THE

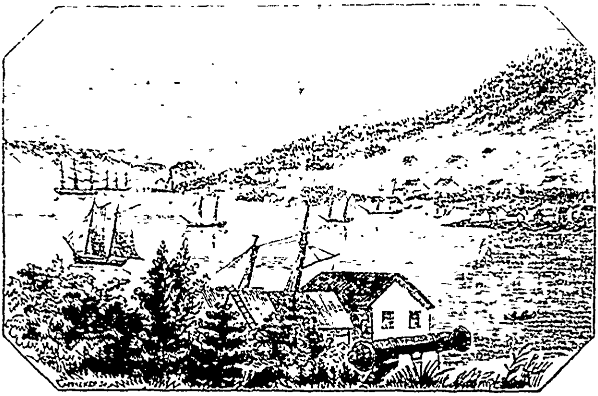
CANADIAN
Naturalist & Geologist,

AND PROCEEDINGS OF THE

NATURAL HISTORY SOCIETY
OF MONTREAL.

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

VOL. III. OCTOBER, 1858. No. 5.



Montreal:
B. DAWSON & SON, No. 23, GREAT ST. JAMES STREET,
LONDON: SAMPSON LOW, SON & Co.

PRINTED BY JOHN LOVELL, MONTREAL.

Price Three Dollars per Annum, in Advance.

THE

Canadian Naturalist & Geologist.

This Magazine will appear bi-monthly, and be conducted by the following Committee, appointed by the Natural History Society of Montreal:—

Notice.—All business communications to be addressed, *pre-paid*, to the Publisher. Articles and communications for the Journal may be addressed to the Editors, care of the Publisher.

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☞ The Editors have to apologise for the tardy appearance of this number, arising from circumstances over which they had no control.

☞ The next number of this Journal will be published on the 15th of December.

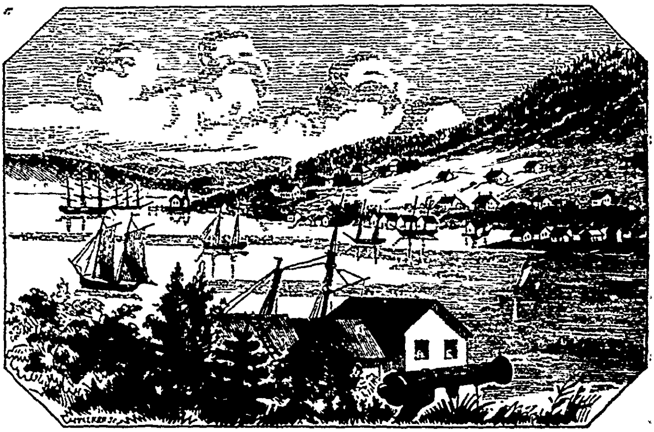
THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOLUME III. OCTOBER, 1858. NUMBER 5.

ART. XXVII.—*A Week in Gaspé.* Read in part before the Natural History Society of Montreal.



In 1843, Sir William Logan informed the writer of this article, at that time engaged in the study of the coal-fields of Nova Scotia and their fossil plants, that he had found in Gaspé a great series of sandstones and shales older than the carboniferous system, and probably of Devonian age, containing remains of fossil vegetables, apparently terrstrial, and a small seam of coal. Such an announcement awakened, as a matter of course, a strong desire to visit a locality so interesting, and to study this most ancient known flora. But Gaspé was practically inaccessible to a naturalist, whose intervals of leisure never exceeded a week or two; and so this long-cherished wish remained ungratified until a month ago, when, armed with hammer and dredge, and other necessary implements for studying the rocks and the sea-bottom, I landed at Gaspé Basin from the steamer Lady Head, on a fine August evening, ready to commence work on the morrow. Only a week could be devoted to the task, but I was fortunate in having the assistance of Mr. Dougall, one of my students in natural history; and in securing the services of two very obliging and intelligent boatmen. So our work speeded well. We formed a large collection of fossil plants, which when added to those previously collected by the Geological Survey, will I trust serve to illustrate the Devonian flora of Canada, in a manner as yet unsurpassed by deposits of that age in any other country. The waters too yielded their treasures of sea-anemones, urchins, star-fishes, shells, and zoophytes, some of them new to me; and we formed for ourselves a somewhat distinct mental picture of Gaspé and its people. The more special scientific results of the expedition, I shall reserve for future occasions, and in the mean time design to give a slight sketch of the general features of the district, and some desultory observations which cannot well be placed under any distinct head.

The peninsula of Gaspé, the land's-end of Canada toward the east, presents within itself an epitome of several of the leading geological formations of the Province; and here as elsewhere, these impress with their own characters the surface and its capabilities. On that side which fronts the river St. Lawrence, it consists of an enormous thickness of shales and limestones, belonging to the upper part of the Lower Silurian series, and the lower part of the Upper Silurian. These beds, tilted in such a manner that they present their up-turned edges to the sea and dip inland, form long ranges of beetling cliffs running down to a narrow strip of beach, and affording no resting-place even for the fisherman, except where they have been cut down by streams, and present little coves and bays opening back into deep glens affording a view of great rolling wooded ridges that stand rank after rank behind the steep sea-cliff, though no doubt with many fine valleys between. At present this inland country appears little settled, but every cove and ravine along the shore is occupied by fishermen, who either permanently reside here or resort to this coast in summer. This bold and picturesque coast, after running down to the low point of Cape Rosier, on which stands an imposing white brick tower, which figured somewhat largely last winter as a disputed item in the public accounts, falls back suddenly to the southward, and then stretches out into the bold narrow promontory of Cape Gaspé, which marks the outcrop of an Upper Silurian limestone believed to be the geological equivalent of that which forms the cliff of Niagara, and the great ridge which divides Lake Huron. Here, with its feet in that same ancient ocean in which shell-fish and corals long since collected its molecules of lime, it asserts its usual character by standing forth as the last member of the Silurian series that lifts its head above the waters. As we passed it the sea broke heavily upon it, and we could in some degree sympathize with stout old Jacques Cartier, when in his first voyage, after battling for many days off this cape and on the opposite shore, against the autumnal northwesters, he called a council of his officers, and, anxious though he was to see what lay beyond, bore away on his return to France. Being fortunate enough to have as a fellow-passenger Mr. Faribault of Quebec, who carried with him a little library of his favorite antiquarian lore, we read the narrative as we passed over the ground. Cartier found here only a tribe of Indians, who appeared to him among the rudest he had seen; a branch of the Micmac tribe that stretched along all the coast from Maine to Gaspé, and afterwards called in this district the Gaspesians. They appeared to have no property but their bark-canoes, under which they slept at night, and nets made of some kind of Indian hemp; and were probably a fishing-party, whose wigwams might have been at the head of the bay, where their descendants still reside. They had abundance of maize and various kinds of fruits, some of which they dried for winter use. The name Gaspé is derived from the language of these Indians, and is stated to mean as nearly as possible the "land's end."*

Resting on the Upper Silurian beds which form Cape Gaspé, and of course newer in geological time, is a series of gray, red, and brown sandstones and shales. These rocks belong to the

* M. Hamel, quoted by Stuart in a paper on Canadian names in Proc. of Quebec Lit. and Hist. Society, gives the meaning as "*Bout de la pointe de terre.*" It is perhaps identical with the termination "gash" in names of points of land in Nova Scotia and New Brunswick; as, Malagash, Tracadegash.

Devonian system, the equivalent of the older part of the Old Red Sandstone of Scotland, and probably of the Hamilton and Upper Helderburg groups of New York. Doubled into a trough along the south side of Cape Gaspé, they form a low country in which Gaspé Bay stretches far inland, affording a noble harbour for shipping, which, could it procure an exemption from the icy fetters of winter, might be the emporium of Canada. As it is, it presents great facilities for the prosecution of the fisheries and for the trade of the peninsula, and appears to be a favorite resort of the American fishermen who frequent the Gulf. Its sides are everywhere thickly settled; and though toward its entrance the coast participates in the precipitous character of the outer shore, as we approach the arms into which its upper part divides, the country becomes low and undulating, though still backed by high hills. The vignette and tail-piece of this article may serve to illustrate its more varied aspects. In the latter sketch, borrowed from the note-book of a friend, we have a portion of the bold Gulf shore; the other, taken from the "battery" on the beautifully-situated property of the County Member, Mr. Boutillier, shows Gaspé Basin, with its steam-mill, its shipping, its neat church and parsonage, and the little town that is growing up at the "Point."

Southward of Gaspé Bay the Devonian rocks are capped by a great mass of Conglomerate, belonging to the Lower Carboniferous series, and made up of pebbles of all the rocks from the Old Laurentian of the North Shore to the Devonian. It is this bed which gives its picturesque character to the scenery of Percé, and, running onward with a slight dip to the southward, underlies the coal formation of New Brunswick.

The whole of the rocks that have been mentioned afford good soils, and, though the climate of Gaspé is less favorable to agriculture than that of many other parts of Canada, there seems no reason to prevent the extended cultivation of all the ordinary crops; and the presence of a large fishing population is one of the best guarantees of a near and good market for the farmer. At the time of our visit, in the middle of August, the hay-crop was being taken in, barley was nearly ripe, oats and wheat were well filled, and we saw one field of the latter with straw six feet in height. Potatoes were abundant and good, though the first autumnal frosts had nipped their leaves in some places; cauliflower was ready for the table; raspberries were in full fruit; and the blush-rose and some other flowers which had passed at Montreal some time before our departure, were in bloom.

For the present Gaspé is essentially a fishing district, and its population, scattered along the coast, presents all those social features which elsewhere mark those who earn their subsistence from the sea. The British American fisherman is an amphibious being, combining much of the roving adventurous temperament of the sailor with the more steady industry of the agriculturist. At one time tossing on the bosom of the deep, at another guiding the plough; living much apart, yet often seeing new faces and strange places, he acquires much mental activity and force of character, and, if blessed with the influences of education and pure religion, becomes a superior style of man. Among the principal disadvantages of his pursuits are the comparative isolation of many families, and the consequent difficulty of access to schools, and the frequent absences of the head of the household from his home. This however creates an early spirit of self-reliance in the young, and I have known in the fishing districts mere boys to carry on the work of the family and its intercourse with neighbours, in a manner which would be quite startling to the little people of more inland districts.

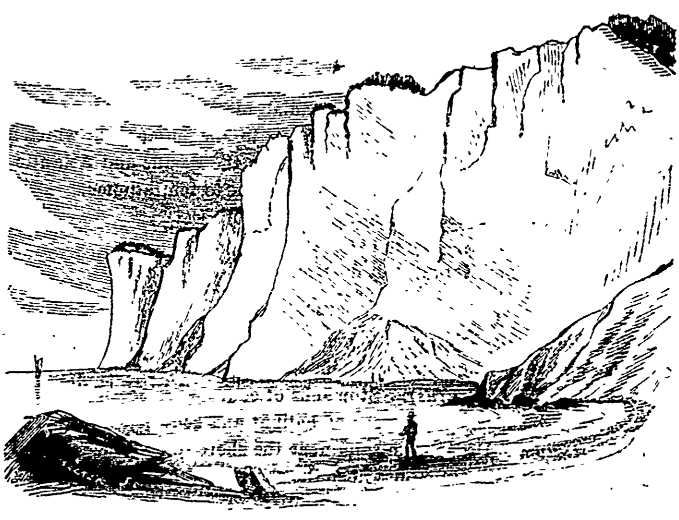
The fishing principally maintained in Gaspé Bay is that of the cod, the most safe and profitable of all our fisheries, and that which cultivates the most steady and orderly habits in the men engaged in it. Morrhua Americana himself and his congeners are steady-going animals, regular in their habits as compared with the vagrant herring and mackarel, and the character of the fisherman is influenced by that of the fish he pursues. Hence the settlements in which the cod fishery is the staple are uniformly more prosperous than those much addicted to the pursuit of the mackarel; and it is as much the good sense of the people concerned, as any other cause, that prevents our fishermen from entering into the latter pursuit as extensively as many over-zealous people would have them. It may be annoying to patriotic persons that the Gulf of St. Lawrence should be filled with the fishing schooners of New England; but if the necessities of an unfavourable position, or excessive artificial stimuli, impel them to this, we should rather congratulate ourselves that we are exempt from these evils. Our comparatively thinly settled coasts could ill afford the frequent unsuccessful voyages and terrible disasters and loss of life that attend the American mackarel fisheries. In our fishing districts the cod fishery forms a stable foundation, and on this, little by little, and as far as prudence warrants, other less certain fisheries are built, and will be extended as opportunity offers in the natural growth of wealth and population; and perhaps their principal use is to afford an opening to those rough and adventurous spirits who cannot endure steady labor. It is with such men, partly Americans, partly Irishmen, partly Nova Scotians or Canadians, that many of the American fishing vessels are manned; and hence their frequent turbulent and disorderly conduct when, in unfavourable seasons and bad weather, they throng our harbours and the dram shops which unfortunately abound in many of them.

