, whom she led to a place where her two daughters were. One was about 20, the other 18 years of age. The women were brought to St. John's, but the daughters being attacked with consumptive symptoms, were hurried back into the interior. The mother lived for some years at St. John's, dying at last of consumption. Nothing appeared to have been heard of this singular race from that date.

J. B. GILPIN, M. D., *Vice President*, read a paper on *Salmo Gloverii*, called by the country people *Grayling*. (*See Transactions.*)

An excellent coloured drawing of the fish accompanied the paper, and sketches of other members of the *Salmonidæ* were also exhibited.

In the conversation which ensued, it was stated that an eminent authority had given as his opinion that the Nova Scotian *S. fontinalis* was a char. Dr. Gilpin believed that *fontinalis* went down to the sea and returned. The remarks of different members, however, only tended to prove that the *Salmonidæ* of the Province required more attention at the hands of ichthyologists.

The President, on behalf of the members, thanked the Lord Bishop of Newfoundland, Dr. FIELD, (who was present as a visitor,) for his kindness in forwarding a specimen of the Great Auk (*Alca impennis*,) from Newfoundland, which had enabled them to become acquainted with the anatomy of a bird which was now extinct.

His Lordship in reply stated that he was glad to find that the specimen in question had proved interesting to the members. It had been taken with two others from a guano bed on one of the Funk Islands, lying off the N. E. coast of Newfoundland, and was by far the most perfect of the three. He should always be happy to render any assistance in his power to further the object of the Institute, in gaining a knowledge of the Natural History of Newfoundland.

ORDINARY MEETING, JAN. 8, 1866.

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

The Rev. JOHN MORTON, Bridgewater, was elected an Associate member at the previous Council Meeting.

Professor JAS. DEMILL, Dalhousie College, and J. RUTHERFORD, were elected members at the previous Council Meeting.

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

In connection with the observations of Mr. Ambrose, Capt. HARDY mentioned a curious circumstance which occurred last summer. A friend who was fishing in the North West Arm, hooked a hake (*Merlucius vulgaris*), and bringing it to the surface it was gaffed by a companion. The gaff, however, broke off at the socket, and the fish made its escape with the instrument sticking in it. After a short time they commenced fishing again, and hooked and gaffed a second time securely, the very same hake with the old gaff fast in its back.

The PRESIDENT read some "*Notes on Hurricanes and Revolving Gales of the North Atlantic*," by J. S. HURDIS, of Southampton, England. (*See Appendix.*)

Capt. W. T. TOWNSEND stated his recollections of the Bermuda Hurricane of 1839, he having been on board a vessel off the coast of Newfoundland at the time when the gale reached that latitude. He described the unusual violence which characterized it, and the quarter from which it came, which differed from that of more southern points on its route.

Mr. R. MORROW exhibited some very curious rounded masses of vegetable origin, which he had procured from the shores of a lake in the forest some distance to the eastward of Halifax, and which had puzzled the minds of several naturalists, as to their method of formation.

Mr. C. FAIRBANKS, by request, laid upon the table a fine series of celts, spear and arrow heads, and several weapons and ornaments which he had procured in different parts of the colony.

ORDINARY MEETING, FEB. 5, 1866.

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

Messrs. J. R. MILLER, JAMES FORMAN, JAMES B. MORROW, and JOHN KELLY, were elected members, and Mr. J. L. HURDIS, of Southampton, England, a corresponding member, at the previous Council Meeting.

Mr. P. S. HAMILTON, Chief Commissioner of Mines, read a paper "*On Auriferous Deposits in Nova Scotia.*"

Professor LAWSON made some remarks upon the different methods at present practised in the crushing of gold quartz.

Capt. W. T. TOWNSEND exhibited a very curiously formed "nugget" of large size in the form of a cross, which had been obtained at one of the mines.

The PRESIDENT read a continuation of Mr. J. L. HURDIS'S "*Notes, on Hurricanes and Revolving Gales of the North Atlantic.*" After its conclusion he called attention to the almost perfect calm which had prevailed at Halifax during the last month or two, when the Atlantic, at a distance of a few hundred miles, had been the theatre of a series of storms of unparalleled violence. He considered that as the Gulf Stream was undoubtedly the great course over which the tropical gales swept their way, those gales were to some extent influenced by the colder atmosphere which rested over the course of the cold ocean current, which at that season of the year came with additional force from the north, filling the intervening space between the western confine of the gulf stream and the shores of Nova Scotia. This cold atmosphere might act as a barrier against the westerly extension of such tropical storms, and turn them in an easterly or north-easterly direction, which would point them to the shores of Europe. He contended that the currents of the ocean might have more influence upon the course of storms than was generally imagined, and considered that it only required time and a proper system of observation to prove the supposition.

Vice President GILPIN read a short paper describing a species of *Blarina*, recently taken near Halifax, which appeared to be entirely new to the Nova Scotian fauna.

ORDINARY MEETING, MARCH 5. 1866.

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

Colonel W. J. MYERS, read a paper entitled "*Notes on the Weather during 1865.*" (*See Transactions.*)

The President read a paper by Professor How, of King's College, Windsor, "*Notes on the Economic Mineralogy of Nova Scotia;—Limestones and Marbles.*" (*See Transactions.*)

The Commissioner of Mines made some observations relative to the white marble that had been noticed in the paper, which was stated to have been full of flaws. He happened a short time ago to be at the quarry, and heard from a person there that the parties who had been at work had actually blasted the marble with gunpowder. He thought this, without reference to other causes, might well account for the shattered state of the specimen taken to England.

At a short distance from this quarry another kind of marble occurred, which came as near to the description of *verd antique* as he considered possible. These marbles were not more than two miles from a shipping place.*

The Secretary read a paper by the Rev. JOHN MORTON, of Bridgewater, entitled—" *Remarks on the Pitch Lake of Trinidad.*" (*See Transactions.*)

Colonel MYERS and Mr. F. WAINWRIGHT, who had resided on the island, gave some interesting descriptions of its natural history.

Capt. LYTTLETON gave an interesting verbal account of his recent visit to the Oil Springs of Canada, and referred to their great commercial value.

ORDINARY MEETING, APRIL 2, 1866.

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

Professor LAWSON, Dalhousie College, read a paper—" *On Sodium as an Amalgam,*" accompanied with interesting experiments. (*See Transactions.*)

The Hon. the ATTORNEY GENERAL had his attention called to the metal when in England lately, where he had visited the laboratory of Mr. Crooks, and had witnessed a series of experiments by that gentleman, having for their object its introduction into gold producing countries. He deemed the experiments quite conclusive and satisfactory, and they were such as Dr. Lawson had exhibited before them that evening.

Dr. DEWOLFE alluded to a communication which had been published by Mr. THOS. BELT upon the same subject. Mr. Belt's design was to procure a patent for a mode he had discovered of applying sodium as a flux of gold. He thought it would be well to ascertain if Mr. Belt's patent was in existence, and also its merits in comparison with the other process.

Capt. HARDY, R. A., (*Vice-President*) made some observations on the chlorides as disinfectants and their mode of preparation.

Vice President GILPIN read a paper " *On the Food Fishes of Nova Scotia.*" (*See Transactions.*)

The PRESIDENT referred to the identity of species in regard to several marine fishes of N. E. America, and N. Europe, and instanced the Cod, Mackerel, Herring and others, as presenting no marked difference from those of the British coast.

Professor LAWSON remarked that the White Fish mentioned in Dr. Gilpin's paper he had always considered peculiar to the large Canadian lakes. Dr. GILPIN, in reply said they were frequent in the rivers of New Brunswick, especially in the Madawaska, and were also taken in Lake Temisquata.

ORDINARY MEETING, MAY 8, 1866.

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

The Secretary read a paper by THOS. BELT, F. G. S.,—" *On the Glacial Period in Nova Scotia.*"—(*See Transactions.*)

Rev. Dr. HONEYMAN, F. G. S., read a paper—" *On the Geology of Antigo-*

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*It is the intention of the Nova Scotian Commissioners to send a fine series of these marbles to the Paris Exhibition of 1867.

nish."—(*See Transactions.*) The paper was accompanied by a carefully executed geological map of the district.

Lieut. Col. HARDY read a paper—"*On Nova Scotian Coniferæ.*" (*See Transactions.*)

A series of photographs illustrating each species exhibited the foliage in minute detail.

Mr. ANDREW DOWNS read a paper on—"*The Birds of Nova Scotia.*" (*See Transactions.*)

DONATIONS TO THE LIBRARY.

Nov. 20, 1865, to Aug. 31, 1866.

IN EXCHANGE.

Boston.—Proceedings of the Boston Society of Natural History, Sept. and Oct. 1865. 1866, pp. 49-80. 81-144. 145-176. 177-224. 225-288. 289-320. 321-352.

Dumfries.—Transactions and Proceedings of the Dumfries and Galloway Natural History and Antiquarian Society, Session, 1863-4.

Montreal.—Canadian Naturalist, 1864, Feb.; 1865, April, June; 1866, Feb.

New York.—Annals of the Lyceum of Natural History, vol. 8; Nos. 6, 7, 8, 9, and 10.

Philadelphia.—Journal of the Franklin Institute, 3d series; vol. 50, Nos. 5 and 6: vol. 51, Nos. 1, 2, 3, 4, 5 and 6: vol. 52, Nos. 1 and 2.

Salem.—Proceedings of the Essex Institute, 1865, July, Aug., Sept., Oct., Nov. and Dec.: 1866, Jan., Feb., March.

Toronto.—Canadian Journal, 1865, Nov.: 1866, Jan., April.

PRESENTED.

Condition and Doings of the Boston Society of Natural History, May, 1865. *The Society.*

Result of Observations on the Drift Phenomena of Labrador, by A. S. Packard, jr., M. D. *The Author.*

Hints on Meteorology, with summaries of observations made at St. John, New Brunswick, between the years 1850 and 1862, by G. Murdoch. *The Author.*

Preliminary Report on the Geology of New Brunswick, by H. T. Hind. *Natural History Society of New Brunswick.*

Observational Astronomy and Guide to the use of the Telescope, by J. T. Slugg. Physical Geography of the Sea, by Lieut. Maury. A Geographical and Comparative List of the Birds of Europe and North America, by C. S Buonaparte. Handbook of the Law of Storms, by W. R. Birt. *Lieut. Col. Austen*, Jersey.

Historical Notice of the Essex Institute. *The Institute*

The Gold of Nova Scotia. Description of the Remains of a New Enaliosaurian from the coal formation of Nova Scotia. Catalogue of Mineral localities in New Brunswick, Nova Scotia and Newfoundland. On the Science of the International Exhibition. Description of an Ancient Sepulchral Mound, near Newark, Ohio, by O. C. Marsh, M. A., F. G. S. *The Author.*

On Fucoides in the Coal Formation, by Leo Lesquereux. *The Author.*

Erster Jahresbericht des naturwissen schaftlichen Vereines zu Bremen. Fur das Gesellschafts jahr vom Nov., 1864 bis ende Marz, 1866. *Smithsonian Institute.*

LIST OF MEMBERS.

Date of Admission.		
1863.	June 24.	Almon, Hon. M. B., Hollis Street, Halifax.
1865.	Dec. 7.	Anderson, Lieut. Archd., Royal Artillery, Artillery Park.
1864.	April 3.	Bell, Joseph, Granville Street, Halifax.
1863.	Jan. 8.	Belt, Thomas, F. G. S., Newcastle on Tyne, England.
1864.	Oct. 12.	Brown, C. E. Granville Street, Halifax.
1865.	Oct. 6.	Chambers, A. P., Argyle Street, Halifax.
1865.	Aug. 25.	Clifford, Lieut. Col., Royal Artillery, Artillery Park.
1863.	May 13.	Cramp, Rev. J. M., D. D., *President of Acadia College*, Wolfville.
1866.	May 4.	De Mill, James, M. A., *Professor of Modern Languages*, Dalhousie College, Halifax.
1863.	Oct. 26.	De Wolfe, James R., M. D., Edin., L. R. C. S. E., *President of the Medical Society of Nova Scotia*, Dartmouth.
1863.	Dec. 7.	Downs, Andrew, *Cor. Mem. Zool. Soc., London*, Walton Cottage, North-west Arm.
1863.	Feb. 2.	Duvar, J. Hunter, Bedford Row, Halifax.
1864.	Oct. 26.	Finnie, A. S., Bank of B. N. A., Hollis Street, Halifax.
1865.	Oct. 4.	Fleming, Sandford, C. E., *Chief Engineer of Railways*, Halifax.
1866.	Feb. 1.	Forman, James, Bank of Nova Scotia, Halifax.
1863.	Jan. 24.	Fraser, R. G., Spring Garden Road, Halifax.
1863.	Jan. 5.	Gilpin, J. Bernard, M. D., M. R. C. S., Barrington Street, Halifax, VICE-PRESIDENT.
1863.	June 15.	Gilpin, Rev. Canon, D. D., Spring Garden Road, Halifax.
1863.	Feb. 2.	Gossip, William, Granville Street, Halifax, SECRETARY.
1863.	June 30.	Gray, Hon. S. Brownlow, *Attorney General*, Bermuda.
1863.	Jan. 26.	Haliburton, R. G., F. S. A., Barrington Street, Halifax.
1863.	Oct. 26.	Hamilton, P. S. *Chief Commissioner of Mines*, Province Building,
1863.	Jan. 26.	Hardy, Lieut. Col. Royal Artillery, Artillery Park, VICE-PRESIDENT.
1863.	June 27.	Hill, P. Carteret, D. C. L., Morris Street, Halifax.
1863.	Mar. 11.	How, Henry, D. C. L., *Professor of Chemistry and Natural History*. King's College, Windsor.
1863.	Jan. 5.	Jones, J. Matthew, F. L. S., Ashbourne, near Halifax, PRESIDENT.
1866.	Feb. 1.	Kelly, John, *Deputy Commissioner of Mines*, Province Building.
1864.	Oct. 12.	King, Capt. J. R., Royal Artillery, Artillery Park.
1864.	Mar. 7.	Lawson, George, PH. D., LL. D., *Professor of Chemistry and Mineralogy*, Dalhousie College, Halifax.
1865.	Nov. 9.	Lordly, E. J., George Street, Halifax.
1863.	Jan. 8.	Lyttleton, Capt., Hollis Street, Halifax, TREASURER.
1866.	Feb. 3.	Morrow, James B., Brunswick Street, Halifax.
1863.	Jan. 19.	Myers, Col. W. J., F. R. M. S., Dresden Row, Halifax.
1865.	Nov. 17.	Nash, J. D., Dresden Row, Halifax.
1865.	Aug. 29.	NOVA SCOTIA, The Right Rev. Hibbert Binney, D. D., Lord Bishop of
1863.	Jan. 5.	Poole, Henry, Glace Bay, Cape Breton.

1866.	July 28.	Reeks, Henry, F. L. S., Hampshire, England.
1866.	Jan. 8.	Rutherford, John, *Inspector of Mines*, Nova Scotia.
1864.	Mar. 7.	Silver, W. C., Hollis Street, Halifax.
1865.	Jan. 9.	Sinclair, Lt. . ColR. B., A. G. M., Dartmouth.
1865.	April 20.	Smithers, George, Granville Street, Halifax.
1866.	Feb. 1.	Townsend, W. T. Argyle Street, Halifax.
1864.	Dec. 5.	Webber, Lieut. H. H., Royal Artillery, Artillery Park.
1864.	June 1.	Whytal, John, North Wste Arm, near Halifax.
1863.	April 16.	Willis, J. R., *Cor. Mem. Bos. Nat. His. Soc.*, et *Liverp. Micros Soc.* National School, Halifax.
1866.	Mar. 15.	Young, Hon. William, Chief Justice of Nova Scotia.

ASSOCIATE MEMBERS.

1863.	Oct. 26.	Ambrose. Rev. John, M. A., the Rectory, St. Margaret's Bay.
1864.	July 1.	Marett, Elias, St. John's, Newfoundland.
1865.	Dec. 28.	Morton, Rev. John, Bridgewater.

CORRESPONDING MEMBER.

1866.	Feb. 5.	Hurdis, J. L., Southampton, England.

J. M. J.

TRANSACTIONS

OF THE

Nova-Scotian Institute of Natural Science.

Art. 1. On the Food Fishes of Nova Scotia. By J Bernard Gilpin, A.B., M.D.., M.R.C.S.

No. III.

(*Read November 6th*, 1865.)

The Mackerel.

Scomber—Scomber—(*Gunther, Catalogue B. Museum.*)
Scomber—Vernalis—(*Dekay, Storer.*)
Scomber—Grex—(*Mitchell.*)

Dr. Gunther, from actual comparison of English and American specimens, considers them identical. The American authorities consider them different. Dr. Gill, Smithsonian Institute, 1865, gives as typical "finlets, 5—6." This is not true as regards any Scomber I have identified in Nova Scotia as *Vernalis* or *Grex*, and must refer to some southern species.

In my two former papers, I have endeavoured to give to the Society all the facts I could collect, relating to the common Herring and to the Gaspereaux, and their habits. I shall this evening, still following up the subject, read a paper upon the Mackerel. Thus in time we shall have the natural history of all what I may term the Food Fish of Nova Scotia. A true knowledge of the nature, habits, food, spawning time, and localities of our fish, has been a long *desideratum* in our Province, as the success of our fisheries must be based upon it.

The description of a fresh Mackerel, bought in the Halifax fish market on the 27th October, 1865, is as follows :—

Length 17 inches; girth in front first dorsal $7\frac{1}{2}$ inches, head one-fourth of body to root of tail, diameter of eye five-eighths of an inch, about two diameters from tip of nose. As the fish lies dead, a membrane from the posterior part of the orbit half closes the eye. The lines of the opercle and preopercle are nearly at right angles with the line of body the margins of sub and interopercle like a V, with its apex pointing forward, the gill rays are entirely covered by the lower edge of the opercle, and the upper labials concealed within the jaw. Very minute teeth upon upper and lower labials, and in this specimen on palatine arch, though wanting in others.

The shape of the fish is long for its breadth, and very round, tapering gradually to the root of a very small deeply cleft tail. Two dorsal fins, the rays of the first hard, and five finlets, adorn the back. The pectoral fins commencing one-third of an inch from opercle, and ventral opposite posterior edge of pectoral, anal opposite anterior insertion of second dorsal, with sharp ray or prick in front, and fine finlets below. Two fleshy keel-like processes nearly parellel, are on either side of the root of the tail. Both caudal and all the fins are very small for the size of the body. Colour—top of head and ridge along the back, dark blue; sides, to an inch below the lateral line, when just from the water a deep green with about 27 to 30 deep blue horizontal zig-zag bars or stripes from opercles to tail; a little below the lateral line a number of indefinite dark spots or lines, extending from pectoral fin nearly to tail, below yellowish white, with opalescent reflections; tips of both jaws black, tongue and inside mouth black, cheeks green above, yellowish white below, with pink and opal reflections, and covered with numerous purple spots; sides silvery; fins, dorsals and finlets dusky, rays showing black; caudal greenish dusky, base and tips dark; pectoral dusky, base dark; ventral tips dusky with reddish tinge; anal white with a reddish tinge; and finlets below white. These colours are very fleeting, the green turning to blue on the sides very soon; scales very minute, gill-ray 5, D. 11, 2nd 11, P. 17 or 18, V. 7, A. 10 or 11, C. not counted; finlets V. above and below.*

In studying this fish we have a very large round body, a thin and compressed head, labials and gill-rays compressed and covered, and we are impressed with a certain inflexibility or stiffness in him. He is evidently formed to give little opposition in passing through the water, but the propelling power, the tail and fins, is very small. It is doubtful if the sharp anterior dorsal is not used for defence, as unless excited the fish usually carries it flat. He cannot be called a swift fish. Like all gregarious fish which feed in large numbers, the food must be ready spread in quantities for their use. Thus no individual instinct is called out in each fish to pursue or capture its prey. Moving in large masses also, the whole must blindly follow a few leaders. We are not disappointed then if we find our fish low in the order of intelligence, if we find in his pouty and greedy mouth a certain resemblance to the batrachians or frogs. His asserted torpidity during winter, and blindness, both which conditions

*A very rare variety is found perhaps two or three times during the season at Halifax These have the zig-zag bars one-half the size and double the number. In some the bars are reduced down almost to lines and spots, and resemble a figured variety in Couch's British Fishes, 1865.

happen to the batrachians, favour these views, though I do not think we have yet sufficient proof to assert them as facts.

The membrane half covering the eye is asserted by the fishermen in early spring to cover the whole eye, hence perhaps the story of his blindness. His small and numerous fins, according to the Agassian theory, inasmuch as he resembles the embryo of all fishes, which have the fins in one narrow continued band from head to tail, also prove him low in the scale of intelligence.

He appears on our coast in early spring, according to Martin Harrigan, Halifax fish market, about May 15; they are then very thin and lean, and are going eastward, the fishermen observing them passing the harbour. The great body are supposed to spawn somewhere to the eastward, but they are never seen like herring during the operation. It is probable they spawn all along our coast, but in deep soundings. During July another run make their appearance, and these the fishermen say are some who have not joined the great spawning schools. About the middle of September they again appear, coming westward; their spawning now over, they rapidly become fat and recruited and remain till the middle of November, when they disappear. Thus from the middle of May to the middle of November they are upon the surface. For the remainder of the year they are hid from us.

Our coast trending north-east and south-west, the terms eastward and westward, must be taken as meaning north and south. Thus the spring opens earlier to the westward, the season is advanced, and the rivers westward are open and free from ice before the eastern. Salmon, herring and gaspereaux make their appearance in the Bay of Fundy—at Annapolis first, then at Yarmouth, Gold River, Chester, and are taken earlier at Halifax than at Cape Breton and Canseau. It would seem that as the sun leaves his winter quarters and low circle on the southern horizon and commences to form his great northern round, he is followed north by the great marine armies surrounding our coast, which ascend to the surface to luxuriate in the calm and warming waters, and to approach our shores. Of the cod family alone we know the winter quarters. All winter long they are taken 10 to 15 miles seaward in about 80 fathoms sounding. Of the rest, with the exception of the herring, which winter in the deep land-locked bays of Newfoundland, and sometimes make unaccountable winter migrations, we know little. The mackerel are no exception to this rule; whilst on the surface they are very susceptible to stormy weather; a rough November sending them off, whilst they linger on the surface during the whole of a mild Indian summer till December.

Although our fishermen maintain that they perform biannual migrations east and west, that they set their nets facing the west in spring and facing east in fall, that they watch them passing from head point to head point, and doubtless those seen at rare intervals on the Labrador must have migrated there, yet I still think these migrations are but very partial, and that the great body of our mackerel retire to deep soundings, as it were, on our coasts, perhaps to bury themselves in the mud and ooze, in a semi torpid condition. Our fishermen affirm that their stomachs are found empty, very late in November, and the fatter the fish the emptier the stomach, as if they were preparing for hybernation, as our bears and marmots do under very different circumstances. The stomach of the mackerel from which I made my description for this paper, 27th October, was filled with about a table-spoonful of green pultaceous matter in which was a fish scale. But the later in the year the fatter the fish; no No. 1's are ever branded in spring or early fall. Thus they disappear in November very fat, and re-appear very lean in May. I am still of the opinion that our fishermen's views are in the main correct, and would again bear testimony to their accuracy. When we consider the immense quantities of food consumed by the large schools around our shores, we must at once perceive that a perpetual migration is necessary. They must continually seek new hunting ground. The various tides, currents and eddies, along our coast, must incessantly influence their motions, since these currents sweep down acres and acres of surface food for them; therefore we are prepared to hear of their appearing at uncertain intervals, of their leaving a coast for years, and then returning unexpectedly to it. There is no doubt that by patient observation of all the facts passing around us, and by comparing them with meteorological tables of past years, one might come to predict a good or bad fishing season, but that we could ever control one, would be beyond our highest expectations. For the two last seasons the catch has been very abundant on our coast. For several seasons before it was very deficient. One reason advanced with some plausibility is, that they range about the mouths of our rivers to feed upon the young gaspereaux, just emerging into their salt water life, and as the dams and obstructions of our rivers are daily cutting them off their spawning grounds, this supply is rapidly diminishing, and therefore they are rapidly leaving us. But we are met with the fact that there are more mackerel than gaspereaux, that the supply is too limited. There is a small crustacean that covers the beaches in winrows, like a shrimp, in July and August. These the fishermen call mackerel bait, and by their quantity or scarcity predict a good or a bad season. One cannot but think the myriads of medusæ which fill our autumnal waters, must serve as food for them. Of their voracity and willingness to take artificial baits, the common saying, "a mackerel will bite at a red rag," is a strong but a true expression; but as this invariably leads us to a history of the mackerel fisheries, we will sum up in a few words our present knowledge of this fish. He appears in May lean and with spawn, and is seen passing eastward, and northward; some few remain passing up and down our shores; he reappears again from the north and eastward, (having spawned in deep soundings,) in September, very lean, rapidly recruits, and disappears during November very fat, to reappear lean again in early spring; that he is uncertain in the place of appearing, and that we need some exact practical facts as regards his food. Mr. Thomas Brackett, Halifax fish market, assured me that he had opened many mackerel this day, November 1st, 1865, and the stomachs of all were empty. He states that he often finds small fish in them earlier in the season.

This valuable fish, though low in the scale of organized beings, is much prized as an article of food, and is deservedly considered our most valuable export. His capture forms the most exciting work of all the wet, toil, and hardships our fishermen endure. There is chance in it—luck as they would express it. By one dexterous cast of net, he may make more than a month's work at the hook and line. Set nets, that is, nets about 30 fathoms long, and 4 deep, are stretched by their head lines between two buoys at the mouth of some inlet, and facing westward, about the middle of May. Many are thus taken. In early spring they are lean and filled with spawn, but are readily sold in the fish market, or make good No. 2's, or second quality pickled fish.

It is very obvious that no creature should be harrassed during the spawning period, and one would at once say there should be a closed period during the spring for mackerel fishing, and that this is the principal reason for the decline of the fishery. Making rash laws, however, are to be deprecated, and our Legislature should first gain an intimate knowledge of the subject of sea and river fisheries, with all its bearings of food, of habits, migrations of fish, their mutual relations upon each other, and on the currents and tides that sweep our coasts, before they legislate away the summer living of men, often too poor to wait the fall supply.

Extricating himself from the nets and toils strewing his path eastward and westward for many a mile, but leaving many a poor fellow behind, branded prime No. 1, our fish now leaves our coasts, disappearing eastward. By the middle of September, especially if the nights are calm and warm, he comes to us again. Now is the grand sea harvest. The fishermen, those hardy reapers of the sea, are in picturesque groups on every headland or far jutting out point, with practised eye scanning the waters for the wake of the coming school. Inside of a deep bay they have their seine set, (a seine being 10 nets or 100 fathoms of head line, and 9 fathoms deep.) With one end attached to the shore it runs off at right angles, about 30 fathoms, where it is fastened to a buoy, it then makes an angle or L of about 30 more fathoms length, the foot ropes lying upon the bottom. At the end of the L a boat lies with the remainder of the seine, all ready to throw out. The look-out man now gives the word. The school is coming. With their eyes and heads just peeping out of water, their stiff inflexible bodies at an angle of 45, and a long train or wake curling back in the smooth water, there come a thousand greedy mouths and glittering eyes, slowly peering about for food, and following the indentations of the shore. Noiselessly and breathlessly the reapers of this sea corn do their work, for so wary is the fish, that a glint of light, a clap of the hand, or the swash of a rope overboard, or even the thud of an oar falling upon the boat, and the whole school is gone, to break water again far to seaward, and perhaps the $500, so nearly bagged, goes with them. In profound silence they watch their prey till it runs quite up far within the bight or elbow of the seine. And then a few rapid strokes of the oars, and as many dexterous tosses of the remaining nets as the boat is rowed to land, and they have secured their prey. This is technically called making a stop. For 36 hours the fish swim in frantic circles, breaking the water every where, they then apparently sulk down to the bottom, and never come up again. These stops are made all around us, and within sight of our crowded streets. Our beautiful Basin is often alive with them, and then in addition, a smart schooner, the floating home of the fishermen now far from the rock hung cottages, adds her tall masts, spread alow and aloft with drying nets, to the pretty confusion of glittering fish, dotted head floats, smart whalers and busy men around.

So close do land and water, the dusty traveller, and the dripping fisher meet in these sweet spots, that I once saw a stop made on the very verge of the rail, and the puffing engine making a back ground to the group, as glittering fish were tossed up and shining dollars cast down, and the farmer returning with the price of the harvest he had watched and toiled over many a weary hour, or of the stock he had fed and folded through many a winter day, was exchanging it with the hardy sea farmer who ploughs no furrows but with his keel, who gives of herds he has never fed, and of harvests that nature has sown broad cast on a thousand rolling hills for him to garner with boat hook and sweep net, rather than reaping knife or bullock-wain.

These stops are made on many parts of our seaboard, in St. Mary's Bay, and Digby Basin, where fish weirs are substituted for nets, and all along the Atlantic coast, and find their way to Halifax markets in lots varying from ten barrels to one or two hundred. As they are included with the deep sea mackerel returns, it is impossible to ascertain the exact number of barrels taken annually by shore fishing; but the whole amount of both shore and sea mackerel fisheries for the year 1865, was somewhat above $1,000.000.

Art. II. On the Geological Features of the Bermudas. By J. M. Jones, F. L. S.

[*Read Nov.* 6, 1865.]

The geological features of the Bermudas are at once interesting and peculiar. The group may be styled a series of sandy islets, more or less covered with cedar trees; for wherever you traverse, either along the shore or on the more elevated land, sand lies beneath your feet, and the cedar tree is rarely absent.

It does not require much stretch of the imagination to conceive the origin of this group, as formations always in progress in different parts of the islands give a clue to what has otherwise proved a mystery.

I have already given an opinion as regards the original formation of these islands in the "*Canadian Naturalist*" for February, 1864. Granting a primitive foundation, most probably the result of volcanic action, at no great depth below the ocean surface, the current of the Gulf stream would supply ample material to form a basis on which the gradual process of islandic formation would be slowly perhaps, but surely developed.

It is to the coral zoophyte, however, that minim in Nature's chain, that the Bermudas owe their existence as a settlement fit for the human race to dwell in. Without its presence the massive barrier reefs which lie around far in advance of the main land acting as walls of defence against the encroachments of the tremendous seas which break upon them, would not exist; and the inhabited districts, where now the neat white dwellings stand snugly ensconced in groves of cedars, would soon be changed to scenes of desolation; for like the locality known as the "Sand Hills" in Paget's parish, the sand would be thrown on shore by the violence of the waves, and the driving gale would hurry it along, burying houses and cedar groves in its course, as it has done in the locality I have alluded to.

Speaking of sand it may be well in the first place to consider the composition of the Bermuda sand. Take it as it lies upon the beach, and you will perceive, without the aid of the lens, that broken coral and shell are the principal ingredients. Pink coloured substances are also seen intermixed. They are fragments of nullipores which coat the reefs and shore rock in abundance. The nullipore fragments, however, are about in the sand, which is found at a distance from the shore, and this hill sand is much smaller in grain and of a dull white colour; probably owing to the same process which according to Darwin takes place at St. Helena, viz., the drifting up of the sea sand to heights above, and the winnowing occurring during the transit.*

In traversing the islands from one end to the other, and ascending the highest positions, the hills are found to be rounded at their tops. This state arises from the action of the wind upon the masses of sand; and from sections of hill sides laid bare by excavation for road and other purposes, it appears that the same kind of formation has taken place in olden time, the shape of the former hills being clearly defined by the hardened mass which covers the underlying formation, and separates it from the recent one above.

From a general survey of the Islands I take it that they rest mainly on a series of caverns, partly and wholly in some cases filled with red earth; but near the shores of the islands these caverns are kept clear of contents by the waters of the ocean, which every flowing tide, find entrance through channels in the sandstone rock. There are some parts, however, which from observation I am led to believe are not so honeycombed by caverns, and these lie on the south shore of the main island, in Paget, Warwick and Sandy's parishes, where the sandstone has become hardened by some particular process into a very compact and close-grained stone. Of this stone lime is made, and when large houses and public buildings are erected, the contract generally specifies that this south side stone shall be used, it being far more durable than any other found on the Islands. Some persons imagine that the locality where this description of stone is found is the oldest land in the group, but it would be rash to concur in this theory where so many cases of recent formations having the appearance of age occur, and especially when we take into consideration the fact, that calcareous deposits soon become compact under the influence of exposure to the elements. Close observation made by residents on the Islands can alone set at rest

*When I last visited the Paget Sand Hills, a house at the summit of the hills some distance from the shore was almost totally buried, the chimney top being the only portion of the dwelling seen. The sand was still slowly but steadily working its way, and a few years more will no doubt cause adjoining properties to fall a prey to its encroachments.

this interesting question. The cavernous condition of the foundation of the group has often led ignorant minds to suppose that the islands rest upon no secure basis, and the circumstance of brackish water always making its appearance wherever holes are dug to the level of the sea, has given more credit to the statement.

In speaking of the cavernous foundation of the Bermuda group, I must not omit to mention a phenomena which may or may not exist in consequence of cavernous communication with the outer sea. Near the eastern end of the main island there is an extensive basin some six miles in circumference, called Harrington Sound. It connects with the sea by a narrow passage at its western end, over which a bridge is placed called "Flatt's Bridge." When the tide without flows, it is carried with great force into the sound through this passage, and likewise when it ebbs, it runs out again with the same degree of force. Now, it would be imagined that with such an increase of water as a flowing tide pours into this lake a rise of a few inches at least would occur: but such is not the case. Not an inch does the sound rise, and when the ebb begins, the waters rush out again to sea with the same impetuosity; yet not an inch has it fallen. Now where does the incoming water at flowing tide go to? And where does the water come from, that replaces the amount lost by the ebb? For there must be some outlet to account for such a singular occurrence. It must be borne in mind that this passage through which the tide ebbs and flows, is the only connection the lake has with the sea so far as can be ascertained. Many reasons have been given, endeavouring to account for this curious phenomenon, but as yet I am not aware of any definite conclusion having been arrived at.

The neck of land which divides this Sound from Castle Harbour is filled with caverns, and presents above ground an uneven and picturesque appearance. Miniature valleys surrounded by rocky ridges, honeycombed into caverns large and small, in the lower parts of which may be seen the clear waters of azure tint, through which the tropic fishes of rainbow hues may be seen floating about; and shrubs and plants of many kinds jutting out of the holes and crannies of the sandstone, while overhead the sage and coffee bushes, cedars and palmettos grow in wild profusion. This is the far famed Walsingham, immortalized by Tom Moore, in his ode to the Calabash tree, which in his time afforded a cool shade, as it does at the present day, to numerous pic-nic parties.

In this locality, I have noticed a curious circumstance, which lends a clue to the formation of certain cylindrical masses existing on the shore at Harris Bay and other places. Mr. Richard Wood, the owner of this lovely estate, showed me certain trees growing out of the solid rock. The stem of one tree, a palmetto, was closely surrounded by the stone, and fitted as tightly as a stove-pipe does into the stone in a chimney. Now when this tree dies there will of course be left a cylindrical hole, and were the rock it exists in within reach of the waves of the sea, this hole which has had its walls hardened by the water which has during many seasons trickled down the stem of the tree, would become a cylindrical mass standing by itself, while the more friable rock around would be worn away. This condition would exactly account for the curious circumstance I have alluded to as occurring at Harris Bay. At that position and close to high water mark, stands a collection of cylindrical masses hollowed within and marked with rust, which I think may be owing to the decomposition of the tree, which once grew in this cylinder when it was part of the surrounding rock, which has been worn away by the action of the waves or spray, which at this point falls heavily during southerly gales. From appearances I should say that these cylinders contained palmettos from their rounded shape at the bottom, which is characteristic of the tree's growth.

I have at the commencement of this paper alluded to the presence of red earth in the caverns. This red earth exists very generally over the surface of the island, and mixed with sand is the common soil of the islands. I have every reason to believe that it is composed of decayed vegetable matter, and this theory is borne out by an analysis which was kindly made for me by Dr. Albert Bernays, the analytical chemist to St. Thomas' Hospital. Colonel Nelson has expressed his belief that the red earth found in caverns was of animal origin, most probably accumulated masses of guano; but as Dr. Bernays has stated that no animal matter whatever can be traced, I think a vegetable character can only be assigned to it, for I see no difference between the cavern red earth and the surface soil, beyond a more compact appearance in regard to the former.

In observing road cuttings in different parts, we see at once how these islands have become raised to their present height, Look at a cutting side. Above all you see some few inches of red soil on which trees and shrubs are growing, then two feet of loose sand, gradually hardening as it descends, the whole filled more or less with semi-fossil shells of *Helix Bermudensis* and other land shells. Thirdly we perceive a large cavern partly filled with red earth, an undoubted cavern deposit, then a smaller deposit, and then a regular bed of red earth again—the whole intervening space filled with hardened calcareous rock.

The lowest layer of red earth was once the surface soil, then drift sand came over it, cavernous holes occurred in the drifting sand, perhaps where a dense vegetation grew, the decomposition of which left the small mass of red earth at the bottom. A second drift again takes place, and then we have red soil and vegetation growing again—and so the land rises; but having attained a particular height, and becoming well clothed with a dense vegetation, it is a question whether under existing circumstances a higher elevation will be attained, unless some change should take place in the current of the Gulf Stream, when the Bermudas would most assuredly suffer in no slight degree, and the sand of the shore would make similar encroachments to those taking place in Paget's Parish at the present day.

To show the gradual formation of the Bermuda shores, we have only to take a walk along the sandy beaches, where we see large masses of sand, intermixed with gulf weed and debris of all kinds, in the form of a low wall above high water mark. These masses have been placed there by the action of the waves during storms. They are gradually hardening, and in process of time will become sandstone rock. On these masses again at intervals are thrown drift matter and tree trunks, some of large size, as I have seen myself. Among the roots of these trees are frequently seen pieces of stone of far different composition to any found on the Islands. These stones have undoubtedly been carried within the entwined roots of those drift trees from the continent of America. They are generally pieces of hard trap, at least all those I have been able to procure are so according to Professor Dawson.

I was not aware of the real origin of these foreign fragments when I hammered them out of the shore rock, about high water mark, until Mr. Belt drew my attention to Darwin's statement in regard to similar occurrences on the shores of Pacific Islands. These foreign stones may be seen *in situ* at Point Shares in the shore rock. Pieces of decomposed iron are also found imbedded in the shore rock, brought there no doubt by wreck materials.

In considering the geological structure of the Bermudas, we cannot help noticing the similarity that exists in many instances between the accumulations occurring in the sandstone, near shore, and those on the shores of Pacific islands, and other places where calcareous deposits occur. On the south shore of the main island of Bermuda, I found in the friable cliffs some curious tubular bodies, hard and compact, which left a cast in the sand on removal. I thought they might be fossilized roots of trees. However, on comparing notes with Darwin's account of Pacific calcareous deposits, I found that the same substances had been found at King George's Sound, on the S. W. coast of Australia, and at the Cape of Good Hope. He styles them "branched bodies." "These branches," he says, "are absolutely undistinguishable in shape from the broken and upright stumps of a thicket; their roots are often uncovered, and are seen to diverge on all sides; here and there a branch lies prostrate. The branches generally consist of the sandstone, rather firmer than the surrounding matter, with the central parts filled either with a friable calcareous matter, or with a sub-stalagmitic variety; this central part is also frequently penetrated by linear crevices, sometimes, though rarely, containing a trace of woody matter. These calcareous branching bodies appear to have been formed, by fine calcareous matter being washed into the casts or cavities, left by the decay of branches and roots of thickets buried under drifted sand. The whole surface of the hill is now undergoing disintegration, and hence the casts which are compact and hard are left projecting. In calcareous sand at the Cape of Good Hope, I find the casts quite similar to those at King George's Sound; but their centres are often filled with black carbonaceous matter, not yet removed. It is not surprising that the woody matter should have been almost entirely removed from the casts on Bald Head, for it is certain that many centuries must have elapsed since the thickets were buried." In concluding his observations on these branched bodies, Darwin says: "Reflecting on the stratification of the deposit on Bald Head—on the irregularly alternating layers of sub-stalagmitic rocks—on the uniformly sized and rounded patches, apparently of sea shells and corals—on the abundance of land shells throughout the mass—and finally on the absolute resemblance of the calcareous casts to the stumps, roots, and branches of that kind of vegetation which would grow on sand hillocks, I think there can be no reasonable doubt, notwithstanding the different opinion of some authors, that a true view of their origin has been given here."

Now, I have every reason to believe that these branched bodies found in sandstone cliffs at Bermuda, have originated in the drift sand covering shrubs or trees, when in a living state; but from observations I have made I consider their formation to have differed from that of Darwin's specimens. Rain water coursing down the opening made by the protruding stems and branches, would cause the sandy particles around to cement together, and form a hardened crust, which, like the cylinder of the palmetto I have spoken of, would, when the surrounding friable sandstone around was cleared away, stand firm. I am led to suppose this course of formation, on looking at a specimen which is hollowed at its centre, presenting as it does an appearance that would indicate such a course. On the rocky shore immediately beneath the cliffs from whence I obtained these specimens, large masses of sandstone rock lie detached from the cliffs, and these detached rocks as well as the cliffs, are perforated with holes, doubtless the casts of branched bodies which have shaken out from their original positions.

Not far from where I procured these branched bodies, at the S. E. corner of the Paget Sand Hills, cedar and other trees are now being gradually buried under drifting sand; and in years to come when the mass around them has hardened into rock, their stems and branches having wasted away, will doubtless leave behind branched bodies similar to those I found in another position, and also to those found by Darwin at King George's Sound, and the Cape of Good Hope. In some cases the branches may have been formed according to Darwin's hypothesis, by the entire decay of the whole branch, root or stem, and the refilling of the cavity left by sand; but as I said before, from observing that in some cases the centre of these Bermuda branches are hollowed, I must repeat again that I consider a gradual hardening of the sandy particles immediately around the vegetable matter, first takes place, and when the decay becomes perfect the vacuum is filled by the same material.

Another circumstance I will now relate, which tends in some measure to shew the similarity of the Bermuda phenomena to those of the Pacific. Below the Paget Sand Hills, and on the shelving beach between high and low water mark, stand some remarkable rocks of the same consistency as the shore rock. One in particular stands perfectly isolated from the rest, and by the action of the waves has its base worn away, making it look like a large head upon a short neck. Although these rocks present a curious appearance, I should not have paid particular attention to them had I not found the occurrence of similar shaped rocks recorded in Dana's work, as existing at Waterland, one of the Rawehe Islands, in the Pacific. The rocks instanced by Dana, however, differ somewhat in consistency, being almost wholly composed of large fragments of corals of the *genera Astræa* and *Madrepora*, and imbedded shells, whereas the Bermuda examples were composed of the usual comminuted shell and coral, with imbedded shells. They nevertheless assimilate in many particulars, and afford evidence of similar agencies at work in coral groups, in the northern as well as the southern hemisphere.

From soundings taken along the outer reefs, it has been found that the Bermudas rest upon a partially columnar structure, for immediately outside these outer reefs the descent is precipitous, more especially on the southern side. To the westward, however, the column appears to be continuous for a space of thirty miles, for in that distance occur three or four masses of rock at a depth of about thirty fathoms. These are well known to the fishermen, who reap rich harvests when they visit them, fish appearing always to congregate in greater numbers wherever rocks lie.

It may be well to notice, that this extension of the Bermuda column is directly towards that point of the main land of America, which juts out for a considerable distance eastwardly towards the Bermuda extension, viz., Cape Hatteras. I mention this in order to point out a probability that in ages past the Bermuda column *may have been* attached to the main; for although I conceive, without conclusive evidence to the contrary, that the Bermuda column owes its origin to volcanic action, yet still as it at present remains a mystery, it will be well to consider the question of origin in every light. Viewing the Bermudas as formerly a portion of the American Continent, let us consider whether there be sufficient ground on which to base our supposition. The Islands are formed, as I have before stated, of sandstone composed of comminuted shell and coral; but the particular stone which I have instanced as forming part of the southern shore, is so compact as to have the appearance of solid sandstone, or, indeed, I may say limestone. Now if we are to identify the Islands as forming part of that main land which juts out in their direction, we must first ascertain if that extension of the main be of similar formation. Speaking to Mr. Hill, the obliging mate of the R. M. S. "Delta," on my return from the Islands in 1860, I found that he was well acquainted with the American coast; and upon enquiry he informed me that the geological character of Cape Hatteras was decidedly a white sandstone or limestone, very similar in appearance to Bermuda stone.

I am sorry I have no specimen of the Hatteras stone, to compare with that of Bermuda, and I also regret that I have not had an opportunity of consulting any work upon the geology of that locality, whereby I could clearly ascertain the real nature of its structure. However, as I merely mention the connection of the Bermuda group with the main as a probability, and *nothing more*, and as my views are decidedly in favour of volcanic origin, we may leave the consideration of the question for future investigation, as I beg to do other subjects connected with the geology of the Bermudas, which, I hope, if life and health be spared me, to treat of in another paper.

Art. III. On Pisciculture. By Lieut. Col. Sinclair.

[*Read Dec.* 4, 1865.]

Viz.: Ombre or Grayling —*France* and *Italy;* Pike— *Italy;* Carp—*China;* Bream —*doubtful;* Tench—*doubtful.*

America could introduce *S. Fontinalis*, Pike, Perch, Gasperæux, Striped Bass, Black Bass, Cat Fish, Sun Fish, *S. Confinis*, and two other varieties of Lake Trout, one not yet determined.

Most varieties of the fresh-water fish proper of Great Britain are exotics, and were introduced by the learned monks of the ancient monastic orders.

These ecclesiastics expended much labour in preparing artificial lakes and ponds, which now exist, and still contain the scaly descendants of the old stock.

In those days, the transportation of live fish across the Channel or German Ocean, must have been a difficult undertaking. There is no account on record, showing that our ancestors were possessed of the knowledge that fish could be cultivated by means of milted spawn.

The Province of Nova Scotia should not be the last country to take advantage of, and reciprocate, the benefits which are likely to accrue from the late advancement made in piscicultural science. Her fresh-water lakes are of every conceivable size and kind; no country in the world offers superior natural advantages for a comparatively inexpensive introduction of many of the fish of the temperate latitudes.

The atmospheric isotherm of Nova Scotia corresponds with the south of Sweden; but her fresh water isotherm will approximate to that of central Germany, where the summers are warmer than ours, and the lake waters are frozen for two or three months during winter.

With one or two exceptions, the fresh water fish of temperate climes (indigenous or imported) cannot endure tepid waters; those few which *can*, do not suffer from hard winters, for the physical reason that the mean temperature of all waters is the same under a frozen surface.

The interchange of different varieties of fish by the agency of man, seems to be peculiarly indicated. In agriculture, the cultivation of exotic plants has much more to contend with: the same zones of latitude will not, as a rule, produce the same crops. For instance: Nova Scotia lies in the same latitude as the south of France, but will not ripen the finer sorts of wine grapes, the olive, and the fig. But the Province is somewhat nearer this condition than Great Britain, where the cucumber and maize will not ripen in the open air. The thermal condition of our lakes is higher in summer than that of the British lacustrine waters, and for a longer period; with reference to the hybernation of fish, for the reason already given, they may be ranked with lakes only frozen occasionally in winter elsewhere.

Aquatic plants give a good indication for comparing the waters of different countries, with the object of ascertaining whether they will sustain similar species of organic creatures.

The white and yellow water lily, the pickerel, and other lake weeds of this Province, are identical with those of Great Britain. There is a far greater diversity in the land plants and shrubs, which are indigenous in the two countries, proving that the thermal condition of their waters approximate much nearer than their atmosphere.

It is probably owing to higher temperature in summer, that many of our lakes have few or no trout in them. For this reason, they would be all the better reservoirs for other kinds of fish.

For instance: no one would now take the trouble to wet a fly in that fine sheet of water, the lower lake at Dartmouth; but were it stocked with fish, perhaps less esteemed than trout, it would afford healthy amusement to many who may not be adepts in the more scientific branches of angling. Enjoyment is only relative, and there are not a few who take as much interest in the bobbing of a cockney float, as in the rise of a pound trout; and even the experts might condescend to enjoy surer, though slower sport in the summer evenings, at a season when the trout, sickened with heat, refuse to take. As for the rising generation, they would be happier and better spending their spare time dibbing for roach, dace, tench, carp, and bream, than idling at home, or in city or town.

It would require a naturalist of practical experience to decide whether the white perch of America is the same as the British perch. It is not likely. The British perch, in all considerable lakes, grows to a very large size, and would probably do so here, where the native perch rarely attains the weight of two pounds.

Without pretending complete exactness, suggestive lists of fish are appended to this paper.

Possibly a correspondence with the Acclimatization Society in Great Britain, might lead to some results in an interchange of fish or spawn. As the delicate salmon roe has been transported and hatched successfully in the Antipodes, there could not be any difficulty or much expense, attending experiments of the same sort with other fish, by means of the mail steamers. The gaspereau would almost certainly thrive in Loch Awe and similar lakes, accessible to and from sea, and fed by a diversity of rivers and streams; and our trout, *salmo fontinalis*, would be no mean acquisition to the British lakes.

It is remarkable that the lithographic history of the ancient world reveals the fact, that there was then a difference of the fish of the European and American continents, although they were less dissimilar from one another than either from modern fish. Some of the ganoid fishes had a vertebrated neck, and were thus able to look about them.

The same similarity prevails in the present day, when man is present to take advantage of it. The great *siluris glanis* of the Danube, whose introduction into Great Britain has caused attention, is undoubtedly one of the types of the large Channel cat fish of America, probably distinguished by some local peculiarity. The sturgeon of the Danube is most likely the same as the St. Lawrence sturgeon, with a difference.

Many of the European fish, if introduced here, might deteriorate in size and quality; but, considering the extent, purity, and varied conditions of our lakes, on the average, quite a contrary result may be confidently anticipated.

LIST OF BRITISH FRESH WATER FISH NOT FOUND IN NOVA SCOTIAN WATERS.

British Trout inhabits both lakes and rivers, as well as small streams, in which he will attain a good weight. Maximum weight, 10 lb.

Thames, and Colne, Driffield Brook, Waltham Tarn.

Affects deep holes in streams, and shallow gravel banks in lakes, and does not roam except near spawning time; runs very greedily at the minnow, particularly in rivers or streamlets discolored by recent rains; his habits are much more stationary and solitary than those of the "*salmo fontinalis*," or American trout; he also grows much larger in some waters than the *fontinalis*, which rarely, if ever, exceeds six pounds; seeks cover under roots and rocks.

B. Lake Trout — Maximum weight, 15 lb.; exceptional weight, one from Loch Awe taken five and twenty years ago, 30 lb.

Lochs Awe, Scotland; Neagh, Ireland; and other Scotch and Irish lakes. The Lake Trout of Cumberland is only an overgrown River Trout, over fed with minnows, found in Crummock Water and other lakes in North England.

There are several varieties — three or four, at least: —

1. The gillaroo trout, of Loch Neagh, which has a gizzard, and feeds partly on clams.

2. The great gray lake trout, of Loch Awe, is distinct from the gillaroo, unless the gizzard story be a myth.

3. The bull trout.

NOTE. — Naturalists are more obscure about the varieties of lake trout than about any other fish. It is impossible for a lay brother to form ideas from reading or catching.

Salmon Trout — Maximum weight, 9 lb.

Decidedly different from our sea trout; has no round white spots, or more obscure; scaled more like a salmon, larger size, and cuts red just like a salmon.

B. Grayling — Maximum weight, 4 lb. Itchen near Winchester, Derwent, Wharfe, Done, and other rivers; varies much in size according to waters; is supposed not to be a "cold water" fish, but has lately been introduced into Scotland.

A delicate, very tender fish, excellent eating, taken almost always with the fly; likes a stream not too rapid, alternating with long clay bottomed glides, and gravelly streams; only one variety found on this continent; Back's grayling in the Arctic regions; the grayling, so miscalled, of Grand Lake, N. S., is a lake trout.

B. Pike — Maxm. weight, 40 lb.

Well known as a voracious fish, not to be trusted as an import; it is difficult to confine him, and he eats all before him, even his own species — frogs, young ducks, and any swimming thing less than his swallow.

Carp — Average weight, 2 lb., but will grow to 8 or 10 lb. invery favorable waters.

A tolerable fish for the table, but of no very superior quality; breeds prodigiously; Chinese by origin, but will live in temperate or even frigid climes; likes gravelly ground, in still waters.

Tench — 3 lb.

Pond and lake fish of very excellent quality; likes muddy or weedy places; stillwater fish.

Bream — 4 lb.

A fine deep-bellied fish, better than carp; he is a stillwater fish, and would most likely attain a large size in those of our lakes where trout are scarce; he gives good sport during summer, when few other fish will take — sport for float anglers, and a well-grown, good fish.

B. Perch — Much larger than the Provincial Perch.

A desirable fish to have as an experiment; might either improve or deteriorate in weight — would probably increase in weight.

B. Barbel and Chub.

Uneatable, and destructive of the spawn of other fish; they are the curse of English waters, and not fit for anything.

Roach and Dace — 1½ lb. (*Isaac Walton*, 2 lb., minus 1 oz., *Roach*.)

Sport for young anglers; tolerable "pan" fish.

Minnow.

Breeds in vast quantities, and useful in streams and lakes as food for trout and other predaceous fish, and a good bait.

Bullhead, loach, ruff, bleak, and a rare fish-burbot (*a siluris*), are not worth consideration; also, fresh water cray-fish, gudgeon, &c.

Charr — Small Herring size. Of the cold deep lakes of the north of England; a very delicate fish, schooling in the autumn, when they are netted and potted for consumption and sale; difficult to transport, the fish being very tender, and their spawning habits obscure. The charr, if introduced, would be of great value. The *fontinalis* has been called a charr, but he is not the same fish at all. The lake charr has his seasons, and disappears and schools again just like the herring, not being seen but in his season.

PRINCIPAL NOVA SCOTIAN FISH NOT KNOWN IN GREAT BRITAIN.

Common Trout, *Fontinalis* — Sea Trout, maximum weight, 6 lb. Colonel Drummond, a very acute ichthyologist, was of opinion that this fish and the N. S. sea trout are the same; that the *fontinalis* runs to the sea when able to get access to it, returning well grown, with a white scale. The *fontinalis* in our lakes is erratic, being constantly on the move in schools like mackerel.

Great Striped Bass — 6 lb. to 50 lb. Would probably succeed in Loch Awe, and in the larger British rivers, where the shad is found, such as Severn, Ouse or Trent; also in rivers accessible from sea, flowing through lakes into estuaries, provided access be available; they would run up Shannon, but the Queen's gaps, lochs, weirs, or weir shoots are too steep; they are a large game fish, heavier than salmon.

Gaspereaux. Do., of high economic value.

***Salmo confinis* — Maximum weight not known.** A lake trout of considerable size; would make a good exchange with the British lake trout.

Grayling (so called) — 3 lb. A handsome white lake trout, not unlike a large salmon smolt fresh from sea.

White and yellow perch, small varieties of roach (shiners), suckers not included, being inconsequential.

ENUMERATION OF SOME OF THE AMERICAN FISH NOT FOUND IN NOVA SCOTIA.

Maskelunge, or American Pike. Lake Erie, Rice Lake, and other Canadian waters. 10 lb. to 30 lb. Similar to the British pike, and that of Norway and the European continent.— See notes in British list.

Black Bass — 3 lb. Canadian rivers and lakes.

A superior fish, habitat lakes with deep rocky rivers, debouching into, or flowing out of them; he is allied to the perch, but will not breed in lakes without rocky rivers or runs.

Pike Perch — Habitat Canadian lakes and Continental American waters. Lakes Erie, Champlain, St. John, Can. Richelieu River, and New Brunswick lakes; not found in Nova Scotia, but very much distributed in other American waters.

A handsome lake fish, more voracious than the perch, less so than pike; he does not exceed 10lb. weight, but averages 4lb.; has the spinous back fin characteristic of the perch tribe; is yellow, with a forked tail, finely tapered; his introduction is questionable. The pike is less actively formed, yet finds its way into apparently inaccessible waters. The pike perch would certainly thrive in our waters, also in the lakes and rivers of England.

Sun fish, cat, shiners, some smaller fry, and the fish peculiar to the great lakes, omitted; the large cat fish and *siluris glanis* might do in St. John River, New Brunswick.

APPENDIX — SUBJECT TO EMENDATION.

SEA FISH OF GREAT BRITAIN NOT FOUND ON THE AMERICAN COASTS. SUBJECT TO CORRECTION.

The Sole. Desirable, if the water be not too cold on the outer Banks.

Turbot.

Large Crab. Desirable.

John Doree. Probably would not thrive, as he is a Mediterranean fish, requiring warmer waters than the Arctic current prevalent on these coasts.

Sea Bass of the South of England.
Prawn.
Shrimp.

Desirable, but water possibly too cold, on account of the Arctic current which covers the Banks of Newfoundland, and flows down our coasts as far as Florida.

The American sea fish non-existent in British waters, would not thrive on the British coasts and banks. The porgee, hog fish, red bass, drum, &c., are inhabitants of Southern waters.

NOTE. — The sheepshead, white fish, and fresh water herring, of the great lakes; also, the Mackinau trout, are the principal fishes omitted, as manifestly not adapted to our waters or those of Great Britain; two or three other fish are omitted for the same reason, but the lists can be amended. Controversy will be declined. — R. B. S.

Art. IV. Some Observations on the Fishing Grounds and Fish of St. Margaret's Bay, N. S. By John Ambrose.

[*Read Jan.* 8, 1866.]

As a list of the fishes of St. Margaret's Bay, is a lengthy one, I shall confine myself in this paper to an account of some of those salt water fishes, which form the staple export from this parish.

In the first place it will perhaps be necessary to give a general idea of the fishing grounds, especially off the mouth of the Bay. This I have obtained, and as far as possible, verified from the accounts of some of the most experienced and successful line-fishermen of Peggy's Cove and Dover.

Leaving Peggy's Cove on a S.S.W. course, we first pass over a "hard," *i. e.*, rocky, sandy, and gravelly bottom, for a distance of nearly half a mile, with a depth of fifteen fathoms, until we find ourselves over a depth of thirty fathoms, with soft black muddy bottom. This gulch extends in a line parallel with the coast, and opens into a similar one running up the Bay. It is about fifty yards wide, bounded on both sides by hard bottom, at an average depth of thirty fathoms. This muddy ravine is the celebrated "Hospital," where diseased codfish are found. Since my last account of this place, I find on further enquiry, that hake in a healthy state frequent it, as muddy bottom is the favourite feeding ground of that fish. But cod abhor the mud bottoms, and are only found in such localities when unable to go elsewhere. Healthy cod are caught at each side of this gulch, but within it the cod are found to be "logies," (*i. e., sick*,) and wounded fish. As codfish will attack and devour the helpless of their own kind, from the spawn up, a muddy gulch not frequented by their strong and rapacious brethren, is plainly a place of safety for the disabled, where by the simple and monopathic method of giving a wide berth to all interested parties, they hope for peace and convalescence, and wait patiently and humbly for such food as chance or a passing fisherman may throw in their way.*

Crossing the smiling waters, over this dark abode of sickness, want and pain, and finding our depth, from fifteen at the further side gradually increasing to thirty fathoms, at the distance of about

*There is another "Hospital" with muddy bottom, well-known as the haunt of sick cod, a short distance outside of Billing's Island, off Prospect.

a mile from Peggy's Point, we approach what at the fishers' point of view would be called a hill, rising from the plain to a height of nearly 130 feet, and having a sort of broken level at top, of some three or four hundred square feet, and at a depth of nine fathoms from the surface of the water. This is called "Quidi Vidi," and often affords excellent cod-fishing, as the rocky bottom on and around it, is the resort of such fish as the cod seek for their prey. After another space of deep soundings, we pass over a rocky shoal called the "Big Shoal," lying at a depth of ten fathoms, and affording good cod-fishing. We next pass over the "Nubbock," twenty fathoms deep. Other rocky shoals lie in different directions out here, having an average depth of about thirty-five fathoms around them, but the summits of all lying at a safe distance below the keels of commerce. At the distance of some eight miles from Peggy's Cove, we cross the "Ridge," a long hill extending from abreast of Pollock Cove to Green Island, some eight or nine miles. The east end of this lies at a depth of about 60 fathoms, but the west end shoals off to about 30 fathoms. The east or deep end consists of clay and rock—a favourite bottom for cod; the west end is rocky, also affording fair fishing. Next comes the "Inner Gulch" of black mud, about 60 fathoms deep and a mile wide,—then level bottom of sand and gravel, about 45 fathoms deep and two miles wide. We now pass the "Outer Gulch" of black mud, 60 fathoms deep and a mile and a half wide. Here are few or no fish, but a sort of large flounder or turbot, which is good eating; but for some unaccountable reason is known among our fishermen as the "Skunk." Next we pass "Cross Island Ridge," running parallel with the coast line, and like the former "Ridge," deepening towards the east end. This Ridge extends for a length of some ten or twelve miles. Next comes a gulch of black mud, 65 fathoms deep, and nearly three miles wide. Next are the "Shore Soundings," a sort of ridge extending like all the rest in a line parallel with the shore, shoal at the west and deep at the east end. The shoal part here, however, is sixty fathoms deep. Bottom, rocks and clay at the east end,—rocks at the west. Next we have the "Big Gulch" with a bottom of black and fetid mud, so soft that the lead buries itself in it. The depth here is about one hundred fathoms, and the width about three miles. Then comes a ridge, lying deep and narrow at the east end and wider and shoaler at the west. The east end, i. e., as far as our men go, is composed of yellow clay, shells and small blue stones, and affords better cod-fishing than the west end, which is rocky, without the favourite mixture of clay and shells. The course from Peggy's Cove Point to the middle of this Bank is S.S.W., and here, looking back towards Aspotogan, we find the top of that well-known hill (a height, by the aneroid, of 410 feet,) just sinking below is our watery horizon. This ridge, extends along the coast from White Point at the Strait of Canseau to Cape LaHave, nearly approaching both these headlands. It is composed—at least that part of it which lies S.S.W. of St. Margaret's Bay,—of slate and quartz. Can it in any way form a sort of connection between the slate and auriferous quartz of Guysboro' and the similar geological formation at the "Ovens," and thus account for the gold washings on the shore at the latter place, which are known to wash in from outside, and become more productive after the heavy storms of winter?

But to return. On this Bank is found the best cod, ling and halibut fishing off our shore. Here lie at anchor, often for three or four days at a time, our venturesome open fishing boats, directly in the track of steamers and large ships, bound to the United States. A light is kept burning in the rigging all night, *but not unfrequently all hands*,—two or three in number—retire to their little cuddy, and having put a few sticks of wood into the stove, "turn in" for the night and sleep soundly till daylight, regardless of the steamers or ships, which in the darkness of the night often rush close past the little craft with her spark of a light,—so close, that one Schlagintweit of Turn's Bay, lying on this Bank, found after his comfortable night's sleep, that some large craft had passed him so closely and rapidly during the night, as to carry away his schooner's bowsprit, without awakening himself or any of his unconscious crew.

Here, one of our men, more vigilant, saw a brig in the night bearing down before the wind, right towards his little craft, and it was only by frantically shouting, snapping percussion caps on a musket, and waving fire-brands, that the notice of the brig's crew was attracted, and our poor fellows saved from sudden destruction. Here Tom Tomline, a fat and easy-going La Have skipper, having anchored his "Banker," hoisted a light in the fore-rigging, and ordered all hands to turn in. All, nothing loth, were soon fast locked in the embraces of Morpheus, whilst the lantern, having burst, set fire to the fore-rigging, burnt up the fore-sail and that part of the hempen cable which lay coiled on deck, so that the schooner slipped her moorings, and drifted off, blazing, until a neighbouring craft sent a boat and awakened Tom and his snoring crew, just as the cinders were beginning to drop down among them from the burning deck over head. Here our open boats lie for three or four days at a time, riding like ducks on a sea which often obliges schooners to heave up and run in, owing to the superior buoyancy of clinker over carvel built vessels. The sea is heaviest in these off-shore soundings, when wind and currents contend against each other, for at times during summer the current sets so strong westwardly, that the fishing leads will not take bottom, but trail off at an acute angle. At other times there is little or no current. In spring this current sets southwardly, during summer westwardly, and in autumn in a south-easterly direction. Coasting vessels bound west often take advantage of this ocean current in the summer season, during calm weather or high head winds, by standing well off shore.

Here is the home of the large cod, ling and halibut, and here are abundance of bank-clams, scallops, and other shell-fish, which their admirers root out of the clayey valleys, on the sides of this submarine hill. Here is no end of star-fish of all sorts, as well as herrings, John Dorees, small cod, cat-fish and the other deep sea food of the more valuable fish. Here the cod are of a different kind from their brethren in-shore, being what are called "bull-eyed" fish, i.e., having their eyes very prominent, and covered with a thicker skin than ordinary. Both of these peculiarities are no doubt required for the great depths for which an all-wise and kind Providence has fitted them. Here a crew of three men will, in the course of two or three days fishing, catch from twenty to thirty quintals of cod, with perhaps a quintal or more of ling, and occasionally two or three, or even half-a-dozen fine fat halibut. Cod, generally, but cusk invariably, evert the stomach in being rapidly hauled up from deep water. After the stomach has thus been turned inside out, so as to project beyond the mouth, the fish, even if it break from the hook, will float to the surface, and there die. Here, if the lines happen to drop in a good spot, such as a little ravine with a bottom of clay, sand and shells, the fish are very frequently caught in pairs, and as fast as the bait can be sent to the bottom.

My informants do not remember catching spawning fish of the cod kind out here, though at the proper season they frequently catch milters with the milts running out. Of the cusk spawners are found in October on this Bank, with ripe spawn in them. In the months of April and May, both cod and cusk bite best in day time, but from the beginning of June to the end of the fishing season, i. e., the last of November, they take bait most greedily during the night. Both also bite best in southerly and easterly weather, but when the wind is north-east they do not take bait readily, so far, as well as in their time of spawning, resembling the lake trout.

Cod and ling do not run together, but in separate schools, each kind by themselves, as indeed is the habit with most sea-fish. Ling are increasing on our outside fishing grounds, whilst halibut which formerly were plentiful and taken close in shore, are now scarce, even on the outer banks. The oil from the liver of the ling is much prized among our people as an outward application to sprains and bruises. The ling caught in deep soundings differ from the others, like the cod taken in similar localities, by having the eyes more prominent and covered with a thicker skin or film. The back skin of those deep water codfish too, is of a darker, bluer cast, than that of the in-shore fish, and the snout is longer and apparently better suited for digging shell-fish out of the clay. In all depths of water the colour of these fish in some degree resembles, that of the bottom on which they feed.

The in-shore codfish come into the Bay to spawn in October. These are not so long as the deep-water fish, but more junky. Some of the very large and long fish, also, come in at the same time for the same purpose. An immense one was caught last October, near Dover, but was so much mutilated in the splitting, that I was unable to get the accurate measurements of it. There is a tradition of one having been caught off Prospect many years ago, which when dried weighed one pound over a quintal.*

*Mr. Saml. Croucher caught a codfish, which when dried weighed 50 lbs. Mr. Benjamin Smeltzer caught one on a trawl this year, which measured 5 feet 10 inches long.

The in-shore cod, are what are known as school-fish, such as those taken at Labrador, (but slightly larger,) as they run in larger schools than the deep water fish. They spawn all around the Bay on gravelly and sandy bottoms. They will eat their own spawn, but have a great partiality for that of the lump-fish. When these dainties are not at hand, however, the cod is not at all particular about his diet. With "hunger-sauce" he will swallow almost anything. A jackknife was found in the stomach of one of these fish at Peggy's Cove. Another was found to have swallowed a "nipper,"—i. e., a sort of woollen mitten, used by fishermen to prevent the chafing of their hands with the line. Some twenty-five years ago, a Mr. Weeks, of St. John, N. B., informed me that he found a man's ear in the stomach of a cod, which he had bought in the fish market of that city. When I was at Economy, N. S., in the month of March, 1846, a cod was caught near that place with a toad in its stomach. This unfortunate toad had, no doubt, on the approach of cold weather buried himself in some suitable place, but too near the edge of one of those sandy cliffs which overhang the rushing tides of the Basin of Minas, and this falling off at the coming out of the frost had carried with it the semi-conscious toad, to serve as a meal for the hungry cod prowling below. Unexpected reversal of confident hope at inhumation!

"The best laid schemes of *toads* and men
Gang aft aglee."

Mr. James S. Keizer, of Peggy's Cove, shot three murrs, on one occasion, off at sea, about eight miles S.W. of Peggy's Point. He immediately cut off the heads, which, with the intestines, he threw overboard, preparatory to cooking the birds. He then sailed on, with a moderate breeze, about six miles from the spot where the heads were left, to "Cross Island Ridge," threw over the grapnel, and beginning to fish, very soon hauled up a cod with a murr's head (quite fresh) in his stomach. He feels confident that this was one of the heads so recently thrown overboard by himself, at the spot six miles distant, as blood still remained on the feathers.

Codfish, like too many among mankind, will often by the indulgence of a depraved appetite, ensure their own destruction. The Maine-law or sea-regulation, confines them to a safe species of drink, but their food is a snare to many of them. They greedily eat garbage, even of their own kind, and find backbiting at sea to be even more dangerous than the like-named amusement on shore, for the sound-bone of fish is too much for their digestion. Cod are frequently caught with a sound-bone, or even the whole undigested skeleton of a cod, cat-fish, or sculpin, in their stomachs, and part of the bony structure protruding through among the intestines. Others have diseased liver, that evidence of a disordered or weak stomach. The sick fish are called "logies" from the heavy lifeless feel of them on the line as they are drawn up from the bottom. The livers of logy cod are always more or less diseased. They are destitute of oil, and of a dark colour, and not unfrequently contain abscesses filled with pus. The liver always shrinks away to far less than the ordinary size, and the fish is found, though of large frame, to be wasted to mere skin and bone. Young fish are very rarely found to be inwardly diseased, so that perhaps, after all, the logies are aged individuals whose vital organs are impaired by the gradual decay of nature.

The livers of all our codfish are of a dark colour and destitute of oil, and the fish is watery in the early part of the spring; but as summer advances, and the herring strike in, the cod livers soon give evidence of the good effect of generous fare. Then the tail becomes round, firm and fleshy,—a sure sign of a healthy fish.

Having already given some idea of the cusk, in connection with the codfish, I shall not at present dwell upon the peculiarities of this excellent fish, which although increasing in numbers on our Banks, are still not thoroughly well known by our fishermen. Like the albicore, they appear to be of comparatively recent introduction here. They are caught on the Banks with ripe spawn in them, by which it would appear that they spawn in deep water; but I do not hear of codfish, those irrepressible egg-eaters, being caught on the Banks with spawn in their stomachs. Further investigation will no doubt in some degree clear up the matter.

There appear to be no logies among cusk,—a singular fact (if it be a fact), which piques the curiosity of the student in Natural History.

Leaving this interesting fish for the present, we come to the Hake or "Goat,"* as he is called by our fishermen, on account of the

*More properly the "Spotted Codling."

long tentacles which, beardlike, hang from his chin, and which—as he feeds on muddy ground, like the monk-fish (*Lophius Americanus*), may be intended to act like the tentaculæ of that sea-monster, to entice and deceive such unwary fish as go half burrowing along the oozy bottom in search of sea-worms. Hake are found in the muddy gulches, whither, except in sickness, cod never resort. Here in deep water hake are to be found in the early part of summer; but they strike in shore about the first of August, for the purpose of spawning, and remain, for all that is known to the contrary, until spring. Indeed, there is a small lagoon about three miles this side of Chester, across the neck or outlet of which the mail coach on its way from Halifax passes, by means of a small bridge. It is called "Frail's Pond," and is brackish, as the fresh water coming into it from the land side is mingled with the salt water which fills it at every tide. Here, throughout the winter, considerable numbers of good sized hake are taken *in day-time*, by hooks dropped through holes cut in the ice. These are, by our fishermen, jokingly called "tame goats." It is quite possible, and indeed probable, that this fish may also be found during winter in many other such brackish ponds, which are so numerous along the shore, between this Bay and Shelburne. I should also expect to find cod in such places, or in the mouths of the rivers along our coast in winter, for they are very frequently caught by the hand in the land-wash in this Bay, and in New Brunswick, in the Kennebeckasis river, off Clifton, and not far from Gondola Point, (where even at high tide the water must be but slightly impregnated with salt, and at low water must be very nearly fresh). Justus Wetmore, Esq., last summer informed me, that in the winter of 1864, large codfish were caught through holes in the ice. Indeed, the winter habits of our sea fish are as yet but little known, owing to the present habit of closing up the shore fishing from the middle of November, to the middle of May.

Hake take the same bait as the cod, and will freely take fish of its own kind, herein differing from cod, which after a few nibbles will desert the hook that is baited with codfish, though they will frequently devour small members of their own tribe. It may here be observed that every bait seems to have its own proper season,—

cod, for instance, ravenously seeking squid in the squid season, but showing rather an indifference to it at other times.

Hake are nocturnal in their habits, never taking the hook in day time at the outer ground; but when in the Bay and on rocky bottom in the spawning season, in the latter part of summer, and in autumn, on the dark days, they will occasionally take bait. Just before sunset during the night fishing, or "goating season," i. e., in autumn, the boats are all at anchor on the hake grounds, and as soon as the sun is below the horizon the work begins. If a seventeen feet whale boat with two men happen to hit on a good spot, she will load before midnight. Seven or eight quintals are frequently taken in a night by two hands, but it is very cold and disagreeable work in the frosty nights, about the last of October and during the month of November.

In the spring, though the liver of this fish contains no oil, it is white, and herein differs from that of the cod. In summer, as the herring begin to strike in, the hake liver soon becomes very fat and yields more oil than the cod liver.

When hake and codfish are salted in the same puncheon, the latter fish are made much tougher by the contact than they would otherwise be, and are therefore less prized for home consumption. Our fishermen always take good care to salt the cod separately, when intended to be used in their own families, or sold to such as are particular in such matters. Hake are very seldom used here, but are shipped to Halifax for the West India market.

There are but few logies among hake, and even these show no symptoms of organic disease. They are also full-grown fish, which would seem to indicate that old age is the principal cause of their sluggishness.

Haddock come next on our list. These lively little fish do not, like cod, ling, hake and halibut, keep always near bottom, but are found at all depths and bite greedily. When feeding on the bottom they are—like our worthy President and our patient and energetic brother Willis—great collectors of shells; and many rare specimens now adorning the cabinets of these enthusiastic naturalists, were brought from mysterious depths by the haddock. "The dark unfathomed caves of ocean bear" in our vicinity, but little which has not been inspected by the prying eyes and vigorous nose of the haddock. They feed by day, and take readily any bait offered to the codfish. They also eat sea-Medusæ or "sea-squalls" as they are called here, and in this resemble the mackerel, which also feed on these jelly-like creatures.

Haddock keep outside in winter, leaving the Bay about the middle of December, and returning about the first of May. The best fishing within the Bay is from the middle of May to the end of June. At this season two hands in a boat will take seven or eight hundred, (equal to six quintals), in a day. It is of no use to attempt to catch codfish from among a school of haddock, as the latter give the larger fish no chance to take the bait. They feed on all sorts of bottom, muddy as well as hard, and are very gregarious in their habits. There are logies among them in spring and summer, but never in autumn. The logy fish are almost invariably afflicted with a sore under the sound-bone, full of pus, and in this case the liver is shrunken and contains no oil, and the stomach is empty. Haddock make a sort of whistling or squeaking noise after being caught.