One branch of the fishery long successfully carried on by the people of Gaspé, is however sufficiently adventurous in its character. Seven whaling schooners are at present owned in the bay; and with their comparatively humble outfit of two whale boats and sixteen men to each, they appear to carry on a thriving business, five out of the seven being known to have made good voyages in the present summer. Formerly, whales could be obtained plentifully in the Bay and its vicinity, but they are timid and not prolific, and the fishermen have already driven them to the north shore of the Gulf, and will probably soon have to follow them farther.

Several species are taken by the Gaspé whalers; but it is not at present possible with certainty to identify all of them with those described by naturalists. The black or right whale, *Balaena Mysticetus*, is the principal and most valuable, though I believe not very frequent. The great rorqual or finner, *Rorqualus Borealis*, usually shunned by whalers, is also sometimes killed, but it yields less oil and is much more dangerous and troublesome than the "Right" whale. Another rorqual, or perhaps a variety of the same, is known as the "Sulphur" whale, from its yellow belly, and is said to attain the length of 70 feet. Another whale often taken is the "Humpback", which is either the *Rorqualus Rostratus*, or one of the whales included in the Genus Megaptera of Gray. All these belong to the Balænidae or whale-bone whales. But beside these, the Gaspé whalers take the Grampus (*Phocaena Grampus*), known here as the "Killer," and said to attack the large whales in packs and to destroy them, a habit attributed to it by the whale-fishers elsewhere, though it has been doubted by naturalists. A smaller whale, known as the Black-fish in the Gulf of St. Lawrence, has been referred by various writers to different species. The skull, the only part that I have examined, corresponds with that of Gray's *Delphinus* (*Globicephalus?*) *intermedius.* The singular and beautiful white porpoise of the St. Lawrence, *Beluga Catodon*, and the common porpoise, *Phocaena Communis*, though well known, do not appear to be among the species to which the Gaspé whalers trust for their profits. It would well deserve the time and attention of any young naturalist to spend a few months with the whalers, and draw and describe with accuracy these various species, most of which are as yet very imperfectly known. The "Canadian Naturalist" would welcome a contribution on the subject. We could only glean a little information from persons who had been engaged in the fishing, and collect a few specimens of the large bones that the whalers have left on the beach.

On the long sand point that, stretching far into the bay, shelters the harbour, and along which we walked in search of whales' bones and shells, I observed an appearance new to me, and of some geological interest. Shoals of the American Sand Launce, (*Ammodytes Americanus*) a little fish three or four inches in length, had entered the Bay, and either seeking a place for spawning or sheltering themselves from their numerous enemies, had run into the shallow water near the point, and according to their usual habit, had in part buried themselves in the sand which they throw up by means of their long pectoral fins. In this situation countless multitudes had died or been thrown on shore by the surf, and the crows were fattening on them, and the fishermen collecting them in barrels for bait. Acres of them still remained whitening the bottom of the shallow water with their bodies. It was impossible not to be reminded by such a spectacle of the beds full of capelin in the post-pliocene clay of the Ottawa, and the similar beds filled with fossil fishes, in other deposits as far back as the old red sandstone. Geologists have often sought to account for such phenomena, by supposing sudden changes of level or irruptions of poisonous matter into the waters; but such catastrophes are evidently by no means necessary to produce the effect. Here in the quiet waters of the Gaspé Bay, year by year immense quantities of the remains of the Sand Launce may be embedded in the sand and mud without even a storm to destroy them. Similar accidents, I was told, happen to the schools of capelin, so that there is nothing to prevent the accumulation here of beds, equally rich in the remains of fishes with those other deposits of ichthyolites that have excited so much interest and wonder.

Gaspé Bay, like most other good fishing grounds, is rich in the humbler tenants of the sea, those "creeping things innumerable" fantastic and curious in form and structure, of which old ocean is the great habitat, and which so vastly outnumber the denizens of the land. By dredging, and in examining the shores, and in the stomachs of fishes, we collected many interesting species, though probably but a small part of those actually to be found. The Bay presents many varieties of dredging ground, in addition to the deeper banks off its mouth, which rough weather prevented us from exploring. Much of the deeper part consists of mud full of tiny foraminifera and containing Tellina Calcarea and a fine Leda; a mud in short, very similar in appearance, fossils and origin, to the clay which the sea, when it stood at a higher level, has left over all our Lower Canadian plains. In other places there is a sandy bottom, full of the curious flat cake-like shells of *Echinarachnius Atlanticus*, the "Dollar-fish" of some parts of the coast. On the more rocky grounds, are immense numbers of various species of Zoophytes and Bryozoa. One of the choicest spots that we found was just off the mouth of the Basin, on gravelly ground in about 10 fathoms, and with a strong tidal current. Here every stone was coated with nullipores and zoophytes, and there were abundance of brittle stars, echini, chitons, and two fine species of sea anemone, in addition to many shells. I trust in subsequent papers to describe such of these specimens as may be new or previously unobserved on this coast, and in the meantime give a list



of those I have been able to determine, which it may be of interest to compare with the list of Post-pliocene fossils from Montreal, and of recent shells collected by Mr. Bell in Gaspé, given in pages 414 et seq., of the last volume of this Journal.

Marine Invertebrates collected in Gaspé Bay, N. Lat. 48° 45′, *August* 1858.

ARTICULATA.

Homarus Americanus.—The common lobster is very abundant, and might be obtained in large quantities for exportation.

Platycarcinus irroratus.—Very abundant, especially near the fishing stations.

Maia.—A large spider-crab, apparently of this genus. Fragments from stomach of a halibut.

Pagurus Bernhardus.—Young specimens inhabiting shells of small *Buccina*, found in stomach of cod.

P. lævis (Thompson).—A specimen was dredged, on sandy ground, in the shell of a small natica, which I cannot distinguish from this species.

Cythere.—A small species, perhaps undescribed. In mud in deep water.

Balanus crenatus.—Common on stones near the shore.

B. Porcatus.—On stones in ten fathoms.

Coronula diadema.—On skin of whales.

C. Reginæ (Darwin).—On shreds of the skin of the humphback whale in one of the whale houses, we found a specimen which corresponds exactly with Darwin's description of this species, hitherto obtained only from the Pacific. It is full grown, being nearly two inches in diameter, and was imbedded nearly to the summit in the skin. It may be easily distinguished from the common whale barnacle, *C. diadema*, by its flattened form, its low and smooth ribs delicately marked with radiations and transverse ribs with minute tubercles at the intersections, and by the thinness of its radial plates. It would be interesting to know if this cornula is peculiar to the humpback, which is very probably an Arctic species visiting both the Pacific and Atlantic.

Spirorbis Sinistrorsa.—Stones and weeds, six to ten fathoms.

S. quadrangularis.—Same habitat.

Serpula vermicularis.—Same habitat.

Several species of Nereids not determined.

MOLLUSCA.

Loligo illecebrosa,—Squid.—Common, and caught for bait by means of a lead sinker having a circle of pins fixed in its lower end.

Fusus pyramidalis (rufus).—Stomachs of cod.

Buccinum undatum.—Stomachs of halibut and cod.

B. trivittatum.—Dredged in sand near the shore, four fath.

Purpura lapillus.—On stones near the shore.

Natica heros.—Sandy shores. Some specimens very large.

N. Grœnlandica.—Stomachs of cod.

N. clausa.—One small specimen, stomach of cod.

Turritella erosa.—S e source.

Lacuna vincta.—Ve , common on fronds of *Laminaria.*

Littorina palliata.

L. Rudis.

Margarita undulata.—Stomachs of cod.

M. helicina (Arctica).—Same source.

Lottia testudinalis.—On stones, eight fathoms.

Acmœa caeca.—A single specimen from stomach of cod.

Chiton marmoreus.—Very plentiful on stones, in ten fathoms.

Mya arenaria.—The common sand-clam grows to a very large size in Gaspé Bay, and is much used as bait. Some shells are nearly six inches in length, contrasting strongly with the dwarfish specimens from the Post Pliocene clays.

Mya truncata.—A single valve dredged on stony ground.

Glycimeris siliqua.—In stomachs of cod.

Saxicava rugosa.—Small specimens in cavities of *Nullipores* and interior of empty shells, attached by an evident byssus.

Machœra costata.—Dead shells on beach.

Solen ensis (Razor-fish).—Same situation.

Tellina calcarea (proxima).—Common in mud, ten to eleven fathoms.

T. Grœnlandica.—Muddy bottoms, various depths.

T. tenera.—Stomachs of cod.

Aphrodite Grœnlandica.—Fine specimens in stomach of halibut; smaller dredged in eight to ten fath.

Cardium Islandicum.—Stomachs of halibut, and small shells in stomachs of cod.

C. pinnulatum.—Stomachs of cod.

Astarte sulcata.—Rare in six to ten fathoms.

Cardita borealis.—Same situation; also in stomachs of cod.

Mytilus edulis.—Common mussel. Plentiful near shores.

Modiola modiolus.—One specimen, dredged from deep water.

M. decussata (glandula).—Stomach of cod.

Leda limatula.—Living in mud, ten to twelve fathoms; also in stomachs of cod.

Pecten Islandicus.—Stomachs of halibut.

P. magellanicus.—Mouth of Gaspé Basin, various depths. Said to be very abundant in Mal Bay.

Anomia ephippum and *Var. aculeata.*—Small shells attached to Pectens, &c.

RADIATA.

Echinarachnius Atlanticus (Dollar-fish, Cake Urchin).—Very plentiful on sandy bottom; also in stomachs of cod.

Echinus granulatus (Common Urchin).—Very abundant, low water to eleven fathoms; the long spined variety, and often of very light colour.

Ophiocoma bellis (aculeata).—Abundant, eight to ten fathoms. Often inhabits interior of dead shells of *Pecten magellanicus*.

Asteracanthion rubens.—Very abundant in Gaspé Basin, where it was seen feeding on *Mya arenaria*.

A. glacialis.—Some small specimens, probably young of this species.

Psolus.—A small animal of this genus, perhaps the young of *P. phantopus*, on stones, ten fathoms.

Actinia dianthus.—Abundant on stones in ten fathoms. The specimens observed differ somewhat from the European in range of colouring and form, but probably are referable to this species. I have not seen any notice of the occurrence of *A. dianthus* on the American coast, except in Stimpson's Marine Invert. of Grand Manan, where it is stated that a specimen supposed to be of this species was obtained by dredging, but lost before it could be examined.

A. ——.—A species resembling in some respects *A. Carneola* (Stimpson), but much larger. It has 150 tentacles in three rows, an elevated disk, red and purple, with two rows of white spots at the base of the tentacles. Exterior finely lined with red or crimson. (These *Actiniæ* will be described and figured in next number.)

Cyanea Postelsii.—Gaspé Basin.

Aurelia aurita.—Specimens cast on shore probably of this species. Multitudes of Medusæ and small Crustaceans were observed to cause a brilliant phosphorescence in the waters of the Bay at night; but not having a proper towing-net we did not obtain specimens.

Tubularia larynx.—Abundant on shells in deep water.

Sertularia argentea.—Same habitat.

Pinnularia falcata.—Same habitat.

In addition to the above species, I find in our collection ten or twelve species of *Bryozoa*, all apparently identical with those described by Johnston and others; two or three sponges; and six species of *Foraminifera*, four of which at least are identical with European species, and three with those found in the Post Pliocene clays at Montreal. I hope at some future time to notice these specimens more fully, in connection with fossil *Bryozoa* and *Foraminifera* recently found at Montreal and Beauport, and with a sufficient amount of explanation to render the subject interesting to the readers of the Journal.

J. W. D.

ART. XXVIII.—*The Fresh Water Algæ of Canada.* A Paper read before the Natural History Society of Montreal, by the Rev. A. F. Kemp.

In the year 1840, when Hassall undertook his researches into the British Fresh-Water Algæ, this department of Cryptogamic Botany was in a very unsatisfactory condition. There were few works on the subject, and the descriptions and figures which they contained were for the most part both inaccurate and obscure. The minuteness of the objects, their fragile and changing character, together with the imperfections of the microscopes formerly in use, made their study sufficiently formidable, and account for the neglect which they met with at the hands of botanists. The improvements effected of late years on achromatic microscopes in a great measure obviates the difficulties which were at one time experienced by observers, the result of which is that many have entered into the field, and are prosecuting with much zeal the difficult problems which pertain to the fecundity and growth of these plants. Among the older botanists there was a want of due appreciation of the value of the characters of this minute class of plants founded on their reproductive organs. Appearances were chiefly relied on for distinguishing families, genera, and species, and hence, as might be expected, their classification was very imperfect and arbitrary. The discrimination of these organs is however in accordance with the natural system, regarded as the only legitimate principle of classification. They are now seen to be of more importance for the determination of genera and species than all their other appearances whatever. While many plants are exceedingly alike in other characters, they are yet on examination found to be exceedingly unlike in their modes of reproduction, and in the forms of their reproductive organs. A better system having thus been adopted by modern algologists, it has resulted in a more scientific arrangement, which it is to be hoped the progress of discovery will yet bring to a greater measure of perfection.

The work which drew special attention to the study of the Fresh-Water Algæ, in modern times, was the valuable treatise of the Rev. Jean Pierre Vaucher, of Geneva, entitled "Histoire des Couferves d'Eau Douce," published in 1803.* A knowledge of the different modes of their reproduction was the chief aim and study of this writer. Many of his observations are exceedingly accurate, of great value, and have been confirmed by subsequent research. The figures appended to the work are curious, and, upon the whole, correct. One finds no great difficulty in determining the plants they are intended to represent, and in this respect they are not inferior to many of the more artistic representations of modern books. The work is still valuable to the careful

* A fine copy of this volume is in the McGill College Library, Montreal.

student. It has been largely used and acknowledged by all subsequent writers, and forms the basis of the more recent and complete volumes of Hassall. Since Vaucher's work was published, in the fiery times of the French revolution, much has been done by both Continental and British botanists in the discovery and classification of new species. Among others may be mentioned, as illustrious for their works and labours, Hugo Mohl, Kutzing, Agardh, Pringsheim, and Chon, in Germany; with Hooker, Turner, Greville, Harvey, Berkeley, Ralfs, and Hassall, in Britain. These men, eminent in science, have both added to our knowledge of the Algæ, and adorned its literature with works of unquestionable accuracy and beauty.

Much obscurity has arisen in this department of Cryptogamic Botany, from observers describing plants without reference to their stage of growth. It is impossible that plants treated in this way can be recognized by future enquirers. In no class of plants is a collector more liable to fall into this error than in that of the Fresh-Water Algæ. In their several stages of growth, while maintaining a uniform type of structure, they are yet so variable in many of their parts and habits, that, without considerable experience, there is great danger of multiplying species without reason. It has, therefore, been considered the wisest course, by modern algologists, to notice only, or chiefly, those species whose reproduction has been satisfactorily determined or accounted for. Upon such principles, our classifiction of the Fresh Water Algæ is grounded.

We are not aware that this order of plants has yet been examined or determined in Canada. It has, doubtless, been noted with more or less attention, by several explorers of our botany; but not to our knowledge has anything yet been published. In the United States, Prof. Bailey is known to have directed some attention to the genera and species of his own country, and, probably, among the specimens of his magnificent herbarium, bequeathed to the Natural History Society of Boston, microscopic or dried illustrations of much value may be found.

So far as our imperfect examination, during hours of rest and leisure, of the rivers, lakes, streams and waters of Canada, has extended, we have found a rich and varied field of research, possessing all the charms of novelty and beauty, and abounding in wonderful evidences of the Creator's perfections. We can fully endorse the remark of Hassall in the introduction to his valuable

"History," that "so abundant are the productions under our consideration, that there is not a ditch or pool of any extent or standing but furnishes one or more species, and even our mineral springs are not entirely free from them. From the uniform nature of the element which the majority of the Fresh-Water Algæ inhabit, it may confidently be anticipated that very many of the species described in this work, will, when the *Algæ* comes to be studied with that diligence and care they so well merit, be found in most of the Continental countries." In this statement he has exclusive reference to Europe, but he might have extended his view also to America. It is a singular fact, that, while in the Phœnogamus plants, and the higher order of Cryptogams, much that is novel, both in genera and species, may be found in this New World; yet that the waters, so far as they have been examined, present no new forms of Algæ, no new genera, and but few plants that are specifically different from those already described as inhabitants of Europe. It may be found that we have even fewer forms here that are to be found in the more temperate zones of the earth. The severity of our winter, for five months in the year at least, for the most part hinders and may altogether prevent the growth of such delicate plants. Again, our arid midsummer, drying up ponds and streams in which Algæ are generally found, is also a hindrance to their developement. On the other hand, the warmth and moisture of our springs and autumns, and the high temperature of our rivers and lakes, are likely to make the genera which we do possess more exuberant and prolific. As instances in point, we have not yet found a single example of the verticellate genus *Batrachospermum.* In vain we have searched for it in places where it might naturally be expected, yet not a frond have we seen. It may still be found, but so far the researches of two years in the Canadas have been in vain. In contrast with this, we find the allied family, Chœtophora, called by Vaucher *Batrachosperme a Mamelons*, very plentiful and much more prolific in its fronds than as would appear from the descriptions and figures of Hassall, pertains to the European specimens. This difference between the two hemispheres, future discoveries in both will doubtless greatly modify, if not altogether remove. We may, therefore, regard it as an ascertained fact that the Fresh-Water *Algæ* of the old and new worlds are all but uniform in the number and character of their genera and species.

In this paper, we shall follow the classification and generally the descriptions given by Hassall in his valuable volumes on the "*History of the British Fresh-Water Algæ.*" This is the best and most systematic treatise which we have on the subject. It was first published in 1845, and is much in advance of any similar work up to that time. It, however, now requires to be re-edited, and its descriptions and figures carefully revised. It is to hoped that the author may yet meet with sufficient inducements to lead him to undertake a new and enlarged edition.

The *three* main divisions into which Hassall divides this *order* of plants are :—

I. ALGÆ FILIFORMES. II. ALGÆ GLOBULIFERÆ. III. ALGÆ FIGURATÆ.

Under the *first* of these divisions we have

Family I. SIPHONEÆ.

Characters.—Algæ *composed of a continuaus branched and cylindrical cell, inarticulate.* Reproductive organs *external.*

Genus I. VAUCHERIA, D. C.

Characters.—Frond *here and there, occasionally inflated.* Reproductive organs *of two kinds capsules ? and antheræ or horns lateral or terminal.*

This is both a curious and highly interesting plant. It is generally found in quiet pools and ditches with muddy bottoms, into which it strikes its roots. It grows in masses, in its young state is of a bright velvety green, but on attaining maturity it takes a light-olive colour. The organs, which are described as reproductive, are very singular in appearance, and quite peculiar to this genus. These consist of capsular bodies, either terminal or projecting from the main stem, at nearly right angles. In fructification the contents of the more or less enlarged extremities of the branches or special projections separate from the general contents of the plant, condense into a globular green mass, and become a spore, which, at length, escapes by a rupture of the walls, moves freely about in the water, in a short time becomes fixed, and developes into a new plant. This was at one time thought to be reproduction without fecundation. But Vaucher, in 1803, observed attached to the capsular bodies which spring from the sides of the plant, horn-shaped projections, which he conjectured to be analogous to anthers. No observer had, up to a recent date, been able to verify his observations, and doubt was cast upon their reality. We find, however, in, "Gray's Structural and Systematic Botany," fifth edition, that Pringsheim, of Berlin, is alleged to have discovered the fecundation, and verified Vaucher's conjecture. In the "Proceedings of the Royal Academy of Sciences, Berlin, March, 1855," he states that the horn-shaped projections are antheridia, or analogous of the anther. They produce myriads of very minute corpuscles of oblong shape,and furnished with a bristle or cilia at each end, by the vibration of which they move freely in the water. These he calls *spermatozoids* from their resemblance to the spermatozoæ of animals, and regards them as analogues of pollen. At the proper time, he says, the antheridia burst at the summit and discharge the spermatozoids. At this time the wall of the projection, which contains the spore, likewise opens and numbers of the free-moving spermatozoids find their way into the opening and into contact with the forming spore, and even penetrate its substance. As a consequence of this, a wall of cellulose is presently formed around the mass, and connects it into a proper fertilized cell or spore." Our examination of this plant has not as yet verified these discoveries, and we have reason to doubt their reality. In the first place, those plants which have no capsules, but whose spores are formed at the extremities of the branches, have no organs at all analogous to antheridia, and, unless their fertilization depends upon the pollen of other species, or other plants, it must arise from another cause. Again, the attachment of one or two spermatozoids to the aggregated granules of the capsules, would not be satisfactory proof that they were pollen. It is well known that these vivacious corpuscles attach themselves readily by their cilia to any body with which they come into contact; being shed, therefore, from the projecting horns of the capsule, it might be expected that some of them would adhere to its surface, or even penetrate its walls. That the cells are not fertile, or do not form cellulose until they come into contact with the spermatozoids, is, we apprehend, mere conjecture.

We are inclined to think, from what we have seen of this plant, that the spermatozoids are true spores, and themselves fertile, while the cell-mass, which, after assuming a definite form, escapes from the branch, is neither more nor less than a fertile bud,—an instance, by no means uncommon in the Algæ, of propagation by fission. Thus we shall, if this be true, have two forms of reproduction in Vaucheria, analogous to that which is found in some of the lowest forms of animal life. The phenomenon of the aggregation of sporules, or the granular contents of filaments or cells, which is so marked a feature in most of the confervoid plants, is one that admits of still further investigation than it has yet received. We have been tempted to think, from various appearances which we have observed in several species of Algæ, that this aggregation may be found referrible to some general principle, peculiar to ferilized zoospores whose escape is retarded by the cell walls within which they are germinated. The subject is, however, a difficult one. The objects to be examined are so minute, that to observe their developement under the microscope, is all but impossible. The evidence upon which a determination must mainly rest, will be of a negative character, and only appreciable by those who have given the subject attentive study. In a future paper we hope to direct special attention to this point.

The Vaucheriæ possess the remarkable property of resisting the action of severe cold for a lengthened time. We collected some specimens this spring, immediately after the dissolving of the ice, in a pond the water of which had been frozen into a solid mass for at least four months and a half. Many of the plants had shed their spores, but others were quite fresh and healthy. Autumn would appear to be the time during which they are chiefly to be found in a perfect state. They may, however, be found in shady and damp ditches during spring and summer.

We have been able to determine the following species :—

I. VAUCHERIA DICHOTOMA, *Ag.*

Char.—Frond *setaceous dichotomous, fastigiate.* Vesicles *solitary globose sessile,* Grev.

Hab.—In ponds and ditches; frequent; annual; spring and summer. In the fields at Mile End Toll-Bar, Montreal.

Hassall's *Hist. Brit. F. Algæ*, p. 51, Plate IV., fig. 1.

Hassall doubts if this species is anything more than a condition of *V. sessilis.* The capsules are the same in both. A yellowish or olive green is the color of all this genus when aged or in seed.

II. V. GEMINATA, *Vauch.*

Char.—Capsules *situated on the peduncle common to both.* Anther *intermediate.*

Hassall's *Hist. Brit. F. Algæ*, p. 55, Plate III., fig. 1.

This belongs to a subdivision of the genus in which the vesicles are pedunculate, in pairs, lateral. In Vaucher's history it is called *Ectosperma geminata*, the generic name being that by which he distinguished the plants; and but for the sake of immortalizing the illustrious algologist, we should greatly prefer it still; a descriptive name being at all times better than an arbitrary title. The filaments of this species are fine, and the seed-vessels, after ascending from the filaments, send off laterally two branches on each of which a capsule rests; the continuation of the peduncle intermediate between the capsules forms the anther. It is not quite certain that this form of the capsule is uniform or characteristic of the species. On the same frond we have observed capsules of various forms,—on the *geminata*, cruciate forms, and on the *cruciata*, sessile forms, &c., &c. There must, therefore, rest some uncertainty upon these characters. It may be that they are all modifications and varieties of the same capsular system, and that we have after all fewer species than are supposed.

III. V. CRUCIATA, *Vauch.*

Char.—Seminibus *duobus, lateralibus, pedunculatis.* Antheræ *intermediæ cruciata*, Vauch.

Hab.—In pools or ditches with mud bottoms. In the fields at the toll bar, Mile End, Montreal.

Vaucher's *Hist. des Conf.*, p. 30, Plate II., fig. 6.

This species is not described by Hassall. He regards it as included with several others in a species which he proposes to call V. Ungeri; but it is found very distinctly marked, the cruciate form of the capsules being very regular and well defined. Vaucher says of it that "it may possibly be but a variety of *geminata;* but there is in it a sufficient difference to entitle it to a distinct place and name."

There are eleven other species described by Hassall, most of which will doubtless be found in Canada in the proper season, and after diligent search.