These fish are salted and dried, like cod and hake, and no attempt has yet been made among us, to imitate the celebrated Finnan Haddies.

I must now draw towards a conclusion, having as yet only begun the enumeration of our fishes. I have had time to read but little on the art of catching and curing fish, but one cannot fail to see that a great deal remains to be done among us, in the way of developing and improving our fisheries, and preparing the fish for the most profitable markets. If the proposed negociations with Brazil and other Roman Catholic countries should open up new markets to our staple product, a great deal has yet to be learned by our shore and Labrador fishermen in the way of curing fish for such markets, for that which has been tolerated among the negroes of the Southern States and the West Indies, will not tempt the fastidious palates of the more civilized people, with whom we hope soon to trade. Time forbids my entering on the superior mode of curing cod, hake, haddock, and pollock, practised by the leading Jersey houses, which gives them a decided advantage over us in the fish trade. This point was touched upon by the late M. H. Perley, in his interesting work on the Fish of British North America.

But I may venture one more observation. I see that the motto of this City is "*E Mari Merces.*" This being the case, one would naturally expect that some little attention and encouragement would be bestowed by the citizens on one great source of this wealth, viz: —the Fisheries. Exhibitions of fruit and flowers are annually held in this city, and liberal rewards bestowed on successful competitors. This is all very well, and no doubt encourages horticulture and increases the number of conservatories. But when did we ever hear of a fish-show, or of prizes being offered for the best specimens of fresh and *well-cured* fish? Fishermen are expected to go on, hazarding their lives and eking out a mere subsistence in hopeless poverty and self-denial, almost unthought of by their superiors, whilst they keep up the most lucrative branch of industry in the Province; and though Agricultural Societies are gotten up, and fostered by Government, in order to encourage and teach the farmer, and supply him with the best stock and implements, we have yet to hear of the very first effort to teach or encourage the poor fisherman. But if we are to see our fish-trade expand under the contemplated treaties, this indifference must be shaken off, and a vigorous effort made to develope a great source of wealth which as yet is only in its infancy.

ART. V. THE AURIFEROUS DEPOSITS OF NOVA SCOTIA. BY P. S. HAMILTON, CHIEF COMMISSIONER OF MINES.

(*Read Feb.* 6, 1866.)

IN coming before the Institute this evening, with a few remarks upon the "Auriferous Deposits of Nova Scotia," I must say that my selection of a topic has been rather an acquiescence in the expressed wishes of others, than a deliberate choice of my own. I say this because of the difficulties which, according to what knowledge I have been able to gather, beset the scientific aspects of the subject; and which utterly preclude my producing a paper satisfactory to myself. I will therefore be brief and confine myself to the statement of a few facts upon the extent of the Nova Scotian Gold Fields, and the distribution of gold therein, and upon some geological and mineralogical phenomena connected with their deposits, hoping that these facts, may be some slight aid to others in pursuing further researches into the subject.

The outlines of the well marked geological districts, which comprise the Gold Fields of Nova Scotia, are already pretty generally known. I will only briefly state that they consist of two distinct districts, of different geological ages. We have upon the Atlantic Coast the Lower Silurian rocks, forming a band which extends the whole length of the Nova Scotian peninsula. This district is not less than fifty miles in width at its western extremity, gradually narrowing as it proceeds eastward, and finally coming almost to a point at Cape Canso. The other district—the Devonian, and Upper Silurian—forms several comparatively lofty and isolated ridges. One of these extends from Digby County, along the south side of the Annapolis valley, to the vicinity of Windsor. Another commences at Cape Chiegnecto, forms the Cobequid Hills, and, with a slight divergence from its original course, proceeds eastward to the Strait of Canso, throwing off spurs north-eastward to the Gulf of St. Lawrence, and south-westward on both sides of the Stewiacke River. In the Island of Cape Breton, nearly the whole of Victoria County, a large portion of Inverness, and several detached eminences in Cape Breton and Richmond Counties, belong to the same formation. Among the gold bearing formations of this Province, I might also include the Trap ridges, considerable as to extent; for auriferous quartz has been discovered and to some slight extent mined, in the Trappean headlands of Partridge Island, and Cape D'Or; but I will leave this geological district out of further consideration.

The extent of the two larger districts which I have indicated, comprises, in the aggregate, a large proportion of the surface of Nova Scotia. I would roughly estimate the area of the Lower Silurian district, at 7,000 square miles, and of the several tracts of the more recent formation at 3,000, in all 10,000 square miles. The whole area of the Province of Nova Scotia, amounts to about 18,600 square miles. It must not be assumed that this large area is throughout auriferous. I will observe, parenthetically, that judging from what is already known, there is every reason to believe that future explorations will prove the greater part of this area to be rich in metalliferous deposits of some kind.

As to gold, I will begin with the Devonian district. The several ridges of high lands which come under this denomination have, as yet, been but little explored for gold; nor is it probable that they will be, to any great extent, for some time to come. These hills are, for the most part, in the interior of the country; their rocks are rarely exposed, being covered with a pretty deep soil, from which has arisen a heavy growth of timber. Gold has been found in the alluvium, brought down by many streams which take their rise in these hills. It has seldom been discovered, as yet, in quartz *in situ*; but, for the reasons just referred to, quartz *in situ* has seldom been seen in this geological district. In Wagamatkook, which is a proclaimed gold district, about the head waters of the river of the same name, in Victoria County, quartz has been mined to some small extent. The little done here in this way did not afford as good promise of profit, as has been met with in quartz mining elsewhere in the Province; but it cannot be considered a fair test of the productions of the district. Most of the gold obtained at Wagamatkook, has been taken from the beds of the streams which flow down from the hills; and the quantity thus procured indicates the presence of numerous auriferous quartz veins in the vicinity. Gold has been discovered in the sands of nearly all, if not all, the streams of Victoria and Inverness which take their rise in these metamorphic hills. It has also been found in the same formation at Cape Porcupine, near the head waters of the Musquodoboit and the Stewiacke, and, I believe, at Five Islands and elsewhere; so that gold may be sought for, with not unreasonable expectations of success, in any part of this geological district.

We have more reliable *data* as to the auriferous character of the better known Lower Silurian coast band; but even with respect to this, they are as yet very incomplete. We know that in the Lower Silurian district there are found bands of quartzite, seemingly nearly parallel with each other, alternating with various slates, extending in a general easterly and westerly direction. These bands are intersected by various masses of granite, in some places extending quite across the whole formation, but more frequently forming detached masses protruding through and surrounded by the stratified rocks just named. In this quartzite, and in a less degree, in some of the slates, we find numerous veins of quartz; and these veins—especially those of the quartzite—we find to be auriferous. Of the number of the quartzite bands and of the latitudinal extent of each, little is yet known. It has indeed been stated that, between the Atlantic coast and the northern confines of this metamorphic district, there are six of these bands; that these represent six lines of upheaval, or east and west anticlinal axes; and that the slates found alternating with the quartzite are, in fact, superimposed upon it. This may be correct; yet I cannot but entertain doubts as to some of the particulars. First, a transverse section quite across the rocks of this metamorphic district has never yet been exposed to the eye of any man. Secondly, the supposed continuation of these quartzite bands from one known gold-bearing tract to another, as represented by the authority just referred to, is now seen to be not borne out by the facts—at least, not in every instance. Lastly, in one at least of these bands represented as embracing a single anticlinal axis, I have found several of such axes. From a general acquaintance with the country and not from actual survey, I am inclined to the belief that these quartzite bands are much more numerous than they have been represented; and that in the aggregate they form the largest portion of the width superficially of this metamorphic district, skirting the Atlantic.

Longitudinally, this quartzite, with its auriferous quartz veins, can, except when interruptions are caused by the granite dykes already mentioned, be traced the whole length of the Nova Scotian peninsula. Gold has been taken from quartz veins at Yarmouth, and on the shore of Chedabucto Bay, and, I might add, at every intermediate point where diligent search has been made for it in the proper formation. The quantity of quartz embraced in this great length and breadth of quartzite vein-stone, must be something enormous. I speak of it in comparison with the bulk of the enclosing rock. Of course we have no sufficient *data* from which to estimate this quantity. The opinion I have just hazarded is based upon observations of the few cross cuttings in the rock yet made, in the few localities of this Province where gold mining is yet carried on; and these openings have in many—I believe I might say, in most instances, been made at mere hap-hazard. On one occasion I myself removed carefully the drift, so as to expose a cross section of the surface merely of the bed rock, for a distance of about one hundred and sixty feet. Within that distance, I discovered over thirty quartz veins, ranging from an inch to fifteen inches in thickness. The whole number of veins would average not less than six inches, or say fifteen feet in all, thickness of quartz, to one hundred and sixty feet of enclosing rock, the dip being here nearly vertical. In another instance after counting and measuring the quartz veins exposed within a distance of two hundred and fifty feet, I estimated their aggregate thickness at twenty-five feet; and yet, as within a part of the distance of two hundred and fifty feet, there was no exposure of the bed rock, the actual thickness of this quartz may have been considerably greater than what I have stated. In both of these cases, the quartz veins exposed, or the greater number of them, were known to be auriferous from examination made at the several spots where laid bare. In other localities, quartz veins of five, ten, and even up to thirty feet in thickness, are found. But I will not multiply instances. Those which I have specified do not, I think, exhibit a much greater thickness of quartz in proportion to that of the enclosing rock, than will be found generally throughout these quartzite bands. As already intimated, I thus judge solely from what is shown in excavations already made, and in Gold Districts of many miles apart. The surface of the gold-bearing rock of Nova Scotia, is for the most part concealed by a thin covering of drift and vegetable matter. Consequently it is an incident of no unfrequent occurrence for a miner, by some accident, or lucky blunder, to stumble upon a quartz vein of exceeding richness, the existence of which he never suspected, but which had lain almost within arm's length of where he and others have been toiling, perhaps with indifferent success, for months or years previously.

There is good reason to believe, then, that this quantity of quartz within easy reach of the miner, in Nova Scotia, is immense. The great economic question to be considered is: to what extent is it auriferous? It would be a sweeping and perhaps incredible statement to aver, that all of these quartz veins bear gold; and yet, so far as one can venture to hold any opinion at all, upon a subject upon which it is so difficult and dangerous to generalize, I rather incline to the belief that they all are more or less auriferous. Certainly the result of my own observations tends to that conclusion. I have seen and gathered some facts, concerning a great number of these quartz veins that had been opened for the purpose of mining, or at least "prospecting." As to the results, individually, of these examinations, I must admit that I do not speak from notes taken on the several occasions; but speaking from memory I can recal no instance where I have seen a quartz lode fairly tested, which did not prove to be auriferous. I have seen a shaft sunk upon a previously untried lode, to a depth of sixty feet without a "sight" being discovered; and then the quartz has become exceedingly rich. In many instances very rich quartz lodes have been temporarily abandoned as non-auriferous, because the miner has happened to commence operations upon a poor section of the outcrop of the vein. It is possible that there are many other abandoned lodes, which will hereafter prove to be highly auriferous. Many quartz veins worked in Nova Scotia, have proved to be very rich in gold. The statistics of the Department of Mines show that, for four years past, the average yield of gold per ton of quartz has exceeded that of any other gold-quartz mining country.

The phenomena observable in connection with these auriferous deposits are almost wondrously various, and are oftentimes very puzzling to the man of science, as well as to the practical miner. These seekers after truth—and something more—are virtually in accord upon one point. Both wish to know the law of Nature by which gold has been deposited in quartz; for that law once being known, gold can be found without any waste of time, capital, or labour. But the miner, of course, looks solely to the end: the man of science, we must assume, regards only the means. I will briefly mention some of these phenomena, many of which are seeming inconsistencies of Nature.

Most of the auriferous quartz lodes which have yet been opened and mined upon in Nova Scotia, have the same strike and dip generally as the rock enclosing them. They are what some mineralogists call "beds," in contradistinction to "true veins," which cut the enclosing *strata* transversely. Yet these "true veins," or "cross leads" as the miners here call them, are found in all the mining districts. As a rule, they are considered unproductive and are not worked. Yet, in the Ovens Gold District, most of the gold obtained from quartz has been out of these cross leads; and in Oldham, a cross lead was accidentally struck, two years since, which proved exceedingly rich, being in this respect, an exception to all other such veins in that district. Again, there are localities where little gold can be found, except at the point of intersection of the "main" and "cross leads"; whilst at that point, the expectation of a rich nest is not usually disappointed. There are A veins, the ridged tops of which are found beneath the surface of the enclosing quartzite, and which rapidly widen as they descend; there are V veins, which are wide at the outcrop, and as rapidly narrow down to nothing as they descend; and there are veins which extend with nearly parallel sides for a long distance, both vertically and longitudinally. There are also the beds of what is called "barrel quartz," which, when laid bare, exhibit a striking resemblance to great piles of prolonged trunks of spruce trees, from ten to fifteen inches in diameter, with the bark still on,—the corrugations of these quartz beds, and of the compact enclosing rock fitting into each other, as closely and accurately as the thread and groove of a male and female screw. Veins are found to be segregated—that is, they thin out to nothing in every direction. I am strongly of the opinion that they are all segregated veins. In some veins the quartz is of almost snowy whiteness, relieved only by the glitter of the golden nuggets it encloses. Such is the case with some at Tangier, whence beautiful specimens for ornamental purposes have been obtained. In other veins, foreign substances largely prevail. The rather celebrated "blue lead" of Sherbrooke, consists in great part of a blue slate, thoroughly pervaded—I may say—by a vitreous looking quartz; hence the name of the lode. Other veins exhibit a variety of metallic substances. Among them mispickel, or arsenical pyrites, usually predominates. It is often found in large masses, and sometimes the lode is more mispickel than quartz. This substance has been ascertained to be largely impregnated with gold; and considerable quantities of it are now carefully saved and sent abroad for more economical treatment than can be given to it here. The rich and well known "Hattie Lead" of Wine Harbour, like some others, is enclosed in a comparatively soft friable rock—so much so that a large portion of the miners' work has there been done by the pick-axe and crowbar, without the aid of blasting powder. The quartz itself partakes somewhat of the same character; and I have seen large specimens taken from this vein in which the apparently shattered quartz was literally held together by clamps of gold. But this lode is erratic in its course, and does not seem to extend far longitudinally. On the other hand, at Old Tangier, the veinstone, where it has been operated upon, is of unusual hardness; whilst there the quartz veins are very regular and of long continuation, and the gold seems to be pretty equally distributed through them. The same contrast has been observed in Australia, between quartz lodes enclosed in hard, and those enclosed in soft rock.

What part of the quartz lode is most rich in gold? To answer this, as far as I can, is to point out some more of the vagaries of Nature. Early in the history of Nova Scotian Gold mining, I observed this fact.—Upon a quartz lode on and along which three or four mining companies were at work, their properties being contiguous, I had an opportunity of noticing operations daily for some months. This was a rich lode upon the whole; but the distribution of gold throughout the quartz was very uneven, and this in a manner most bewildering to the miner. I at length found that there were pretty distinctly marked sections of the lode which were much more rich than the intervening sections. These richer "streaks," as they have been called, did not run horizontally, nor vertically, as the miners first supposed when they found that there was an inequality in the distribution of gold, but *obliquely*. Upon a subsequent examination of several other auriferous quartz veins—some of them among the most noted in the Province,—I found that precisely the same rule applied to them. I supposed and am still inclined to suppose, that I had established a theory; but I would not venture to insist upon the universality of the application of this theory. In some veins, the greater portion of the gold is found in "nests," or "pockets"; and these pockets seem to be distributed, without regard to any rule whatever. In others, the gold is, with less extremes of variation, distributed throughout the vein, both longitudinally and vertically.

If we take cross sections of auriferous quartz veins and examine them, we shall find almost as great a diversity in the distribution of gold. In one case, we shall find the gold nearly all upon one side of the vein. Another lode, precisely similarly circumstanced, will show it upon the opposite side. In a third—these cases are more rare—it forms a plane, or leaf, in the middle of the lode. Again, it will be mostly found in the slate "casing" of the vein, and not in the quartz itself. In most cases which have come under my notice, however, the gold is scattered throughout the thickness of the quartz and casing; and is sometimes quite invisible to the naked eye. Until very recently, it has almost invariably been found that quartz lodes became richer in gold as they descended. Facts have lately come under my notice which tend to show either that this rule does not apply to all lodes, or that at least it does not apply to all beyond a certain depth.

I would like to conclude with some remarks upon the theories, which have been offered to the world as to the origin of gold in quartz; but to do so with any justice to the subject at all, would extend this paper to unreasonable limits.* I will only now say, with some hesitation indeed, and with all deference to the opinions of the many learned men who have discussed the subject, that the quartz veins of Nova Scotia, on a careful examination of them, seem to me to present serious difficulties, to the adoption of the theory that gold was deposited there from aqueous solution; and also to the adoption of the opposing theory, that its presence there is the result of igneous action. I suspect, perhaps with improper incredulity—that the secret of the formation of auriferous quartz deposits, yet remains to be divulged.

ART. VI. NOTES ON THE WEATHER AT HALIFAX, NOVA SCOTIA, DURING 1865. BY COLONEL MYERS.

[*Read Dec.* 4, 1865.]

THE cold of the winter of 1864–5, seems for the most part to have expended itself during the latter part of December, 1864; and January, 1855, began, and continued throughout, mild and serene. The mean temperature was 22°, one degree less than that recorded on the same month of the previous year.

High winds prevailed during February, but the weather generally fine and mild for that month. Mean temperature 24°, being 2° less than in 1864.

*Perhaps I may, in some future paper, recur to this branch of the subject, which must be by far the most interesting to the scientific mind; but it is the most perplexing to deal with.

March generally fine, with an almost entire absence of the stormy weather which frequently attends the vernal equinox. Mean temperature 34°, being 6° higher than in 1864.

April was for the most part calm and fine, with indications of an early spring. Mean temperature 40°, exceeding that in 1824, by 4°.

The rainy, foggy, and unsettled weather of May, caused a serious interruption to agricultural operations, compensated, however, to some extent by the impulse given to the grass crop by the warm moisture. Mean temperature 49°, one degree higher than in 1864.

In June the weather was very fine and calm; but frosts, which occurred in some parts of the Province, did much injury to fruit trees and gardens. Mean temperature 58°, one degree higher than in 1864.

July was also a very fine month, most favourable to hay-making, which, in the neighbourhood of Halifax, began about a fortnight earlier than usual; and generally through the country the crop was safely housed. Mean temperature 60°, being 2° below that in 1864.

August generally fine, with the exception of some unsettled foggy weather towards the end of the month. Mean temperature 63°, one degree below that in 1864.

September very fine throughout. The autumnal, like the vernal equinox, was remarkably free from gales of wind. Mean temperature 57°, one degree higher than in 1864.

October, much unsettled weather during this month, with some gales towards the end of it. Mean temperature 44°, being 2° below that of 1864.

November unsettled, with much rain. The month ended with a heavy gale from S.E. Mean temperature 39°, the same as last year.

December generally fine for the season. A sharp, though short, gale occurred on the 21st, when the barometer fell to 28.51; and the 22nd, 23rd, and 24th, were very cold days. Mean temperature 24°, being 3° lower than in 1864.

The highest temperature in the shade recorded during the year, was 85°, on the 3rd August; the lowest—6° on 23rd December. The highest monthly range was 49° in May; the lowest 35° in July. The yearly range was 91°.

The hottest month was August: the coldest January. The mean temperature was the same as last year, viz: 43.

The highest reading of the barometer during the year was 30. 35, on the 14th March; the lowest 28.51, on 21st December. The highest monthly range was 1.59 in December; the lowest .59 in July and September. The yearly range was 1.84. The mean for the year 29.65.

The annexed table (see appendix), gives the monthly and yearly means and range of the temperature, and atmospheric pressure for the years 1863, 1864 and 1865, deduced from three daily observations. The comparison of these three years, one with the other, exhibits a remarkable equability as well in the monthly, as in the annual results.

The most prevalent winds during the year were N.W. and S. W.; the least prevalent E.

Rain fell on 136 days; snow on 52; hail on 3; fog occurred on 60 days.

Auroræ Boreales were observed on 55 nights; solar halos on 5 days; lunar halos on 12 nights; thunder storms occurred on 4th March; 25th May; 29th July; and 23rd October. Lightning was seen, but thunder not heard, on 23rd June; and 1st September. Thunder was heard, but no lightning seen, on 9th and 17th May.

The latest snow in the Spring fell during the night of 6th, 7th May; and its earliest appearance in the autumn was observed on the forenoon of 21st October. July was the only month entirely free from frost.

The weather during the year was generally fine. The winter of 1864–5 was remarkably mild, and broke up early. A humid spring was succeeded by an extremely dry summer, occasioning ndeed inconvenience in some localities, but favourable to the hay crop, which throughout the country was abundant and of excellent quality; nor does it appear that other crops suffered to any great extent from the dryness of the season.

Drought, with the temperature above the average, seems to have been, in the past two summers, the abnormal climatic condition of many parts, not only of the American, but also of the European Continent; followed this year by great atmospheric disturbance in the North Atlantic, and, in this Province, by a winter of unusual severity.

The storms, which, in the autumn and early part of the winter, swept with such destructive violence over the Atlantic, did not visit Halifax, whose exemption during another year from any remarkably stormy weather, tends to support the hypothesis of the late Judge STEWART, that it is the centre of a storm circle. Another idea, broached by the President at our last meeting, in connection with Mr. Hurdis' paper on the recent storms on the English Coast, is worthy of consideration, viz: "That tropical hurricanes take the course of the Gulf stream, and, repelled from this coast by the cold barrier caused by the Arctic current, pass to the eastward of Halifax, and are thrown upon the western coasts of Europe." Yet supposing this to be the case, it remains to be accounted for, why gales, which prevail in many of the neighbouring countries, approaching, in our own Province, as near as Truro and Windsor, so seldom reach Halifax. It may be, that storms, travelling from the south along the eastern coast of America, pursue their course up the Bay of Fundy, and, leaving Halifax to the eastward, pass on to the Gulf of St. Lawrence; but all that can at present be said is mere conjecture, nor are we expected to arrive at any satisfactory solution of the many difficulties which surround a question of such importance to our maritime and fishing interests, till stations shall have been established in different parts of the country, from which reliable reports of the course and strength of the winds at each place may be received daily. Extracts from the log-books of vessels, which, on approaching this Port, encounter stormy weather, would be of valuable assistance in the investigation of this interesting subject. Let the cause, however, be what it may, there is the fact, that Halifax is rarely visited by destructive storms. Its noble harbour too affords a safe refuge from the tempests without, and an easy access, at all seasons, to a country possessing a climate as fine and healthy as any in the world, with abundant resources, in its minerals, fisheries, and agricultural capabilities, the development of which opens to the capitalist a productive field for operations, and to the enterprizing and industrious of all classes, a fair prospect of independence and prosperity. That Nova Scotia affords advantages such as these, ought to be widely published abroad, for, once known.

they will hardly fail to attract the tide of European emigration towards the Province.

Among the Auroræ Boreales observed during the year, two of very singular appearance, which occurred in the month of February, seem worthy of particular notice.

On the night of the 21st February, a fine Auroral Arch was seen to span the northern sky, from east to west, at about fifteen degrees above the horizon. At 9 P. M. the eastern extremity of the arch began to double under the other part, till it assumed the form of an oval, with the circumference nearly completed. Occupying the space in the sky from which the arch had receded, there then appeared a dark mass, resembling a huge rock, having the distorted arch to the westward, while from its eastern side bright streamers shot forth. The whole shortly afterwards broke up into luminous patches which spread themselves over the sky, even beyond the zenith; a belt of light remaining on the northern horizon till midnight. The second of these remarkable appearances was on the 25th February, when at 10 P.M. an arch was observed in about the same position as that last described, studded on the upper surface with luminous balls, if I may so term them, each having a halo of bright rays, presenting altogether a most magnificent object. Streamers were at the same time floating over other parts of the heavens. The arch, after having apparently absorbed its curious appendages, remained gradually decreasing in brilliancy, till about midnight, when it disappeared.

The following periodic phenomena were observed for the most part, at the Dutch Village:—

March—11th, flocks of wild geese passed over Halifax; 26th, Mayflowers picked in the woods near the tower; 29th, butterfly seen, and house flies make their appearance, a honey bee flying about, and "water boatman," beetle stirring in ponds; 30th, grass sprouting in meadows.

April—1st, a cowslip, unprotected during the winter in a garden, in bloom; young leaves of clover fully formed; 3rd, young ants lively under stones; 4th, "Camberwell beauty," butterfly about; 8th, lilac in forward bud, and frogs pipe at night; 9th, water spider in ponds; 10th, frog spawn in ponds; 11th, honeysuckle in bud; 14th, aspen bursting into flower; 16th, migratory thrush sings at early morning; 18th, a swallow seen by Mr. Gossip, at Hoosier's River. I am not aware that an earlier appearance in this Province has ever been recorded. 26th, hacmatac, withrod alder, and blue berry in bud; large copper butterfly about; 27th, small blue butterfly appears; 28th, Mayflowers abundant, ants busy about their hillocks; 29th, white violet in flower; garden currant, and wild rose bursting into leaf; 30th, meadow crow-foot well up, swallows appear.

May—2nd, dandelion in flower; 30th, withrod bursting into leaf; 4th, dock in full leaf; 5th, blue violet in flower, lily of valley in full leaf, hermit thrush sings, black flies appear; 6th, leaves of white birch unfolding; 11th, blackberry and elderberry in leaf; 12th, wild strawberry in bloom; 14th, spotted snake first seen, red maple leaves bursting out; 20th, mountain ash, white birch, beech, blackberry, red maple, and wild cherry in leaf; timothy grass, pigeon-berry, and moose bush in flower; 21st, azalea flowers just opening, blueberry and wild cherry in blossom, balm of Gilead poplar in leaf; American toad about; 26th, apple, pear, and plum trees begin to blossom, buttercup in flower; 28th, aspen in full leaf; 31st, "painted lady" butterfly about.

June—1st, swallow-tailed butterfly first observed; 10th, white weed in blossom; 11th, wild strawberries ripe; 13th, small copper butterfly about; 22nd, brown cockchafer very abundant.

July—18th, pigeon berry in fruit; 28th, wild raspberries ripe.

August—10th, blackberries ripe and abundant.

September—2nd, leaves of white birch turn yellow, and begin to fall; 3rd, several maples turn colour in the Dutch Village woods.

October—11th, maple leaves falling fast.

December—2nd, snow birds seen on the common.

Wild fruits of the field and forest, were extremely abundant in the autumn, especially blackberries and huckleberries.

Before bringing this paper to a close, I would briefly advert to the progress Meteorology is making in the world. In England, the "British Meteorological Society," an institution of not many years standing, publishes every quarter its proceedings, containing a large amount of information, useful and important, not only to the scientific, but to almost every class of society. The system of storm signals too, has been brought to that state of perfection, that the indications they give of approaching gales are rarely incorrect. Yet it is difficult to persuade men, especially sailors long accustomed to rely upon their own judgement with regard to the weather, to place that confidence in this practical application of science which it deserves. How different might have been the fate of the hapless steamship "London," had the storm signals, hoisted at Plymouth, when she was leaving that Port, been attended to: but it was probably the undaunted courage of the captain, so conspicuous throughout the subsequent trying scenes, and too great reliance on the powers of the fine ship he commanded, which caused him to disregard the warning; the deplorable result of which carried desolation and woe to many a bereaved household, and a thrill of horror to the hearts of all who heard the piteous tale of the foundering of that vessel, with upwards of two hundred souls on board.

From the governments of almost all the great nations of Europe, this branch of science is obtaining the attention it merits; and in Russia especially, measures are being adopted for its application to the foretelling of approaching storms, for the use of sailors and agriculturists, on a scale commensurate with the vast extent of that Empire. On the seaboard and inland, upwards of one hundred meteorological observatories, furnished with complete sets of instruments, have already been established, from which communications by telegraph are received daily at a central station. Nor are operations confined to the land, but are carried on extensively at sea under the directions of the government. Arrangements are also in progress with France, Prussia, Italy, Austria, and Holland, for a gratuitous interchange of meteorological observations between these countries.

Nearer home, there is in the neighbouring Republic the Smithsonian Institute, doing a vast amount of good in developing this and other sciences, encouraged by, though, I believe, independent, in a pecuniary point of view, of the aid of the government.

But leaving these old and well established countries, we find the governments of many of our own colonies becoming alive to the advantages to be derived from the cultivation of science among their people: Australia and Canada, not to mention others, liberally assist all efforts to that end. In the latter are several observatories, each of which, if I am correctly informed, receives a Provincial grant for its support.

With such examples before us, we may surely venture to hope, that Nova Scotia never backward in promoting whatever has a beneficial tendency, will not refuse to extend a helping hand to this Institute, whose publication of its transactions every year is diffusing, at home and abroad, much valuable information respecting the resources and capabilities of this fine Province, but whose endeavours to become of more extended practical utility, are paralysed by the want of the pecuniary means, requisite to enable it to carry out effectually the objects it has in view.

Art. VII. Notes on the Economic Mineralogy of Nova Scotia: Part III.; Limestone and Marble. By Prof. How, D. C. L., *University of King's College, Windsor.*

(*Read Feb.* 6, 1866.)

Limestones.—These are found in practically inexhaustible quantities in the Province, where there is estimated to be a thickness of thirteen thousand feet of the various strata comprising the carboniferous system, among which limestones are frequent, especially in the lower carboniferous beds, which in fact consist largely of them and measure six thousand feet in thickness. This system is developed almost exclusively to the north and north-east of the capital, in which part of the Province upwards of eighty beds of limestone are indicated in Dawson's geological map; the rest of Nova Scotia, including the whole western portion and the southern shore, has but two small patches of carboniferous rocks. The limestones have sometimes been thrown by metamorphic action into the crystalline state, and frequently converted under these circumstances into marble, so that many varieties of this material are met with. Geological details respecting this deposit are given in Dawson's *Acadian Geology*.

The economic value of the limestones will probably always be found in the making of lime for washes, mortar and cement, and for manuring, and in their use as fluxes in iron smelting, since the great abundance of excellent freestone will almost preclude their use as a building material except in rubble work and making foundations. As regards the use in manuring, a considerable portion of the agricultural districts in the Province lies in the formation affording limestones, and except for special and occasional purposes lime will not be required in their cultivation—but it must find profitable application by the farmers in the rest of the Province where lime rocks are altogether absent or but scantily developed. In recent years stone bridges have been constructed for railways, and wooden buildings have been replaced in the capital by those of brick and stone; before this change there could have been little demand for lime, which must have been used chiefly for building foundations and chimneys, because the walls and ceilings would be almost everywhere of the plaster made from the gypsum, which is found as the very frequent associate of the limestone.

On comparing the census returns of 1851 and 1861, we find, of course, that with the progress of the country there is increased use of lime. In the former year there were burned in the Province 28,603 casks; taking four bushels to the cask, which is St. John measure, the amount will be

Lime burned in Nova Scotia in 1851, 114,412 bushels.

By the late census we find there was of

Lime burned in Nova Scotia in 1861, 136,848 bushels.

And no doubt, for the reason just given, the next census will show as great an increase as the latter numbers do over the former.

As regards the amount of lime employed, Mr. Lang thinks tha for the last five years not less than eight to ten thousand barrels o lime have been used per annum in the city of Halifax, and that there will be wanted from seven to eight thousand pounds worth of lime during the ensuing summer.

The details of the census returns are interesting: they show that five counties only burned no lime and that the rest of the eighteen gave very different quantities:

Census Returns for 1861.

Counties.	*Bushels of Lime Burned.*
Colchester,	4,860
King's	
Cumberland,	10,635
Annapolis,	
Pictou,	35.990
Hants,	17,474

Counties.	*Bushels of lime burned.*
Sydney,	3,232
Inverness,	6,486
Halifax,*	26,050
Lunenburg,	3,100
Yarmouth,	3,500
Digby,	
Guysborough,	320
Victoria,	4,730
Queen's,	
Shelburne,	
Richmond,	406
Cape Breton,	20,092
Total,	136,848

It is perhaps remarkable that, notwithstanding the vast profusion of limestone in the Province, a good deal of limestone is imported from the West Indies, and much lime from New Brunswick. There is no doubt that the native rocks yield with careful burning excellent lime, and the cost of it is probably less than that from the foreign rocks. At Windsor lime will sell at the kiln at three and sixpence the barrel, and the price would be lower if there were more demand; as it is I am told the New Brunswick lime costs more money: for some reason however, the latter often obtains the preference, as was the case in building the new library at King's College, Windsor, in the neighbourhood of rocks affording excellent lime, as will appear by an analysis in a subsequent page. This is not, however, an invariable rule, and the Nova Scotian stone has been used and found to give excellent lime: in the construction of the railway bridges on the line between Halifax and Windsor, lime from the neighbourhood of the latter place was employed and gave great satisfaction to the engineer, who pronounced it to be a very "strong" lime. A limestone found at Indian Point, Chester, of a deep blue colour, yields a lime which becomes as hard and lasting as a cement: the rock is much valued in Halifax for building up the arches of kilns, a situation in which poor limestone crumbles away while this remains quite hard. The lime prepared from this rock was preferred to that from New Brunswick in building the Wellington Barracks, in Halifax.

*The greater part of the lime burnt in the city, Mr. Lang thinks, is from foreign limestone.

Mr. Peters, the builder of the barracks, is my authority for this character of the Chester rock and he tells me that the lime from it is the only one yet found to his knowledge fit to use in making concrete. A black limestone is found at St. Peter's, Cape Breton, which is said to afford most excellent lime.

Hydraulic Limestones.—These are limestones which contain a certain proportion of clay and sometimes magnesia and have in consequence the valuable property of setting under water after being burned to the proper degree.* These important minerals should receive careful attention ; they are reported to exist in several parts of the Province. Mr. G. Lang informed me last year that Shubenacadie affords a limestone the lime from which was used twelve years ago in building a chimney for a steam-engine and that the work under water cannot now be separated. He says now that this lime takes the first place in the family of limestones on this continent as affording a lime for mason work and for all exterior work. The lime from it slacks with unusually little water and takes as much sand again as any other used in the country, and makes a mortar which is better than any cement except the Portland, made in England, resisting the severe frosts and sudden thaws much better than that made with lime from St. John or West Indian limestone. He has burned about 300 tons and now has his kiln ready to burn about 2,000 tons. Hydraulic limestones are also reported from Windsor, and from St. Peter's, Cape Breton.

Cement-stones are limestones containing foreign ingredients, which when burned and ground can be made into cement. Mr. Handley, of Halifax, showed me a cement he had used in putting together fire-bricks, which he had made from a stone found near St. Peter's, Cape Breton, by careful burning, grinding and mixing with sand in certain proportions: he assured me it was a very strong cement. Such stones are very valuable : during the construction of railways and other public works in Canada one manufacturer made on the average 80,000 bushels of cement annually. The limestones of Walton and Teny Cape, in Hants Co., often contain magnesia, but in what quantity is not known, nor have they been examined as to their hydraulicity. A good deal of work on this subject awaits a

*An excellent account of these is given in Weale's Series on "Limes and Cements." See also Chem. News, xii p. 287, and xiii p. 86, and Geology of Canada, 1863, p. 805.

geological survey. Limestones fit for making lime for manure are those which are nearly pure carbonate of lime. I have heard it objected to the use of Windsor lime as a manure that it contains magnesia in large quantity; this is certainly not the case with that obtained from the rock on the property of O. King, Esq., for when I made an analysis of a specimen of that found on the bank of the Avon behind his house, it gave me:

Carbonate of Lime,	97.64
Carbonate of Magnesia,	1.10
Oxide of Iron,	.07
Clay, sand and silica,	0,68
Phosphoric Acid,	traces
	99.49

results which show that there is but little magnesia in it, even for an ordinary lime; for the sake of comparison I may state that in Professor Anderson's "*Elements of Agricultural Chemistry*," the analyses of two common limestones are given as examples of the composition of these rocks, and 1.61 and 7.45 are the respective percentages of carbonate of magnesia.

As many limestones of the Province, like that of which the analysis has just been given, are chiefly made up of the shells of *mollusca* it will not be out of place here to give an unpublished analysis* of a recent shell made many years ago; the cleaned shell of the Periwinkle (*Litorina litorea*), gave

Carbonate of Lime,	97.175
Sulphate of Lime,	.479
Organic Matter,	2.010
Phosphoric Acid,	0.001
Silica and Sand	0.164
	99.829

whence it appears that there is not a great difference between the composition of the recent shell and the rock which, many hundreds of thousands of years ago probably, was to a great extent made of the remains of the shells of allied animals.

*Published with others since this paper was read, in Silliman's Journal of Science, May, 1866.

The presence of phosphoric acid in a manure is valuable in most cases, and there are limestones in which this acid exists in considerable proportion, as Dr. Dawson mentions in speaking of those found at the Joggins: I have examined one of these, of a black colour, which I obtained from a bed on the beach and can fully confirm his statements; I found in it a notable amount of phosphoric acid; he justly says that such would be worth about three times the price of ordinary limestones, and that the richest of the beds found would possibly be sufficiently appreciated on trial to allow them to be profitably worked.

(I may mention here that a deposit consisting in small part of carbonate of lime, but made up mostly of clay and sand found near Mill Village, Parrsboro', was examined by me some time ago at the request of Rev. W. King, and found to be so rich in phosphoric acid that it ought to prove a good manure).

LIMESTONE AS A FLUX.—At the only iron works now carried on in the Province, viz: the Acadia Iron Works, Londonderry, limestone from the neighbourhood is employed. When the Nictaux works were in operation limestone was imported from New Brunswick to a port on the Bay of Fundy and thence conveyed by land carriage some eleven miles to the furnace. The importance of having a supply of this rock near the works is seen by observing the amount employed. In 1861 the quantity of iron made at Londonderry was 1,200 tons, and Mr. Jones, the manager, stated (see these Notes, Part I), that 200 bushels of limestone were required to smelt one ton of ore, so at that time there was a consumption of 240,000 bushels of limestone, a quantity more than two-thirds greater than that of all the lime burned in the same year throughout the Province,

MARBLES.—These have been long known to exist in various localities but none of them have been worked, an attempt having been made at one place only to make use of a deposit. A fair representation of the varieties best known was made at the International Exhibition of 1862*, when there were shown thirteen specimens from eleven localities.