Passing over five families, of which we have as yet found no examples, we come to,—

Fam. VII. CHÆTOPHOREÆ, *Hass.*

Char.—Algæ *gelatinous, ramose, composed of principal stems and smaller filaments for the most part ciliated.* Reproduction *usually by means of zoospores contained in the filaments, but in some cases said to be capsular.*

This family has a strong resemblance to the *Batrachospermeæ*, which immediately precedes it. Both of them are highly mucous to the touch, and their lubricity chiefly arises from the presence of innumerable lashes or ciliform appendages which terminate their branches. They likewise agree in habit, dwelling for the most part in fresh, pure water, in spring-wells in which there is a constant current, and upon rocks and stones in the shallow and sheltered parts of rivers and streams. It is doubtful whether a separate family should be made of this group of genera. The genus *Drapernaldia* which it embraces, has certainly in its mature state a close resemblance to the *Batrachosperms*, while in its early stages it approximates to the character of *Chætophora*. The only point in which the *Batrachosperms* differ materially from this family is in the verticellate fronds or filaments of the former; but it may be doubted whether these are more than mere generic distinctions. Our idea is that Vaucher's arrangement in this respect is much to be preferred to that adopted by Hassall.

Genus I. Drapernaldia, *Bory*.

Char.—Filaments *free, not immersed in a gelatinous matrix.*
Hassall's *Hist. Brit. F. Algæ*, p. 118.

Bory, in his *Annales du Museum*, dedicates this genus to Drapernaud, a distinguished but modest naturalist, who took great delight in the study of the Couferveæ.

The mode of its reproduction is simple. If a specimen be examined in a young state, the filaments will be found to be made up of cylindrical cells; but by and bye the green granules which the cells contain, become enlarged and swell up the cells, so that the filaments assume a beautiful beaded form, which gives a most distinct character to the frond. This inflation is indicative of the period of reproduction. The cells soon rupture, and the zoospores escape through the aperture, and after swimming about for an hour or two become fixed, and germinate by the elongation and division of the cells.

Of this genus we find the following species in Canada:

I. Drapernaldia plumosa, *Ag.*

Char.—Frond, *gelatinous.* Filaments *gracile, elongated.* Branches *subpinnate.* Tufts *elongated, scattered, approximate to the branches, ciliated.*
Hassall's *Hist. Brit. F. Algæ*, p. 121, Plate, XII, fig. 1.

Hab.—Quiet deep and clear pools or spring-wells; fine specimens collected on the Mountain, and in the fields at Mile End toll bar, Montreal.

This species is, in its young state, of a bright beautiful green, very gelatinous, delicate, and fragile. As it becomes mature, it changes to a green olive. It is a very elegant, and, as a microscopic object, possesses great beauty. The branches are long and graceful, and the head-like form of the cells give them a sparkling gem-like lustre.

II. D. CONDENSATA, *Hass.*

Char.—Filaments *of considerable size, sparingly branched.* Branches *only occasionally compound, short, with short cilia.* Cells *abbreviated.*

Hassall in *Annals of Nat. His.* Vol. XI., p. 429. *Hist. Brit. F. Algæ*, p. 122, Plate XI., fig. 1.

Hab.—In the quiet and clear waters of the St. Lawrence; found in spring, while the ice was upon the river, at the steamboat wharf, Morrisburg.

This species is described as one of the finest and most distinct of the genus. There is no difficulty whatever in recognising it. It is very sparingly branched. The ramuli are never tufted; irregular in length; occasionally very short; and the cilia are rarely prolonged. Only in the locality mentioned have we found this species. Our specimen when found was of a lustrous green color. In the dry state it has taken a yellowish tinge.

III. D. TENUIS, *Ag.*

Char.—Filaments *slender ciliated, moderately branched.* Branches *usually simple and solitary, but sometimes sub-fastigiate.* Cells *of the stems twice or thrice as long as broad; those of the branches rather longer than broad.*

Hassall's *Hist. Brit. F. Algæ*, p. 123.

Hab.—The rapid streams which run through the railway pier at St. Lambert, Montreal; also at St. Helen's Island.

This species is very tenacious, and is an inhabitant of streams and rivulets the current of which is strong. It is found in great profusion and beauty in the localities referred to. Its bright green fronds fringe the rocks, stones, and drift-wood, and add brilliancy to the rushing waters. The filaments are very long, and are as hardy as the *Cladophera glomerata.* The branches are irregular or alternate, more or less furnished with scattered ramuli whose tops are either acute or drawn out into long setaceous colourless points. Harvey in his Manual says that at first the filaments are enclosed after the manner of *Chætophora* in a common somewhat definite gelatine. Afterwards, on its bursting, they issue from it like a *Conferva*, but are at all times very gelatinous. In the dried state it makes a beautiful specimen for the portfolio.

IV. D. NANA, *Hass.*

Char.—Filaments *highly mucous, very slender, sparingly branched.* Branches *acuminate, not usually ciliated.* Cells *rather broader than long.*

Hassall's *Hist. Brit. F. Algæ*, p. 124, Plate X, fig. 3.

Hab.—Stagnant pools on the road by the river to Point St. Charles, Montreal.

This species is not unlike *D. condensata.* Its characteristic distinction is the fineness and mucosity of its filaments, and the shortness of its cells. Our specimens were found in stagnant pools upon dead wood. Its habitat may both account for its want of ciliæ, and entitle it to be considered as a distinct species.

Genus II. CHÆTOPHORA, *Schrank.*

Char.—Filaments *embedded in a gelatinous matrix, globose or lobed, aggregated, branched, articulated, sometimes setaceous, and issuing from a common base.* Branches *nearly colorless.* Ramuli *colored.*

Derivation from *chaite*, a bristle, and *phoreo*, to bear.

Hassall's *Hist. Brit. F. Alg.*, p. 124.

Vaucher classes this genus among the Batrachospermeæ. He notes also in the gelatinous matrix of the older specimens a number of stony particles which he conjectures to be ruptured cells, and destined to reproduce the species. It is questionable if these stony grains belong to the plant at all. Most probably they are foreign matter absorbed by the gelatine in the process of its growth. The general character of this genus is very distinct. In external appearance some of the species are exceedingly like *Nostochineæ*; but the filaments contained in the matrix, differ widely from that family in being aggregated, frequently branched, and in springing from a common base.

Of this genus we have found specimens of the following species:

I. CHÆTOPHORA ENDIVIÆFOLIA, *Ag.*

Char.—Mucous matrix *somewhat compressed, sub-dichotomously branched.* Primary branches *frequently parallel, apices of ultimate* ramuli *ciliated.*

Vaucher's *Hist. des Conf.*, p. 116, Plate XIII, fig. 1. Hassall's *Hist. Brit. F. Alg.*, p. 125, Plate IX, figs. 1 and 2.

Hab.—In the stream on the south side of St. Helen's Island, and on the south-east side of Moffatt's Island, St. Lambert, Montreal.

This species is met with in slowly-running clear water, adhering to rocks and stones, and is in good condition in summer and autumn. It has to the eye the appearance of a green protruberance, irregularly lobed at its extremities, and, in the more prolific specimens, waving with the motion of the water. It seems to grow in much greater luxuriance with us than it does in Europe. Vaucher says of it that "it is but little more than a few lines in length, and about half as broad." Our specimens are greatly larger than this, and more prolific in their branches than any that appear to have come under the notice of European botanists. One which lies before us has a knotty stem as thick as a crow's quill, and about an inch in length. From allsides of it branches spring irrer gularly, and are from an inch to an inch and a half in length, twice and thrice compounded. The plant is of a bright-green color, which it retains when dried. It spreads over the paper in length four and a quarter inches, and in breadth two and a half. Mr. Harvey, in his description of this species, compares the mode of branching of the frond to stags' horns, a comparison which conveys a very good idea of the appearance of this beautiful object.

The filaments contained in the matrix are fastigiate, articulate, and closely packed in the gelatine. They throw out from their sides dichotomously-branched ramuli, in a racemose manner, or as one would arrange flowers in a bouquet. The whole surface of the lobes or main branches has the appearance of being covered with bristles, from the apices of which, and extending beyond the mucous, there spring long gelatinous ciliæ. One marked character of this species is that the bristles do not tuft or form protruberances; but are equally distributed over the lobes, a good illustration of which is given in Vaucher's fig., Plate XIII.

II. CH. MAMMOSA ?

Char.—Mucous matrix *somewhat compressed, subdichotomously branched.* Primary branches *frequently parallel, containing numerous irregular protuberances.* Ultimate ramuli *of the filaments tufted, fasciculate.*

Hab.—Same as the preceeding.

This species differs evidently from any that are figured or described by either Vaucher or Hassall. The mucous is much firmer and less lubricous than in *endiviæfolio;* mature specimens, are leathery to the touch. Its peculiar characteristic, in which it differs from any other known to us, is the *mamillæ* or wart-like protuberances which cover its fronds. *Tuberculosa* would have been a good descriptive name, but this has already been given to another, and a very different species. We have therefore ventured *provisionally* to call it *mammosa.* These protuberances arise from the peculiar form of the contained filaments, the ramuli of which are found to branch dichotomously, and ultimately to form tuffs not unlike an umbel. Several of these tuffs grouping together form external protuberances on the mucous. This species is undoubtedly closely allied to the preceding, but is clearly more than a mere variety. Its main branches are neither so delicate nor so long as its are, and even to the eye the mamillæ give it a character peculiar to itself.

III. Ch. TUBERCULOSA, *Hook.*

Char.—Gelatinous matrix, *at first glabrous and firm.* Filaments *very slender, flexuous, hyaline.* Ramuli *coloured palmate fasciculate.*—Harvey.

Hassall's *Hist. Brit. F. Algæ.* p. 126, Plate IX, figs. 7, 8; Harvey in Manual, 1st edition, p. 121.

Hab.—In a pool at the west end of St. Helen's Island, adhering to the stems of aquatic plants, and to stones.

Harvey describes the fronds of the European species of this plant as bright-green, and an inch and more in diameter. The largest of our specimens have not exceeded a quarter of an inch, and several of them are no larger than the head of a pin. In this respect they bear a resemblance to C. *elegans,* which according to Vaucher "is formed of gelatinous protruberances of all sorts of figures, and of a diameter which varies from a point to an inch." It is evidently identical with the *Batrochospermum intricatum* of Vaucher. In English Botany the filaments are figured without ciliæ, and in this respect agree with our specimens. We have no doubt that this is a permanent character and distinguishes it from C. *elegans,* whose apices are setigerous and produced beyond the gelatine. Under the microscope this is an exceedingly beautiful object. The cells of the filaments are about one and a half times long as broad, and in maturity become round and bead-like. The branches begin at the fourth or fifth cell from the base of the filaments and bifurcate at every fourth or fifth cell twice or thrice; the ultimate ramuli are long and parallel, and slightly incurved at the apices as if conforming to the globose form of the matrix.

It is ascertained that this species has a corpuscular fructification, observed on but few of the Fresh-water Algæ, and analogous to that which is characteristic of the Marine Rhodosperms. "The fruit of *Chætophora* appears hitherto, says the "Annals" for June, quoted by Hassall, to have been observed only by Mr. Berkeley, a figure of which he published in his "Gleanings of British Algæ." Dr. Müller of Detmold has however met with and figured similar fruit. He has made moreover a very curious observation, viz., that the fruit is accompanied by and at length connate with a red globule of a similar form but smaller in size, which he considers as the male fructification As the female capsule advances to maturity, the male approaches it, becomes elongated, and at length is united with it, emptying the pollen globules into the female fruit. This process being accomplished, it falls off.

His account of the development of the spores within the capsule is also curious. From each of the seeds a hyaline thread is developed. formed of the globules which press forward from the inside of the seed; this at length becomes green, and consists of a very tender hyaline tul filled with a moniliform row of globules. Finally, the uppermost globule is elongated into a new tube, which is of a paler green than the rest of the thread. The capsule is no longer visible, and the whole now resembles a *Rivularia* and soon asumes the form *C. tuberculosa*.

It has not been our good fortune to discover these capsules as yet in this plant, nor to verify this process of reproduction. We have however observed certain red globules or granules, in the cells, or assuming a large and independent external position. Further investigation may thus enable us to verify this interesting discovery of Müller's.

CH. ELEGANS, *Ag.*

Char.—Mucous matrix *sub-globose, or lobed, rather solid, green.* Filaments *sub-dichotomous.* Ramuli *fastigiate, the apices produced beyond the gelatine and setigerous.*

Hassall, Hist. Brit. F. Alg., p. 127, plate ix., figs. 3, 4.
Harvey in Manual, p. 122.

Hab.—On sticks and stones in stagnant and clear pools. In the fields at Mile End Toll-bar; not very common.

Vaucher says of this plant that "no species is more easy to recognise; it is formed of gelatinous protuberances of all sorts of figures, and of a diameter that varies from a point to an inch." In our specimens the globose frond is sometimes solitary, and sometimes grouped in masses five or six together, and of various sizes. It is of a deep green colour and very solid, requiring considerable pressure to prepare it for the microscope. The internal filaments are very prolifically branched, and from the apices of the ultimate ramuli mucous setigerous threads protrude beyond the gelatinous matrix. In this last particular, as well as in its greater density, it is readily distinguished from *Ch. tuberculosa.*

One curious fact is well ascertained in regard to many of these plants, namely; that there is a double process of development into maturity: *one* of the primary spores into several individuals, and *another* of the individuals by subdision into fronds. The spores are sometimes parted twice, thrice, and four times, by the constriction of their hyaline integument. By this means it is obvious that a single plant, with its numerous cells and countless spores, will reproduce itself at an immense ratio. Provision is thus made by the Creator against the injury and destruction to which these tiny germs are exposed, to ensure the perpetuation of their species, and to maintain the progressive chain of creation.

Another curious feature, especially found in the families now described, is their power of secreting large quantities of Gelatine. The mucous of the *Chætophora* is greatly disproportioned to the organised filaments of which it is composed. Whatever function of nutriment this substance may possess, it unquestionally serves the purpose of protecting the plant from injury—presenting no points of resistance to the running water, or to the smaller bodies which are carried along in its course. This mucous answers also as food for aquatic insects, and for the smaller fishes. Dr. Livingstone in his "Travels" mentions a fish in the Zambese River of Central Africa, which feeds on a mossy kind of substance which grows in the bottom of the river. Now we have no doubt that this mossy substance is our Gelatinous *Chætophora.* These therefore are some of the important uses which the mucous so largely secreted by these plants serves in the economy of nature.

(*To be continued.*)

ART. XXIX.—*Description of two species of Canadian Butterflies.*

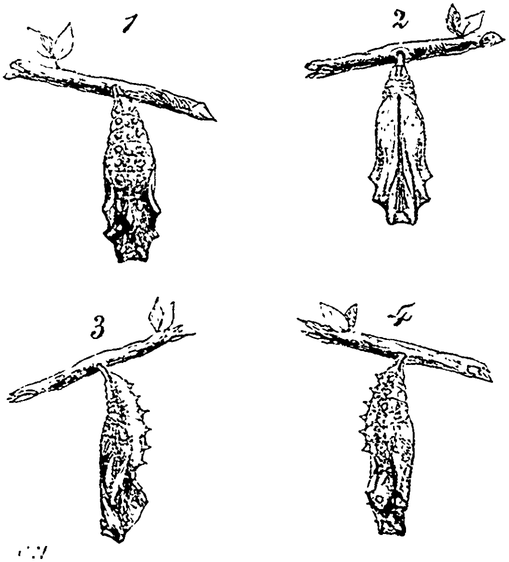
I. CYNTHIA CARDUI (the painted lady.)

The Imago.—The colours of the upper side are brown, tawny-orange, black and white distributed as follows:—The fore wing at the base or next the body is brown; a large space of the tip black, with five white spots. Of these latter, the one nearest the body is the largest; it is of an irregular oblong shape, one end touching the front margin of the wing. The other four white spots are nearer the tip of the wing, and arranged in a short curved row. The outer margin of the wing is also marked with several whitish or yellowish semi-circular spots. Situated on the edge, and parallel with these at the distance of about half a line from the border, is a second row of obscure yellow spots. The greater part of the central portion of the fore-wing is tawny-orange, with some irregular black patches, connected with each other by slender points of the same colour. The hind wing is principally tawny-orange or reddish, with three rows of black spots in the posterior half. The first row consists of five round spots, the two largest sometimes touching each other; the next, of seven or eight small irregular diamond-shaped spots; while those of the third or marginal row are somewhat larger, and of a triangular shape, projecting out to the edge of the wing. About the centre of the wing there is a large irregular spot of black curving across it. The base and front margins are black. The posterior edge is delicately bordered with crescents of yellow. The upper side of the body and the base of the wings are covered with fine long brown hairs.

On the underside the fore-wings are marked nearly the same as on the upperside, but the dark colours are not so strong. The undersides of the hind wings are beautifully dappled with olive-brown, white, and grey, the veins being white. Near the posterior margin is a row of five beautiful eye-shaped spots, the two in the centre being the smallest. Behind these is a slender chain of elongated light-blue spots, each with a narrow black border, and nearer the edge are two other faint parallel black lines, the outer one consisting of a series of short curves. The underside of the body and legs are yellowish-white, the clubs of the antennæ tipped with the same colour.

The Larva.—The caterpillar is dark-brown, or nearly black, with greyish scattered hairs, and several rows of tufted spines, There are two very narrow bands of yellow along the back, divided by a line of black. On the lower part of each side there is also a stripe of a yellow colour, but not so conspicuous as those upon the back, on account of its position being nearly on the underside of the body. On each of the 2d, 3d, and 4th segments of the body there are four spines; 5th, 6th, 7th, 8th, 9th, 10th, 11th, seven spines; 12th, four spines; 13th, two spines. All the specimens I have observed are more or less speckled with minute spots of yellow, and sometimes these are so numerous, that the caterpillar has a yellowish instead of a brown or blackish colour.

The Chrysalis is about three-fourths of an inch in length, and of a light or dark-grey or ash colour, with three rows of golden tubercles on the dorsal side. There are nine of these in each of the outer rows, and six in the central. The latter are very small. Two of those of the outer rows, one large and a very small one beside it, are situated in the constriction of the back. On the sides of the head are two or three small projections.



CHRYSALIS OF C. CARDUI. Fig. 1, *View of the Dorsal side.* 2, *Ventral side.* 3, *Left side.* 4, *Right side.*

Cynthia cardui was very abundant in the city of Montreal and around the base of the mountain, during September and the beginning of the present month of October. In the small common below the McTavish house, fifty or sixty of these beautiful insects could be counted at once, regaling themselves on the flower of the thistles growing in that locality. In one small yard in the city about twenty of the chrysalides were observed attached to the fences and projections of the roof of the shed. There were a few thistles growing in the yard, and these were much frequented by the caterpillars. The larva, chrysalis, and imago could be all well observed at the same time. A caterpillar was taken into the house on the 19th of September, and put in a box covered with a piece of gauze, and placed upright so as to afford it a chance of suspending itself. It immediately crawled to the top of the box, and, in about half an hour more commenced to spin a quantity of fine white silk from its mouth. The next morning it was found suspended in the usual position, with the head downwards. It remained in this position two days, apparently becoming smaller and shrivelling up. During the third night it was transformed into a chrysalis, in which condition it remained until the 13th of October, when the butterfly was produced.

Another, which suspended itself to a window-sash, on the 13th of September, had entered into the chrysalis state sometime between that date and the 16th. On the 11th of October the butterfly appeared. A chrysalis was taken from the fence, on the 17th of September, and brought into the house produced a butterfly on the 2nd of Oct., the time observed being 17 days. How long it had been in the chrysalis state, previously, is not known. At this time of the year, therefore, this species remains in the chrysalis state from three weeks to one month.

This butterfly is one of the most interesting of all the Lepidoptera, on account of its very extensive geographical range, it being common in North America, New South Wales, Java, Africa, Brazil, and Great Britain. Its appearance appears to be somewhat irregular. Thus Westwood states:—"This is one of those species of butterflies remarkable for the irregularity of its appearance; in some years occurring plentifully, even in the neighborhood of London, after which it will disappear for several years. Indeed, instances are on record in which, owing to the vast numbers, migration has become necessary; and in the "Annales des Sciences Naturelles," for 1828, an account is given of an extraordinary swarm which was observed in the preceding May, in one of the cantons of Switzerland, the number of which was so prodigious, that they occupied several hours in passing over the place where they were observed. The precise causes for this phenomonon were not investigated, and the time of the year is remarkable."*

In a paper by Prof. J. P. Kirtland, of Ohio, on the Butterflies of that state, this species is noticed as having been introduced into North America from some foreign country. The author states that in some seasons it becomes extremely numerous, while in others the collector of insects will hardly discover a solitary individual. All the thistle family are eaten by the larva. Even the forbidding Canada thistle I have found in Wisconsin to be stripped of leaves by the larva." †

Boisduval and Leconte, who describe it as a species of *Vanessa*, say that it is not so common in America as in Europe. "Cette Vanesse, très commune dans toute l'Europe, l'Afiique et les Indes orientales, est beaucoup plus rare en Amerique, quoique du reste elle se trouve dans presque toute l'entendu de ce continent."‡

Mr. Emmons has described it in the Natural History of New York, but gives no particulars as to its distribution in that state whether abundant or otherwise. He has also figured a caterpillar which does not at all resemble those we have observed at Montreal.

CYNTHIA HUNTERA (Fabricius).

At the same time that *C. cardui* was seen in such abundance below the McTavish house, *C. huntera* was observed in still greater numbers further up the mountain, and west of the monument. Several specimens were also met with on the top of the mountain. Although a diligent search was made, none of the larvæ or chrysalides were found. It was, however, most interesting to find these two beautiful species of insects on the same day so numerous in two localities which are only three or four hundred yards apart. This is also an English species, and as Westwood's description agrees exactly with our specimens we shall give it entire. He says "it measures 2¾ inches in the expanse of the wings, which are of a less twany-orange colour than those of *C. cardui*; brown at the base, the orange disk much broken in the fore-wings by blackish irregular bars, the apex blackish with a long white costal spot

* Westwood's BRITISH BUTTERFLIES, p. 57.

† Kirtland on DIURNAL LEPIDOPTERA OF NORTHERN AND MIDDLE OHIO Annals of Science, Vol, 2, p. 73.

‡ Boisduval et Leconte, Vol. 1, p. 179.

and four dots near the apex, white, between which and the margin is a pale broken rivulet. Beyond the middle of the hindwings is a slender interrupted brown bar, succeeded by four indistinct eyelets, a black submarginal bar, and two very slender submarginal dark lines. But the great beauty of the insect consists in the underside of the wings, the anterior being elegantly varied with white, brown and black, with two eyes near the apex. The disk of the hind wings is white, with the veins and many lines and bars of brown; these form a double scallop beyond the middle of the wing, succeeded by a white bar of the same form; the terminal part of the wing being brown and ornamented by two very large eyes, margined with black; between these and the margin is a bar, and two dark thin marginal lines."*

These two species much resemble each other; but can be distinguished without difficulty by the marking of the underside of the hind wings. *C. cardui* has five ocelli or eye-like spots beneath; while *C. huntera* has only two, but much larger.

As before stated, we have not seen the caterpillar, and the several authors describe it differently. Drury says it is green, with black rings round the body. According to Boisduval and Laconte it is blackish-grey, striped with yellow; while Abbot says it is brown with a yellow lateral line.

It occurs in most of the Southern and Western States, and is said to appear once in five or six years in great abundance, while at other times it is scarce.

As yet we have no published observations upon the natural history of the above two species of insects in any Canadian work. The foreign authors do not give many reliable details. In fact, with regard to all our Lepidoptera it may be stated that not one species is perfectly known. We need not be surprised at this, because even in England, where there are perhaps more enthusiastic collectors and more good observers than in any other part of the world of the same extent, the natural history of the sixty-five species of butterflies found in the country is not complete. Upon this subject Mr. Stainton, editor of the Entomologist's Annual, makes the following remarks:— *

"A recent writer in the 'New Quarterly Review' has remarked:—'The metamorphoses of the British butterflies, of which there are only about sixty-five, are proportionably less known

* Westood's British Butterflies, p. 57.

* See Stainton's British Butterflies and Moths, page. 70

than those of the small moths! The books which describe our butterflies, it is true, also give descriptions of their caterpillars and their food; but these cannot be depended upon; they are only copied from other books, and may be traced back from author to author, until they turn out to be the original descriptions of some old French, Dutch, or German entomologist, who looked at objects with a very different eye to that which we use. As such, they remind us rather of the astonishment expressed by Mr. John Robinson's friend on finding he was really alive:—

> 'Somebody told me that some one said
> That some other person had somewhere read,
> In some newspaper you were somehow dead!'

Our readers are therefore recommended to catechize themselves by seeing how many of the following questions they can answer, with reference to those butterflies with which they may consider themselves best acquainted:—

1. Where is the egg laid?
2. How soon is it hatched?
3. How long does the larva live before changing its skin?
4. What change takes place in the form and markings of the larva when it changes its skin?
5. Is the larva gregarious or solitary?
6. Is it active or sluggish?
7. Does it feed by night or by day?
8. What is its principal food-plant?
9. On what other plants is it sometimes found?
10. At what period is the larva full fed?
11. What change takes place in the appearance of the larva when full fed?
12. Where does it change to pupa?
13. How is the pupa suspended or attached?
14. What is the form of the pupa?
15. How long does it remain in that state?
16. What are the motions of the perfect insect?
17. To what flowers is it most partial?
18. Does it hybernate or not?