Parrsboro' yields a purplish coloured marble with green spots of serpentine. *Onslow* mountains furnish a chocolate and a red variety, Cheverie a reddish brown with red bands. Pictou Co., affords

*Want of time prevented as good a representation at the Dublin Exhibition.

several kinds: one of a greenish hue, and among the rest one which is very remarkable. It is of a grey colour and when polished shows concentric waved bands covering the entire surface in beautiful markings. The specimen exhibited had perhaps a square foot of surface and was due to the liberality of Messrs. Wesley & Sanford, who also polished some of the other marbles shown. So far as I know this marble is unique and if it should be found in large slabs of the same character as that which was shewn and excited so much admiration there can be no doubt it would be very profitable. Even in small slabs it would be probably prized for inlaying. Cape Breton has large deposits, there are known a white marble with blackish veins, a black with white veins, and a white and deep green variety, which is very handsome. All the specimens at present met with are from the surface. The deposit of marble which is best known is that at Five Islands, in the Basin of Mines, where it forms large beds in the metamorphic rocks; the marble is of excellent grain and of a fine white colour, surpassing in beauty, when polished, according to Messrs. Wesley and Sanford, the Italian Marble. It is this which has been to some extent tried as to its value. About 1852 a gentleman was sent from England with two quarrymen to get out a block. He remained for some months and finally shipped a block of considerable size at an expense, it is said, of about £1,000. The explorer is reported to have stated that the marble was superior to any he had seen from Carrara, but on the arrival of the block in England it was pronounced unserviceable from being shattered. This condition of the specimen is considered to have been due, at all events in part, to the block having been got out by blasting, so that this trial may not have determined the real value of the deposit, and I have also heard from a resident in the neighbourhood at the time of quarrying, that more might have been done at the same expense. Even if larger and better conducted operations do not show that large masses can be got out, at least it is probable that smaller blocks suitable for busts and statuettes may be obtained.

A material may be mentioned here which may prove, under certain circumstances, a useful substitute for marble, viz: the hard plaster or anhydrite, which is found abundantly, and could probably be obtained in blocks of any useful dimensions. It occurs at Falmouth and St. Croix of a white colour, at Windsor of a bluish tint and also a mottled white; at Parrsboro' a purple rock is met with and no doubt it presents other varieties elsewhere. Its greatly superior hardness at once distinguishes it from the ordinary plaster. It is used in this neighborhood (Windsor), in building the foundations of houses. At the International Exhibition two specimens of the Windsor hard plaster were shown cut and polished: one gave a finely clouded surface and the other was rather uniformly spotted; both were grey, and one showed in some lights a slightly bluish tint: the edges of both at the meeting of the polished surfaces were remarkably sharp and perfect. Since sulphate of lime (the chemical name of plaster) is not insoluble in water, polished surfaces of hard plaster would lose their lustre in the open air, and the material can only be used when cut and polished in in-door work; under these circumstances it may prove more durable than marble, which is said to be so subject to change from variations of temperature that the mantle of a chimney piece immediately over the fire is invariably in a crumbling condition long before the sides or those parts which are not so exposed to heat. This statement is given in Hunt's Hand-Book to the International Exhibition (Vol. I, p. 325), and we find there also (p. 332) in a very interesting passage, that some alabaster, a variety of *soft* plaster, is more durable than Purbeck marble. The author says "notwithstanding alabaster is decidedly so soft a substance that it may be easily cut with a pocket-knife, or abraded with the nail, it is nevertheless an extremely durable material, if not openly exposed to the weather. In most of the large churches in the south of England, especially in Westminster Abbey, there are instances of monuments constructed with Purbeck marble, and ornamented with alabaster tracery, niches, canopies, and little figures, which are almost without exception perfectly free from decay; angles sharp, surface smooth, colour scarcely altered; while the Purbeck, a harder material, upon which the alabaster is fixed, has scarcely any of the original surface left: although these two substances are close together, equally exposed to the same atmospheric influences of damp and dry, summer and winter, from the fifteenth or sixteenth century, to the present time, yet one is apparently unaltered, while the other is certainly perishing, disintegrating, and gradually mouldering away."

Having been led to the subject of alabaster, I may state that the compact gypsum of Antigonish has quite the character of alabâster. I have only seen small pieces but probably larger ones are to be got. The quality of this as a material for carving was shown at the Dublin Exhibition, it proved excellent. A small piece was carved to represent a bunch of grapes and some leaves by Mr. C. Harding, of Windsor, whose skill and taste in another department of fine art, viz: pen and ink drawing, have contributed materially to the adornment of the Nova Scotian Courts in both the late Exhibitions. It came under my own notice that both the carving and the material, attracted the attention of a wood-carver and called forth the expression of his favourable opinion.

In the Provincial Building now being erected, an opportunity offers for testing the value of native materials in internal decoration, and perhaps the public voice will be heard in favor of embracing it as the matter is surely one of Provincial interest.

ART. VIII. REMARKS ON THE PITCH LAKE OF TRINIDAD. BY REV JOHN MORTON, LAHAVE.

[*Read March* 8, 1866.]

THE Pitch Lake of Trinidad lies on the western side of the island and about a mile from the Gulf of Paria. It is nearly circular, and about three-fourths of a mile across. There is no point from which a view of the whole lake may be obtained, as it is broken in upon by islands and obtruding points. These lie principally about 400 yards from the western side of the lake; and from these the view easterly is very striking, and relieves the disappointment which is generally felt upon the first view of the lake. The expression *lake* is apt at first to mislead. The pitch is not in a fluid state, except in a very small spot, and may be safely walked upon over all the rest of the lake. Indeed teams might be driven over a great part of it, although any heavy weight left on it would gradually sink. The pitch, which from the heat of the sun and probably also from subterranean fire, is hot all over the lake, becomes hotter as you approach a point near the centre, where it is simmering and boiling over very gently. You can safely advance to the very edge of this spring and obtain a specimen, care being taken not to burn the fingers.

The surface of the lake is intersected by little canals, particularly on the western side. Some of these are shallow and narrow, others are three or four yards wide and from three to five feet deep. The edges of these canals are rounded like the lips of an ancient urn. And they seem to have been formed by the pitch, which had boiled over from different springs, having met and cooled. Where the springs have been near each other the overflowings have run together, so that their meeting can scarcely be traced. But where they have been more distant the pitch waves have had time to cool somewhat before meeting, and thus hardened have met at the bottom without running into each other, and the interval between their edges forms a deep canal, wide at the surface and rounding down to a crack at the bottom, where the overflowings have met. Lips more or less gently closed may serve to illustrate the shape and varieties of these canals. They are always full of water. We enjoyed a tepid bath in some of the deepest and found them of the same shape as the others. None of these canals intersect each other; but where overflowings from three different springs have met, three canals are formed, deepening in their course until they converge into a deep triangular pool. The pitch does not always boil at the same part of the lake, nor always with the same activity. And these overflowings point to a time when the pitch springs have been near the western side of the lake, and perhaps more than one of them active at the same time.

The western side has a shore or border of pitch, sloping more or less gently towards the lake, indicating a depression in its level. The eastern side presents a different appearance. Here the soil covered with grass and bushes comes close to the lake. The lake itself is smooth, and the canals on its surface few and small, indicating a greater internal heat. At the edge of the lake the soil is only a few inches deep, and the land is very level, and seems really a continuation of the lake with a superjacent shallow layer of earth. This is confirmed by appearances further inland, where the formation can be traced for about six miles. If, as we conjecture, the land here rests, for some little distance, upon the pitch in a soft and but little inspissated condition, it is easily seen that on a subsidence of the lake, the land floating upon it would subside with it, without altering the appearance on the surface. Whereas on the western side, the solid formation adjoining the lake would hold its position, and thus indicate the subsidence of the lake in a shore such as that to which we have referred.

From the western side of the lake, the land descends without interruption to the Gulf of Paria. In this slope there is a very gentle depression, beginning where the shore of the lake is least elevated, and where it appears even now almost ready to overflow, and traceable to the Gulf, where the pitch is found exposed along the shore, and forms a point that stretches into the Gulf about 400 yards. Here the appearances are of a nature not to be misunderstood. The pitch is exposed for about a quarter of a mile along the shore, and in some places for several rods above high water mark. And it is clear that it has not been thrown up by the tide, as some have asserted, but has flowed from inland. The flowings are as distinctly marked as if they had occurred but yesterday. The manner in which they have been turned aside by obstructions and their uniform slant, together with the clearly marked edge where the flowing has cooled, admit of no doubt in this matter. In the bight formed by the point of pitch which juts out into the Gulf, the beach is wholly of pitch; it is very steep and has the rounded contour of the edge of a large pitch wave, as if it had been here arrested in its progress and cooled by the tide. Southerly from the point of pitch the beach becomes more level, and is covered with black pebbles, in some places to the depth of a foot. These on examination prove to be pitch and scoria rounded by the action of the tide. Passing on we find a well defined flowing that seems to have hardened before it reached the tide. Here the land rises abruptly, the beach becomes sandy, and we lose all traces of the pitch.

A public road enables us to trace the formation up the depression of which we have spoken, the whole way to the lake. In some places several feet of soil overlie it, but as you approach the lake the soil becomes shallow and has been washed from the road by summer rains, leaving the pitch quite exposed for a considerable distance. All along the road and particularly where the pitch is thus extensively exposed, the hardened overflowings are as well defined as on the shore. Their appearance is well illustrated by what may be seen on many hill sides during our Nova Scotian winter, where water has congealed in successive overflowings. The conclusion is inevitable, that the Pitch Lake has been, and is still to some extent, an immense Pitch spring or series of springs, and that the depression from the western side of it to the shore of the Gulf of Paria, is the bed down which the products of this vast spring has at one time flowed, causing the appearances on the road and on the shore, and pressing out into the Gulf has formed the point of pitch above referred to.

I have not been in a position to consult any standard geological works on the subject except Sir Charles Lyell's. And as my object was not to compose a scientific essay, but merely to accompany the specimens with a few remarks, I have confined myself to the result of my own observations.

Sir Charles' works contain little on the subject. In his "Principles" (p. 250, 9th ed.) he says:

"Fluid bitumen is seen to ooze from the bottom of the sea, on both sides of the island of Trinidad, and to rise up to the surface of the water. Near Cape La Braye there is a vortex which, in stormy weather, according to Capt. Mallet, gushes out, raising the water five or six feet, and covers the surface for a considerable space with petroleum, or tar; and the same author quotes Gumilla as stating in his 'Description of the Orinoco,' that about seventy years ago, a spot of land on the western side of Trinidad, near half-way between the capital and an Indian village, sank suddenly and was immediately replaced by a small lake of pitch, to the great terror of the inhabitants."

"It is probable," says Sir Charles in continuation, "that the great pitch lake of Trinidad owes its origin to a similar cause."

When on the spot I was not aware that such statements had been published, and consequently made no special enquiry about them. But I never heard anything corroborative of them, except that bitumen was sometimes seen in small quantities floating near La Brea. Such a *vortex* as Capt. Mallet speaks of would be too notorious to be overlooked by persons living there, when answering the enquiries of strangers respecting the wonders of the place. Nor did I ever hear of *a small pitch lake,* such as Gumilla speaks of. His location of it is very indefinite, and points as much to the great pitch lake, as to any place on the whole western coast.

The town of San Fernando, is about twenty miles N. of LaBrea. A hill rises abruptly, behind the town, to the height of upwards of 1000 feet. The cutting of a road, across a spur at the north side of this hill, lays bare a surface of pitch. It is very hard and has the appearance of having been thrown out of place by some convulsion. The valley of the Naparima, extending inland some nine miles and about four miles in breadth, is well cultivated, and a tramway runs up through it, in laying which several considerable cuttings have been made, but no pitch has been any where discovered. From this and from the fact that there are decided indications of volcanic action on the hill, it seems probable, that the pitch has been here thrown up from a considerable depth, by volcanic action; and that the formation extends over a considerable part of the W. side of the island, from the middle to the southern ranges of mountains, flowing out at LaBrea, underlying the surface further north, and thrown up by volcanic action at San Fernando Hill. All this part of the island is subject to volcanic action. At Pointa Pierre six miles N. of San Fernando, there are hot springs; and in the forest twelve miles east, I visited some small but very interesting and active mud volcanoes.

Near the southern range of mountains, sulphur has been found almost in a pure state, reminding one of a similar connection of pitch and brimstone at the Lacus Asphaltides, under which the slime pits, or bitumen wells, of the Valley of Siddim, continue to throw up their products, and on whose shore brimstone is found in large quantities.

The pitch of Trinidad is manufactured on the Island, with common coal, and then used for raising steam. M. Stollmeyer, is largely engaged in manufacturing it for paving, or flooring stores; it being preferable to wood where insects are so troublesome and destructive. But it is scarcely hard enough for paving streets in so hot a climate. It is largely shipped to France and Hamburg, for paving. The pitch for shipment, is raised at the point that runs out into the Gulf of Paria, whence it is conveyed in boats to vessels anchored a few hundred yards off. The pitch here, being more inspissated than at the lake, is better adapted for conveyance in large quantities. Much of the pitch manufactured on the island is taken from the lake. When thrown into heaps it runs together into a solid mass. And the place from which it is taken, although near the side of the lake where the pitch is hardest, gradually fills up again by the pressing in of the surrounding mass. The supply being so large and so easily attainable, it must continue for ages of vast economic importance.

ART. IX. ON SOME RECENT IMPROVEMENTS IN THE AMALGAMATION PROCESS FOR EXTRACTING GOLD FROM QUARTZ. BY GEORGE LAWSON, Ph. D., L. L. D., *Professor of Chemistry, Dalhousie College.*

[*Read March* 8, 1866.]

THE paper was chiefly occupied with a discussion of the properties of the metal SODIUM, (Na.) and of the Sodium Amalgams, and of the use of the latter in promoting the amalgamation of Gold.

The metal sodium, a discovery of Sir Humphrey Davy, was particularly described, and the method of removing it from its combination with oxygen. It was prepared by decomposing carbonate of soda by means of charcoal, at a high temperature, this last having a greater affinity for oxygen than sodium. The use of sodium in the arts has so diminished its price that it can now be obtained at 6s. stg. per lb. Specimens of large size, contained in naphtha, were exhibited. Its colour is silver white, sp. gr. 0.972—it is as soft as butter at the ordinary temperature of the atmosphere, fuses at 194°, and oxidizes rapidly in air. It burns on a slight increase of temperature. Several interesting experiments of its fusion and burning were exhibited. It decomposes water rapidly, uniting with the oxygen it contains, and liberating the hydrogen. The Doctor illustrated its action on water by some beautiful experiments,—amongst others, by the preparation in course of a few minutes of a large jar of hydrogen gas, by the action of sodium upon water; the hydrogen was afterwards exploded to show the converse of the experiment. The property of sodium in promoting the action of mercury and amalgams upon other metals had been known for many years. Recently, however, Mr. Crooke, F.R.S., a distinguished chemist, who had discovered the metal thallium, has applied sodium to the purpose of gold amalgamation. The Doctor here explained the ordinary process of separating the gold from the quartz, by using mercury alone, a process which was often inefficient, owing to the presence of sulphides, which, coating the gold, prevented the action of the mercury upon it. It was found by Mr. Crooke, that by combining the sodium with mercury, an amalgam was formed that had much greater power of taking up gold than mercury alone. By means of a sand bath and a glass vessel, the experiment of combining the mercury and sodium was shown to the meeting, and a considerable piece of amalgam made with the requisite proportions of mercury and sodium; and the action of the amalgam so made was shown on thin slips of gold freshly annealed, from the Waverley mines. It was shown that these slips of gold were not at all affected when drawn through ordinary mercury; but the moment they came into contact, however slight with mercury to which some of the sodium amalgam had been added, they were completely and permanently coated with mercury. The following was the account given of Mr. Crooke's process, which had been fully investigated by an extensive series of experiments in Professor Lawson's laboratory, and so favourably reported upon that a patent has been granted:—

"This invention relates to certain improvements in the method of treating the ores or substances containing gold and silver by amalgamation, and whereby those metals can be more perfectly and completely extracted and separated therefrom, than by the processes hitherto adopted. A solid amalgam of sodium is in the first place formed by combining about one part of sodium with about thirty parts by weight of mercury. The solid amalgam thus formed is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantity of metal contained and the state in which it occurs in the ore or matrix. If however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid and its manipulation inconvenient. The effect of thus combining the sodium with the mercury, is to impart to the latter a greater affinity for or power of adhesion to the metal under treatment, than it possesses in its simple and uncombined condition. Instead of using the solid amalgam as hereinbefore mentioned, the sodium may be combined directly with the mercury employed, the proportions varying according to the requirements of the case.

"This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and in cases where amalgamating vessels or receptacles constructed of iron are employed, an additional advantage arises from the fact that mercury combined as before mentioned with sodium forms a thin film over the surface of the iron, thus collecting very minute quantities of the metal under treatment, and which may be removed by the ordinary process, and subjected to the subsequent treatment usually employed.

"The mode of treatment employed is as follows :—An amalgam of sodium is in the first place formed by combining sodium with mercury. The proportions may be varied within wide limits, that is to say, from less than three to more than thirty parts of sodium to one hundred parts by weight of mercury. The sodium and mercury must be caused to unite, and the amalgam prepared with the customary precautions well known to and understood by chemists. The last mentioned method of forming the sodium amalgam is that which the inventor usually prefers in actual practice ; but, if desired, the amalgam may be prepared electro-chemically, as described by Becquerel and other chemical authors, or by any other suitable means. The amalgam is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantities of precious metal contained, and the state in which it occurs in the ore or matrix ; but as in the process the beneficial effects of the sodium are gradually removed, the action should be maintained, if needed, by occasionally introducing fresh supplies of the amalgam into the charge of mercury contained in the machine employed. The quantity must, however, be regulated and determined by the skill and judgment of the operator, as no definite and absolute proportion can be laid down as necessary. If, however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid, and its manipulation may be inconvenient. The effect of thus combining the sodium with the mercury is to impart to the latter a greater affinity for or power of adhesion to the precious metal under treatment than it possesses in its simple and uncombined condition, so that it will readily amalgamate with the gold or silver, even when the latter metals are soiled by grease or other extraneous matter. Although he prefers that the amalgamation shall be conducted in the presence of water, as in the usual processes, the operation, if desirable, may be performed in a dry manner. The amalgam above mentioned should be stored in air-tight vessels, or under naphtha, such as metallic sodium is usually kept in. Instead of using the amalgam as hereinbefore mentioned, the sodium may be combined directly with the mercury employed, care being taken that the proportions shall remain substantially as already indicated.

"This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and, in cases where amalgamating vessels, or receptacles or places constructed of iron or other metal are employed, an additional advantage arises from the fact that the mercury combined as before mentioned with sodium forms a thin film over the surface of the iron or other metal, thus aiding in the collection of any minute quantities of the precious metal under treatment. The subsequent extraction of the gold or silver from the mercury may be conducted in any desirable manner. It is not found in actual practice that a small quantity of sodium, if accidentally allowed to remain in the mixture with the gold or silver and mercury, affects the subsequent treatment in any appreciable degree. In cases where, from the nature of the ores or substances under treatment, the mercury used for amalgamation becomes divided into minute globules, technically known as "flouring" or "granulating," there is frequently a difficulty in separating the globules from the heavy particles of the powdered ore or substances containing the precious metal; the addition of the sodium amalgam to such a mixture is found to induce the coalescence of the liquid or viscid metallic particles, so that a mechanical separation of the gold or silver amalgam from the gangue may be readily effected. The employment of sodium in combination with mercury will especially be found beneficial in cases where gold or silver occurs with pyrites, sulphurets or minerals containing arsenic, antimony, tellurium, or bismuth. The process of amalgamation with ordinary mercury is difficult to perform in the presence of such minerals without great loss both of mercury and of the precious metal under treatment, owing to the surfaces of the latter being in such a tarnished or soiled state that mercury alone will not touch them (as, for instance, when gold exists in pyrites). and also owing to the mercury becoming what is technically termed "sick" or "floured," in which state its power of uniting with the precious metals is much diminished; in these cases the addition of sodium amalgam will be found highly advantageous; whenever the mercury has become "floured" or powdered by the result of distillation, or from any other cause, it is readily restored to the liquid or bright metallic state by the addition thereto of sodium, either in its simple metallic condition, or as an amalgam with mercury.

"Although sodium is mentioned as used in the processes above described, other alkali metals, such as potassium and lithium and other metals strictly analogous thereto in their chemical and physical characters, may be employed in lieu thereof in combination with mercury for the purposes of this invention.

"Having thus fully declared and ascertained the nature of his invention, and the manner in which it is to be performed, Mr. Crooke claims that what he considers novel and original, and therefore as constituting his said invention, is, the employment of an amalgam of sodium, or such other alkali metal as aforesaid, in treating ores or substances containing gold or silver for the extraction and separation therefrom of the precious metals, as hereinbefore substantially set forth and described."

Dr. Lawson, then explained the simplest methods by which chlorine and hypochlorous acid might be generated for sanitary purposes; and Mr. Outram described the process of manufacture of chloride of lime as conducted in the great works at Glasgow.

6th September, 1866.

P.S.—Professor Lawson has requested the Secretary of the Institute, to insert the following memorandum of some further results in regard to Mr. Crooke's Process, which is now coming into use in our Gold Mines:—

"Experiments have lately been undertaken at the Lake Major Company's Mines, Waverley, with the view of testing in a practical manner the value, or otherwise, of Crooke's new process of amalgamation by means of sodium-amalgam. The crusher and other machinery of these mines being much superior to those of any similar establishment in the Province, the best opportunities have been afforded for a fair trial. The experiments have been carried out by Dr. Krackowizer, the manager of the mines, in conjunction with Prof. Lawson of Dalhousie College, whose laboratory investigations of the process were detailed sometime ago to the Institute of Natural Science. The results are highly satisfactory, and fully confirm the favourable opinion that has been formed of Crooke's process, and of its adaptability to Nova Scotian ores. One great advantage of the process is the action of the sodium amalgam upon pyrites, which material abounds in our quartz veins and is known to contain gold, but has hitherto been accumulating around the mines in enormous quantities as a waste material. A portion of this material operated upon by the new process gave at the rate of 5 *ounces of gold per ton of pyrites*. This is regarded as a remarkable result, and one that will certainly lead to the profitable extraction of gold from pyrites, especially as no extra apparatus is needed such as would be necessary for the chlorine process."

No. X. On the Food Fishes of Nova Scotia. No. IV. The Trouts and Salmons. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.,

[*Read April* 2, 1866.]

I have identified five species of the genus *Salmo*, as inhabiting the fresh and sea waters of this Province. They all closely resemble each other, in their powerful tail, and strong muscular back, their armature of numerous and recurved teeth, their tendency in the young to vertical markings, and the most of them to spots,—by all having the false or internal opercle as noticed by Muller,—by all spawning in November,—and all requiring highly ærated water in which to deposit their ova, thus seeking shallow streams of swift running water,—by hunting for their food singly, or in small numbers,—by a common voracity, and boldness, all with one exception having the power of throwing themselves several feet above the surface of the water,—by all seemingly enjoying life, and parting with it by fierce struggles—this last making them game-fish,—and lastly, by all of them being marked by a fatty fin, without rays, a typical mark whose use we cannot explain, and which they share with the very kindred geni of *Corregonus*, and *Thymallus*.

In identifying *S. Salar*, (Lin.), *S. Fontinalis*, (Mitch.), *S. Canadensis*, (Ham. Smith), *S. Gloverii*, (Girard), *S. Confinis*, (DeKay), and attributing them to their rightful first describers, I have met with much difficulty. The principal writers seem to have had no personal knowledge themselves of the fish in question, whilst the best observers seem to have wanted what the first gentleman had, a scientific tact and skill of observation. Thus Perley, followed by Frank Forrester, has confounded *S. Canadensis* with *S. Trutta* of Europe, and *S. Gloverii* and *S. Confinis*, with *S. Ferox*, also European. I need scarcely say how soon Yarrel, or "Couch's British Fishes" would correct this error. In the present paper I have only given facts that I have identified myself, or that have been told me by local observers. The works I have referred to are those of Richardson, Dekay, Storer, Gill, Norris, Frank Forrester, "*Game Fish of the North*," Perley, and manuscript correspondence of F.W. Putnam, Esq., Salem, U. S.

Salmo Salar—The Salmon.

The description of a fresh run fish from the ocean, as they appear in spring in our market, would be — weight from six pounds up to twenty, head small, body very deep, and at the same time round or thick through; back very muscular, and tail large and strongly based; the opercle is circular on its outside edge, in this a very marked contrast with the trout, in which it is angular; the free edge of the labial is rounded, whilst the same part in the trout is sharp; the eye rather small and about two and a half diameters from tip of nose; the nostril double, like all the genus; the outline of back rounds up from the head, then runs in nearly a straight line to the first dorsal, which has twelve rays, the first very thick and short, and of an irregular rhomboidal shape; the anterior edge of the second dorsal or adipose fin is opposite the fifth ray of the anal, its posterior edge opposite the last ray; the tail very strong, rays twenty, the anal ten, first very thick, and ventral nine, the pectoral fin rises close to the margin of opercle; the colour fresh from the sea is black along the back, running gradually into steel blue, with green reflections to the line of raised scales, all below of the brightest silver; the head and opercles are, upper half dark blue, lower silvery; the fins, dorsal pale lavender with irregular spots, rays dark blue, adipose blue, caudal base and edges dark, middle pale yellowish white, anal pale yellow; ventral with large accessary fins yellowish; rays and anterior edge dark, pectoral pale bluish white, anterior edge and rays dark blue; on the pre-opercle and opercle are one or two black irregular spots; a number of black blotches occur at irregular intervals along the sides and side of the belly. Teeth on intermaxillary, upper and lower maxillary, palatine bones, in vomer, but not more than two or three, and on tongue about nine or ten around the edges; scales very large Fin rays—D. 12, V. 9, P. 11, A. 9, C. 20, a large axillary scale to V. Gill rays—11 on each side. Posterior edge of opercle round, free end of maxillary round.

Such is a description of this king of fish, as he appears from the ocean. But it gives but a faint conception of the flashing lights thrown back from his sides of molten silver, upon the tender blue of his back, or of the dying but fair lavender of his fins. Filled with the only food upon which he thrives, the ova of various echino dermata, or the flesh of the sand eels, his huge back is swelled out and rounded like a race horse. The flesh itself is tinted red, and fat flakes lie thick in the fibres of every muscle. His courage and strength are equal to his form and colour,—and he has need of them all. A long and weary journey is before him, with scant food and hard toil. He enters our rivers, beginning in March at the most southerly and westward ones, to ascend the lakes to his spawning grounds. Towards the end of June the run at Halifax is over. He buries himself now in our lakes, and for a time nothing is seen of him. On his passage up he takes the fly, and is seen leaping over the natural obstacles or artificial barriers that arrest his progress. From six to eight feet is his utmost perpendicular height. He is often seen lingering in the deep holes of the streams which he is ascending. He becomes lean and thin almost immediately on entering the fresh waters. His flesh loses the lively red tint and exquisite flavor, his silvery sides turn yellow, and his steel blue back a dingy black, reddish diffused patches stain his sides and head and cheek. In the male, changes much more characteristic are stealing over him, the upper jaw lengthens, teeth both more numerous and larger appear; an eagle-like hook is formed; the lower jaw lengthens, curves up, is armed with supplementary teeth, and a nob or hook of gelatinous substance sprouts out of its end, which fits into a hollow of the upper jaw.

On the 10th July, 1865, I noticed many large salmon taken from the fresh water river, Shubenacadie. They had been some time in fresh water, had lost their blue and silver hue, and pink flesh tint, and had also lost their teeth, some of them almost entirely, others partially. Their jaws were arched, the bone evidently absorbed. I was much puzzled to account for so many old fish being taken at once, and only in fresh water, since such fish were never known from the sea. On the 26th November, 1865, M. Brown, Esq., Halifax, sent me a salmon, a male fish, weighing perhaps sixteen pounds, whose head and jaws were so peculiar as to need an exact description. The intermaxillary articulation was very loose and much enlarged. The intermaxillary bone itself had grown at least two inches in length, formed into a beak like an eagle's, and filled with very large teeth. The lower jaw had also grown to correspond in length, and was also armed with large teeth. A cartilaginous knob projected upwards from the lip, which fitted into a groove above in the intermaxillaries. The new jaws were so arched that it was impossible for them to close in the centre, and the teeth were much larger and with wider bases than the usual teeth. I am now of the opinion that the toothless fish I saw in July were preparing, by losing their original teeth, for this spawning growth, soon to sprout from their denuded jaws, of not only increased osseous matter, but of an entirely new set of teeth, and that the whole of the huge structure in a few months, broken down or worn away by conflicts and by furrowing up the sand and gravel, becomes totally absorbed on reaching the ocean, and is again replaced by the ordinary teeth, thus each male salmon having two sets of teeth during the year.

Towards the latter part of November he is seen frequenting the shallow, sandy bottomed running streams. He is busy furrowing up the gravelly bottom with his lower jaw, in water so shallow that his tail flaps upon the surface. The loitering sportsman often overlook him working up stream so as not to foul his water, and sedulously conducting his mate into the furrow where he impregnates the ova streaming from her teeming sides, or rushing out upon the shoals of young males in clouds about him, each a miniature salmon with hook and bill, though barely six or seven inches long.* The lumberman too is sometimes tempted from his toil by suddenly coming upon a shallow lake literally covered by hundreds if not thousands.† Serious encounters are sometimes instanced between two rival males, the wounds taken and given are often frightful. At the end of the season, an old male thoroughly emaciated, lean, dingy yellow, his jaws literally worn to the bone or hanging in fragments, his body torn into gaping wounds, with his pale blue gleaming eyes, is truly a ghastly form, flitting dark and dull and

*Charles Anderson, Esq., Magistrate, Musquodoboit.

†Mr. John Duncan, Ingraham River, told me that he once with a party of lumbermen, came upon at least a thousand salmon, spawning upon Snake Lake, Halifax County. For every man and teamster to desert his work, and rush into the shallow waters, with axe, or pole, or ox goad, or young sapling, was the work of an instant. Some eight or ten were the only spoils that rewarded their cupidity.

half seen through his watery home. They are now said to return to the sea, principally because we find them there in early spring. This part of his return journey has not so many landmarks about it as I could wish. Indeed some say they remain all winter in the lakes, and no doubt many do. Thus it may be said that the salmon in Nova Scotia have their principal run from the ocean to the lakes in April, May and June—that they spawn in November and immediately return. But this is only generally true. From a number of facts I am led to conclude there is a perpetual passing up and down during the whole summer. On the 20th of May, 1865, I procured from the tide way at Bedford Bridge, five young salmon from six to eight inches long, these I suppose were fry of the ast year, fifteen or sixteen months old, going to the sea for the first time. With the exception of a few vermillion spots upon them, and that the nose was rounded and short, they were true salmon, teeth perfect and some with ova. It is now admitted (from the numerous and conclusive experiments of marking fish) that they visit the ocean and return in a few weeks weighing six to seven pounds, and spawn in November. Successive runs of these fish must be perpetually passing up and down our rivers. In September, female spawning fish, entirely discoloured, and filled with spawn of the size of buck shot, which escapes readily, are exposed in market from the Shubenacadie river, and one would never think they could retain their spawn till November. The year just past was unusually dry and the lakes and streams low. Thus Bedford river, near Halifax, was thronged with fish unable to get up. In November thirty were counted from Flat rock in one deep hole. Our markets have always a run of November salmon taken outside on the ocean, in the highest condition, and which according to Col. Hardy, have the ova very small and undeveloped. Thus at one point of time we have three sets of fish, one spawning or spawned in the lakes, one running up, and a third ranging the ocean unimpregnated. From these facts we must deduce that there are modifications perpetually occurring to vary within certain limits any general law. On his passage he readily takes the fly, during his sojourn in the lakes not; though of these facts I am not quite certain. In the ocean we find him a deep feeder, his food being said to be the spawn of various fish, and he is often taken by bait fishing on our coast some distance from shore, and at about sixty or seventy fathoms. There can be little doubt that he also feeds upon smaller living fishes as well as flies and larva.

One must witness a score or two of these fine fish for sale in the Halifax fish market dripping fresh from the ocean, before they can truly appreciate their magnificent proportions, their great depth and thickness, and great round backs swelling into so massive a foundation for their huge tails,—the clear silver laced with blue of the sides, the opal tints flickering around their bellies, or the fleeting lavender of their fast stiffening fins. Those figured by Yarrell and Couch, by Dekay, and even Agassiz, a Halifax fisherman would not allow upon his stall. The extreme length and want of depth would condemn it at once as a spent fish. Of the many stories of marvellous captures of these fish, the best and certainly the truest is the following, which happened in my own time and neighborhood:—Mr. Baillie, grandson of the "Old Frontier Missionary," was fishing the "General Bridge river" up stream for trout, standing above his knees in water with an old negro named Peter Prince at his elbow. In the very act of casting a trout fly, he saw, as is very usual for them, a large salmon lingering in a deep hole a few yards from him. The sun favored him, throwing his shadow behind. To remain motionless, to pull out a spare hook and pen knife, and with a bit of his old hat, and some of the grey old negro's wool to make a salmon fly, then and there, he and the negro standing in the running stream like statues, and presently to land a fine salmon was the work of but a few moments. This fly must have been the original of Norris's killing "silver gray."

Salmo Fontinalis—Mitchell—Brook Trout.

The description of this fish as usually seen in the lakes about Halifax, would be—in length from ten to eighteen inches, and weight from half a pound to two pounds—though these measurements are often exceeded or lessened. The outline of back starting from a rather round and blunt nose rises gradually to the insertion of the dorsal fin, about two lengths of the head from the nose; it then gradually declines to the adipose fin, about a length and a half from that runs straight to form a strong base for the tail. The breadth of the tail is about equal to the length of the head. Below, the outline runs nearly straight from the tail to the anal fin, from thence it falls rapidly to form a line more or less convex (as the fish is in or out of season), and returns to the head. The intermaxillary very short, the maxillary long with the free end sharp pointed, the posterior end of the opercle is more angular than in the the *S. Salar*, the lower jaw shorter than upper when closed,—appearing longer when open.

The eye large, about two diameters from tip of nose; nostrils double, nearer the snout than the eye Of the fins, the dorsal has ten or eleven rays, not counting the rudimentary ones, in shape irregularly rhomboid but the free edge rounded or curved outward, the adipose fin varies, some sickle shaped with free end very long, others having it very straight and short. The caudal fin gently curved rather than cleft, but differing in individuals. Of the lower fins, they all have the first ray very thick and flat, and always faced white with a black edge, the other rays more or less red. The head is blunt and back rounded when looked down upon. The teeth are upon the intermaxillary bone, maxillary bones, the palatine, and about nine on the tongue. There are none so called vomerine teeth, though now and then we find one tooth behind the arch of the palate, where they are sometimes irregularly bunched together. The colour varies but through all the variations there are forms of colour that always persistent must be regarded as typical. There are always vermillion spots on the sides, there are always other spots, sometimes decided in outline, in others diffused into dapples—but always present. The caudal and dorsal fins are always spotted and of the prevailing hue of the body. The lower fins have always broad white edges lined with black and colored, with some modification of red. The chin and upper part of the belly is always white. With these permanent markings, the body colour varies from horn colour, greenish, grey, blue grey running into azure, black, and black with warm red on the lower parts, dark green with bright yellow lower parts, and lastly in young fish, vertical bands of dusky black. The spots are very bright and distinct when in high condition or spawning, faint, diffused and running into dapples when in poor condition. Of four trout purchased from a negro woman at Halifax, Oct. 28, 1864, during the spawning season, three were dark green, bright yellow spots, bright yellow bellies, dorsal fin spotted black on yellow ground, caudal spotted black on scarlet ground; lower fins scarlet with white facings lined with black. The fourth was nearly black above washed with red, the red becoming exceedingly vivid on the belly, all the fins bright scarlet marked as the others, spots bright scarlet—all had white chins, and stripe on the belly white, spots in all very small and vermillion specs in all, all the hues were most vivid and heightened by profuse nacre. This may be considered the colour in the highest condition. In others, the spots are very pale yellowish white and running on the back into vermicular lines, the irides in all dark brown. I have seen the rose or red coloured ones at all times of the year The young of the first year are green horn colour, with brown vertical stripes and bright scarlet fins, and tail already showing the typical markings and spots, and also the vermillion specs. Fin rays D. 13, P. 13, V. 8, A. 10, Gill rays, 12. Scales very small; dorsal has two rudimentary rays, ten or eleven long ones, varying in different fish. Typical marks, axillary plate nearly obsolete—free end of maxillary sharp, bars in young, vermillion specs, both young and adult lower fins red with white and black edge.