When these questions can be answered with reference to each species of our butterflies, we may then admit that their natural history *is* known; and it would then become practicable to write a good monograph of the group.

ART. XXX.—*The Observatory at St. Martin, Isle Jesus, Canada East.* Notes by Prof. CHARLES SMALLWOOD, M. D. LL. D. Read before the Canadian Institute, 20th February, 1858.*

The following sketch of the general appearances of the building and instruments, from the pen of Dr. Hall, of Montreal, furnishes a very suitable introduction to Dr. Smallwood's account of the Observatory established by him at St. Martin, Isle Jesus.

A small wooden building, distant about twenty yards from the dwelling house of Dr. Smallwood, contains the whole of the apparatus which has for many years furnished such valuable results. A short distance from it, and on a level with the ground, is the snow gauge. Immediately in front of the entrance to the small building is a dial, with an index to point out the course of the clouds. Contiguous to the building again may be seen four erect staffs. The highest of which—80 feet—is intended for the elevation of a lighted lantern, to collect the electricity of the atmosphere, the copper wires from which lead through openings in the roof of the building to a table inside, on which a four-armed insulated conductor is placed. The lantern is made to ascend and descend on a species of railway, in order to obviate all jarring. On another pole is placed the wind vane, which, by a series of wheels moved by a spindle, rotates a dial inside the building marked with the usual points of the compass. Another staff, about 30 feet high, contains the anemometer, or measurer of the force of the wind, which, by a like arrangement of apparatus, is made to register its changes inside. The last pole, 20 feet in height, contains the rain guage, the contents of which are conducted by tubing also into the interior of the building, in which, by a very ingenious contrivance, the commencement and ending of a fall of rain are self-marked.

At the door entrance on the right side is a screened place, exposed to the north, on which the thermometer and wet bulb thermometer are placed, four feet from the surface of the earth. A similar apartment on the left contains the scales with which experiments are conducted throughout the winter to ascertain the proportional evaporation of ice.

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* From the Journal of the Canadian Institute. We are indebted to its Council for the use of the wood engravings.—*Eds.*

On entering the door, in the centre of the apartment is a transit instrument *in situ*, for the convenience of using which openings are made in the roof, usually kept closed by traps. This apparatus is not the most perfect of its kind, but is amply adequate for all its uses. On the left is a clock, the works of which, by means of a wheel, are made (while itself keeps proper time,) to move slips of paper along little railways, on which the anemometer by dots registers the velocity of the wind; the rain guage, the commencement and end of showers; and the wind vane, the continually shifting currents of the wind. This is effected by a pencil, kept applied by a spring to a piece of paper on the dial previously alluded to, and as, by the clock-work, the dial and the two previously mentioned slips of paper move at the rate of one inch per hour, so it is easy to determine, in the most accurate manner, the direction and force of the wind at any hour of the day, or any period of the hour. With the exception of the clock, the whole of this miniature railway-work, with all its apparatus, wheels, &c., &c., is the work of Dr. Smallwood's own hands, and exhibits, on his part, a mechanical talent of the highest order.

At the extreme end of the room is a table, beneath which is an arrangement for a heating apparatus, and on which is the four arm conductor previously alluded to. To the two lateral and front arms hangs, respectively, two of Volta's electrometers, and one of Bennet's, while beneath the knob on the anterior, there is a discharging apparatus, with an index playing over a graduated scale, to measure during thunder storms the force of the electric fluid, by the *length* of its spark. On this subject we cannot avoid a reflection on the fate of the unfortunate Richman. In this case such precautions are adopted as will obviate any casualities whatever; great precaution, however, is required in these experiments, and Dr. Smallwood, fully aware of it, has the whole placed in connection with the earth by means of a brass chain and iron rod. As another proof of Dr. Smallwood's ingenuity and mechanical skill, we may notice that the whole of this apparatus, even to the electrometers, is the result of his own handicraft; and the whole arrangements in the little room are a signal proof how much a man may do unaided, and how well he can effect an object when thrown entirely upon his own resources.

On the right wall of the apartment are suspended the barometers, of which there are three. 1. A standard of Newman's; 2. Another of Negretti's, but of different construction; and 3. One of Dr. Smallwood's own construction. The means of the three observations is the measure adopted for the observation.

The only other instrument deserving of notice is the one to determine the terrestrial radiation; and this also has been made by Dr. Smallwood. It consists of a mirror of speculum metal, (composed of copper, zinc. and tin,) of six inches in diameter, and wrought into the form of a parabolic surface, in the focus of which, at the distance of eight feet, a self-registering spirit thermometer is placed. The construction of this was a labor requiring great nicety in execution, and involving the sacrifice of much time; but perseverance even here conquered the difficulties, and we witnessed a mirror whose reflecting powers would not have disgraced Lord Ross' telescope. In fact, placed in a telescope, it has, we are informed, proved itself capable of resolving those singular stellar curiosities—the double stars.

Dr. Smallwood certainly deserves great credit for his perseverance of a favorite study, under the most unpromising circumstances; but in nothing is he so remarkable as in that peculiar ingenuity which has led him to overcome difficulties in the prosecution of scientific enquiry, which, to most minds, would have been utterly discouraging.

The Natural History Society of Montreal have petitioned the legislature for a grant of money to enable them to publish Dr. Smallwood's tables of observations for the last twelve years. This is a measure, on which no difference of opinion can be anticipated, and must meet with the support of every man who has the welfare of science and Canada at heart.

DESCRIPTION OF THE OBSERVATORY BY DR. SMALLWOOD.

The observatory is placed in the magnetic meridian, is constructed of wood, and has an opening in the roof, furnished with sliding shutters for taking observations by means of the Transit Instrument, of the passage of a Star across the meridian for the purpose of obtaining correct time.

It is also connected by the Montreal telegraph with the principal places in the United States; the wires being laid into the Observatory. It has also a seven-inch achromatic telescope, 11 feet focus. The object glass, by Frauenhofer of Munich, is mounted equatorially and possesses right ascension and declination circles; and observations are taken on the heavenly bodies as often as there are favourable nights.

Observations for the purpose of Meteorology, are taken by the usual instruments, at 6 and 7 a.m. 2, 9 and 10 p.m. daily, besides extra hours, on any unusual occurrence. Constant tri-daily observations are also taken on the amount and kind of atmospheric electricity, also on the amount of Ozone, and likewise particular attention is directed to the phenomena of thunder storms—all of which observations are regularly recorded. Besides these daily observations, record is kept of the temperature of springs and rivers and the opening and the closing thereof, by ice; also on the foliation and flowering of plants and trees, and the periodic appearance of animals, birds, fishes and insects, besides the usual observations on auroras, haloes, meteors, zodiacal light, and any remarkable atmospheric disturbances.

Many of the instruments, are self-registering and to some the photographic process may be applied, being constructed for that purpose.

The Observatory is furnished with four barometers. 1. A Newman standard, 0.60 of an inch bore; the brass scale extends from the cistern to the top of the tube, and is adopted for registration by the photographic process. 2. A Negretti and Zambra's tube, 0.30 of an inch bore; another of a small bore, and also an Aneroid. The cisterns are all placed at the same height (118 feet,) above the level of the sea and are read at each observation.

Thermometers of Sixes, Rutherford, Negretti, &c., the readings of which are corrected, with the standard instruments of the new observatory, and most of the scales are engraved on the stem of the tubes. Care is taken to verify them twice a year, they are placed four feet from the ground, and have occupied the same position for some years, being placed free from radiation, and carefully shaded from the sun and rain.

The *Psychrometer*, consists of the dry and wet bulb thermometers, the scales of which are coincident, and have been carefully read together. There is also a Saussure's hygrometer. In winter the wet muslin is supplanted by a thin covering of ice which requires frequent renewal.

For *solar radiation* a maximum Rutherford's thermometer is used, with the bulb kept blackened with Indian ink; the tube is shaded by a piece of glass blackened also with Indian ink, which prevents the index from adhering to either the tube or the mercury, as is often the case when not shaded.

Terrestrial radiation is indicated by a spirit thermometer of

Rutherford, which is placed in the focus of a parabolic mirror, 6 inches in diameter and of 100 inches focus.

Drosometer or dew measurer.—One is of copper, like a funnel, the inside of which has been exposed to the flame of a lamp and has been coated with lamp black; the other is a shallow tin dish painted black and ten inches in diameter.

Rain-guage.—The reservoir is thirteen inches in diameter, and is placed 20 feet above the soil. It is self-registering, and is attached to the anemometer and shews the beginning and ending of the rain and the amount of precipitation in inches on the surface.

The *Snow-guage* presents 200 square inches of surface, and is placed in an open space. The surface of the snow requires to be lightly levelled, before taking the depth, which is recorded in inches. A tin tube, 3 inches in diameter and 10 inches long, is used for obtaining snow for the purpose of reducing the amount to the relative amount of water. The tin tube fits in another vessel of tin of the same diameter, and the snow is easily reduced and measured.

The Evaporator exposes a surface of 100 inches, and is carefully shaded from sun and rain. It is made of zinc and a glass scale, graduated in inches and 10ths, is well secured in front of it, a strip of the metal being removed the glass scale supplies its place, so that the amount evaporated can be easily read off. Its place is supplied in winter by a pair of scales, upon one of which is placed a disc of ice, and the amount of evaporation from the surface is estimated by being very accurately weighed.

The *Ozonometers* are Schonbien's and Moffat's. The solution consists of one drachm of starch, boiled in one ounce of distilled water, to which is added when cold 10 grains of the Iodide of Potassium—this is spread on *sized* paper which is found to answer better than bibulous or *unsized* paper, for the solution is more equally distributed over the surface, whereas on bibulous paper it is very difficult to spread the solution equally. It is cut into slips of about 3 inches long and 5 inches wide—having been previously dried in the dark it is also requisite, to keep it dry and free from light. When required one of these slips is placed 5 feet from the ground and shaded from the sun and rain,—another of these slips of ozone paper is elevated and exposed at an altitude of 80 feet, for the purpose of comparison. It is also well to place slips of this prepared paper in the vicinity of any vegetables, which may be affected with disease, for instance during the prevalence of the potatoe rot.

A *Microscope* and apparatus for the examination of snow crystals and also obtaining copies by the chromotype process, is also provided.

The Electrical Apparatus.—This consists of three parts: a hoisting, a collecting and a receiving apparatus.

The hoisting apparatus consists of a pole or mast 80 feet. It is in two pieces, but is spliced and bound with hoop iron, and squared or dressed on one face for about six inches. It is dressed in a straight line to receive cross pieces of two-inch plank, 8 inches wide and 12 inches long, which are firmly nailed to the mast or pole about three feet apart; this serves as a ladder to climb the pole in case of necessity. Each of these cross pieces is *rebated* to receive pieces of inch board 4 inches wide, and placed edgeways in the *rebate*, extending from the top to the bottom of the pole, and forms a sort of vertical railway; these pieces are also grooved or rebated to receive a slide, which runs in these grooves and carries the receiving apparatus. From the top of the sliding piece passes a rope over a pulley fixed at the top of the mast, and from it to a roller and windlass, by which means the collecting lantern is raised or lowered for trimming the lamps. It has also been used for the purpose of placing the ozonometer at that height (80 feet). The lower part of the mast or pole is fixed into a cross piece of heavy timber, and is supported by four stays. These cross timbers are loaded with stones, and are thus rendered sufficiently firm.

The collecting apparatus consists of a copper lantern 3 inches in diameter, 5 inches high. (See top of mast G, fig 1.) The bottom is moveable and the lamp is placed in it by the means of a small copper pin passing in a slit, which is a very easy method of fixing it. This lantern is placed on top of a copper rod ¾ inch thick and 4 feet long: the bottom of the lantern having a piece of copper tube fixed to it, a very little larger than the rod, and is thus easily removed and replaced. To the lower end of the copper rod is soldered an inverted copper funnel, a *parapluie*, for protecting the glass insulating pillar upon which it is fixed by means of a short tube firmly soldered to the underside of the *parapluie*. This glass pillar passes into and is fixed firmly in a wooden box, and is freely exposed to the heat of a second lamp, which is placed in this box. It is trimmed at the same time as that in the collecting lantern, and keeps warm and dry the glass pillar, by that means securing a more perfect insulation. From this upright rod and collecting apparatus descends a thick copper wire which serves to convey the accumulated electricity to the receiver which is placed in the observatory.