Unlike the salmon who is always a stranger, this beautiful fish is a favorite with all. He is with us the whole year, in large lakes, in brooks, in tiny rills were the young lurk for security, and even in the tide waters, to which he will always resort if in his power. In June, 1866, I saw some of exceeding beauty and colouring taken from the tide waters of Digby basin. At the outlet or inlet of some still water is his favorite resort, where poised on ever fanning fin he awaits his food. Whoever has had the privilege of lying at full length on a mossy bank and watching him in his lair—an old root or a tiny cave washed from the overhanging clay banks of the swift running waters, will agree with Agassiz*—"that a true figure of him has yet to be done." Head elevated at a slight angle, his capacious gills opening and closing, round mouth half open, and great round head and speckled and spotted back, overhung by the spotted dorsal hanging athwart, and throwing wavy circles off from every point, his gaudy scarlet tail and lower fins all tremulous, there he awaits his prey, be it an idle fly touching the surface, a larva coming down stream, or a venturous young perch. No spotted pard makes a fiercer rush than this marine tiger, on his quarry. The perch, if he is an ender (coming towards him), disappears at once, or the fly is snapped with an unerring precision. The true figure which yet has to be drawn must make him with a luminous brown eye, round in head and back, the dorsal hanging loose across his back and half elevated and floating watery circles from every point. The pectoral and ventral extended in parallel lines at nearly a right angle from the body and ever fanning—a double pair of propellers, the anal trembling through all its line, and the huge tail vibrating, every ray loose and every membrane floating. The ordinary plates make every fin stretched and rigid, and the pectoral always thrown back upon the side. In October and November he leaves the deep waters for the spawning shallows. In winter he is taken by bait through the ice. Of his muscular power in runningup rapids, Dr. Fisk, of St. John, N. B., an accomplished sportsman, informed me that once fishing the upper waters of the Miramichi he saw trout repeatedly rush up a perpendicular fall of water about six feet, then pause, tremble violently all over, and in a moment throw themselves clear of the stream and fall into the basin above, about four more feet. Many assert this is done by bringing head and tail together, but in the simple terms of an eye witness, a "trembling" was all he could perceive, which no doubt was all that was to be observed.

Six pounds is the largest weight of any trout taken in this Province to my knowledge, two and three pound fish always attract attention. I have never seen one myself four pounds. The colour

*Fishes of Lake Superior, 1850

of his flesh varies from red to pink, and pale yellowish white. Inferior in taste to salmon, it is only prized by those who cannot get the sea-board fish, yet it tastes very savoury roasted and eaten ten minutes after swimming in the cool waters, from a sharp pointed stick stuck around a camp-fire.

Salmo Canadensis—Hamilton Smith.

In early spring there is taken by gill nets or by fly fishing about Halifax, a sea trout. The tide water mouths of the various rivers are its favorite resort. In these waters he remains till August, sometimes running up the rivers with the tide a few miles, then again running sea-ward. A very gaudy fly will tempt him out of cover, in the thick tangled kelpy marine forests. Again he is found lurking in the up river deep holes of our turbulent streams. After August he is never found. This is the Trutta of Perley and Frank Forrester, confounding it with the English species. This is the salmon trout of "*The Game Fish of the North*," whose author identifies it with *S. Fontinalis;* and also this is the *S. Canadensis* of Hamilton Smith, in Griffith's Cuvier, as given in Dekay and Norris's *American Angler*. The question has been still more complicated by the brook trout running to sea, which they are always fond of, and thus being classed as sea trout.

On 26th May, 1864, Mr. John Butler, Bedford Hotel, gave me two taken from tide water. June 18th, J. Willis, Esq., gave me one from Cole Harbour, and during July I examined some dozen from Musquodoboit, and finally Wm. Silver, Esq., Halifax, gave me one in Sept. from the fresh water, the rest were from the tide water.

The description of these fish would be thus: of those from the tide way, length from twelve to fourteen inches, deepest breadth, something more than one quarter from tip of nose to insertion of tail. The outline rounds up rather suddenly from a small and arched head to insertion of dorsal, slopes quickly but gently to adipose fin, then runs straight to insertion of caudal, tail gently curved rather than cleft, lower line straight to anal, then falling rather rapidly to make a very convex line for belly and ending at the gills. The body deeper and more compressed than the brook trout. The dorsal is quadrangular, the

Note.—Wm. C. Silver, Esq., gave me a trout Sept. 29, 1866, taken on his own grounds, weighing about two pounds, fifteen and a half inches long, entire depth five and a half inches. This was a male fish, milt well developed. The intermaxillary enlarged and armed with larger teeth having a notch in it to receive the lower jaw, also lengthened and hooked. These changes altered the profile of the fish giving him a pointed nose. The colour was most brilliant, the belly tints carmine and the sides of the tenderest azure. The lower fins and lower edge of tail had the broad white and black anterior rays very well developed.

free edge convex, the lower fins having the first rays in each thicker and flatter like the brook trout. The adipose fin varies, some with very long and arched free end, in others small and straight. The specimen from the fresh water was very much longer and thinner, and head proportionally larger. The colour of those from the tideway was more or less dark greenish blue on back shading to ash blue and white below, lips edged with dusky. They all had faint cream coloured spots, both above and below the lateral line, with one exception they all had vermillion specks, but some only one of a side, others two or three. The head in all greenish horn colour. The colour of the fins in pectoral, ventral and anal, varied from pale white, blueish white to pale orange, with a dusky streak on different individuals. Dorsal dusky with faint spots, and caudal with dusky tips, on some a little orange wash. The lower fins had the first ray flat and white and edged with dusky. In two specimens the entire fish was spotted with minute black spots on every part, save the fins where the spots were red, but I considered these to be diseased fish. I leave it to better pens than my own to describe the glorious colouring of this fish dripping from the ocean. The fair green vying with the tender blue of the head and back, the silver of the sides, the lovely pink flesh showing through the silver of the belly, and the catching reflections crossing everywhere. In the specimen taken 10th Sept. from the fresh water, the blue and silver had disappeared, and dingy ash colour had spread down below the lateral line; the greenish horn colour had spread itself over the whole gills except the chin, which was white. The silvery reflections were all gone, the cream coloured dapples were much more decided in colour and shape, and the vermillion specks very numerous. The fins, the caudal and all the lower fins had an orange wash, the dorsal dusky yellow with black spots, the lower fins retaining the white flat ray with a dusky edging—and the caudal a few spots.

The teeth of all were upon the intermaxillary, maxillaries, palatine and on the tongue, none on vomer except now and then one tooth behind the arch of palate.

Fin rays, D. 13, P. 13, V. 8, A. 10. Gill rays 12. Axillary scale very small. Dorsal with two rudimentary rays, ten or eleven long ones, free edge convex, first ray lower fins flat, scales very small but rather larger than brook trout.

The weight of this fish goes as high as seven pounds, their general average is about two pounds. The flavor of their flesh exceeds salmon when fresh, salted or pickled it is very dry. I have said before that from May till August he is taken in our tide waters, both in the Bay of Fundy and along our Atlantic sea board and at Cape Breton. After August he is found in the lakes and streams. C. Anderson, Esq., magistrate, informs me he has taken them during winter through the ice by bait, from one to twenty miles from the salt water, and that he has often seen them returning to the sea in March. Mr. John Duncan, St. Margaret's Bay, is of the same opinion. Wm. C. Silver, Esq., of Halifax, who has studied their habits for years, and in waters running through his own lands, and almost past his own door, is of opinion that they remain all winter in the fresh water, leaving the tideway in August, that they rapidly change their colour and shape in fresh water, approximate to the brook trout in both, but are always distinguishable.

In classing this fish we must acknowledge it exceedingly closely allied to *Fontinalis*, that it has the teeth, shape of fins, axillary plate, tail, dapples, vermillion specks, spotted dorsal, alike; that when it runs to fresh water, it changes its colour, and in doing this approximates to its red fin and dingy green, and more numerous vermillion specks still more closely. Whilst on the other hand, we find it living apart from *Fontinalis*, pursuing its own laws, attaining a greater size, and returning year after year to the sea. That *Fontinalis* is often found unchanged under the same circumstances. That it always preserves its more arched head, deeper and more compressed body, and perhaps shorter fins. That this has been so for certainly a hundred years, and most probably for thousands, nor have we any evidence that it was at any time not so, except by analogy. In giving it a specific name therefore, and using the appropriate one given it by Col. Hamilton Smith, so far as I can discover, the first describer, I think I will be borne out by all naturalists.

Salmo Gloverii—Girard.

Under the misnomer of *Grayling*, a very handsome dark brown trout has long been known to sportsmen as being killed in the lakes about Halifax. The largest were about seventeen to twenty inches long, and weighed two to four pounds. But it was more celebrated for its courage and game qualities, one of half-pound weight giving better sport than a salmon of six or eight pounds; they are often known to spring six feet out of water, three or four times in succession, when struck; they are taken by bait also, being greedy feeders. That they approach the shallow water, and spawn in November, and at other seasons, may be taken the whole year in the deep waters, being lake trout,—and that their young are taken during summer, in the margins of our lakes, having the red spots and tendency to

Note.—*S. Imaculata*, of Storer, with large scales, very large axillary plate, larger pre-opercle, is not to be confounded with this species. It is a more Northern species, and not taker in our waters. The dorsal is concave instead of convex. I have examined hundreds, but they were all pickled and from Labrador. The very large ones had no spots of vermil, but the smaller ones all had. In other respects Storer is correct. His description is based on one specimen.

vertical bars of the *Genus Salmo*,—is all that I have obtained of its habits. Their flesh is deep yellow in some cases, in others white and of no great flavor. I am indebted to F. W. Putnam, Esq., Salem, for directing my attention to a description of this fish by Girard, in the proceedings of the Philadelphia Institute Natural Sciences, May, 1854, the only notice I believe extant, and thus preventing me noticing it as an undescribed species. I here beg to acknowledge his courtesy as well as the scientific knowledge so kindly given to an entire stranger. The following description is taken from specimens given me by Lt. Col. Hardy, the late Archdeacon Willis, and Canon Gilpin.

Length, about seventeen inches; breadth of widest part from first dorsal, two and a half inches; length of head, nearly two and a half inches; the shape of head fine and small, the back rising rather suddenly, from posterior to head, sloping very gradually upward to insertion of dorsal, thence downward to insertion of tail, lower line corresponding with line of back; a long elegant shaped fish with a strong base to a powerful tail; eye large nearly half an inch in diameter and two diameters from end of nose; opercles rounded, and with the pre-opercles marked with numerous concentric streaks; the lower line of inter-opercle parallel with line of the body, labials both upper and lower arched, line of pre-opercle not so rounded as opercle; the pectoral fins coming out very far forward almost touching the gill rays, dorsal commencing about two lengths of head from tip of nose, sub-quadrangular, free edge concave, ventral about opposite sixth ray of dorsal, adipose fin opposite posterior edge of anal, and caudal deeply cleft, and very nearly the length of head in depth. In one instance the tail was square, intermaxillaries, maxillaries, palatines, vomer and tongue armed with sharp and recurved teeth, the teeth on the vomer extending half an inch down the roof of mouth, a fleshy line extending from them to the gullet, the upper jaw notched to receive the lower. In two specimens a prolonged hook in lower jaw advancing beyond the teeth. Girard says the male fish has adipose fins opposite anterior edge of anal, the female opposite posterior edge. Whilst in the following description taken from a female fish I have verified his remarks, I have added, in the male the adipose fin is very much larger, which is almost the same thing. Colour black above shading down to sepia brown at the lateral line, the brown being the back ground to numerous black spots, some round, some lunated extending from opercles to tail. The opercles partake of the same general colour with yellow reflections and blue tints, but also marked with spots extending to the pre-opercles, beautifully round and distinct; sides yellowish and belly white with pearly tints, the whole covered with bright scales larger about the sides than beneath. The colours vary much by the reflected lights made by turning the fish. The colour of the fins fresh out of water, caudal brown, dorsal brownish black and spotted, lower fins dark brown, edges and tips dark, a very fleeting lavender wash on dorsal, sides yellowish. In one adult specimen I nôticed a few red spots on sides, but in the young fish they are very marked and beautiful. Some seen by myself in July had vertical bars, red spots, were very silvery on sides and all even the smallest had the typical opercular spots very distinct.

They were exceedingly beautiful and might have readily been taken for a different species. On opening the fish, from gills to tail the heart with its single auricle and ventricle first presented, the liver overlapping the stomach and pale yellow, the stomach descended about one-half the length of the fish, was then reflected suddenly upon itself where it was covered by numerous *cœca* (about thirty), these are the *pyloric cœca* of authors. It then turned down again and soon was lost in small intestine ending at the vent. The spawn were each of the size of currants and bright scarlet, about a thousand in number, and encased in a very thin bilobular ovary, the left lobe occupying the left side, being a little over three inches, and only one-half the length of right lobe occupying right side; a second fish gave the same placing of ovary. Both these fish were taken on the 2nd and 4th November at Grand Lake, Halifax, and evidently near spawning. Fins, D. 12 or 13, P. 14, V. 9, A. 9, C. 20. Axillary scale small. The first dorsal ray in some instances contains two in others three small rays. Typical marks, spots on opercles.

The Loch Lomond trout near St. John, N. B. are identical with these fish; I saw some at Stubb's Hotel, taken by H. Gilbert, Esq.; Perley confounds them with *S. Ferox*. With the exception of Girard I believe this species has not been noticed by naturalists or sportsmen, yet it is worthy of notice from both, by one for its game qualities, and by the other for its most resembling the European trout, in its teeth down the vomer and brown colouring and spots.

Salmo Confinis—DEKAY. *Salmo Adirondicus*—NORRIS.

For some years reports have been made of a large black fish seen in our interior lakes, principally from Chester. They were generally considered spent salmon. One gentleman about twenty years ago, built a boat, and camped for some time on the lakes, but was not successful. About two years ago Col. Sinclair sent two specimens to J. M. Jones, Esq., who identified them as the lesser lake trout, the *Salmo Confinis* of Dekay, common to most of the small lakes of the Northern States. Subsequently Col. Chearnley sent some to town taken by the Indians. From these and other specimens taken from great Pock Wock lake near Halifax, the following description is taken. The first, of one weighing about three pounds, and evidently a young fish.

Length eighteen and a half inches. Length of head one fourth of length to insertion of tail. In some others the head was rather longer. Insertion of first dorsal two lengths of head from tip of nose. The outline commencing from a round obtuse snout, rose almost immediately and suddenly, owing to the large orbit of a very large eye placed very high in the head, and ran gently upward to insertion of dorsal, then straight to adipose fin, then rather suddenly depressed to insertion of a very strong and deeply curved rather than forked tail. The outline of belly much more convex than that of back. The greatest girth in front of dorsal and about one-quarter of length to insertion of tail. The labials arched, the eye very prominent and set high in the head, about two diameters from tip of nose, not quite four to outer edge of opercle, pre-opercle very thick and puffy, its outline at right angles with line of body, and subcircular. Interior edge of inter-opercle parallel with line of body. Colour fresh from water, black on back running to dusky below lateral line, where it assumes a yellowish wash and ending in white on the belly (one was mottled or obscurely spotted with white on sides, another had vertical bars of dusky). Head of the same colour as body, a little bronze on opercle and pre-opercle, tip and edges of chin blackish and below white. The dusky hue was caused by minute dots, the dots taking the form of scales on the belly. The colour of fins was—dorsal dusky yellow, spotted with three irregular rows of spots, rays lighter than webs, adipose blackish, pectoral and ventral yellowish dusky, when folded tips dark, a slight orange wash on tips, anal and caudal yellowish dusky, a slight orange wash on tips in anal. Teeth on palatines, vomer, upper and lower maxillaries, intermaxillaries and tongue, in one a few teeth down the centre of tongue as well as on the sides, upper lip notched to receive lower. D. 10, P. 14, V. 9, A. 8. Gill rays, 12. The first dorsal ray very thick, containing perhaps a rudimentary ray, the first rays of all the lower fins flat and thick, caudal cleft about one-half a length but outline rounded. Irides salmon yellow, scales minute, typical marks very large head, one-fourth length, fleshy pre-opercle and teeth down the middle of tongue.

These young fish resembled in outline, the plate of *S. Siscowitz* (Agassiz), the fins differing. They also resembled Norris's figure (*American Angler*) of *S. Adirondacus*, but in comparing them with other specimens weighing from seven to ten pounds, I found these last coincided with Dekay's figure, except that it is feebly drawn and not giving the strong characteristics of the adult fish, and that both, although the young fish was slender and elongated, and the older thick and stout, preserve the strong typical marks of the species. The large eyes set high in the head, and projecting orbit, the very fleshy pre-opercle, the short distance between posterior end of anal and caudal fins, the same colour and teeth, both having the very peculiar triple row on tongue, and the very large head. As the fish becomes larger all these typical marks become stronger, till one weighing twenty pounds or upwards, in his huge and fleshy jaws, thick back and tail and great girth, resembles more a cod than a salmon. Of the half dozen I examined, one, evidently an old fish, had an irregularity of caudal fins, the lower lobe much the longer. I attributed it to an injury, but Col. Hardy noticed the same irregularity, and Mr. T. Mackie, who has fished numbers of them, assured me it was quite common. I have no explanation for these facts. As regards colour, when taken immediately out of the water, the heads are a dark greenish horn colour, the backs black, sides yellowish with spots and belly white. These colours are varied and heightened by the thick nacre and reflected lights of the scales. As the fish becomes stale, the nacre dries, and a light purplish or amethystine colour pervades the whole. The tip of caudal and lower fins faint orange or yellowish. *The third row of teeth* on the tongue so peculiar to this salmon alone, is not always to be found, even some adult fish have it not. Dekay and Perley give them, Frank Forrester not, yet each from actual inspection. I have examined specimens both with and without them. They are taken with a whole line, as fishermen call thirty fathoms. Our alpine lake basins having this great depth. The flesh is coarse. They are usually bottom feeders, though the Indians assert they will rise to a red rag, and perhaps never exceed twenty-two pounds, although there are many accounts of their huge size attained in lakes where there are no weighing scales.

In concluding, all what I could procure either personally or from reliable sources of this very interesting genus, a very few general remarks will suffice. In regard to teeth, we find as typical marks they are not so reliable as in the *Mammalia*. It is all but certain that *S. Salar* renews his teeth in the male twice a year. One species has a triple row on the tongue, and that not constant, the others having a double row. As regards vomerine teeth or rather teeth down the roof of the mouth, two, *Fontinalis* and *Canadensis* have none, or at best one tooth and that not constant, the *Salar* has two or three, and *Gloverii* and *Confinis* a strong row. I say teeth down the roof of mouth, for strictly speaking they all have vomerine teeth, for the palatine bones being each side of an arch of which the vomer is the keystone, and the palatine teeth being an uninterrupted circle round the arch, it follows that the head of the vomer always has teeth but not always down the bone. The author of that very pleasant book, "*Game Fish of the North*," should remember this when he asserts that *Fontinalis* has no vomerine teeth. When he indulges in sneers against naturalists, and smart writing about marine dentists, he should at least be correct, especially as only a scholar, a naturalist and sportsman combined, could have written as he has done of rock and flood. We have one species common to both worlds, another *Fontinalis*, in its teeth, red spots, rose belly, and broad plated white edged orange fins, is the true analogue to the *Char* of Europe. Whilst *Gloverii*, in its brown colour and teeth resembles *Fario* of Europe and *Confinis*, the great lake trout of Scotland's lakes. So far I have never heard of *Corregonus* the analogue to the *Vendace* of England, but may find it at any time; not so with the splended analogue to the *Grayling* of Europe, the *Signifer* of Sir John Richardson. His range is too northern, and his great beauty and typical dorsal would have betrayed his whereabouts long since.

Art. XI. The Glacial Period in North America. By Thomas Belt, F. G. S.

[*Read May* 8, 1866.]

I. Introduction. II. Glaciated Rocks and Drift-Beds of Nova Scotia. 1. *Eroded valleys and scratched rocks.* 2. *Drift-beds.* 3. *Gold in the Drift.* 4. *Marine beds of the St. Lawrence.* III. Origin of the Glacial Period. 1. *Theories of Origin.* 2. *Recent changes of level of the land in northern hemisphere greatest towards the pole.* 3. *Effect of shutting off warm currents from the Polar Basin.* IV. Action of the Ice. 1. *Statement of the question.* 2. *Accumulation of the Ice.* 3. *Culmination.* 4. *Retreat.* V. Application of the Theory to some of the Phenomena of the Drift. 1. *Local character of the Drift.* 2. *Transported Blocks of Berkshire, Massachusetts.* 3. *Drift of the St. Lawrence. Terraces and Stratified Deposits.* VI. Conclusion.

I.—INTRODUCTION.

Until the last few years most geologists have taught that the glacial period was one of a great submergence of northern land, over which floated icebergs bearing from more arctic regions, stones, gravel and clay. Agassiz had long ago argued that land and not floating ice had been the effective agent in the glaciation of countries, but his theory met with little support, until the investigations of Norwegian and Swedish geologists proved that the glaciation of the Scandinavian peninsula had radiated from the central mountains, and could not have been produced by currents drifting icebergs from the north. The same result has been worked out in Scotland by Mr. Jamieson, and in North Wales by Prof. Ramsay, and now geologists are agreed that at the time of the greatest developement of the ice in Europe, the land was elevated above its present level and covered with ice, which descending from the higher ranges, deepened and widened the valleys down which it flowed.

The continent of North America is more glaciated than that of

Europe, but there is not the same evidence of the radiation of the transported blocks from central heights; and whilst Agassiz, Dana and other eminent geologists have adopted the theory of land ice, Lyell and Dawson have advanced many arguments in favour of that of icebergs. The question is therefore an open one, and no where can it be more appropriately discussed than before this Institute; for Halifax stands on ice-moulded hills, on an ice-cut harbour, and is surrounded by glaciated rocks and ice-carried drift.

During the progress of the exploratory works of the Nova Scotia Gold Company, carried on under my direction, I obtained what appeared to me conclusive evidence, that neither during nor since the glacial period has the southern coast of Nova Scotia been covered by the waters of the ocean. I purpose in the present paper to describe these facts, prefacing them with a short sketch of the glaciated rocks and superficial deposits of the Atlantic coast of the Province, and afterwards to discuss the question of the glacial period in North America, of which these phenomena are the monuments.

II.—GLACIATED ROCKS AND DRIFT-BEDS OF NOVA SCOTIA.

1. *Eroded valleys and scratched rocks.*—The Atlantic coast of Nova Scotia is cut into by long, narrow deep bays or fiords. The direction of the bays is roughly north and south. The hard rocks that bound them exhibit everywhere glacial scratchings and groovings in an excellent state of preservation and with a similar north and south direction. Going farther from the coast the long bays give place to deep and often narrow lakes, also pointing north and south. Chains of lakes sometimes reaching across the country have the same direction.

The whole country is hugely cut into irregular meridional ridges and furrows, which are as much part of the glaciation of the land as the scratchings and groovings. The valleys are scooped out of extremely hard quartzites and other metamorphosed rocks. These are highly inclined, and their strike is north-east and south-west. The valleys have been excavated across their upturned edges, transversely to their strike. Scratches and grooves might be caused by icebergs grinding along the bottom of a shallow sea, but the glaciation of a continent and especially the scooping out of long valleys, requires the uniform action of a more powerful agency.

2. *Drift-beds.*—It is, however, in the composition and distribution of the drift-beds that we find the most convincing evidence of the supra-marine character of the glaciating agent. In Nova Scotia the hollows are comparatively free from drift excepting where mounds across valleys mark the position of old terminal moraines. It has generally been pushed into recesses in the ranges, or to the south end of hills where it was sheltered from the ice moving southward.

Thus Lake Thomas near Waverly is bounded to the west by a rather steep range running north and south parallel to the lake, down to and into which it rapidly slopes. The structure of this hill has been well exposed by cuttings made in search of auriferous quartz veins. The northern end and the side next the lake has a thin covering of clay, gravel and boulders. The bed-rock is rounded, scored and grooved. Masses of quartz have been broken off from the lode and carried southwards. The southern end of the hill is composed entirely of clay, gravel and large angular stones. A tunnel was driven into it for about two hundred feet and no solid rock could be found, nothing but huge stones and other drift pushed in under the lee of the rocky beds to the north.

The transported blocks and the direction of the scratchings show that the glaciating agent moved from the north. If it had been floating ice and the hill at the time a submerged rock, the icebergs ought to have stranded on and deposited their freight at the northern, and not at the southern end. If on the contrary it was glacier ice the phenomena are just such as we might expect to find.

Again, if this drift had been dropped from icebergs floating over a submerged land, and we could imagine any possible means by which it could be arranged as we find it, we have still to account for the greater difficulty, that whilst the land slowly rose again from beneath the waters of the supposed glacial sea, and was exposed to the action of the waves on the spreading coast line, these ridges of incoherent drift were left unlevelled, and these bare hollows were left unfilled.

3. *Gold in the Drift.* — Through much of the drift grain gold is sparingly disseminated, and its distribution affords another argument in favour of the supra-marine theory. In Australia all the most important deposits of alluvial gold have been found in valleys lying immediately above the bed rock, beneath beds of gravel and clay; wherever surface washings have been discovered much richer

deep sinkings have been found in the vicinity. This indeed seems to be a necessary result of the sorting arrangement of water.

But in Nova Scotia, though denuded auriferous quartz lodes are abundant, no similar deposits have been found with one exception, to the consideration of which I will return. The gold instead of being concentrated at the bottom of the superficial deposits, is either distributed throughout them, or occurs in greater abundance at the surface than below.

At Lawrencetown extensive washings were projected, in consequence of the discovery of spangles and grains of gold in the surface soil. It was expected that it would be found in larger quantities in the lower parts of the beds of gravel, as in other gold producing countries; but these expectations were not realized. A little gold was found throughout the gravel, but nowhere so abundantly as at the surface. Probably the gold had been originally distributed throughout the drift, and its partial concentration at the surface had been caused by subærial denudation. The process of denudation may be seen in operation on every hill side. During the severe winter the ground freezes to about two feet from the surface; when the spring thaws set in this is completely disintegrated, and much of the finer soil is carried off into the rivers by the water from the melting ice and falling rains. The heavier stones and the gold are left behind, and thus are produced the surface gold washings, and the surface accumulations of stones culminating in the well known barrens of the Province. Since these gravels were deposited, they cannot have been rearranged by water ; its sorting action would have carried the heavier gold to the bottom of the deposits, as in other gold producing countries.

The great richness of the gold washings in Australia and their scarcity and poverty in Nova Scotia, notwithstanding the abundance of auriferous lodes that have been denuded, may be thus explained: In Australia the denuding agent was water, which carried off the ground up rocks but left behind the gold—so that in the gravel beds nearly all the gold but only a small proportion of the original rock mass is left. In Nova Scotia the denuding agent was glacier ice, which carried off alike the stony masses and their metallic contents. The drift-beds left contain only the same proportion of gold as existed in the original rock mass, excepting where subærial denudation has concentrated it on the surface.

Perhaps in sediments older than the glacial period and which have escaped destruction during it, or in the beds of existing streams, or on the present sea coast, deposits of grain gold may be found, but they will be only the exceptions to the general rule. I have mentioned one exception. It belongs to the third class: it has been produced by the waves of the sea on the existing coast line. I refer to the gold washings at the Ovens, near Lunenburgh, which, though limited in extent and soon exhausted, for a time largely remunerated some of those employed upon them. From the side of a rocky promontory, traversed by numerous small auriferous quartz veins, spreads out a bed of glacial drift, throughout which grain gold is sparingly disseminated. The sea is slowly eating into this bed and rearranging its materials. It grinds up the stones to shingle and finally to sand and mud, which it carries off to deeper water, leaving behind the tough heavy gold. This is found at the bottom of the shingle between tide marks, on the surface and in the crevices of the bed rock, where the gold formerly distributed throughout a large mass of drift has been concentrated. Now if the country had been submerged during the deposition of the glacial drift, every part of it, during its subsequent elevation, would at some time have formed a portion of its ever advancing coast line, and been subjected to the action of the waves; and such deposits as those of Lunenburgh instead of being confined to the present shore would have been formed all over the emerging land.

4. *Marine Beds of the St. Lawrence.*—In the valley of the St. Lawrence marine beds with sea shells are found at various elevations, up to five hundred feet above the sea near Montreal. These beds lie above the glacial drifts, and prove that subsequently to the deposition of the latter, the country was submerged to at least the height at which the marine beds are found. From a consideration of the facts stated above, I am convinced that the Atlantic coast of Nova Scotia did not participate in this depression, and a study of the marine deposits themselves leads to the same conclusion. At Montreal sea shells have been found up to a height of five hundred feet above the sea, but lower down the St. Lawrence they do not occur excepting at a lower level. Thus on the Metis river they are found at a height

of two hundred and forty-five feet, and lower down still at Matan river they have not been found much higher than fifty feet above the sea. I do not suppose that these shells mark the extreme heights to which the sea has reached at the different places, but so far as the observations go, they show a decrease of the submergence towards the mouth of the Gulf. I am not acquainted with the drift-beds of the Province of New Brunswick, but I have no doubt that they will be found to bear out the same inference, namely, that going eastward from Montreal the elevation of the marine beds marking the former submergence of the land gradually decreases, until in Nova Scotia it reaches zero.

The gold washings of the valley of the Chaudiere within the area that we know, which from the evidence of sea shells was submerged after the glacial period, show us what would have been found in the auriferous districts of Nova Scotia, if that Province had also been submerged. The absence of gold washings in Nova Scotia and their presence in Lower Canada, are strictly in unison with the absence of marine deposits with sea shells in the one district and their presence in the other.

II.—ORIGIN OF THE GLACIAL PERIOD.

1. *Theories of origin.*—It is far beyond the scope of this paper to enter upon the discussion, or even to give an account of the various theories that have been advanced in explanation of the origin of the glacial period. It is less necessary for me to do so as the whole question is quite a modern one, and the views of Croll, Frankland and others have been so recently made public, that the scientific world is well acquainted with them and with the objections that have been urged against them. I will therefore confine myself to the consideration of the one that seems to me the most satisfactory

Sir Chas. Lyell in his admirable *Principles of Geology* long ago showed that the extremes of heat and cold might be produced by the grouping of the land; in the one case, about the equator, and in the other, about the poles. There can be no doubt that a rise of polar and a submergence of tropical and sub-tropical lands, would greatly lower the temperature of the arctic and temperate zones.

That during the glacial period or part of it, the land now glaciated stood somewhat higher than at present, has been inferred from the depths to which fiords have been excavated, and from the fact of littoral shells having been dredged many miles from existing coasts. With regard to the submergence of tropical and sub-tropical lands, it is now well established that at the same period the African Sahara was covered by the waters of the ocean, so that we have an approach towards the conditions required for the production of extreme cold. That the conditions were all fulfilled is very improbable, indeed that they were not is proved by the ice having extended much farther south in North America than in Europe.

2. *Recent changes of level of the land in northern hemisphere greatest towards the pole.*—In a paper on some movements of the earth's surface in recent times,* I have remarked that in two instances in the northern hemisphere, one of depression, the other of elevation, the movement is greatest towards the pole. This matter is so important in dealing with the question of the probability of a rise of Arctic lands in the glacial epoch that I may be permitted to refer to it again, and to supplement the argument with some additional facts bearing upon it.

It has long been known that parts of the coasts of Sweden and Norway were slowly rising, and in the time of Linnæus marks were made on the rocks by which the rate of elevation at different points has been determined. It appears that at Gottenberg in the south, the land is only being raised about four inches in a century, but that the rate of motion gradually increases northwards, until at Cape Cod, the extreme point where it has been measured, the land is being raised about four feet in a century.

Opposite to this area of elevation, on the other side of the Atlantic, there is a corresponding area of depression. It appears to be well established that the Atlantic sea board of North America is slowly sinking. In New England the subsidence is scarcely perceptible, but it gradually increases as we proceed northwards. In Nova Scotia the submergence of marsh lands and of rocks has been generally remarked by the residents on the coast, and Cobequid bay and Cumberland basin submarine forests attest the long continuance of the downward motion. This subsidence attains its maximum on the west coast of Greenland, where the land is so rapidly sinking that in quite recent times the settlers have had to move

*These Transactions, vol. I, Part I, p. 24.

inland more than once the poles on which their large boats are placed. Here again the rate of motion is greatest towards the pole.

The present period of subsidence was preceded in part of eastern North America by one of elevation, which brought up the marine deposits of the Champlain period; to which the Montreal beds already mentioned belong. On the southern borders of New England these marine beds are only found up to about forty feet above the sea. As we proceed north they are found higher and higher. At Montreal they reach to five hundred feet above the sea, and in the extreme north, on Cornwallis and Beechey Islands in Barrow Straits, they have been found at an elevation of over one thousand feet. Here again the elevation is greatest towards the pole and gradually decreases southwards. To produce extreme cold according to Sir Chas. Lyell's theory, we only require a similar movement on a larger scale, and these smaller oscillations with their vertices towards the pole, may point to some general law governing the upheaval and subsidence of the earth's crust which would, if it could be deduced, explain the elevation of the land towards the north and its depression towards the south during the glacial period.

3. *Effect of shutting off warm currents from the Polar Basin.*—We do not know how small a change in the distribution of land and water might again produce a glacial climate. The effect of a change in the direction of the Gulf Stream, has been discussed by Mr. Hopkins and other writers, but I do not think that it has been noticed that a much greater change of climate would be produced, if all warm currents were shut off from the polar basin. Sir John Herschel has indeed stated that if Behring's Straits, which are only thirty miles broad, were closed so as to prevent the water circulating from a warmer region, finding its way into the polar basin, there would probably be a continual accretion of ice which might rise to a mountainous height.*

But if, besides the closing of Behring's Straits, there were a partial emergence of land from beneath the ocean, connecting Europe through Iceland and Newfoundland with America, we can scarcely appreciate the effect it would have in altering the climate of the northern hemisphere. There would not only be a great lowering of temperature through the increase of land around the poles, but

*Herschel's Physical Geography, page 41.

the heat of the Gulf Stream and other warm currents that is now expended in tempering Arctic seasons and melting polar ice, would then be spent in evaporation; and greater evaporation would give greater precipitation on the frozen lands of the north. The formation of continental ice requires both a low mean temperature and an abundance of moisture. The rise of northern lands, and the closing of the Arctic basin to southern waters, would give the one, and the greater warmth of tropical and sub-tropical seas, into which no polar currents ran and from which no warm waters flowed, would give the other.

IV.—ACTION OF THE ICE.

1. *Statement of the question.*—Turning our attention now to the possibility of land ice having glaciated the whole of eastern North America, we encounter the difficulty that has prevented many from accepting the theory of continental ice, who are fully impressed with the satisfactory solution it affords of the distribution of the drift-beds and the erosion of valleys. It is that whilst the rock scratchings and transported blocks prove that the glaciating agent moved from the north, there are no mountains in that direction from which it could have descended, and that any elevation of Arctic regions sufficient to give a slope that would bring the ice southwards like a great glacier is utterly improbable, if not physically impossible. With this opinion I fully coincide, but so far from considering it fatal to the theory of land ice, I believe that no such slope was necessary, and that the theory better explains the phenomena of the drift, on the supposition that there was no great elevation of northern lands than by a contrary hypothesis.

The subject may be best understood by tracing in imagination the accumulation of the ice and its progress southwards, its culmination and subsequent retreat, and noting whether or not its probable mode of action will account for the facts to be explained. It will be convenient to limit the discussion to one great area such as that of eastern North America, where the glaciation though on a grander scale than elsewhere, is more uniform from the very vastness of the agent that effected it.

2. *Accumulation of the ice.*—As the glacial period, from whatever cause, came on, snow and ice would gradually spread from the arctic circle southwards. Wherever there was not inclination of the

surface sufficient to carry it off bodily, as a glacier it would accumulate and be piled up until the higher portions slipped over the lower.

It has been suggested above that one of the most powerful causes that brought on the glacial period, was the shutting off the gulf stream and other warm currents from the arctic area, where at the present time they are ceaselessly employed in ameliorating the climate and melting up the ice at its source. They now eat into the very vitals of the icy foe, which attacked and routed in the rear draws in its forces to its inmost citadel. In the glacial period the breaches that now let in the invading waters from the south, were closed, and the icy hosts gathering in the north, pushed out their legions southwards, and drew their very sustenance from the forces that now beat them back to their arctic fortress.

Piled up then in the north the ice and snow would spread southwards. Where it encountered a high range running transversely to its flow, it would at first be diverted from its course, but it would gradually accumulate behind the obstacle until it overtopped it, at first flowing through passes in the range and ultimately overwhelming the whole ridge. In advance of the great mass, streams of ice would flow down pre-existing valleys and through passes in opposing ranges, deepening, widening and glaciating them, like pioneers cutting out roads for the main body. In some cases, passes through chains of hills would determine the erosion of valleys in front of them, by the ice that poured through from behind.

This moving margin of the advancing ice would be the effective tool in glaciating the country. To its action every portion of the surface would be exposed, whether its slope conformed to the course of the ice flow or was opposed to it; just as every part of a coast between tide marks is washed by the rising flood. And as the waves run forward on the shore and retire, to again advance, and again retreat, although the whole body of water is steadily rising, so we may suppose that the ice margin might greatly advance during a series of cold seasons, and retreat during warmer ones, to be again thrust forward and again drawn back, although during a great number of years the advance of the main body of ice would carry the fluctuating margin far forward and subject a new zone to its action. Thus the whole continent from the arctic circle to as far south as

Baltimore and Ohio was slowly and successively worked over. Many of its old valleys would be deepened and many new ones excavated. Lines of faults, of fractured or of softer strata, would be worn into valleys and lake basins. Everywhere the ice would find out the weakest points of the rock masses and work deepest there.

The moving margin of the ice flow and especially the glaciers thrown out in advance, would be the great producers and carriers of drift. The stones borne along upon a glacier are from the cliffs and peaks that rise above it and not from the rocks beneath, over which it passes. The latter are only smoothed and rounded, but the cliffs that bound a glacier are eaten into like a river bank. Masses of rock are undermined and fall down upon and are carried away on the ice, to be deposited in terminal and lateral moraines.

3. *Culmination.*—At last the ice reaches its limits. Mount Washington is glaciated nearly to its summit, and at the time when there was most ice only its top could have stood out—a desolate island in a frozen sea. To the north the whole continent must have been covered without a single peak rising above the universal pall.

It is probable that during the greatest development of the ice, most of the drift that had been produced would be destroyed by being ground to powder under the mighty moving mass, and carried away in the water which we know flows turbid from beneath every glacier. The time of thickest ice was not that of the production of drift, but of the rounding, polishing and grooving of mountain masses. Could the icy covering have been lifted the rocky skeleton of the country would have been exposed, with scarcely a patch of gravel or soil upon its bare, scarred frame.

The scratchings on the highest peaks show that the main body of the ice moved south-easterly. Here we see the action of two forces—one, from the north, was the accumulation of ice in that direction; the other, from the west, was the slope of the continent towards its eastern sea board.

4. *Retreat.*—If then drift was not formed when the ice was at its height, and that which had been produced during its advance was then destroyed; whence the heaps of gravel and the transported blocks that now cover the face of the country? They were distributed during the slow retreat of the ice, when again every part of the country was subjected to the action of the moving margin. Just

as the whole of a sandy beach is rippled between high and low water marks by the retiring tide, so during the gradual retrogression of the continental ice, every portion of the country that had been covered, —from the valleys of the Ohio and the Missouri to the Arctic hills, and from the summits of the hills to the bottoms of the deepest valleys,—became again for a time, as they had been during the advance of the ice, the shore of an ice sea, or the boundary of an ice stream. Again the ice wore into its rising banks and carried off stones and gravel and formed terminal and lateral moraines.

The transportation of drift from any region began as soon as any of its mountain tops emerged above the subsiding ice. The highest peaks would send the farthest carried fragments, and lower and lower as the ice flow ebbed, so nearer and nearer to their source would its burdens be deposited.

Like its advance, the retreat of the ice was probably slow and fluctuating. During some seasons it would diminish greatly; during others advance again, but taking a number of years together there would be a decided retreat. The ice would act on the rocks during its subsidence as it had done during its rise, but the drift formed and deposited instead of being destroyed by the advancing mass, was left in the valleys and on the hills as we now find it. The only differences on the southern coast of Nova Scotia that we can detect are, that the moraines in the valleys have often been cut through either by the streams that issued from beneath the retiring glaciers, or by those that now run through them, and that large stones and grain gold have been concentrated on the surfaces of drift-beds on the hill sides.

V.—APPLICATION OF THE THEORY TO SOME OF THE PHENOMENA OF THE DRIFT.

1. *Local character of the drift.*—Having thus sketched out the probable action of the ice during its advance, culmination and retreat, and explained the general distribution of the drift, it only remains to apply the theory to a few of its more striking features. The local character of most of the drift stones in Nova Scotia is one of these. Here and there a few blocks of granite are found, that have been brought two, four, or even eight miles, but the great majority of fragments belong to the rock formation over which they lie. Boulders of slate occur where bands of slate cross the country,

and boulders of quartzite where the bed rock is quartzite. Fragments of quartz sometimes containing gold are easily traced to the lodes (invariably to the north of them) from which they have been detached, and thus many auriferous lodes have been discovered.

The local character of the stones in the drift is opposed to the supposition that to the north the land was so elevated that the ice moved over the country like a great glacier, and is in favor of the theory that it was formed by the retreating margin of a great accumulation of ice. If there had been during the glacial period, high mountains to the north of Nova Scotia, far travelled blocks would have been of frequent occurrence. But without high ranges northwards and with its own hills only of moderate elevation, we find as we might expect, that the blocks are easily traced to their parent rock. Some boulders of granite have been carried farther, because here and there granite hills rise above the general elevation of the country.

2. *Transported blocks of Berkshire, Massachusetts.*—Sir Chas. Lyell has described some long trains of large blocks that in Berkshire, Massachusetts run, in nearly straight line, for distances of five, ten and twenty miles, across hill and dale alike.* The direction of the trains is N. W. and S. E., and they cross three chains of hills with intervening valleys running N. N. E., and S. S. W. The blocks, starting from the most north-westerly ridge, pass in long lines across the valley to the next, and on to and in like manner through gaps in the third range.

It is argued that these blocks could not have been carried by glaciers, as they would have followed the slope of the valleys and not have crossed them; and that it is more likely that they were dropped by icebergs when the country was submerged, so that the tops of the hills became islands and the passes straits, through which the icebergs floated driven by a current from the north-west. The argument is a valid one against a theory of local glaciers, but not against that of continental ice. I have already shown how the advancing ice would act when it encountered ranges running transversely to its flow. This is an example, only I suppose the blocks were left by the retiring ice when the same process was repeated. At its greatest height the ice covered the ranges and rounded them. When during its subsi-

*Lyell's Antiquity of Man, page 356.

dence the highest points rose above the ice, rocks would be undermined and carried away. As the ice diminished and the ranges emerged, a time would arrive when the passes would become icy straits through which flowed ice from behind. It could not move down the valleys, for at that time the great north and south valleys of the Hudson and the Connecticut must have been filled with the ice that dammed up the lateral valleys.

The first stage in the formation of the trains began when the two valleys were filled with ice, and glaciers streamed through the passes in the most southern range bearing blocks from those behind. As the glaciers wasted the boulders would be left in lines marking the retrogressive points to which they reached. When the passes of the third range were free from ice it would still flow through those of the second, and as it receded it would leave step by step the monuments that now mark the direction it took. The resemblance of many of the phenomena of the drift to those that might have been produced by floating ice, proceeds from this,—that the valleys were filled with ice as they would have been by water in the former case, and that glaciers flowing through the gorges in the hills took the place of the suppositious icebergs.

3. *Drift of the St. Lawrence.*—Dr. Dawson of Montreal, has pointed out that the drift of the valley of the St. Lawrence has been carried up the valley. He argues that it ought to have been carried down it if the transporting agent had been land and not floating ice.

This objection is again rather against a theory of local glaciers conforming to the slope of the valleys, than that of continental ice.

The great valley runs from south west to north east, and the ice coming from the north must have flowed up it, if it was influenced by it at all. The general direction of the ice flow was from N. N. W. to S. S. E., but it could scarcely fail to be somewhat influenced by such a wide and deep valley running obliquely to its course. The valley must have filled from the bottom upwards, and drift would be carried from the high grounds on the sides to the bottom of the valley farther up, even if the ice was not pushed up by the weight of the mass behind. Again, when the ice from the north reached the bottom of the valley of the St. Lawrence, it would dam it up, and a great inland fresh water sea might be formed, up which would float icebergs. Thus all the phenomena might be produced that characterise a submerged country, excepting remains of marine life.

The accumulation of ice in the region of Lake Champlain, caused by the valley of the St. Lawrence diverting in that direction that which would otherwise have flowed to the south-east, might furnish the advocates of the excavation of lake basins by ice, with an argument in favour of their theory.

4. *Terraces and stratified deposits.*—In Nova Scotia, terraces and stratified beds of sand and gravel are not uncommon. I have noticed a very conspicuous terrace running at the same height on both sides of a valley running into Cole Harbour, and which is crossed by the Lawrence-town road. Stratified beds of sand are found in many of the valleys tributary to the Shubenacadie lakes. These undoubtedly point to the action of water, but the entire absence of marine remains might make us pause before we came to the conclusion that they were formed by the sea. All the examples that have come under my notice occurred in lateral valleys, such as for instance those running into Cole Harbour, and into the Shubenacadie lakes. I believe that they were formed on the shores of lakes, caused by the damming up of the lateral valleys by the great glaciers that flowed down the principal ones.

VI.—CONCLUSION.

The question that I have discussed in this paper is so extensive that it would require a volume to discuss it fully and in detail. This I have not attempted to do, as not only was it far beyond the limits of this paper, but already the glacial period both in Europe and America, has received great attention from eminent geologists, and its leading facts are well known. I have therefore confined myself to original observations made in Nova Scotia, and to deductions therefrom; and in the discussion of the general question have only given prominence to what I believe to be new or modified views respecting the origin of the ice of the glacial period and its mode of action. I will briefly recapitulate the conclusions arrived at.

1. The arrangement of the heaps of gravel on the flanks of hills, and the distribution in them of grain gold, in Nova Scotia, are opposed to the theory of the submergence of the country either during or since the glacial period.

2. The submergence of part of eastern North America, during which the marine beds of the Champlain period were formed, was not participated in by the southern coast of Nova Scotia.
3. To explain the movement of land ice from the Arctic regions southwards, it is not necessary to suppose that the continent to the north must have been greatly elevated, nor do the facts connected with the distribution of the drift agree with such a supposition.
4. That there was some elevation of northern lands during the glacial period is, however, probable: *Firstly*, because all the oscillations of level of the lands in the northern hemisphere since the glacial period, with which we are acquainted, have been greatest towards the pole; and *secondly*, because a rise of land sufficient to prevent the entrance of heated currents to the polar basin, would occasion a great accumulation of ice in the circumpolar regions, by the heat of the tropical and sub-tropical waters being spent in evaporation instead of, as at present, in melting the ice within the Arctic circle.
5. The drift-beds were formed during the retreat of the ice, and not during its greatest development.
6. Terraces and stratified beds in lateral valleys, were formed when these were filled with water, dammed back by the glaciers that still flowed down the main valleys.

Art. XII.—Geology of Antigonish County, N. S. By Rev. D. Honeyman, D. C. L., F. G. S., Member of the Geol. Soc. of France, Hon. Memb. of Geol. Assoc. London, &c.

[*Read May* 8, 1866.]

This county, known until lately as the county of Sydney, is the north-east county of Nova Scotia proper. It is bounded on the north by Northumberland strait, which separates it from Prince Edward Island,—on the east by St. George's Bay,—on the south by the county of Guysboro',—and on the west by the county of Pictou. It is somewhat mountainous, and contains numerous small lakes and streams. The principal mountains are the Antigonish mountains, whose corner nearest to the town of Antigonish is about three miles to the north-west. Considering this range as sub-triangular, one side stretches in a westerly direction into the county of Pictou, its length being about thirteen miles, terminating in the Marshy Hope, and in its progress forming one of the lofty walls of this beautiful valley; the eastern side stretches northerly, terminating near Malignant cove, and extending about eight miles; the remaining side begins with the sub-conical mountain which terminates the side just described, and extending in a general south-west direction until it unites the Pictou termination of the first side. The Arisaig mountains, of my Geology of Arisaig, form the Antigonish part of this side of the triangle. Another range commences about two miles south-east of Malignant cove, and runs parallel to the shore of Northumberland Strait, until it reaches about two miles from the north side of Cape St. George. The Sugar Loaf mountain, which rises a mile and a half from the town, begins another range, which extends in a northerly direction to Morristown, a distance of about seven miles. The last range is the Ohio mountains, which this county has in common with Pictou county. These nearly meet the Antigonish mountains at the Marshy Hope, and form its other wall. The eastern side of this range, beginning at the Beaver Meadow about two miles from the entrance of the Marshy Hope and about eight miles west of Antigonish, trends in a southerly direction about nine miles, sending off a spur towards Lochabar lake. This lake is about twelve miles south-west of the town; it is five miles in length, reaching a little beyond the county line into Guysboro' county. About three or four miles east of this lake we have Polson's lake and South River lake. Besides these there are Gaspereaux lake, about four miles south-west of Antigonish, and the North and South lakes of Morristown. The streams are the South River, which rises in South River lake, is fed by Polson's lake, winds through fertile intervales receiving numerous small streams, and at length flows into Antigonish harbour. Ohio River rises in the Ohio mountains, flows through beautiful and fertile meadows, and unites with James' River, which rises in the Antigonish mountains, in West River. This last after flowing and winding through fertile meadows, receives at the town the tributaries of Rights River and Braley Brook, which also rise in the Antigonish mountains, and then it flows into the harbour. Besides these there is North River, which flows into the north side of the harbour. In the north of the county there are Malignant brook, Doctor's brook, Arisaig brook and McAra's brook.

As a field for the practical geologist this county is of the highest importance. Here we have all the geological formations that are known to exist between the old silurian of our gold fields and our Bay of Fundy triassic, and situated in a line connecting distinguished representatives of both. We appear to have in this county the lineal and direct descendants of the formation, which extending through Guysboro' on the south, has the gold fields of Sherbrooke, Wine harbour and Isaac's harbour—as we have the direct predecessors of Prince Edward Island triassic on the north. The greater number of the formations in the county are represented in Arisaig on Northumberland Strait. In my paper on the Geology of Arisaig I have already explained the character of the group, designating the lowest member of the series A, and the others in ascending order B, B', C, D. By comparing a large collection of the fossils of D with the figures of the Upper Ludlow fauna in Nicholson's Siluria, I was convinced that D was equivalent to the Upper Ludlow. Dr. Dawson simultaneously designated it Lower Helderberg, of which the other is the British equivalent. This was the first step in the proper designation of the Arisaig series, this opinion being subsequently confirmed by Mr. Salter on an examination of my specimens in the exhibition of 1862. Dr. Dawson and Prof. Hall had given it as their opinion, that B' was equal to the Clinton, as a characteristic of this is a graptolithus not distinguishable from the *G. Clintenensis* (Hall). Mr. Salter regarding the specimens in the exhibition as *G. Ludensis* considered B as Ludlow, while he considered the specimens from C as equivalent to the Aymestry limestone. The fossils of B were not discovered until I made the minute examination of the district of which my Arisaig paper is the record. The bed of graptolites found in B led me to regard it as of age prior to the Upper Ludlow. Shut up by Mr. Salter's opinion on A, which he was led to consider from the few specimens then collected as equivalent to the May Hill sandstone, I was induced to regard B as the equivalent of the Lower Ludlow. I had thus come to the conclusion, that the Arisaig group was wholly Upper Silurian.

Hall's noble work on the Canadian Graptolites, has led me to consider that there is yet something to be done in the correct deteramination of the equivalency of the Arisaig group, as the graptolites of B appear to have the facies of the graptolites of the Hudson River group, so that A and B may be the Arisaig equivalent of this group. Instead therefore of beginning with the upper silurian age, it may begin with part of the lower silurian, so that in Arisaig

A and B are probably equivalent to the Hudson River Group —Lower Silurian

B = the Clinton,
C = the Niagara Limestone, } Upper Silurian.
D = the Lower Helderberg,

It may be interesting to observe that graptolite life in Nova Scotia appears to range higher than in the United States, as according to Hall and Dana, *Graptolithus Clintonensis* existed alone there, and was the last of its race, while with us *Graptolithus Clintonensis* is associated with several other monoprionideans, and in 1864 I found in C, associated with crinoids, in shale interbedded among strata containing noble *cephalopoda, a diprionidean* graptolite of singular size and form. This graptolite is being examined by Prof. Wyville Thomson, and is to be described and figured in his work on Graptolites. Since I wrote the paper on the Geology of Arisaig referred to, I have had occasion to make a more particular examination than I had before made of the junction of the silurian with the carboniferous, at McAra's brook, and I am led to believe, by comparison with other localities, especially with Lochaber, which we shall shortly examine, that the apparent uncomformability is not real, and that the strata exposed on the shore and up the brook, are a formation intermediate between D, the equivalent of the upper Ludlow or lower Helderberg, and the lower carboniferous that forms the adjacent mountain west of the brook, in other words that the strata in question are Devonian. From these observations it would appear that in Arisaig we have a series ascending from the Hudson River age into the lower carboniferous, without any break in succession. These observations tend to modify the opinion expressed by Prof. Leslie, quoted by Dr. Bigsby in his paper read before the Geological Society—"On Missing Sedimentary Formations." It appears from this that Prof. Leslie is of opinion that the lower carboniferous at Arisaig lies unconformably on the Clinton equivalent. At Lochaber lake, which was mentioned in an introduction as in the extreme south of the county, while Arisaig is on its northern boundary, we have a group of strata of Arisaig age. My attention was first directed to this locality by finding a beautiful cast of a *Petraia Forresteri—Salter*. Subsequent examination of the rocks on the west side of the lake disclosed a set of strata with organisms of a peculiar kind and different from any of our former acquaintance. I found the *Petraia* in abundance and evidently characteristic, associated with casts of strange *orthes* and *rhynconellæ*, and a trumpet shaped cornulite. The containing strata rest on the syenitic rocks of the spur of the Ohio mountain already referred to. Similar *Petraia* led to the discovery and identification of the same formation at Arisaig, Marshy Hope, James river, and at Barney's river, French river and East river in the county of Pictou, all occupying the same position in relation to the syenitic, except at Arisaig, where the strata in question are synclinal. These strata, which I designated in the Arisaig group, A, are at Lochaber associated with other strata, which appear lithologically identical, but are distinguishable into Arisaig A, C, D, by the fossils which we find in the loose rocks. In these we find the *Homalonatus* of C, the *Dalmania Logani, Crania Acadiensis* of D, and *in situ* at the side of the lake I have found Nova Scotia *Chonetes* of D. Succeeding the strata containing the *Chonetes* and occupying the same relative position as the strata which I consider as Devonian at Arisaig, is a very broad band of reddish brown and grey argillaceous slates, which form an island in the lake extending to Polson's lake and beyond it. In their strike they extend to the west of Lochaber lake in the one direction, and through South River lake and the river itself in the other direction; and at right angles to the strike they pass into Guysboro'. On the western side of Lochaber lake there are magnificent exposures of the brownish red strata, in the course of a small brook that enters the lake. To the south of the brook there is a thick band of laminated limestone, altered and contorted, containing blue fluor spar. Between Lochaber lake and Polson's lake these slates contain veins of quartz of considerable thickness, interspersed with plates of specular iron ore, and at one of the streams that flow into South river grey and brownish red slate is associated with quartzite, which contain crystals of colourless quartz of considerable size and beauty. We also find garnets at Polson's lake and rhombic duodecahedral crystals of iron pyrites to the west of Lochaber lake, but these are not found *in situ.* The upper part of this band of Devonian slates at Polson's lake, is of a darker hue than the others. In these are found a vein of specular iron ore of considerable thickness, highly micaceous, and among the drift are masses of oxide of iron with cupriferous iron pyrites. Attached slate show decisively that these have been derived from the underlying slate, and it is probable that the massive oxide of iron was originally a carbonate of iron. Small veins of carbonate of iron with copper pyrites have been found in the slates exposed by mining. I would observe that these strata in this locality have been complicated by trap dykes, and considerably eroded and obscured. I have been unable to discover fossils in this extensive formation. In the Marshy Hope which is intermediate between Arisaig and Lochaber, there are certain hard slaty rocks outcropping about ten and eleven miles from the town, where the Antigonish mountains come near to the highway. After the discovery of the *Petraia* (A) rocks of Lochaber, I observed those of Marshy Hope, and was struck with the resemblance between the two, and on examination I found that they were identical. In the latter locality I discovered *Lingulæ,* then *Petraia Forresteri*, *Orthoceres*, *Orthes*, *Cornulites*, and *Cornulites* (trumpet-shaped), &c. Subsequently I found, although not *in situ*, still nearer to the town, near the Antigonish mountain road and near a small tributary of James' river, other fossils of the same age. These discoveries led to the conclusion that the one is the extension of the other, and that they do exist or have existed as a band skirting the Antigonish mountains. This opinion was confirmed by a still farther discovery of similar rocks containing similar organisms at the western extremity of these mountains, on the side of the road at the western entrance of the Marshy Hope. I have not yet succeeded in ascertaining their eastern termination. In the place where I first discovered the strata in question in the Marshy Hope, I also found a specimen of the *Avicula Honeymani* (Hall). This fossil is one of the characteristics of Arisaig D. It is found in abundance in this position, both at Arisaig and East River, Pictou, and in this position only. I am persuaded that we have here Arisaig A and D, or the equivalents of the Hudson (?) and lower Helderberg in contact, while B, B' and C are missing. We have several out-crops of rocks from this onward to the town of Antigonish for a distance of about five miles, —which furnish a section of the sedimentary rocks of this side of these mountains. In the first mile the order is descending, as in the next outcrop we have only A. About a mile nearer the town we have a large outcrop of quartzite, which I regard as Devonian. One mile nearer we have outcrops of lower carboniferous conglomerate, succeeded by limestone, and then six miles from Antigonish we pass between gypsum pits. The Devonian quartzite which is of greenish hue, appears to be of considerable thickness. It is exposed in various places on the flanks of the Antigonish mountains. There is a grand exposure at the falls of James' river. These rocks form an elevated peak which rises abruptly above the falls. The water flows in great volume over precipitous rocks, and from a height of about one hundred feet into a capacious basin, the whole presenting a scene of impressive grandeur. These strata appear also to constitute, to a great extent, "the mountain," at the south-east angle of the range, and after a break of about two miles they appear outcropping near the top of the Sugar Loaf mountain.

I have thus directed attention to the earlier sedimentary formations existing in this county—the Silurian and Devonian. It will have been observed that there has been considerable irregularity in the deposition of the strata that have passed under review. Comparing as I have done, the respective localities with the Arisaig type, we find that B and B' are missing at Lochabar, and that B, B' and C are missing at the Marshy Hope, while in both of these localities there is a greater development of the Devonian than we find at Arisaig, so that it is impossible to lay down any trustworthy rule in regard to the occurrence of any member of the series, where we have no outcrop or other superficial indications; in other words we may have Silurian, and no Devonian underlying more recent formations, and *vice versa*. As to origin, the strata are marine—A, the lowest of the series having been deposited in comparatively shallow water, possibly about seventy fathoms, while B, B' manifest deposition at a greater depth, and the aggregate thickness of the Silurian and Devonian would appear to require still greater depth of water for their deposition. This shows that in the process of their formation there was subsidence as well as deposition. Their present superficial position, their great elevation, especially at Lochaber, above the sea level, and the vertical position into which they have been thrown, show that they have been subjected to a great elevating process. The conformability in these respects of the Devonian and Silurian in this representative district, shows that the elevation took place after the deposition of the Devonian, while the unconformability of the succeeding formation, the lower carboniferous, and other considerations to which we shall yet allude, show that the elevation took place prior to the latter period. In the Marshy Hope we find a similar order of things, showing that the elevation of Silurian and Devonian, and the formation of the mountains of this county, was *post* Devonian, and generally *pre*-carboniferous. The Silurias and Devonias of Arisaig with their synclinal arrangement *(vide Geology of Arisaig)* show the effects of a later upheaval, to which I shall yet refer. These formations which I have just examined are only a skirting of the mountains of the county. These mountains are mainly composed of metamorphic felspathic rocks of uncertain age and origin, or syenite and diorite, &c. Whatever may be their age and origin, I believe that as regards both they resemble the granite of the Nova Scotia auriferous zone. I also believe that while it is probable that the latter was elevated prior to the deposition of A, it may not have been exempt from subsidence coeval with that to which I have already referred. Be this as it may there can be little doubt that the felspathic rocks under examination, formed the bottom of the shallow sea in which strata A were deposited. That the metamorphism of the one was antecedent to the deposition of the other is evident, from the fact that organisms of A in closest proximity to the rocks in question remain unaltered, while at Arisaig the typical strata A in contact with trap of a subsequent period, are altered into a jaspideous rock, stratification and organisms being thoroughly obliterated *(vide Geology of Arisaig.)* Succeeding the sedimentary rocks already examined in the localities so often referred to, we find a certain amount of obscurity, and then sedimentary rocks of coarser material, which cannot be confounded with those preceding. Dr. Dawson has named these lower carboniferous; so far as I have observed in this county, they may be called *sub*-carboniferous. In these there are three degrees of coarseness observed. The finest strata occur at upper South river, succeeding the Devonian of the Lochaber series. Here the carboniferous approximate nearest in fineness and colour to the preceding Devonian. Still, however, the difference between them is obvious, as the carboniferous is arenaceous, and the difference of inclination manifests unconformability. At Arisaig near McAra's brook, the carboniferous strata are much coarser than at upper South river, but of the same brownish red colour. Here we find the carboniferous sandstones forming mountains equal in elevation to the Silurian, having been upheaved by the trap which appears between the supposed Devonian up McAra's brook and the sandstone of the mountain. But the conglomerate is by far the most extensively distributed. We find it on the north-east side of Arisaig, and largely developed at Cape St. George. It is found at the south-east side of South river lake, occupying the same position in relation to Devonian here, as the fine brownish red sandstones to the Devonian at upper South river. It occurs on the south side of the Sugar Loaf north of the town, filling up the great break between this range and the Antigonish mountains. Here its width, or north and south extension, is about five miles. About six miles from the town it attains to a mountain elevation. It runs along the foot of the Antigonish mountains, and terminates apparently where it outcrops near the entrance to the Marshy Hope. I have already noticed this outcrop as succeeding the Devonian. This conglomerate unmistakably declares its age and origin. It was accumulated on the shores of the post Devonian sea, and formed from the felspathic rocks and slates of the mountains. Oxide of iron is its colouring matter, and streaks of green show the existence of thinly distributed carbonate of copper, while carbonate of lime largely agglutinates. The malachite is seen chiefly in the Sugar Loaf and Antigonish mountain conglomerate. Succeeding the upper South river lower carboniferous sandstones we have a thick bed of limestone, which probably owes its existence to organic agency, although it has not yet been found to contain organisms. On the road to Lochaber I found what appears to be a continuation of the same limestone, containing a deposit of beautiful brown ochre, and on the banks of the Ohio river the limestone continues; this is exposed in the bed and on the lofty banks of a small brook which runs into the river. Here the limestone is black and shaly, and contains numerous fossils, among which are *spiriferi sp.? producta spinosa*, and the *pygidium* of a *Phillipsia*. This is now the second locality in the Province where the lower carboniferous limestone is found to contain the trilobite, the *Phillipsia Howi* having been found by Dr. How in the Kennetcook limestone in 1862. These limestones in the possession of this genus of trilobite, correspond with the mountain limestone of the British Isles, so that the one and the other are undoubtedly approximately contemporaneous. Succeeding the conglomerates of the Antigonish mountains and reposing directly upon them, we have limestone of considerable thickness; this can easily be traced continuously from the Marshy Hope to Morristown, a distance of about sixteen miles. In several places where it is quarried for building stone, large deposits of brown ochre are found, and the slabs are often coloured with films of carbonate of copper, and in one quarry where Braley brook issues from the mountains, I found some years ago imbedded in ochre several pieces of copper pyrites of considerable size.

Succeeding these limestones of the Antigonish mountains, we have an enormous bed of gypsum; its length is nearly equal to that of its associated limestone. It appears at the forks of James' river and the Ohio river; it passes over nearly in the course of James river until it reaches within one hundred paces of the limestones; its mountain side runs parallel with the limestones, Braley brook running between and along the bottom of the abrupt and lofty gypseous wall for about three miles. After parting with the brook the gypsum pursues its course until it reaches Right's river, nearly a mile north of the town. After an apparent break of two miles it again appears on the east side of the Sugar Loaf and proceeds onwards into St. George's bay, its land terminus being Ogden's lofty cliff.

Dr. Dawson shows this cliff in a plate in his *Acadian Geology*, where he examines very fully and satisfactorily the gypseous formation from Right's river to St. George's bay, so that in examining this part we traverse the ground which he has already rendered so familiar to the geologist. The breadth of this great gypsum deposit is duly proportioned to its length. It stretches from the mountains at North river, through the harbour and up the west side of South river, presenting at its southern terminus as well as on either side of the harbour and elsewhere in its course, a striking conical aspect. The southern terminus is seen by the traveller on the right and left of the road to the Strait of Canso, about three and a half miles from the town. Again, beginning with the outcrop at Right's river, the pits in Trotter's pasture, and the great conical outcrop on the road to Braley brook settlement in front of the mountain break, the gypsum beyond a doubt passes under the town and to the south of it, until it outcrops on the banks of West river. Some years ago an attempt at sinking a well in the immediate vicinity in the west of the town disclosed the gypsum bed, and I there obtained specimens of fibrous gypsum of surpassing beauty. Associated with this bed of gypsum and apparently above it, we find limestones with lower carboniferous limestone, *brachiopoda*. In addition to this there are also numerous saltsprings rising from this deposit; it therefore appears to be somewhat analogous to the *sub*-carboniferous of Michigan; and the Nova Scotia Salt Company, have thereby been induced to engage in boring operations, with the hope of discovering brine. Besides these beds of limestones there are also limestones of the same age at Doctor's brook in the Arisaig district, and in the trough between the Sugar Loaf range of mountains and the range between Malignant cove and Cape St. George. I have not yet been able to determine whether the latter belong to the north side of this trough or the south side. They appear to me to belong to the north side, like the gypsum which occurs at Ballantine's cove on the S. E. side of Cape St. George. At the side of the cape we have an interesting small section exposing sandstone strata having casts of shrinkage cracks, and others containing palæoniscus scales, and other strata containing carboniferous flora, calamites, and lepidodendria. These strata appear to be the equivalents of the strata on the south side of the same trough, some of which have attracted attention on account of their highly bituminous character. These also contain scales of palæoniscus and carboniferous flora, lepidodendria, cardaites. I expect to investigate this part of the country more rigidly if opportunity presents at some future time. I have yet to examine properly the remaining carboniferous or S.E. district of the county. In the meantime I have nothing to add to the observations which Dr. Dawson has already made on that district—(*vide Acadian Geology*.)

The questions now occur, by what agency have these post

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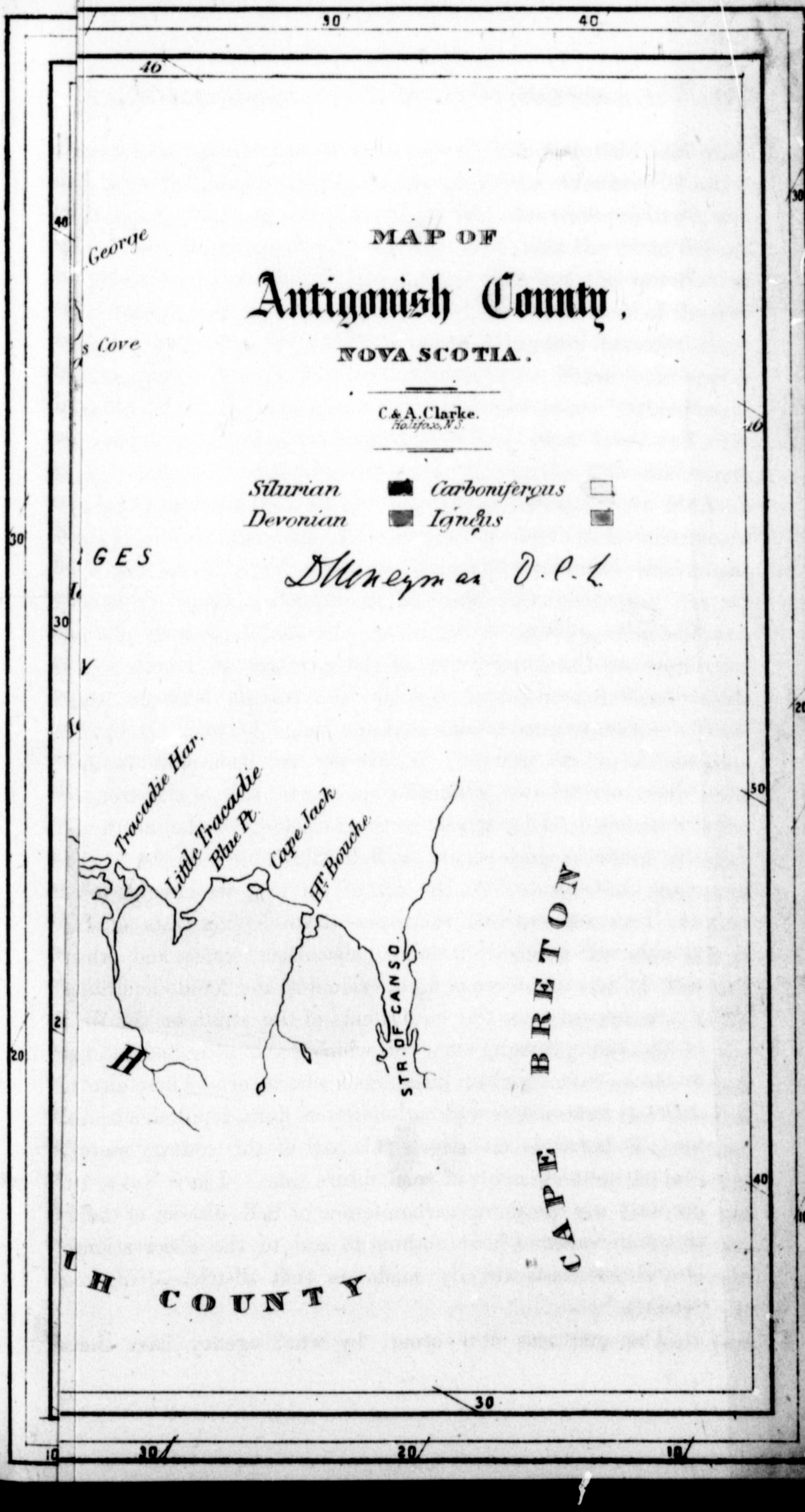

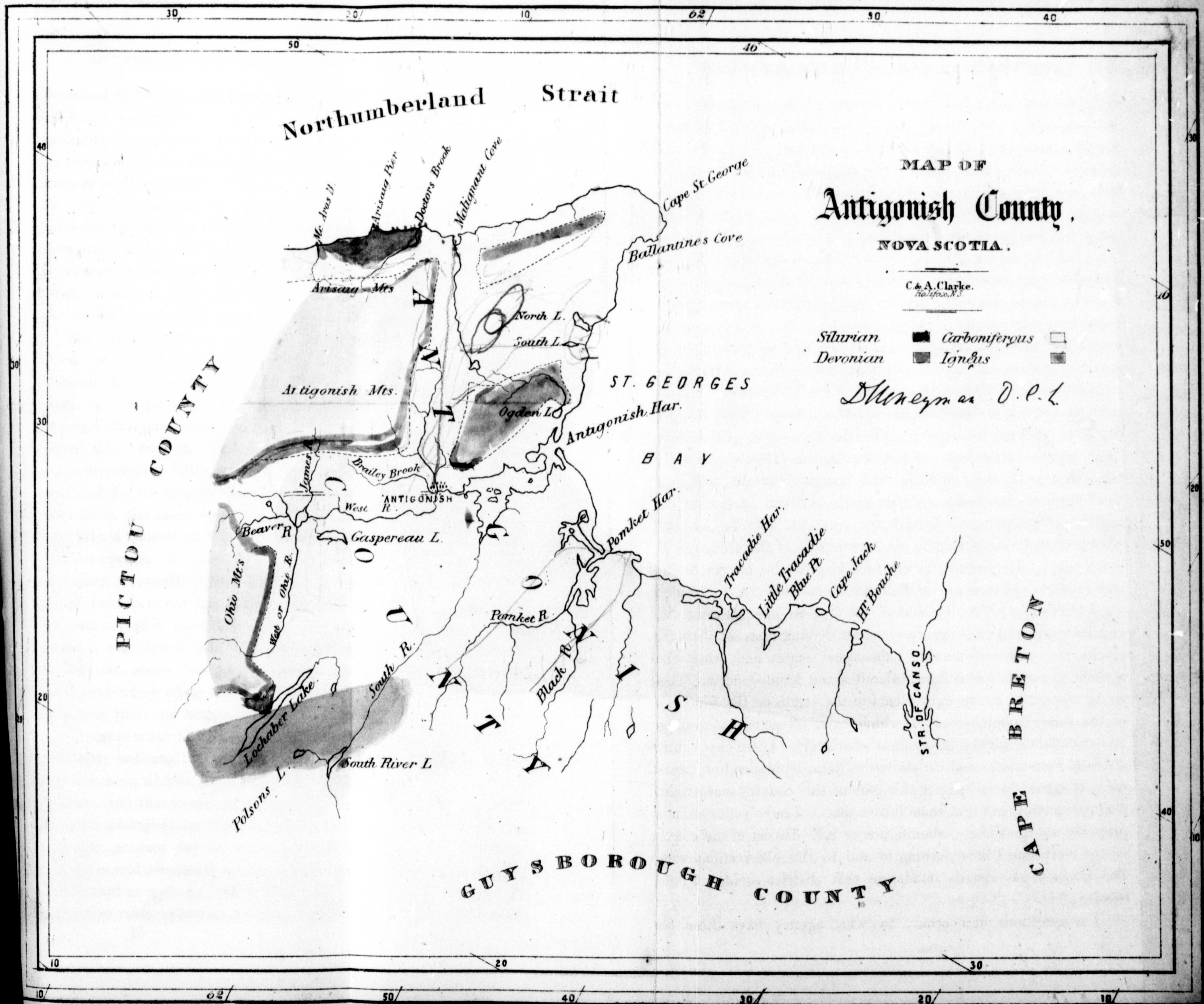
MAP OF
Antigonish County,
NOVA SCOTIA.
C. & A. Clarke.
Halifax, N.S.
Silurian
Devonian
Carboniferous
Igneous
Northumberland Strait
Cape St. George
Ballantine's Cove
Mc Aras B.
Arisaig Pier
Doctors Brook
Malignant Cove
Arisaig Mts.
North L.
South L.
Ogden L.
Antigonish Mts.
ST. GEORGES BAY
Antigonish Har.
Brailey Brook
James R.
ANTIGONISH
West R.
Beaver R.
Gaspereau L.
Ohio Mts.
West or Ohio R.
Pomket Har.
Pomket R.
South R.
Black R.
Tracadie Har.
Little Tracadie
Blue Pt.
Cape Jack
Hr. Bouche
STR. OF CANSO
Lochaber Lake
Polsons L.
South River L.
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ANTIGONISH COUNTY
GUYSBOROUGH COUNTY
CAPE BRETON

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Devonian strata been elevated, fractured and distorted? and when did this event happen? We have no difficulty whatever in ascertaining the cause by which the effects referred to were produced, and we seem to have no difficulty in determining that the event did not happen until after such and such a period; but the question of time remains unanswered. About the geological base of the carboniferous system we find trap rocks, intervening between these basal strata and the strata of a preceding age. These rocks appear in enormous mass in contiguity with the lower carboniferous conglomerates on the eastern side of South river lake, and they extend backwards to Polson's lake, disturbing the Devonian strata in that locality, as we have elsewhere observed. At McAra's brook, at Arisaig, we have already observed their occurrence between the Devonian and the lower carboniferous sandstones, elevating the latter to the altitude of lofty mountains. As we approach Malignant cove and near it, we observe on the road and either side, trap in closest contact with lower carboniferous conglomerate, the latter being metamorphosed into a hard jaspideous rock by the original contact with its igneous associate. These are seen in the same connection in Malignant brook, and crossing it in such a manner as to form the foundations of two mill seats, and the opposite abutments of a bridge; and in the same relation extending westward to Doctor's brook, forming an elevated ridge which runs between the older sedimentary or Silurian strata and the metamorphic mountains—(*vide Geology of Arisaig.*) In that paper it was shewn that this trap also bounded the other side of this silurian series from their eastern terminus, east of Doctor's brook, extending along the shore, and much altering strata A, as far as Arisaig pier, and being in the space intervening obscured by the sea, it reappears at the shore at McAra's brook, and up the brook as already indicated. From this it would appear that the upheaval of the Arisaig silurian group took place at the period of this trappean eruption, and that it was still in depths of the sea after the others of the same geological age were subaerial. I know not how we can otherwise account for the occurrence of the lower carboniferous limestones and associated strata of the same age at Doctor's brook, as indicated in my map and section,—(*vide Geology of Arisaig.*) It seems that this upheaval of sedimentary strata was at least post lower carboniferous, but how long after this period it is difficult to determine. On the opposite coast of Cape Breton an interesting shore section at the new coal mines of Mabou, north of Mabou harbour, seems to illustrate the subject I am now investigating. We find in this section the lower carboniferous conglomerate of immense thickness, succeeded by a thick bed of rose coloured gypsum, succeeded by sandstones, with flora, a thick seam of coal, modiola shale, shale with calamites, clays with bands of clay iron stone, thick sandstones with flora, impure coal, clays and shales. The whole of these strata have been thrown into their present highly inclined position at the same time, and that too doubtless at the period of the trap eruptions in Antigonish county. I consider that the Mabou section represents geological time at least equivalent to that of the whole carboniferous formation of Antigonish county, and therefore conclude that all the carboniferous rocks of the county and the silurian of Arisaig assumed their present position at one and the same time. The formations in this county which we have thus examined, having become subaerial, continued so while deposition was in progress in the north of what is now the county of Antigonish. I have already brought under your notice lower carboniferous conglomerate, sandstone and limestone, with associated trap, at Malignant cove, Doctor's brook and McAra's brook. These undoubtedly are a part of a carboniferous series, which extending into Northumberland Strait and into the Gulf of St Lawrence, constitute part of the foundation on which Prince Edward Island triassic sandstone rests. In an age long posterior to the formation of the rocks of Prince Edward Island and their elevation, another very characteristic feature of the geology of the county was formed. I refer to the great deposits of drift which occur in every direction, obscuring the subjacent rocks and rendering the work of exploration often difficult and perplexing. The more prominent accumulations are the hills that occur in the break between the Antigonish mountains and the Malignant cove and Cape St. George range. At the north about one mile from the Malignant cove there are low mounds; gradually they increase in size and number, until at the distance of three miles south of the cove or at the south entrance of the break, the last of the series forms the elevated site of a Catholic chapel, which is conspicuous for several miles. On the banks of the Ohio river are numerous mounds of the same character, and in and around the town of Antigonish are similar elevations of peculiar interest. My attention was specially directed to these about three years ago by the sinking of a well on the side of the one on which the old court house stands. After passing through several feet of gravel a bed of clay was struck which was peculiarly dry, compact and light in colour, containing imbedded fossil wood in abundance, well preserved, in the centre of which was phosphate of iron of a beautiful blue colour, which might be used as a pigment. On examining other mounds on the bank of Right's river I discovered sections of these exhibiting the same structure, and also having the same fossil. A great part of this superficial deposit is evidently derived from the subjacent rocks of the particular locality in which the deposit is found, and hence we naturally look at these deposits for information regarding the character of the prevailing rocks of the locality, especially in regard to the existence or probable extent of the distribution of these rocks. Of course great caution is to be observed in the application of this principle, owing to the fact that a part of this deposit and that possibly the larger, may consist of transported material which has been so triturated and rolled as to leave the question of its source open to all sorts of conjecture. In regard to the transportation of these I am disposed to consider that it was the effect of glacial agency. I have not yet been fortunate enough to discover so satisfactory indications in the region in question as we have elsewhere, of the existence of the glaciers. It will appear not at all astonishing that such a deposit derived largely from felspathic and calcareous rocks, and so extensively distributed, should give the county a character for agriculture. To a great extent, however, this character has arisen from a partial redistribution of the deposit, which I have just described, with the addition of organic matter, and in some instances with an addition of lime, gypsum, salt and felspathic constituents. This new deposit forms flats on the sides of rivers, past or present, and a great delta at their confluence. These are commonly called intervales. We have thus the rich and extensive intervale of the Ohio river and the Beaver meadow —the great intervales of West river and South river, and the smaller ones of Right's river, James' river and Braley brook, and what is by the old inhabitant often called the "great intervale," or the delta on which the town of Antigonish is chiefly built. These intervales, although comparatively recent, are still doubtless of high antiquity, and were probably the haunts of the mastodon and his confreres, as the deposits are doubtless coeval with the intervale of Middle river, Cape Breton, which produced, upwards of thirty years ago, the thigh bone of *Mastodon Ohioticus*, now in the Provincial museum, and the flats of Baddeck, C. B., in which was found about seven years ago, the tooth of *Mastodon Ohioticus*, now in my own collection. It is the confidently expressed opinion of intelligent inhabitants who have been in the habit of observing landmarks for upwards of half a century, that the land is slowly subsiding. I have not yet ascertained precisely the grounds upon which this opinion rests. This point and others already indicated, may be the subject of notes on a future occasion.