The receiver consists of a cross of brass tube (gas tubes), each about 2 feet long, and is screwed into a large tube fitting upon a glass cone, which is hollow, forming a system of hollow pipes for the passage of the heat internally, and keeping up a certain amount of dryness and consequent insulation. The glass cone is fixed upon a table over an opening made in it, fitting to the hollow part of the cone. Immediately under this table is placed a small stove of sheet-iron, about 8 inches in diameter, made double, the space of about 1 inch being left between the two chambers; and this plan has been found to effect a good insulation by keeping the whole of the apparatus warm and dry. Charcoal is used as fuel, and is, I think, preferable to a lamp. A coating of suet or tallow is applied to the glass cones or pillars. Care must be taken not to rub or polish the collecting apparatus as it seems to deteriorate its power of collecting and retaining atmospheric electricity; and I have found that its collecting powers increase with its age. Suspended from these cross arms hang the *electrometers.* 1. *Bennet's electroscope* of gold leaves; this scarcely needs a description. 2. *Volta's electrometers, No.* 1, consisting of two straws, two French inches long: a very fine copper wire passes through these straws, which are suspended from the cross-arms. This electrometer is furnished with an ivory scale, the old French inch being divided into twenty-four parts, each being 1°; this forms the standard scale for the amount of tension. 2. *Volta's electrometer, No.* 2, is similar to the No. 1, but the straws are five times the weight of No. 1, so that one degree of Volta's No. 2 is equal to five of No. 1. *Henly's electrometer* is a straw suspended and furnished with a small pith ball: each of the degrees of Henly's is equal to 100° of No. 1 of Volta's. These electrometers are all suspended from the cross-arms. *A discharging apparatus,* furnished with a long glass handle, measures the length of the spark, and serves also as a conductor to carry the electricity collected to the earth, and is also connected by a chain and iron rod passing outside of the observatory for about twenty yards, and buried under ground.

Various forms of *Distinguishers* are used to distinguish the kinds of electricity. The Volta's electrometers may be rendered self-registering, with great facility, by the photographic process. By placing a piece of the photographic paper behind the straws, and throwing the light of a good lens upon them, the expansion is easily depicted, and serves well for a night register. There is also a Peltier's electrometer, another form of electrometer, consisting of two gold leaves suspended to a rod of copper two feet long; the upper end being furnished with a wire box, in which is kept burning some rotten wood (touch-wood).

The *Anemometer* consists of a *direction shaft* and a *velocity shaft:* to the top of the direction shaft is placed the vane, which is eighteen feet in length. The shaft is made of three pieces, to insure lightness and more easy motion: each piece is connected by means of small iron-toothed wheels. The two shafts are six feet apart, and work on cross-arms from a mast firmly fixed in the ground. The vane passes some six or eight feet above the velocity shaft, and does not in any way interfere with the other movements. The lower extremity of these shafts are all furnished with steel points, which work on an iron plate or a piece of flint, and pass through the roof of the Observatory; the openings being protected by tin parapluies fixed to the shaft, and revolving with them. Near the lower extremity is placed a toothed-wheel, eight inches in diameter, connected to another wheel of the same diameter, which carries upon its axis a wooden disc, thirteen inches in diameter, upon which is clamped a paper register (old newspapers answer very well) washed over with whiting and flour paste. Upon the surface of this register is traced by a pencil the direction of the wind. This register is renewed every twelve hours.

The *velocity* shaft is in two pieces, connected by means of the toothed wheels and steel pivots, as in the direction shaft; and, practically, the friction is *nil*. At the top of the velocity shaft are fixed three hemispherical tin or copper caps, ten inches in diameter, similar in construction to those of the Rev. Dr. Robinson of Armagh, and are firmly rivetted to three iron arms of $\frac{5}{8}$-inch iron. These caps revolve always in the same direction, and one revolution is found to be just one third of the linear velocity of the wind. I have no reason to doubt Dr. Robinson's formula for this calculation. At the lower extremity of the velocity shaft is fixed a one-toothed wheel, $2\frac{3}{4}$ inches in diameter; this moves a second, or ten-toothed, wheel, which also gives movement to a third wheel. This marks a hundred revolutions of the caps, which are so calculated that each one hundred revolutions are equal to one mile linear; and whenever one hundred revolutions have been accomplished, a small lever is elevated by means of an inclined plane, fixed upon the edge of the last wheel, and which gives motion to the lever. The other extremity of the lever is furnished with a fine steel point, which dots off, upon a paper register, the miles as they pass. This register is of paper, one and a quarter inch wide, and is removed every twelve hours.

Between the two shafts, at the lower extremities, are placed two runners of wood, *rebated*, to receive a slide or train, which carries the register. To the underside of this slide is fixed a rack, and it is moved by a pinion, the movement of which is communicated by a clock,—the cord of the weight being passed over a wheel and pulley,—and advances one inch per honr, and the lever before described dots off the miles as the register advances under the steel point. In this manner it shows the increase and decrease of the velocity, and also the moment of its change. Attached to this moveable train is a rod of wood carrying a pencil, which passes over the disc connected with the direction shaft, and there traces, as it advances, the direction of the wind, the moment of its changes, and the point from which it veered. The extreme height of the vane is forty feet, but this might be increased if required. The clock is wound up every twelve hours, which brings back the train to its starting point.

There are also a polariscope, prisms, and glasses of different colors, for experimenting on the different rays of light, in connexion with the germination of seeds, and the art of photography. The Observatory possesses a quadrant and artificial horizon, which serve for measuring the diameter of halves, and altitudes of auroral arches, &c.: also a dial for the indication of the direction and course of the clouds; and other minor instruments.

EXPLANATION OF EXTERNAL VIEW OF THE OBSERVATORY.

A. Thermometer for solar radiation.

B. Screen of Venetian blinds.

C. Thermometer.

D. Opening in ridge of the roof, closed with shutters, to allow use of transit instrument.

E. Rain guage with conducting pipe through the roof.

F. Velocity shaft of the anemometer.

G. Mast for elevating apparatus for collecting electricity.

H. Cord for hoisting the collecting apparatus.

J. Copper wire for conducting the electricity into the building.

I. Direction shaft of the anemometer.

EXPLANATION OF THE PLAN OF THE OBSERVATORY.

A. Anemometer.

B. Small transit for correcting time.

C. Electrical machine for charging the Distinguisher.

D. Peltier's electrometer.

d. Space occupied by Drosometer, Polariscope, &c.

E. Electrometer. e. Discharger.

F. Distinguisher.

f. Small stove—sometimes used in damp weather.

G. Thermometer placed in the prismatic spectrum for investigations on light.

H. Nigretti & Zambra's barometers and cisterns, 118 feet above the level of the sea.

I. Small-tube barometer.

J. Newman's barometer.

K. Aneroid barometer.

L. Quadrant and artificial horizon.

M. Microscope and apparatus for ascertaining the forms of snow crystals.

N. Thermometer, psychometer, &c., 4 feet high. A space is left between the two walls to insure insulation and prevent radiation.

O. Ozonometer.

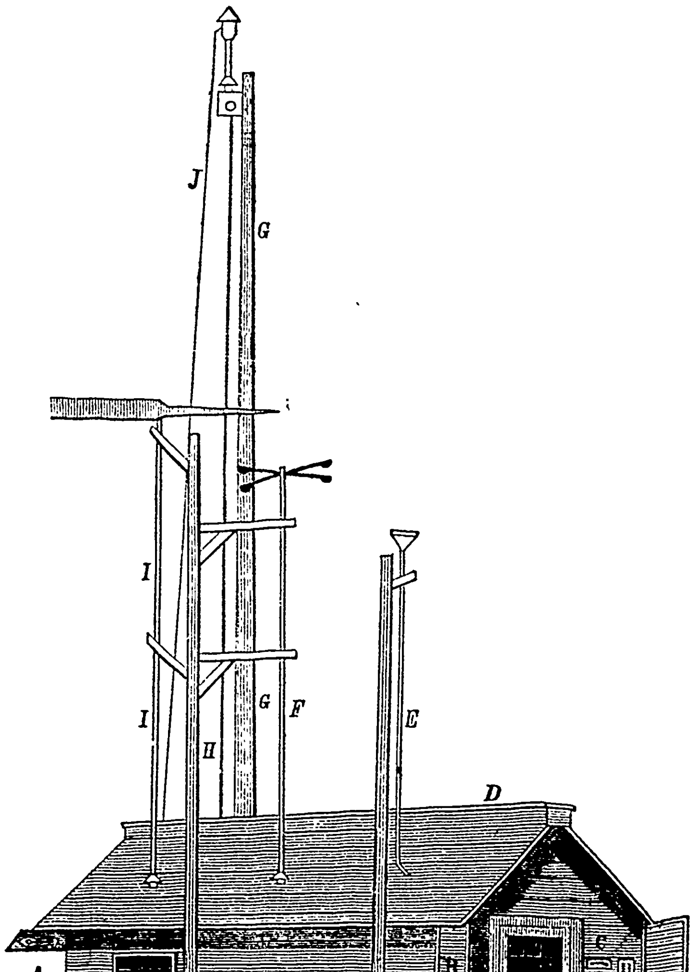
P. Evaporator—removed in winter and replaced by scales for showing the amount of evaporation from the surface of ice.

Q. Post sunk in the ground, and 40 feet high, to carry the arms of support for the Anemometer.

R. Solar radiator.

S. Venetian blinds.

T. Iron rod beneath the surface of the ground connected with the discharger to insure safety.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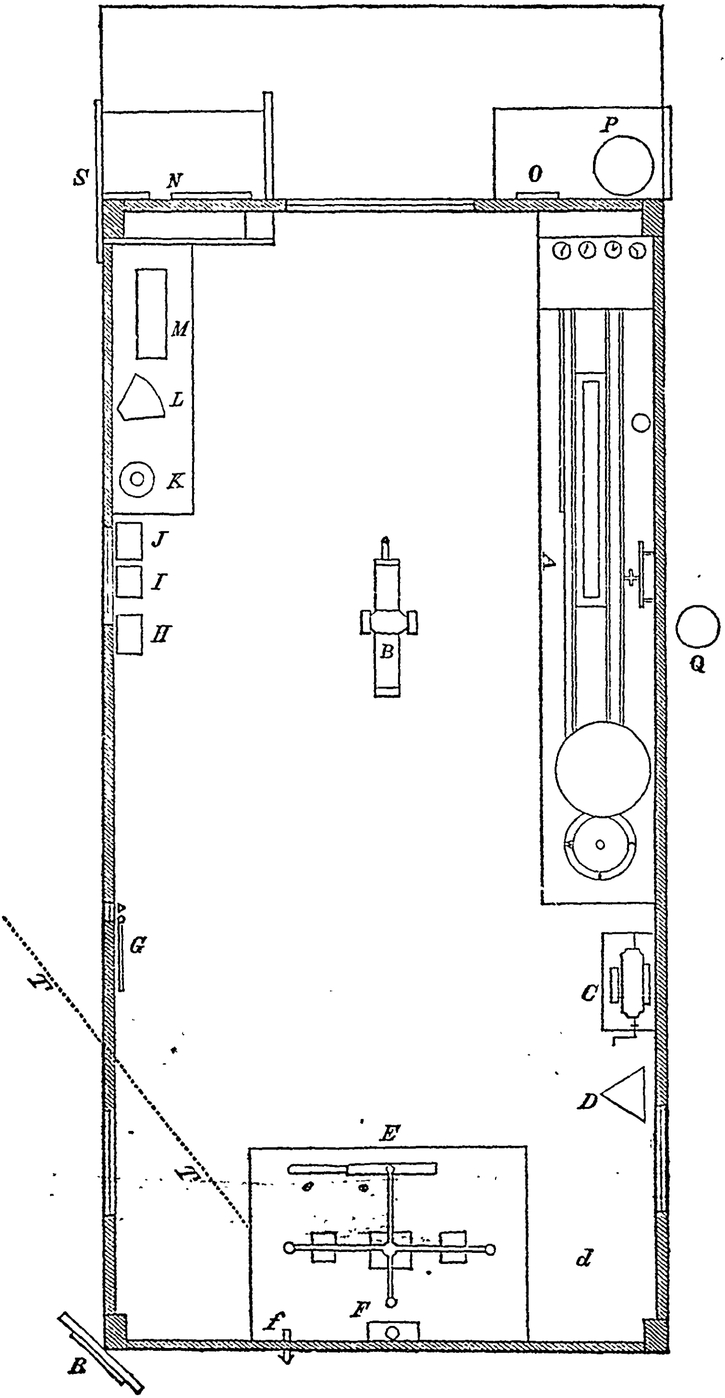

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ART. XXXI.—*Answers to Questions proposed to the Essex Institute on Lightning Conducting Rods.* By a Committee of the Institute. [*Vid.* "Proceedings," vol. ii., part i., p. 164.]