Art. XII. Nova Scotian Conifers. By Colonel Hardy; Part I.

[*Read May* 3, 1866.]

A glance at a physical map of North America, will shew how the great prairies, extending diagonally through the continent, from the Gulf of Mexico to the shores of the great Slave Lake in the North-West, at this latter point appear to divide into two streams the evergreen forest, here composed solely of coniferæ, which forms a broad and continuous belt from the eastern shores of Labrador to the Pacific.

These fir forests in their northern extension, ever growing more stunted, gloomy and monotonous, at last merge into the treeless and snow-covered barren, where the small Arctic cariboo and musk ox obtain a scanty living on the lichens of the rocks, and grass-tufts of the valleys. Their character is sombre in the extreme; their growth and appearance indicate the severity and hardships of the climate; the twisted trunk, the bare and bent top, and the profuseness of the moss-beards clinging to the limbs of the spruce and scrub pine, the almost exclusive trees of the region, shew how slow has been their growth, and with what difficulty it has been attained. Dr. Richardson states that, on the borders of the Great Slave Lake, four hundred years are required to bring the stem of the white spruce to the thickness of a man's wrist.

Leaving these desolate scenes, and tracing the influence of decreasing latitude and more genial climate upon the great belt of coniferæ where, skirting the prairies, it enters the lake districts of Canada, we find that at about the neighbourhood of Lake Winnipeg the forest is diversified by the accession of several species of deciduous trees, the elm and the ash; further south, by the various descriptions of maples, oaks, and beeches; and, at length, by the shores of Superior, the character of the Canadian forest becomes fully developed, exhibiting that beautiful admixture of deciduous trees with the various pines and spruces, which constitutes its picturesque grandeur.

Embracing the Canadian Lakes and the shores of the St. Lawrence, this woodland district stretches away to the Atlantic seaboard, and covers the provinces of New Brunswick, Nova Scotia, and Prince Edward Island, including a large portion of the Northern States. This large tract of forest has been termed by Dr. Cooper in his admirable monograph on the North American forest-trees, the Lacustrian Province, from the number of its great lakes, and is chiefly characterized by the predominance of evergreen coniferæ.

The consideration of this family, extending over so large a portion of our North American colonies, involves many subjects of great importance as to the physical aspects and climate of the country, the influence of its forests on rainfall and springs, on the vegetation and on the health of its inhabitants, which cannot be discussed this evening. Nor can we notice, more than briefly, another interesting topic in connection with our subject—the extreme geological antiquity represented by the fir-tree. Hugh Miller states, that he found a fossil of coniferous lignite in the Lower Old Red Sandstone, and that Pine forests existed, and there was dry land, where it had been previously thought that all was covered by the ocean.

Conifers formed a leading feature of the coal formation; and, though all the ancient species, up to the Post Tertiary period, have perished, the type is still continued in all its low state of organization.

The animals characterizing the North American fir forest are all, likewise, of most ancient type; especially the musk ox, the reindeer and the moose, whose ancestors have doubtless lived contemporaries with the mammoth in the earlier period of the Post Tertiary.—"America" says Hugh Miller, "though emphatically the New World in relation to its discovery by civilized man, is, at least in these regions, an old world in relation to geological type, and it is the so called old world that is in reality the new one.

A. Nigra (Poir), Black Spruce, Double Spruce.*

Leaves short ($\frac{1}{2}$ in. by $\frac{2}{3}$ in. long) rigid, dark green; cones ovate or ovate oblong (1—$1\frac{1}{2}$ in. long) the scale with a thin and wavy eroded edge. *A. rubra*, a northern form.

The Black Spruce is one of the most conspicuous and characteristic forest trees of North Eastern America, forming a large portion of the coniferous forest growth and found in almost every variety of circumstance. Sometimes it appears in mixed woods of beautiful growth, of great height and its numerous branches drooping in graceful curves from its apex towards the ground, which they sometimes sweep to a distance of twenty to thirty feet from the stem, the summit terminating in a dense arrow head, on the short sprays of which are crowded heavy masses of cones. At others it is found almost the sole growth, covering large tracts of country, the trees standing thick with straight clean stems and but little foliage except at the summit. Then there is the black spruce swamp where the tree shows by its contortions, unhealthy foliage and stem and limbs shaggy with usnea, the hardships of its existence. Again on the open bog* grows the black spruce, scarcely higher than a cabbage sprout—the light olive green foliage living alone on the compressed summit, whilst the grey dead twigs below are crowded with pendulous moss; yet even here, amidst the cold sphagnum, Indian cups, and cotton grass, the tree lives to an age which would have given it a proud position in the dry forest.† Lastly in the fissure of a

*The Black Spruce assumes a singular appearance in these swamps. The tree, seldom exceeding 30 feet in height, throws out its arms in the most tortuous shapes, suddenly terminating in a dense mass of innumerable branchlets of a rounded contour like a beehive, displaying short, thick, light green foliage. The summit of the tree generally terminates in another bunch. The stem and arms are profusely covered with lichens and usnea.

†Indeed these groves of miniature trees in bogs where the sphagnum perpetually bathes their roots with chilling moisture, have a very similar appearance to Brussels sprouts on a large scale. The water held in the moss is always cold: on May 5th, 1866, the tussacs of sphagnum were frozen solidly within two or three

granite boulder is to be seen its hardy seedling, and the little plant has a far better chance of becoming a tree than its brother in the swamp; for one day, as frost and increasing soil open the fissure, its roots will creep out and fasten on the earth beneath.

As a valuable timber tree the Black Spruce ranks next to the Pine, attaining a height of 70 to 100 or even 150 feet, it forms excellent material, strong and elastic, for spars and yards of vessels, and is converted into all descriptions of sawed lumber—deals, boards, and scantlings. From the young sprays of the Black Spruce is prepared the decoction, fermented with molasses, which is the celebrated spruce beer of the American settler, a cask of which is always kept by the good farmer's wife in the hot, thirsty days of haymaking.* To the Indian, the roots of this tree which shoot out under the moss to a great distance, are his rope, string and thread: with them he ties his bundle, fastens the birch-bark coverings to the poles of his wigwam, or sews the broad sheets of the same material over the ashen ribs of his canoe.

As an ornamental tree in the open and cultivated glebe, the Black Spruce is very appropriate: the numerous and gracefully curved branches, the regular and acute cone shape of the mass, the clear purplish-grey stem and the beautiful bloom which the abundant cones assume in June, all enhance the picturesqueness of a tree which is long-lived, and, moreover, never outgrows its ornamental appearance unless confined in dense woodland groves.

The bark of the Black Spruce is scaly, of various shades of purplish-grey, sometimes approaching to a reddish hue, hence doubtless, suggesting a variety under the name of Red Spruce, which is in reality a form depending on situation. In the latter, the foliage being frequently of a lighter tinge of green, strengthens the supposition. No specific differences have, however, been detected between the trees.

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inches of the surface. The centre of these bogs, often called cariboo bogs by reason of this deer frequenting them in search of the lichen, *cladonia rangiferinus* is generally quite bare of spruce clumps, which fringe the edge of the surrounding for the trees increasing in height as they recede from the open bog.

*** Essence of spruce is obtained by evaporating the decoction of young shoots in water mixed with sugar and molasses, to the consistence of honey.**

A. alba, Mich. (*White Spruce.*)

The White Spruce, or Sea Spruce of the Indians, is, as has been already stated, a conifer of an essentially boreal character. Indeed in its extension into our own woodlands it appears to prefer bleak and exposed situations. It thrives on our rugged Atlantic shores, and grows on exposed and brine-washed sands where no other vegetation appears, and hence is very useful, both as a shelter to the land, and as holding it against the encroachment of the sea. Its dark glaucous foliage assumes an almost inpenetrable aspect under these circumstances. On the sandy shores near the entrance of Musquodoboit harbour there is a grove of White Spruce, which, constantly exposed to S. W. gales, have become so compressed and flattened at the tops, which lean inland from the sea at scarcely ten feet elevation, that a man can easily walk over them as on a platform, and the shelter beneath is complete.*

The Balsam Fir growing in these situations assumes a very similar appearance in the density and colour of its foliage and trunk to the White Spruce, from which, however, it can be quickly distinguished, on inspection, by the pustules on the bark and its erect cones. In the forest the White Spruce is rare in comparison with the Black, whose place it however altogether usurps on the sand hills bordering the limit of vegetation in the far north-west. The former tree prefers humid and rocky woods. The timber is used in frame work. I know of no peculiar properties of this tree in an economical point of view, except, that the Indians affirm that the inner bark or *liber* is useful to chew as a demulcent in the case of colds.

General Description.—Leaves pale or glaucous; cones cylindrical, about 2 inches long, the scales with an entire edge. Leaves $\frac{1}{2}$ to $\frac{3}{4}$ inch in length placed on all sides of the branches. The cones are first of all light green, afterwards tinged with pink, and on ripening change to a very pale brown.

A. Canadensis, Mich. (Hemlock Spruce.)

Leaves linear, flat, obtuse $\frac{1}{2}$ inch long; cones oval, of few scales, little larger than the leaves, $\frac{3}{4}$ inch long.

The Hemlock Spruce has a wide range in the coniferous woodlands of North America, extending from the Hudson Bay territory to the mountains of Georgia. This great southerly extension of the

* The White Spruce is in frequent groves on the slopes of Point Pleasant. There are some trees of this species nearly 60 feet in height on McNab's Island.

northern forms of trees on the south-east coast, is due to the direction of the Alleghanian range, which, commencing in our own Province of vegetation, carries its flora as far south as 35° north latitude, elevation affording the same conditions of growth as distance from the equator.

The Hemlock is found as a common tree throughout Nova Scotia, loving rich mossy hill sides in the neighbourhood of lakes, though generally mixing with other evergreens in all situations. It is found, however, of heaviest growth (70–100 feet), and in large groves, principally in the former situation, and here vies with the White Pine in the gigantic proportion of its trunk, which grows like a mosaic column, throwing out its first branches gnarled and contorted at a height of 60 feet from the ground. The foliage is light and feathery, resembling that of the yew, and in the old forest tree clings round the summit above in dense masses, from which protrude the twisted limb by which the column is abruptly terminated.

Perched high up in its branches may often be seen, in winter time, the sluggish porcupine, whose presence aloft is first detected by the keen eye of the Indian through the scratches of its claws on the trunk, in ascending its favourite tree to feed on the bark and leaves of the younger shoots.

Large groves of Hemlock growing together in the sloping woodside present a noble appearance; their tall straight stems resemble the pillars in the aisle of an old abbey; the ground beneath is generally free from undergrowth, and deeply covered with a soft carpeting of moss, and affords great ease to the foot-sore hunter. One can see far through the far shady grove of giants, and the softened light, entering through the thick foliage above, gives an air of pleasing mystery to the interior of these vast forest cathedrals.

The timber of the Hemlock is lightly appreciated for building purposes, being brittle and shakey, and coarse-grained. It is used extensively for wharf and fence posts, being able to resist the action of water a long time, and also has come into demand for railway sleepers. The late Dr. Gesner states, that granaries and grain bins made of Hemlock are not attacked by mice. The bark, which possesses highly astringent properties, is much used in America for tanning, almost entirely superseding that of the oak. It is very scaly, and, though light grey outside, shews a rich red-brown tint when chipped. The sojourner in the woods seeks the dry and easily detached bark which clings to an old dead Hemlock, as a great auxiliary to his stock of fuel for the camp-fire; it burns readily, long, and emits an intense heat; and so fond are the old Indians of sitting round a small conical pile of the ignited bark in their wigwams, that it bears in their language the sobriquet of "the old Grannie".

The Hemlock, as a shrub, is perhaps the most ornamental of all the North American evergreens. It has none of that tight, stiff, old-fashioned appearance so generally seen in other spruces: the graceful foliage droops loosely and irregularly, hiding the stem, and, when each spray is tipped with the new season's shoot of the brightest sea-green imaginable, the appearance is very beautiful. The young cones are likewise of a delicate green.

The spray of the Hemlock is often used by the woodsman in hard times as a decoction in water in lieu of tea, as also is the ground Hemlock. The bark is very ornamental for decorating garden flower baskets in a rustic style.

A. balsamea—*Marshall*—(Balsam Fir). Canada Balsam or Balm of Gilead Fir,

Leaves narrowly linear; cones cylindrical, large, violet-coloured; the bracts obovate, serrulate, tipped with abrupt and slender point, slightly projecting upwards. Leaves 1 in. or less in length, narrower and lighter-green than those of European or Silver Fir. Cones 3 to 4 in. long, 1 in. broad, the scale very broad and rounded.

So very similar is the American species to the Silver Fir (*Picea*) of Europe, that, when visiting England, I have had to search the stem for the characteristic pustules of balsam, found on our fir, before assuring myself of the difference. The general appearance of the trees is very analogous: the same silvery lines on each side of the midrib under the leaf, which glistening in the sun as the branches are blown upwards by the wind, gives the tree its name. The leaves, however, of the American species are neither so broad nor so dark in colour as those of *Picea*. Dr. Cooper assigns the range of the Silver Fir, N.E. S.W, between the Labrador and the mountains of Penn. It inhabits moist woods and, though growing to a large size, is a short lived tree—often falling before a heavy gale, and shewing a rotten heart. This Province and New Brunswick, perhaps, afford the finest specimens of this tree. Here I have seen it growing to the height of 60 feet.

The large, erect, sessile cones of the Balsam Fir are very beautiful in the end of May, when they are of a light sea-green colour, which, changing in June to pale lavender, in August assumes a dark slaty tint. They ripen in the fall, and the scale being easily detached, the seeds are soon scattered by the Autumnal gales* leaving the axis bare and persistent on the branch for many years. In June each strobile is surmounted with a large mass of balsam exudation.

The summer of 1864 was marked as a most fructiferous season amongst all species of coniferæ on the American continent. The casual observer passing along the roads could not help observing the masses of brown cones which everywhere burdened the tops of the pines and spruces, and from which the Indians augured an unusually hard winter, through much the same process of reasoning that the English countryman prophecies a rigorous season from an abundant crop of haws and other autumnal hedge fruits. The hard season did not arrive, but the immense crop of cones killed a large number of trees, especially of the species under consideration. If not actually killed, many instances of the Silver Fir with a dead leading shoot, or with one just recovering its vitality may be constantly seen by any roadside observer. In the former case, a new leader, elected from the nearest tier of branchlets, is already lifting its head to continue the growth of the tree, and the latter instance, in which all the surrounding shoots and foliage have been vitally drained by the exhausting cone-crops, may be supposed to account for the long spaces or intermissions between the lateral branches of firs, at certain intervals up the main stem which are often to be observed.

The Silver Fir is remarkable for the horizontal regularity of its branches, and the general exact conical formation of the whole tree. An irregularity in the growth of the foliage, similar to that occurring in the black spruce, is frequently to be found in the fir. A contorted branch, generally half-way up the stem, terminates in a multitude of interlaced sprays which are, every summer, clothed with very delicate, flaccid, light-green leaves, forming a beehive

*** The cones of other species of Ashes and Pines generally do not ripen until the 2nd year, whilst the expanded strobile remains attached to the tree for long after.**

growth like that of the spruce. It may be always noticed, however, that whilst the spruce growth of this nature is persistent in its foliage, that of the fir is annually deciduous.

The Silver Fir is a graceful shrub up to a certain age, and its sprays, soft and flattened, form the best couch in the woodman's camp. The bark of the tree readily peels in summer, and is used in sheets to cover the lumberer's shanty, which is now built in prospect of the winter's campaign. The resinous fluid contained in the pustules is the Canada Balsam of commerce.

I am not aware that any exportation of balsam, or, indeed, of any resins is made from Nova Scotia. All such productions might be made profitable, as prices have recently been high in consequence of the American war, commerce having been plentifully supplied with tar, pitch, resin and turpentine from North Carolina and other states of the Confederacy. It must be noticed however, that the pines of the Southern States are not found in these Northern latitudes. They are the long-leaved or yellow pine (*P. Palustris*), and the loblolly or old field pine (*P. tæda*). Our common *P. strobus* affords but little resin. *P. resinosa* and *P. Rigidsa* or pitch pine are both resinous woods, as is also the larch. It is much to be regretted that so many thousand acres of these woods are yearly disappearing by fire and through wanton waste, whilst a source of profit like the above is still allowed to slip by unnoticed.

In conclusion I will append a few remarks on the transplanting and acclimatization of evergreens, a subject which I am glad to observe has been very practically studied of late years. It is patent to every one, resident in Halifax, that we are now compelled to suffer everywhere on this bleak peninsula for the wholesale destruction of trees on the part of the earlier inhabitants. The bitter winds experienced on a winter's drive over the common, and the roads to the N. West Arm and Three Mile House, oftentimes denuded of snow, which is at others piled in drifts, whilst the sleighing is excellent in both town and country, point, as a cause, to the cutting away of the road-side fringe of sheltering trees; and now the slow remedy of replanting must needs be applied. As a winter shelter the evergreen tree is naturally adopted, though in former times its association with the rigor of the climate doubtless resulted in its wholesale downfall at the hands of the early settlers, and there is still a strong tendency about us to obliterate the evergreen vegetation.

Such however, happily, is not the exclusive spirit of our age, and I cannot refrain from adducing, as an example, the following letter which appeared recently in the local press, headed "Nova Scotia Evergreens":—

To the Editor of the Sun.

SIR,—To my fancy, there is not a tree that grows in the woods of Nova Scotia, that looks so graceful and becoming as evergreens near a dwelling house in winter. They refresh the eye, protect the building and small shrubbery, and give the homestead a snug, social aspect. They also bring up pleasant memories of summer and green fields, and, almost unconsciously to the beholder, promote healthful imagination and a refreshing quiet and repose.

Those who have tried to beautify their houses with Nova Scotia evergreens, mostly confess that they have failed in their object. There is not a tree that grows in our forest that is so hard to raise by transplanting as the Black and Red Spruce and the Balsam Fir; and yet, if properly treated, they will grow as freely as any plant of the forest.

I would say to those who love to see their own native evergreens growing around their dwellings, be not discouraged by any past attempts; success will be attained if they perform the work according to my plan and treatment.

Cultivated soil will not answer for evergreens, unless it is poor, and the subsoil clay or gravel is near the surface. The best soil for black or red spruce is the common light yellow clay or gravel, free from iron rust, and well mixed with greywacke rock and whinstone. If the clay should be mixed with fragments of iron-stone and blue slate, the White Pine, the Hemlock, and the Balsam Fir should be planted. The limestone soil is more suitable for White Cedar. Peaty or vegetable soil is best for the Larch.

The last week of April, and the first week of May, is the best time to remove evergreens for transplanting; then the soil is very soft, and the young trees easily taken out without fear of bruising their tender roots. Strong young plants can always be found on the outskirts of the woods. The average height of the plants should range from a half to two and a half feet, thickly set, with close branches and free from white moss. The plants should be removed on a dull day;—put them into bundles of one dozen each, and tie them with a soft string, and if a trench is already prepared, place the trees in just as they are, in bundles, close together, and cover the roots well with the clay; let them remain there until the tender feeders of the roots grow white. About the 1st of June you can remove the string and transplant them for a hedge or clump around the dwelling house, or elsewhere. They must be well protected from the high winds; the north-east and easterly winds are more injurious than any other.

The Balsam Fir or Silver Fir should be planted by themselves. No pruning is required for ten or twelve years, and then sparingly.

No other class of trees should be planted near the Evergreens, for they always grow more rapid when they are some distance from any other trees. It is labour in vain to transplant Evergreens in the fall of the year.

Halifax, Nov. 27, 1865. F. McKAY.

Our writer recommends transplanting evergreens in the spring, saying it is useless to attempt it in the fall. On this point, however, the evidence which I have collected from most local authorities on the subject tends to reverse his conlusion; as it is generally admitted that the very best time for transplanting these trees is in the end of May or beginning of June—just when the young shoots, having broken their capsules, are conspicuous by their new bright-green colour. The plant now seems to be full of energy, and will adapt itself to circumstances in order to continue its efforts more quickly then when partially dormant. Very early in the season is perilous, as the Fir having so large an amount of evaporating surface is more apt to receive injury from the cold drying wind of early spring than deciduous trees. Spruces should be placed in the ground with their long diverging roots as near the surface as possible, merely placing around them the upturned sod.

Planting by seed is the usual plan for growing evergreens in the English and Scotch nurseries. The young plants have excellent roots, and are much more easily removed. The success of the Fir plants which have come over to this country is very noticeable, and the Norway Spruces on the Common, the Scotch Firs and Larches in the Cemetery and Horticultural Gardens, are much more forward than any of our indignious transplants. These trees appears to thrive admirably in this country: the English Larch is now everywhere in blossom, (May 7th,) with budding foliage, whilst our own species still seems wrapped in its winter sleep; the leading shoots of last season's growth on the Norway Spruce are nearly a yard in length, when the indigenous transplant rises but a few inches.

Art. XIII. On the Land Birds of Nova Scotia. By A. Downs, *Cor. Memb. Zool. Soc. of London.*

[*Read May* 3, 1866.]

Having in my last paper completed the list of the Birds of Nova Scotia as far as the warblers, I now proceed with the wrens, creepers, sparrows, &c; but as our Institute has an abundance of matter for insertion in the next number of Transactions, I will not trespass too much by making this paper a lengthy one, but will reserve my additional remarks for next session, when, if life and health be spared me, I hope to complete the whole of the land birds.

I wish to remark, however, in regard to my last paper, that as European naturalists have been misled by my having given our barn swallow as *Hirundo rustica*, it would probably be better to insert Wilson's specific name *Americana* instead. Most of the European and American birds are perfectly distinct, although some authors have given them a similar name, and without thought I repeated the error.

BLACK AND WHITE CREEPER—(*Certhia varia*).—This pretty little bird with its black and white streaked plumage so clearly defined, is somewhat abundant, and generally observed in company with the warblers and arriving about the same time. Its nest is very difficult to find.

BROWN CREEPER—(*Certhia familiaris.*)—This bird which is considered to be identical with the European Brown Creeper is by no means abundant. I have shot specimens in the vicinity of Grand Lake, that famous locality for birds of all kinds, and have also seen it once on my own property in the village. I think it breeds about Grand Lake.

WINTER WREN—(*Troglodytes hyemalis*).—Nearly always found inland. I have seen it about Grand Lake, and in the neighbourhood of Kentville, but never about Halifax. This bird has a very powerful song taking into consideration its small size, and at times makes the forest ring with its pleasing note, It is solitary in habit, and, unlike some of the wrens which court the society of man, appears to shun it. You may see it in some secluded part of the forest, hopping about old fallen tree trunks and endeavouring to screen itself from observation.

RUBY CROWNED WREN—(*Regulus calendula*).—This is not a common bird, and partakes of the habits of the former species in keeping away from cultivation, and in power of song. I have shot a specimen in Byer's swamp in the village.

AMERICAN GOLD CREST—(*Regulus satrapa*).—This nimble little bird is a constant resident in the Province. It breeds in the denser parts of the forest. In winter time when all nature appears to be in a deep sleep the gold-crest and the black-cap-tit flit from tree to tree in search of insect life, scanning the cracks and crevices, from which they appear to obtain enough for their support.

BLACK-CAP-TIT—(*Parus atricapillus.*)—Very common in winter time. It breeds in the Province in holes of trees. I once observed one in the act of taking some sheep's wool for its nest. The wool was beneath a stick on the highroad, and the bird was endeavouring to collect all the wool, which it did by carding it out and surrounding its whole head with a perfect ball of the fuzzy material. Country people say, that when he cries "sweet weather, sweet weather," a storm is brewing. It is commonly known as the "*chick-a-dee*" from its oft repeated note, which sounds like the words "chick a dee dee dee". It delights to feast on fat of any kind, and I saw it light upon candle moulds set out to cool and pick out the grease. I once saw one enter a good sized marrow bone and disappear entirely in the hollow within. It becomes very tame when fed from a window, and during the past hard winter Mrs. R. G. Fraser, had a perfect flock of black-cap-tits and other birds, which regularly came to be fed night and morning.

Hudson's Bay Tit—(*P. Hudsonicus.*)—Although similar in habit to the preceding species it is not so common, but may occasionally be seen in company with it. It breeds in Nova Scotia.

Solitary Vireo—(*Vireo solitarius.*)—This rare bird is almost unknown to me, although I believe it breeds in some parts of the Province.

Warbling Vireo—(*V. Gilvus.*)—Common. It breeds about the village, generally on the slopes of the hills among the birch groves.

Blue Bird—(*Gialia Wilsonu.*)—This handsome bird is only occasionally seen here, being out of its usual latitude so far north. I once saw four on a willow tree near Kidston's house, and got a box and fixed it up like they do in the United States, but they never took possession.

Cedar Bird, or Waxwing—(*Bombycilla Carolinensis.*)—Generally appears here about the first day of June when the apple blossoms are out. It feeds upon fruit and insects, and is a fearless bird allowing a person to come close to it. It breeds in the village, a boy having brought me a nest taken near the church school house.

Bohemian Waxwing.—This bird occurred here in the winter of 1864–5. A flock was seen near the Three Mile House, and Mr. Bellis shot some specimens. This is the only instance on record of its appearance in the Province so far as I know.

Song Sparrow—(*F. melodia.*)—This is the most common species we have: It breeds about clearings, making a nest on the ground, in which it lays four blotched eggs. In habit it resembles the wren, hopping about faggot heaps and jerking its tail up and down: indeed I may say it supplies the place of the English wren in Nova Scotia. A few stop all winter, and I have heard them singing in February, in the Hon. Edward Kenny's garden in the city. Some I have in confinement sing at night. Boys call it "Spring Bird." Its note sounds like "chink, chink, chol vo ree: old Bill Pickett sha'nt have me."

White-throated Sparrow—(*F. Pennslyvanica.*)—Its welcome note to the fisherman on the lakes is first heard about the end of April. It builds its nest in tufts of ground juniper in low spots, and lays four eggs. I once heard the cry of this bird in distress making a pitiful noise, and on arriving at the spot saw a red squirrel with a young sparrow in his mouth. I threw a stone at him and he let go his prize, when I found that he had eaten its head off. This squirrel will also rob the nests of the migratory thrush, taking eggs and young. This bird from its note is called "Poor Kennedy's Bird."

Bay-winged Sparrow—(*Emberiza graminea.*)—This is a very rare species. Capt. Blakiston and I had great work trying to get a specimen.

Chipping Sparrow—(*E.socialis.*)—This bird appears to become more common every year as the country becomes cleared. In the United States it is very common, hopping about the roads in the city parks and other frequented places, almost under the feet of passers by. It breeds in this Province in evergreen trees, a pair or so at my place; in the States it builds in the cedar; it is only of late years I have seen this bird about Halifax.

Tree Sparrow—(*E. Canadensis.*)—This is one of the birds which visit us only in winter, when it may be seen on the snowy roads picking at horse droppings. As spring advances it leaves us for the far north, where removed from danger it builds its nest and rears its young in security.

Savannah Sparrow—(*E. Savannah.*)—Not a common bird here. It is evidently a ground species, as I have never observed it in a tree. A few breed in the province every year.

Swamp Sparrow—(*Fringilla Palustris.*)—This is a very rare species, observed but seldom, and I know nothing of its habits.

Snow Bird—(*Junco hyemalis.*)—This is probably with the exception of the robin, the most familiar bird in Nova Scotia, being the only one that is seen in our yards and gardens at all times. Some call it the "blue bird" from its slate coloured back. A few stay all winter and come into out-houses to search for food. Some years ago, a pair of these birds made their nest on a beam in an unfinished house, in Lockman street, where a carpenter was continually at work, but his labour did not appear to interfere with their incubation. When a stranger, however, came in, they at once flew off and remained until his departure. They finally hatched their four young ones and took them away. Their usual nest is on the ground, a situation frequently taken advantage of by the spotted snake, (*Coluber sirtalis,*) which frequently makes a meal of the young. I have some in confinement.

Snow Bunting—(*E. nivalis.*)—This well known bird arrives with the first snowstorms of winter, and leaves about the beginning of March. The citadel hill is a favourite resort of this northern species, and it appears to prefer the most exposed situations. It has always been a mystery to me where these birds shelter themselves at night, or during a heavy snow storm.

Purple Finch—(*Fringilla purpurea.*)—Very common. It is easily trapped; its appearance and song causing it to be kept in cages. It loses the red plumage in confinement and becomes yellowish. The young birds are grey until the second year, when they assume the mature red plumage. This is the bird called by bird fanciers red linnet and the grey linnet—they are the same.

Northern Redpole—(*Linaria borealis.*)—In former years this bird was more abundant than it is now. It visits us in flocks in winter. Mr. J. M. Jones informs me that he has shot this northern bird in winter time in the Bermudas. All go north in spring.

Pine Finch—(*L. Pinus.*)—A constant resident all the year, plenty in winter. It is a very familiar bird allowing a person to come close to it without showing any fear. One I have in confinement will come and sit on my finger. It feeds principally on the seeds of the *coniferæ*, but in confinement takes common bird seed. W. Winton found a nest in March some years ago with eggs in it, the high winds blew the eggs out of the nest.

Indigo Bird—(*Fringilla cyanea.*)—Very rare, only a straggler occurring now and then.

American Goldfinch—(*Carduelis tristis.*)—This bird is common inland, especially about Truro and Windsor, but is rare in the vicinity of Halifax. It breeds here and a few remain during winter, changing at that season to an olive colour. Its call note is pretty and something like that of a canary.

Pine Grosbeak—(*Corythus enucleator.*)—Common during the winter, attracting attention by the rose coloured plumage of the male bird. It is very tame, sitting on a bough on the road side while a passenger goes by. Some years ago I shot one of these birds behind Mr. James Forman's house, a female. No sooner had the lifeless body fallen to the ground than the male bird flew down and began to protect it by placing dead leaves around. The scene was so touching that I would never wish to cause its enactment again. Mr. Foreman tells me several of these birds have frequented his garden during the past hard winter. All leave here in spring for the North. I am told it breeds in Newfoundland.

Rose-breasted Grosbeak—(*Coccovorus ludovicianus.*)—This is a summer bird with us, and both for plumage and song is kept in cages. It is to be found about Mount Thom, near Truro, and also at Pictou, and I am told equally so at Prince Edward Island. We rarely see it about Halifax. It usually frequents hardwood hills, and breeds about Grand Lake, and other parts of the Province that abound with large hard wood trees.

White-winged Crossbill—(*Loxia leucoptera.*)—During some years it is abundant, while at other times it is rare. It breeds in the Province and feeds on the seeds of the *Coniferæ*. Mr. Henry Piers assures me that he has found a nest of this bird with young in it in midwinter, it was in a hollow tree that was chopped down for fire wood.

Common Crossbill—(*L. curvirostra.*)—The same description will answer for this species. I may add that it has always been a puzzle to naturalists in what position these birds breed, it is supposed to be identical with the European.

In conclusion, I wish to make a few brief remarks pertaining to the arrival and departure on their migrations, of the various birds which visit our Province.

Nova Scotia is very favourably placed for observers, and I feel confident that if a more extended series of observations in this respect were made, we should become possessed of valuable information now unknown to us. Vast flights of wild fowl pass and repass over this peninsula in spring and autumn, to and from the coasts of Labrador and Newfoundland, and even still farther north; and it would be extremely interesting to ascertain with what precision such arrivals take place each year, and whether an early spring or a late autumn have any particular influence upon such movements. In my humble opinion I am inclined to think that such casual occurrences have little effect upon the feathered tribe, but that they move north at the close of winter and south at its commencement, with great regularity, guided alone by that wonderful instinct which is implanted within them by their Allwise Creator.

APPENDIX.

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

1865.	Thermometer. Max.	Thermometer. Mean.	Thermometer. Min.	Thermometer. Range.	Barometer. Max.	Barometer. Mean.	Barometer. Min.	Barometer. Range.	Winds. Most prevalent.	Winds. Least prevalent.	Weather, &c. Rain fell on	Snow fell on	Hail fell on	Fog on	Aurora Borealis	Solar halos on	Lunar halos on	Lightn'g.	Thunder.
											Days	Days	Days	Days	Nig'ts	Days	Nights	Days	Days
January.....	49°	22°	4°	45°	30·26	29·55	28·83	1·43	N.W. & S.W.	E.	8	13	...	5	4	1	3	...	...
February ...	44	24	8	36	30·25	29.63	29·09	1·16	N. E.	S.	5	14	1	3	5	1	...	...	...
March.......	50	34	11	39	30·35	29·75	28·95	1·40	N.W. & S.W.	E.	12	5	1	2	6	...	...	1	1
April	64	40	25	39	30·22	29·80	29·15	1·07	S. W.	E.	14	2	...	6	4	2	3	...	...
May	78	49	29	49	30·11	29·64	29·12	99	S.E. & S.W.	E.	17	1	...	15	2	...	2	1	3
June.........	74	58	35	39	30·10	29·73	29·46	·64	S. W.	E.	8	...	...	5	2	...	...	1	...
July	84	60	49	35	29 98	29·60	29·39	·59	S. W.	E.	14	...	...	7	4	1	1	1	1
August......	85	63	45	40	30·05	29·67	29·34	·71	S. W.	E.	9	...	...	8	11	...	...	...	...
September..	81	57	35	46	29·99	29·72	29·40	·59	N. W.	E.	8	...	...	1	5	...	1	1	...
October	72	44	24	48	30·18	29·48	28·73	1·45	N. W.	E.	15	2	1	4	8	...	...	1	1
November..	63	39	16	47	30·07	29·60	29·07	1·00	N. W.	S.	16	6		1	3	...	2	...	...
December..	51	24	6	57	30·10	29 60	28·51	1·59	N. W.	S.	10	9	...	3	1	...	...	...	...
Yearly..	...	43	...	91	...	29·65	...	1·84	...	...	...	...	...	...	...	...	...	...	...

MONTHLY AND YEARLY MEANS AND RANGE FOR 1863, 1864 & 1865, HALIFAX, NOVA SCOTIA.

	THERMOMETER.						BAROMETER.					
	Monthly Mean.			Monthly Range.			Monthly Mean.			Monthly Range.		
	1863.	1864.	1865.	1863.	1864.	1865.	1863.	1864.	1865.	1863.	1864.	1865.
January	30°	23°	22°	42°	54°	45°	29·60	29·61	29·55	1·60	1·17	1·43
February	23	26	24	53	51	36	29·80	29·81	29·63	1·55	1·67	1·16
March	25	28	34	45	36	39	29·66	29·47	29·75	1·17	1·19	·40
April	38	36	40	41	43	39	29·66	29·63	29·80	1·24	·86	1·07
May	47	48	49	46	38	49	29·66	29·64	29·64	·68	·76	·99
June	54	57	58	36	55	39	29·64	29·66	29·73	·71	1·00	·64
July	65	62	60	35	33	35	29·79	29·73	29·60	·60	·54	·59
August	64	64	63	34	34	40	29·75	29·72	29·67	·97	·71	·71
September	58	56	57	42	33	46	29·81	29·72	29·72	·96	·98	·59
October	51	46	44	36	34	48	29·84	29·56	29·48	·84	1·04	1·45
November	40	39	39	47	37	47	29·64	29·68	29·60	·99	1·05	1·00
December	26	27	24	36	50	57	29·70	29·55	29 60	1.12	1·78	1·59
Yearly	44	43	43	96	97	91	29·71	29·65	29·65	1·75	1·78	1·84

THE following remarks upon the Red Indians of Newfoundland, by Mr. ELIAS MARETT, are contained in a letter to the PRESIDENT :

"213 GOWER-ST., ST. JOHN'S, N. F.,
October 15, 1865.

"*My Dear Sir,*—

"Sometime back on my meeting with you at Halifax, I had occasion to mention the discovery of a grave of one of the aborigines of Newfoundland, and also that I had visited the place and had withdrawn several of the relics, which I then described to you from memory, but which I had long before parted with. Since that time I recently met with an old friend, the Rev. M. Blackmore, Rural Dean of Conception Bay, who was the first visitor to the place, and who retains in his possession a number of curiosities collected by himself at the last resting place of the solitary Bœothick, or Red Man of Newfoundland.

"I will now give you his own statement, and in his own words :—'They were found in the year 1847, on one of the Islands forming the Lower Burgeo group, called "Rencontre." This Island is uninhabited, and considerably elevated—difficult also of access in rough weather. It is in a great measure covered with broken fragments of rocks which have fallen from the heights. About half way up the mountain (if I may so term it), and in a hollow formed by a large piece of fallen rock, with every opening carefully closed by small pieces of the broken rock, we, that is I, and the men who had the evening previous discovered the cavity but who would not search into its contents until I came with them, found the bones of a human being wrapped closely round with birch rinds; on removing these rinds a quantity of gravel mixed with red ochre became visible, and on removing this we found the oblong pieces of carved bone, together with the flat circular stones, some glass beads, two iron hatchet heads, so rusty that we could pick them to pieces, a bone spear head, the handle of a knife with part of the blade still in it, also some flints designed for arrow heads—all these articles were together and had been placed apparently under or just before the head of the individual buried—all carefully enclosed in the rinds. The skull was that of a full grown male adult with a very flat crown and large projection behind; the place of interment was singularly wild, high up in a cliff overlooking a little cove facing the open sea, and only acessible on this side in very smooth water. It was discovered by a boy while gathering brushwood. This boy seeing a piece of wood projecting from the rock pulled at it to add it to his store, and so loosened the smaller rocks and found the cavity with its contents. He left the stick being too much frightened to take it home. The head of this stick which was about four inches in diameter was ornamented. There were four fragments of sticks, and they must I imagine, have formed a kind of canopy over the body. These relics certainly do not belong to the tribes of Indians at present sojourning in Newfoundland, for on shewing them to some Mic-Macs they at once gave me to understand that they belonged to one of the aborigines of the

Island, and that the owner must have been a great "witch," the word used by the Indian—who also informed me that by use of these oblong pieces of bone, the man could kill his enemies—their use from this it would appear was not ornament only, but a charm also.'

"Such is the account of my friend the Rev. Martin Blackmore, and as I was the next person to visit the place though some four years later, I must say that his report tallies in every respect with my own observation. The Indian's account also agrees perfectly with what was told me by Indians to whom I shewed some of the bones and arrows that I myself had collected in the same place. The presence of iron weapons is easily accounted for, as since the reign of Henry VII. the shores of Newfoundland have been visited by British seamen in pursuit of the cod-fishery, and collisions occasionally took place between the natives and the crews of the fishing-vessels—the fishermen, though not allowed to form settlements or raise buildings in the colony, except such as were absolutely necessary for the pursuit and curing of the fish, customarily left such things behind them as could not easily be transported at the close of each season, and the natives watching for the departure of the whites, invariably plundered their depots. The disappearance of the Red Indian of Newfoundland is only of recent date, and many persons now living have come into personal contact with members of the race. They are now all extinct, and the last representative of them (Mary March as she was named,) died some 35 or 40 years ago. She had been taken when a child and brought up in her captor's family as a servant, but had escaped at different times to visit the haunts of her departed race. Through the kindness of my friend Mr. Blackmore, I am enabled to send you the accompanying sketches which I have made from his collection. The lance or spear head of jasper is one found by myself.

"As I know you are much interested in the antiquities of North America, I hope the sketches will not be without interest to you. I must remark in conclusion that several of the bones are much decayed. An extra amount of work has interrupted the travelling which I had mapped out for myself, and my principal having been seriously indisposed has kept me almost a close prisoner,

"I remain dear Sir,
"Yours very faithfully
"Elias Marett."

ON NORTH ATLANTIC STORMS.

BY J. L. HURDIS.

Many years ago, when Redfield and Reid were only beginning their observations on storms, I happened to be a passenger on board a sailing ship, bound in the autumn of the year, from England to British North America. Weary with contending against westerly winds, in mid-Atlantic we were cheered by a fine breeze and promising clouds springing up in the S.E., and speculating on keeping the fair wind for some days at the least, when the skipper, a seaman of experience in those latitudes, chilled our hopes by stating that no reliance could be placed in these easterly winds, which were sure to veer to to the South and S,W. blowing very hard with rain at the latter point, then "jumping" into the N.W., there ended, leaving you once more to the vexation of a head wind and blue sky—all this, too, it was prophesied, was to happen in the brief space of three or four hours. The skipper was marvellously correct. Several of those minor revolving gales, all alike, passed over us in succession, convincing me that there must be some law of nature regulating these things. After years found me in the Bermudas, a region, I may say of revolving gales, and now I have spent ten years in this country; and when I connect my experience of former years with recent observations, I cannot avoid the conclusion that all the revolving storms of this country, and they are very many, come to us from the tropics of the Western World.

The following notice occurred in the "*Bermudian Royal Gazette*," of September 12th, 1865.

"Yesterday was the anniversary of the dreadful hurricane with which Bermuda was visited in 1839. The wind on the 11th September, 1839, as on yesterday, was from the Eastward. It subsequently, however, during the continuance of the hurricane, went to E.S.E.—S.—then S.W. and eventually to W. Though the appearance of the sky yesterday was very unsettled, it did not bear any thing approaching the copper coloured hue which it presented on the eventful day above alluded to.

"The hurricane of 1839 commenced at about 7.p.m., and the storm did not subside till about noon on the 12th. The Barometer fell to 28·3, and soon after the storm subsided, it rose to 30·1. The Thermometer ranged from 85-81, and went down to 71 soon after the weather moderated.

"The melancholy appearance of the Island on the 12th from the destruction which the gale had caused, can never be forgotten by those who witnessed it. Scarcely a house escaped injury; some were levelled, others unroofed and side-walks split to the foundation; trees broken and prostrated, and a number of vessels and boats driven on shore.

"A distressing drought of nearly six months' continuance preceded the hurricane."

This Hurricane of the 11th September, 1839, reached Charlottetown, in Prince Edward Island, 46 N. lat., on the 13th September, at 2 p.m, the wind blowing from the N.E., and freshening rapidly.

I was at that time stationed in the Island, and, at the commencement of the gale, watched the two ferry-boats as they crossed the Hillsborough. At 3 p.m., I returned to my own residence on the north side of Charlottetown, the storm then blowing with sufficient force to hurl sundry loosened bricks from the top of one of my chimneys.

This hurricane was, therefore, forty-three hours in traversing the 983 English miles between the Bermudas and Charlottetown; being at the rate of 22·86, or nearly 23 English miles per hour. The time occupied in passing over the Bermudas was seventeen hours, which, measured by the speed above mentioned, gives a diameter to the storm of 388 English miles, at that particular period of its existence. Reduce this diameter 28 miles in order to be within bounds, and it will then be 360 Eng. miles in breadth. Now, suppose the extreme height of this hurricane from the surface of the earth, to be two such miles, which is probably beyond the reality, and we shall have a whirling mass of atmosphere and cloud, representing a flattened disk, the width of which would be equal to 180 times its own thickness, or, resembling, in diameter and thickness, the proportions of an ordinary dinner plate. This immense circle would cover an area of 101,787 square miles, and would be quite flat if the surface of the earth presented a dead level; but, moving over a rounded or globular form—the segment of a sphere—the under side of the hurricane would necessarily be concave, and the upper surface convex, to correspond.

In this form, I conceive, did the hurricane of 1839 advance from the Bermudas towards the N. and N.E., revolving upon its centre (which centre passed immediately over those islands) from right to left, if viewed from a standing point in the centre; with what velocity we know not, but if estimated at five times the rate of direct progress, it would give 120 miles per hour. During the prevalence of this hurricane in Prince Edward Island, the wind veered from N.E. to S.E. S.W. and N.W., where it terminated sometime before daybreak on the 14th. A few old buildings were levelled to the ground, and sundry trees of thirty years growth blown down, but, with these exceptions, little material damage was sustained. The outer margin of the gale extended to Bay Chaleur, where H.M.S. "Andromache" was then riding at anchor. In that locality, however, it was not severe.

In Keith Johnston's Physical Geography for Schools, it is stated that the West India hurricanes commence near the Leeward Islands, travel to the W.N.W., and then round the shores of the Gulf of Mexico, following the Gulf Stream, and are lost between the Bermudas and Halifax. Other writers terminate such storms south of the Island of St. Pierre, Newfoundland.

The hurricane of September 11th, 1839, took a more easterly course, and was certainly not *lost* in the longitude of Bermuda, or St. Pierre, Miquelon.

It is a remarkable fact that in the ten degrees of latitude north of the equator, in the Atlantic, hurricanes are unknown, and that the same exemption extends to every part of the South Atlantic. It is, then, between the 10th and 20th parallels of north latitude that we must look for the commencement of these storms, so ably described by Mr. Redfield and the late Sir William Reid.

The greater number of the so-called West India hurricanes pass to the north, between the Bermudas and the shores of the United States, sometimes in close proximity with the former, and on other occasions sweeping over the seaboard of those States. The hurricane of September 11th, 1839, passed, however, directly over the Bermudas, eastward of the usual track, and we know that it was not *lost* in the longitude of Halifax, N.S., but continued its course into the Atlantic with fearful violence.

A revolving tropical tempest of this enormous extent, high rate of speed, and power, with a wide ocean before it, free from islands, mountains, and other physical obstructions, must, under the circumstances, continue its onward and irresistible course for hundreds of miles, and thus be found on the European side of the ocean, without exhibiting any material symptoms of exhaustion. Expansion, and a corresponding loss of speed and power, are, I believe, characteristic of these storms, and for this due allowance must be made, to render it possible for opposing winds to offer resistance to its progress. If a north or south wind of less velocity or power than the revolving gale, comes in contact with it, at this period of its career, such a wind would be compelled to give way; not, however, without infringing upon and disturbing the outer circumference of the hurricane, and causing portions of whirling matter to be separated from it. These minor portions of the cyclone would, I conceive, retain their revolving character, and continue their easterly course, somewhat diverging from that of the present storm.

I think it probable that many of our West India hurricanes are broken up by repeated collisions of this nature, and that, from this cause, arise those minor revolving gales which sweep over the British Isles and the coast of France in rapid succession, during the autumn months of the year.

It is likewise evident to my mind that revolving gales of greater diameter and force than these miniature cyclones, occasionally cross the Atlantic and reach the shores of Europe. The gale in which the unfortunate "Royal Charter" was wrecked on the Welch coast, in October, 1859, may be cited as a case in point. The warm temperature of that gale was alone sufficient to distinguish it from a cold straight blowing easterly wind.

Valuable information regarding these mighty storms might assuredly be found in the log books of ships which constantly cross and recross the Atlantic in the latitudes of their occurrence. The steam packets of the Cunard line, on their outward and homeward voyages must have encountered these gales again and again; must have steamed into them and through them, or gallantly held their course as the storm swept over them in its N. E. course.

Now, in regard to the late storms of December 1865, and Jan. 1866, there is no room for doubt; one and all have shewn the same tropical characteristics; revolving and proceeding in a N.E. direction. As to their destructive tendency, the published accounts sufficiently speak. Was the storm in which the "London" foundered, a revolving one or not?

The "Amalia" sailed from Liverpool on the same day the London left Plymouth, following in her track. The Amalia's published account says the storm set in on the 10th January, at noon, with a fresh breeze from S.W.

4 p.m.	Gale increasing.
6 p.m.	Blowing a hurricane.
8 p.m.	Violent hurricane.
9,45 p.m.	(Barely 10 hours) Engines stopped, and ship unmanageable.
January 11.	Similar weather.
2 a.m.	Deck pumps rigged.
9 a.m.	Set canvas on ship.
3,30 p.m.	Sighted S. Sh. "Laconia."
Midnight.	Squally, and high sea.

All this time the ship was sinking—January 12th, 9 a.m., "Laconia's" boats came alongside, crew saved.

I think it most likely she first encountered the storm from the S. then S.W., and so on. The ship sunk in Lat. 46° 31′ N. and Long. 8° 40′ W.

The Royal Mail Steam Ship "Rhone", Captain R. Woolward, Commander, on her way from Southampton to Lisbon, fell in with the same gale. The Captain says, in a letter to the Secretary of his Company:—"We encountered a severe cyclone on the 11th instant, wind from S.E., veering eastward to north, in which I am sorry to say the two life-boats on the port side, and the cutter were lost, the starboard cutter and mail boat damaged, the rails and deck furniture much injured, two horses killed, and one of the crew had his leg broken. I have never before experienced such a gale. The barometer fell an inch and 11·100 in 12 hours, going as low as 28·34, and although the wind was fair, we were obliged to lie to for ten hours."

This is valuable information, and with that supplied by the crew of the "Amalia," we gain a fair insight into the character of the storm.

Again on the 14th January, the P. & O. Company's Steam Packet "Tanjore," arrived from the Mediterranean, having experienced very heavy weather in the Bay of Biscay, during which "phosphoric balls," as my informant called them, appeared on the extremities of her yard arms. This may, or may not be a characteristic of tropical storms, but whether it be so or not, I mention the fact as one worth recording.

With such evidence before us, I hardly think any one will be disposed to question the revolving character of the late Bay of Biscay storms.

The next consideration is, whether there have been any great tropical storm, or storms, in the centre of the Atlantic, which might be connected with the storms recently experienced on the coast of England and France.

Of this I think there can be little doubt. The "Palinurus," from Liverpool, and the American Ship "Christiana," from London, both bound to New York, found themselves, at half passage involved in a furious hurricane, which crippled the first, and made a complete wreck of the second. Unfortunately, I can obtain no reliable data whereby to fix the locality of this storm upon the map, or to trace it in its progress to England. All my calculations, so far, have failed in any useful result, beyond an impression that the storm was much slower in direct progress than such storms on the western side of the Atlantic.

Thus the Christiana had the storm on the 19th and 20th December—no latitude and longitude given. The Palinurus in longitude 39° 20′—no date stated.

Mariners, in describing the storms that have recently passed over this part of the world, almost invariably allude to the presence of a heavy *cross sea*, as one of the great difficulties they had to contend with.

A gale, blowing in a straight line, will cause the ocean swell to roll in one direction only; and, if two straight gales should meet from opposite points, or at right angles, a cross sea would be the result.

These cross seas are very perplexing if not dangerous. In my December voyage across the Atlantic, the vessel I sailed in, was unfortunately becalmed in a very heavy cross sea, and the awful wildness of the extraordinary scene I shall never forget. Huge waves were rolling in different directions and coming into collision with each other, the two united sometimes rising to a peak, and representing what our skipper was pleased to term a "church steeple." Great attention was paid to the compass during this commotion of the sea, and the astonishment of the skipper, and of an old sea captain who was a passenger, is still fresh upon my memory; as a mighty wave upon the starboard beam swung the ship half round the compass, and a cross sea, or seas, from the opposite direction, completed the circle, the passenger captain exclaiming, "zounds, why she has gone completely round the compass on her heel, never saw such a thing before in my life." It was not pleasant to be knocked about for two hours in such a cauldron, and I was heartily thankful when a fine fair wind set in and enabled us to extricate the ship from her dangerous position. Cross seas had certainly much to do with the destruction of the London and Amalia, flooding the between decks, quenching the engine fires, and ultimately causing both these overloaded ships to founder.

With regard to the "phosphoric balls," seen on board the "Tanjore," let me observe that the phenomena is by no means a common one, many an old seaman never having seen it. I believe it is called "*St. Elmo's fire*"—"*Corpus sanctum*,"—and a variety of names which appear to be corruptions of the latter. I am happy to say I once witnessed this concentration of the electricity of the atmosphere upon the rigging of a ship. It was on the same December voyage from Prince Edward Island, our little brig, the "Eliza," not quite two hundred tons register, was making her *debut* upon the ocean, and had been scudding before a severe gale during the eight hours of daylight which we enjoyed at that late season of the year. The darkness of night had come upon us, but with two good men at the wheel, and our skipper, a superb seaman, conning the ship and steering by the stars, all proceeded well. Wearied in body by watching the progress of the storm all day, I seated myself upon the cabin floor, in front of a bright fire in the stove, placing one arm round the leg of the cabin table to secure my position, and here I was rocked to and fro to the hoarse music of the winds and waves, until half asleep, when a seaman entered to say the captain wanted me on deck immediately. The mandate was instantly obeyed. Pointing to the main-top-gallant-mast head, the captain called my attention to a bright light upon the copper vane spindle. It was like a brilliant star in the dark heavens, and was mistaken for one by the skipper before sending for me; a heavy lurch bearing the light with it convinced him of his error. This light, during my presence on deck, was brilliant for a full minute or perhaps longer, when it disappeared altogether.

Some weeks later I happened to mention this circumstance to a relation residing at Abbeville, in France, when he related to me, as a singular coincidence, that two French gentlemen of his acquaintance, had recently travelled together, on horseback, from Amiens, and night having overtaken them upon the open plains, they were quietly proceeding along the road, in conversation with each other, when one of them exclaimed with surprise, "do you see that light upon my horse's ears!" Hardly had the observation been made than the light also appeared upon the eartips of his companion's horse.

St. Elmo's fire, old mariners affirm, usually appears on the extremities of the lower yard arms, first, then removes to the top-sail yards, and so on till it reaches the mast head. An old officer of the *ci-devant* East India Company, tells me, that on one of his voyages the look-out man proclaimed, "a light ahead," and on some officers proceeding to ascertain whence it emanated, they were astonished to find this electric light in possession of both ends of the spritsail yard.

Reverting to the subject of Atlantic revolving storms, let me add in conclusion, that I consider their usual course, indeed their never varying course, is from the West Indies northwards between the Bermudas and the North American coast to latitude 30, where they head to the north-east, and passing Nova Scotia and Newfoundland, rush onwards towards Europe. Bermuda thus represents a sort of turning point, round which these storms describe their course, but at such a distance as most frequently to avoid coming into collision with the spot. Exceptions of course take place, especially in the winter season, when Bermuda gets a full share of these revolving gales. Now, from Nova Scotia to the meridian of 30 west, these gales must have prevailed during December and January, for in that longitude their violence was something terrible to contemplate—witness the wreck of the "Christiana," the "Jane Lowden," and a host of other ships, all crumpled up in the open sea, in a manner truly marvellous. These storms were *moving* to the north-east, and most assuredly did not *commence* their motion in that longitude, but far away in the tropics; generated by that great motive power, *heat*, the source of all motion, if I mistake not. Well, from longitude 30 to our own shores, the track of these storms is only too distinctly marked out by the dismal amount of ships and cargoes that have been strewed in fragments upon the surface of the sea, and to which brave men have too often clung in the vain attempt of saving their lives. The rest we know and will pass over for the present.

Bear in mind that in the Indian Ocean, north of the equator, where no cold Arctic current is known, its revolving storms move in the same direction, turn in the same latitude, and obey the same laws as those of the Atlantic. Also, that none but straight winds belong to the temperate regions of the earth; that the coast of Africa lies almost entirely within the tropics, where trade winds always prevail; and that whenever a revolving storm appears in the north, we may safely set it down as a tropical wanderer. I cannot for a moment entertain the idea that revolving storms can be generated to the north of the tropics.

Fourteen years of isolation in the Bermudas made me somewhat familiar with the winds of the Atlantic, and I can confidently assert that no hurricane or revolving gale, great or small, ever came upon us there except from the south or south-west. Taking all these circumstances into consideration, could we otherwise conclude than that the revolving storms which annually speed on their destructive course over the wide waters of the North Atlantic, originate in the region of the tropics.

FIELD MEETING AT ASHBOURNE, JUNE 26, 1866.

BY invitation of the PRESIDENT, a Field Meeting of the Institute was held at his residence at Ashbourne, North West Arm, and vicinity, on Tuesday the 26th June.

The programme contemplated,—1. a visit to Downs' Zoological collection, head of the North West Arm, and thence to Ashbourne. 2. A visit to the grave of the late TITUS SMITH, eminent in Nova Scotia as a Naturalist, where the President would read a short sketch of the life of that person; thence to proceed to Geizer's hill, where a splendid panorama of the surrounding country is presented, and where the party could study the botany and geology of the district. 3. An excursion from Geizer's hill to Byers' lake. 4. The return to Ashbourne to dine, and afterwards to visit the President's private museum.

The party assembled at the Province building, where conveyances were in waiting to take them to Downs' cottage. The day was beautifully fine but intensely hot, the thermometer ranging 84° Fah. On arriving they were received with a hearty welcome from Mr. Downs, who very politely escorted them over his grounds, and showed them all the curiosities. Amongst these the principal and more imposing are a splendid young polar bear, a seal, and several deer and antelopes from southern America. The collection consists otherwise of foreign, British and native animals, birds and beasts, of rare and interesting species, all well worthy the inspection of naturalists, and of strangers visiting Halifax. After passing an hour delightfully, the party next proceeded to Ashbourne, the mansion of the President, where they were hospitably entertained, and rested for a while previously to entering upon the further business of the day.

Ashbourne is prettily situated, at an easy distance from the city, and just beyond its taxation, an advantage not to be despised even by men of science. The grounds are tastefully cultivated, and on either side, within a neighbourly distance, are neat suburban residences, and progressive improvements, which at no distant day will make the "Dutch Village," so called, one of the most delightful spots in Nova Scotia. The scenery embraces northward, a view of Bedford basin, bounded by the sombre pine-clad hills; eastward, the well cultivated fields and farm houses of the peninsula, and beyond, the citadel and the upper portion of the city of Halifax; southward is the North West Arm, the harbour of Halifax, and a grand ocean distanee. The soil, which is susceptible of the highest cultivation, rests on the metamorphosed slate of the peninsula, and here and there on the surface are scattered granite boulders, large and small, derived from the glacial action of which the district has largely partaken. There can be little doubt that here as elsewhere in the metamorphic coast band, gold is present in the numerous quartz veins that make their appearance wherever the rock is exposed. Westward, and at a short distance, are the chain of lakes which help to furnish the city with a copious supply of water. These, as well as the valley of the Dutch village, have evidently been scooped by glaciers, which have also formed the North West Arm, and largely denuded the rocks and excavated the depths along the western shore of the harbour.

From Ashbourne a walk of half a mile through the forest led to the Naturalist's grave. It is a quiet spot on a rising ground in view of the surrounding landscape, covered with a young growth of birch and other deciduous trees—just such a place as a philosopher might be expected to select for his last repose. Here all around " the rude forefathers of the hamlet sleep,"—the Dutch and German emigrants, who more than a century ago, settled at this place, which was called after their name. A wooden railing, fast going to decay, marks the grave of the " Philosopher of the Dutch village." The party encircled it, and with bared heads listened to the interesting recital by the President, of the biography with which he had been furnished. At its close, anecdotes and reminiscences of the departed were conjured out of the past, and related by those who had known him and admired his talents and unobtrusive virtues. It would be an act of grace, while the remembrance of the man lingers among the present generation, to erect a more befitting monument to one who may be truly regarded as a pioneer of civilization and science in Nova Scotia.

This tribute rendered to departed worth, the journey was made to the top of Geizer's hill, the highest ground in the vicinity, from which there is an extended view of the country that amply compensates the fatigue of the ascent. Geizer's hill is nearly of the same elevation as that on which the citadel stands, and which it pretty well commands. It is composed of metamorphosed slate and quartzite, much disturbed, with granite boulders interspersed—the compactness of the rock, and probably its elevation, preventing the erosion which has evidently befallen the land for some distance on either side. The retreat of the glaciers however, must have left a considerable deposit of clay and drift, and this impregnated in the lapse of time with granitic and slaty detritus and decomposed vegetation, has in some places produced a fertile soil, which at this height appears to reward the labour of its cultivators.

The land at a short distance from the hill inclines with a gradual descent to the chain of lakes which skirt the Margaret's bay road. Byers' lake, the next requirement of the programme, is about a mile distant in a north-westerly direction. Just however as it came in sight, after a hard scramble through bushes and over interminable boulders, it became the unanimous opinion,—taking into consideration the intense heat, and the exertion required to overcome the difficulty of the way, and the little of interest that might be expected when the goal was reached,—that it would be wise to retrace the route. The main body accordingly returned to Ashbourne, where they were soon after joined by stragglers who had taken another direction, but eventually had arrived at a similar conclusion. The extreme heat and toil had told more or less upon all, but all were in excellent humour, and in half an hour were well prepared, with sharpened appetites, to discuss the ample repast prepared by their worthy entertainer.

An excellent dinner was served under the trees, in a hardwood grove a little distance from the mansion. Mr. Parish the photographer was on the ground, and attempted a sketch of the scene, but owing to the broken light among the trees, was but partially successful. A pleasant hour quickly passed, after which a visit was paid to the PRESIDENT'S private museum, which is contained in a building erected for that purpose.

The collection of specimens gathered together in this building is varied and interesting, comprising many rare and curious forms in every branch of zoology, brought at much trouble and expense from various parts of the globe, and exhibited either in the drawers of cabinets, or in table cases which extends down the centre of the room. The foreign entomological collection, principally from the East Indies and South America; the conchological collection containing some rare land shells from New Guinea, Arroo and other Pacific islands; and especially the beautiful specimens of corals from the Bermudas—attracted the notice of the members. But perhaps the most interesting portion of the whole lay in the series of madrepore and asteroid corals, illustrating the growth of the Bermuda reefs, which is considered by Mr. Jones to be far more rapid than is generally supposed. Coal, glass bottles, recent shells, containing their inhabitants; roots of trees, &c., were here to be seen coated with a vigorous growth of coral, affording facts sufficient to prove beyond a doubt that some polyps are able to secrete their calcareous forms very rapidly in the Bermuda waters, in comparison with similar or allied species in other parts of the world, which according to some naturalists are *supposed* to take thousands of years to form a few feet of calcareous matter. The collection of Nova Scotian reptiles was also worthy of notice, as it possessed nearly every species known to the country, and in some cases species were exhibited in all stages, from the embryo to the adult. The whole collection comprises from seven to eight thousand specimens.

This ended the first Field Day of the Nova Scotian Institute, for 1866. A subsequent half hour was spent on the green sward amid the quiet beauties of nature and in merry social converse, under the influence of a delightful summer evening. Carriages then arrived to take back to the city the Members and their friends—and the party broke up, after kind adieus to the worthy PRESIDENT, by whom they had been so agreeably entertained.

W.G.

SOME ACCOUNT OF THE LIFE OF TITUS SMITH. BY WILLIAM SMITH.
(COMMUNICATED BY THE PRESIDENT.)

AT a Field Meeting of the Institute held at Ashbourne, near Halifax, the residence of the PRESIDENT, June 26, 1866, one of the places of interest visited was the grave of TITUS SMITH. Mr. SMITH resided at the commencement of the present century for several years in the vicinity of Halifax, leading a retired life and devoting nearly his whole time to the study of nature. He was one of the first observers who paid attention to the Natural History of Nova Scotia, and his manuscript notes contained in the archives of the Province, bear testimony to the careful manner in which he registered all facts, especially those relating to the botany of the country. Being employed in different Provincial surveys in the interior he had ample opportunity of pursuing his favourite study, and made such good use of his time while in the forest on these expeditions, that he was enabled to write a concise history in manuscript of Nova Scotian Forest Trees, and Shrubs, which contains much valuable information. He retained a vigorous intellect even to extreme age and by a kindly disposition manifested to those around him gained the good will of all. He died at his residence in the Dutch Village, a small-farm house on the borders of the forest, which had been for many years his home, and according to his wish was buried in a picturesque spot in the pine woods overlooking the calm waters of Bedford Basin.

The following letter was written by his brother, resident in the United States, in answer to enquiries made respecting his early life :—

"WATERTOWN, JEFFERSON COUNTY,
March 10, 1850.

"*Dear Sir,*

"Yours of the 4th ult., came duly to hand, in which you inform me that the friends of my late brother are making arrangements to publish his *writings*, and ask me for such facts as memory can furnish relative to his parentage, the character and standing of his father, his motives for leaving the United States and adopting Nova Scotia as his final residence, and his position during the American Revolution. Also, indications of character, and predominating attachment to particular branches of science manifested by my brother in early life; also for his correspondence with me. The latter has been wholly of a very domestic character, and very few of his letters remain in my possession, having been transmitted to a sister of his and mine, residing at a distance, and who now like him is numbered with the dead. On the general subject of your enquiry, the information must necessarily be limited, about fifty-four years having passed away since I last saw my brother; but such information as I have here to give, obtained from my father and some of his early friends, added to what memory can supply on the subject of your enquiry, will be most cheerfully communicated, Indeed it is a source of gratification that the gentlemen you name, should give so distinguished a mark of consideration to the memory of one so very dear to me, the constant companion of my childhood, and to whom I feel indebted, for the early inculcation of the principle 'that knowledge is better than fine gold.'

"I shall speak in the first person in naming recollections of our ancestors, who at an early day emigrated from England and settled on the Connecticut River, in South Hadley, county of Hampshire, and now state of Massachusetts. The first of whom I have any knowledge, was my grandfather, generally known as Deacon John Smith, who was born about the year 1690, and was by occupation a farmer. During much of his life theological considerations engrossed almost the entire public mind. The settlements too were surrounded with tribes of hostile Indians, so that procuring the necessaries and comforts of life, and guarding the frontier against the inroads of the savages, left little time for literary pursuits. Neither have I any knowledge of his tastes. He held the rank of a captain in the Frontier Guards, and occupied for most of his life the position of Select-man; (three officers bearing that title being elected by the inhabitants of the town, to whose hands was committed the public concerns of the town); he was considered a man of strong common sense. My father who was his fourth son, was born June 4, 1734. Of his early history I know but little. His constitution was not strong, and having an ardent desire to study, he fitted for college; but the war with France of 1756 coming on, and the French having brought many of the Indian tribes into their interest, the utmost vigilance was required to protect the inhabitants of the frontier. My father on that occasion was a volunteer. After that danger subsided he entered Yale College, and I think in 1765, having given much of his mind to theology, he went after leaving college as a missionary, and spent I think, two or more years with the Six Nation Indians, now Central New York. On his return in 1768 he married a Miss Nash, to whom he had been engaged seven years. My brother Titus was the first child by this marriage; he was born in 1769. After my father's return from the Indian country he followed preaching for a time as an itinerant, often in the open field, and to audiences of many thousands. Finding his health giving way, yet thinking he might attend to the duties necessary in a small parish, he settled in West Suffield in Connecticut, but was soon driven from the pulpit by bleeding at the lungs and a diseased liver. On retiring from this field of labour he commenced the study of medicine, which he pursued with all the energy that his low state of health would permit. About this time his attention was attracted by a theological treatise written by Dr. Glass, of Scotland, and also a work entitled "Theron and Aspasio," written by Mr. Robert Sandeman. His mind was forcibly struck by what he deemed the unanswerable truth contained in these works. He opened a correspondence with Mr. Sandeman, which resulted in the removal of that gentleman to America. A church was soon after formed at Dunbury in Connecticut, called a Sandemanian Church, to which place my father removed. Mr. Sandeman after forming several churches finally died at my father's house in Dunbury. My father had fully imbibed the theological opinions of Mr. Sandeman, and had accepted an appointment of a presiding elder over one of these churches. This religious sect was remarkable for putting literal constructions on the bible. Although my father entered deeply into the feelings that produced that revolution that resulted in a separation of the colonies from the mother country, yet believing as he did that duty required him to render obedience to existing powers as being ordained by God, he declined taking an active part in the revolution, and sought for and obtained leave from Congress to remain neutral, on his word of honour to do no act to aid or assist the enemies of his country; but nothing is more vividly impressed on my mind than the great energy with which I have heard him undertake to foretell that the American Revolution would under Providence raise up a people and nation that would afford a refuge for the oppressed and distressed of every nation; that by the disconnection of church and state religion would be left free, and the volition of the mind being untrammelled would open a new era in the world. About the year 1779 my mother died leaving four living children, of whom I was the youngest having been born in Feb., 1777. In 1785 my father was called by a church formed at Halifax to preside over them as an elder. He located himself on a farm in Preston. In the month of Oct. 1795, I left home for the United States, and have not since visited that country. My brother Titus became an early reader under the teaching of his father. At four years old he read English books with facility. He had at a very early age the advantage of a good private school kept by a Mr. Daniel Humphrey, a graduate of Yale College. At seven he had made considerable proficiency in Latin, and at twelve could translate the most difficult Latin authors, and had also made good progress in the Greek.

"In early youth he evinced no desire to mingle in the amusements of children, but always sought the society of those from whom he could derive knowledge. His earliest desires appeared to be to perfect himself in a knowledge of languages, Latin, Greek, German, and French. He was more attached to biographical history than any other reading.

"As it was the constant practice in my father's family that one should read and the rest hear,—when the book was in a foreign language, it fell to his lot always to be the reader. Often have I listened with pleasure to hear him read the Commentaries of Cæsar from the Latin text, which he did with great facility. He became early attached to mathematics and astronomy, in which he had early made some proficiency, owing perhaps to a constant cause always operating with him—that was an entire absence of desire to engage the mind in the ordinary amusements that too often draw the mind from the matter in hand. I think it may with literal truth be said of him, that from two years of age he was never known to cry and seldom to laugh. I never saw him angry, and seldom much elated. With an even temperament he pursued whatever he undertook until it was accomplished. About the year 1790 or 1791 my father was furnished by Governor Wentworth with a complete set of the botanical works of Linnæus.

"From this time until I left home, much of the flowering season of the year was devoted to botanical studies, of which his father also was passionately fond

"From that period onwards for more than half a century I have no personal knowledge of his progress; but what may not the mind of man accomplish when the key to knowledge is obtained and the storehouse unlocked, and nature's works are placed in view of an eye that is not diverted or drawn aside by the countless trifles that beset us on every side. Titus had in early childhood lived a few years in the City of Newhaven; while in that city the most of those who visited his father's house were men of letters, and disputations on religious subjects were common.

"From this place his father removed to Long Island on the Sound, nearly opposite the city of New York, and soon after into the city. You enquire as to scenery, and the habits of those with whom his early life was passed. There is nothing remarkable in the surrounding scenery of either of the places of his early residence, neither was he made for a painter or poet.

"Matters of fact—things of real life, and not of imaginary, claimed the greatest share of his attention.

"He was always liberal, setting no very great value on wealth, except so much as was necessary to supply the ordinary wants of life. He thought but little of high birth or titles of honour; I think he only valued men by their knowledge and goodness. I regret that it is not in my power to give you more information, and you will also perceive that much that I have written is from imperfect memory. Only my dates may be wrong, but the story is near the truth. Should anything else occur to you in which I can render service, you have but to make your wishes known. Be pleased to present my kind regards to the family.

"I am, Sir, very respectfully,

"your obedient servant,

"WILLIAM SMITH."

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