1. Has the exemption of buildings through lightning rods, been such as to justify the general confidence reposed in them?

To most of those who have given any attention to the subject, it is a matter of surprise that any doubt should exist, that *nearly absolute safety may be secured* by the use of rods erected on scientific principles.

Mr. Ebenezer Merriam, of Brooklyn, N. Y., in a communication to the Journal of Commerce, says, that he recorded 39 deaths by lightning, and 27 thunderstorms, in July, 1854.—"Our record, says he, gives an aggregate of 750 deaths on the land for the period of 14 years, *only one of which* occurred in a building furnished with lightning conductors, and that one in the summer of 1855, at Little Prairie, Wisconsin. There were three buildings burnt by lightning in this country, the last year, which were furnished with conductors, a barn in West Chester Co., a house in Richmond, Va., and the house of Mr. Van Renssaler, in St. Lawrence Co., N. Y. We have in vain endeavoured to learn the particulars in each case." He proceeds to declare that in no other instance, ashore or at sea, has any case of death been made known to him. He recommends *continuous rods with glass insulators*, as the surest protection against lightning. He gives a description of the house of Mr. Nathan Frye, of this city, and attributes the failure of the two rods to protect it, to the size of the house, to the number of chimneys and the imperfect arrangement of the rods. He gives an extract from a letter by Prof. Henry, relative to the shock which visited the building of the Smithsonian Institute, in which the latter declares that the reports of great injury done were much exaggerated, and he was in the building at the time and was not affected; that two other persons stood within a few feet of the rod and felt no shock.

Mr. M. describes the shock that struck the house of Mr. James Spillman, of Morrisania, though protected by rods, and shews that the injury to the house resulted from the *upward passage of the rod from the chimney to the top of the roof*, at which point the injury was done, while another part of the house at which the rod descended directly to the earth was uninjured.

From events of this character, doubt has arisen in some minds of the efficacy of lightning rods, when, if the causes of their failure were duly weighed, the incidents would furnish additional proof of their value.

A work recently published in England, entitled "Three years in Canada," written by F. MacTaggart, Civil Engineer of the British government, contains the following *patriotic* declaration:—"Science has every cause to dread the thunder rods of Franklin; they attract destruction, and houses are safer without than with them."

As if for the express purpose of deciding this question, the Nautical Magazine of March, 1853, says, "objections to the employment of lightning rods have been so strenuously made, that the Governor and Council of the East India Company, were led to order the lightning rods to be removed from their powder magazines and other public buildings, having in the year 1838 come to the conclusion from certain representations of their officers that lightning rods were attended by more danger than advantage."

In the teeth of which conclusion a magazine at Dum Dum and a corning house at Mazagon, *not having lightning rods*, were struck by lightning and blown up. But no such instance of magazines preserved by rods for seventy years has occurred.

No supposition can be more erroneous than that which ascribes to a well constructed lightning rod the power of drawing the thunder cloud into its vicinity. An experiment by Dr. Franklin sets this matter in its proper light. He insulated a scale beam hung on a vertical pivot, from which one of the scales had been removed, and into the other a light bunch of cotton wool had been placed. He then charged the beam with positive electricity, giving it at the same time a horizontal rotatory motion over the surface of a table; when he placed beneath the scale as it revolved a piece of blunt iron, the scale descended towards the iron to give off its explosive discharge; but when he substituted an iron point for the blunt iron, instead of descending, the scale having lost its electricity to the iron point rose quickly above the table. Thus a cloud, instead of approaching a forest of lightning rods in a village, would be deprived of *the electricity which has kept it so near the earth by attraction* and ascend in censequence of the loss of it.

That the confidence so generally felt in the efficacy of the protection of lightning rods, is not misplaced, has been triumphantly proved cases in innumerable.

In 1769, the Jacob tower, in Hamburg, was furnished with a rod; and after the cathedral at Sienna had been repeatedly struck by lightning the authorities concluded to follow the example of Hamburg, and erected conductors. The inhabitants at first regarded them with great terror, and stigmatized them as heretical. But on the 10th of April, 1777, a heavy shock of lightning visited the tower and glided harmlessly to the earth; the church has not been injured since, and the conductors are absolved from the charge of heresy.

Old St. Paul's church in London, unprotected by rods, was twice struck and damaged. The present structure, though more elevated, being provided with rods, has never suffered from electricity.

The cathedral of Geneva, the most elevated in the city, for more than two centuries enjoyed immunity from lightning; while the neighboring bell tower of St. Gervais, though not so elevated, has often been struck and damaged. In 1771, Saussure by examination discovered the cause to consist in a complete coating of tin plate from the top of the Cathedral spire to the base of the tower, thence by metallic water pipes to the ground, forming a series of conductors analagous to those of Harris.

But if lightning rods are useful to protect buildings, still more useful are they for the protection of ships. In the British navy, between the years 1810 and 1815, forty sail of the line, twenty frigates, and twelve sloops were damaged by lightning. Between 1739 and 1793, seventy-three men were killed, and several hundred dangerously wounded by the same instrumentality. The amount of property destroyed cannot be estimated. The mainmast alone of a seventy-four, costs originally $5000. To this must be added the cost of its removal, of ruined spars, rigging, hull and stores, and the daily expenses of the ship, varying from $400 to $550 per day. This estimate glances at the cost of *repairing* those not totally destroyed by lightning. In the space of forty-six years the *average* expense thus occurring amounted to $30,000 per annum. Probably some of those ships that "sail from their port and are never heard of more" are destroyed by lightning.

To the foregoing estimate must be added the casualities occurring to vessels weakened by the electric shock, and afterwards lost in struggle with the wind or the foe. "The Guerriere is an instance," says the Nautical Magazine, "of a frigate fighting a superior force with her main mast in a defective state, by a stroke of lightning, and which might have stood but for this defect. The mainmast was carried away in battle, by the fall of the foremast across the main stay, which certainly might not have led to this disaster, had the main-mast been in an efficient state. The loss of all the masts was the loss probably of the ship."

The British government at length resolved to furnish the national vessels with the most approved system of conductors, that of Sir Wm. Snow Harris. This measure was fully justified by the result. For between the years 1828 and 1840, upwards of sixty ships of the line had been exposed to lightning in all climates without sustaining any damage; while for the rest of the navy on different stations and not so protected, there were damaged by lightning, 7 ships of the line, 7 frigates, 30 sloops, and six smaller vessels and steamers, in all 50 vessels, averaging more than one-fourth of the British navy in commission. In a period of twenty-two years, of the ships of the navy at sea, those without conductors, compared with those with conductors, the number struck was in the proportion of three of the former to two of the latter.

Induced by such facts and considerations, the British government in the year 1846, selected ten vessels to wear suits of lightning conductors, and sent them to different parts of the world and into all climates during one year, and, finding every ship effectually protected, before the year 1848, furnished every vessel in the British navy with a similar protection, and the East India Company followed the example of the British government.

The Committee therefore do not hesitate to declare their belief that "the exemption of buildings from injury by lightning, through the protection of lightning rods, *has been such as to justify the general confidence reposed in them.*

2 Have not single trees and groves afforded greater protection than the metallic rod?

It admits of no doubt that trees serve as natural conductors, and especially those, of which the leaves are linear. A case in point is quoted in Franklin's Letters. A Mr. Wilcke saw a large fringed cloud strongly electrified, and extending its inferior surface towards the earth, which suddenly lost its electrical character in passing a forest of tall fir trees. The ragged and dependent portions shrank back upon the main cloud, and rose up as it were from the earth.

The conducting power of trees results only from the water they contain; for dry wood, especially when baked, becomes a non-conductor; water by the estimate of Mr. Cavendish, has to iron a conducting power of only one to 400.000,000.

Whether a grove would adequately protect a dwelling, depends entirely on the quantity of metal used in the construction of the latter. It appears that the trees which have been visited by thunderbolts have not been able to protect themselves. In other words the obstruction to the current of electricity has been such as to furnish no passage to a large quantity of the fluid, as in the case of lightning rods badly insulated, which have been forsaken by the fluid for a better conductor.

Among the trees struck and more or less injured by lightning the past year, have been noticed sycamores, pines, oaks, apple trees, elms, and locusts. If trees possess a higher power of conduction than a moistened bundle of wooden rods of the same heigth, it is attributable to the increased evaporation from their leaves and branches; especially is this true, when the electrical condition of atmosphere is highly intense. By experiments, its has been shown that a living plant evaporates from one third to one fourth more, when electrified, than in its natural state; so that not only the tree, but its column of vapour, serves as an electrode through which the positive electricity of the air passes to the earth Animals, in like manner, by their profuse evaporation, greater than that of vegetables from their higher temperature, furnish better conductors than trees; in confirmation of this, is the common direction given in our scientific works, to avoid the shelter of trees. The electricity, leaving the worse conductor the tree, selects the better the animal. It may even be lured from a lightning rod of small capacity, by a mass of the same metal of greater magnitude.

Some facts furnished by Mr. Warner, before quoted, are here available.

He writes, "there were apple trees of good size on the North and the South of the barn that was struck, at about the distance of three rods. I have a barn 65 rods west of my house, which has been struck; the same shock went through an apple tree to a post in a fence some seven feet from the tree, which it split and tore in pieces. I could see no mark on the tree, but it has since died. This tree is 30 feet from the barn. Six rods northerly is wood land; lightning has struck in these woods. I do not know of any minerals in the land in this vicinity, which would attract the lightning, but the land is rolling and of a strong moist soil."

In South Abington, an oak was shivered, and a pine was struck; and another in Reading. In Plymouth, an apple tree was struck. In Exeter, a pine tree was cut off, and fell to the earth in an erect position. July 15th, a locust was split in Hamilton, 80 rods from Dea. Loring's house. A large elm was struck at Dedham.

In every instance of the passage of lightning through trees, brought to the attention of the Committee, the tree has been found to suffer to a greater or less extent.

If then we find the tree incapable from its conducting power, of defending itself, we should judge that lightning would need little inducement to forsake it for a building in which iron to a greater or less extent is employed; nay, even animals in the vicinity of trees would be exposed to greater danger than in an exposed situation in the open air; for the tree by its great height would first receive the shock, but would not withhold it from an animal within the sphere of attraction. The Committee would therefore decide the second question in the negative.

3. Whose rods, and of what construction have afforded the greatest security?

The best rods or those which have stood longest the test of time were invented by King Solomon; for the temple, was unharmed by lightning during one thousand years. The whole roof bristled with metallic pinnacles, the body of the building was covered with plates of gold, and water spouts from the roof descended into deep cisterns of water. This was the system of Solomon.

If then we elevate a sufficient number of points to furnish a passage for the electric fluid, and with surface sufficient to prevent any part of it from seizing some iron bar, zinc roof, tinned porch or widow-casing, we have complied with one essential condition; if we keep open a sufficient number of these passages to the earth, and spread the rods into points below as above, we have answered another condition. If different parts of the house are furnished with metals, these substances should be united by wires with one of the main trunks; if, however, we insulate the system with conductors, furnish a sufficient number of them, and thus prevent the fluid from reaching the imperfect conductors within the building, we shall have answered the same purpose.

An excellent system of conduction for our buildings is that of George W. Otis; for ships that of W. G. Harris.

The rods of the former are constructed from 3-8 in. iron, elevated above each chimney, the points of the ridge pole and other prominent elevations, presenting either a branch of points or a single point, gilt, extending over the ridge-pole down the rafters to the earth, united with a screw and socket, and insulated from the building by means of glass cups.

That of Mr. Harris, consists of a double strip of copper, sunk into each mast and spar by a shallow channel, to bring the metal flush with the wood; the strip being interrupted at every few feet to give way readily with the bending of the spar, and still so as to preserve its continuous extension. The strips extend from the mizen mast to the stern-post, from the steps of the mast to the metallic bolts passing through the kelson and keel to the water: also bands of copper pass under the beams leading to the iron knees or metallic fastenings, passing through the side of the ship, the whole formed with shut joints, and making of the ship a compound metallic mass, little liable to be destroyed by any electrical shock to which it may be subjected; this system has had a trial of 18 years in the British navy, and even the common sailor has merged his suspicion into admiration.

The Committee declare it to be their opinion, that *any system* of conductors, sufficiently elevated, presenting a sufficient number of points, perfectly continuous, presenting competent surface, and pursuing the most direct route to the earth, claims and should receive full confidence of the public.

4. Are some trees better conductors than others, as the elm for instance than the pine, and therefore more efficacious protectors?

In the cases of this nature which have been noticed the past year, it has almost invariably been found that the pine when struck has been shivered. But the elm receives the shock most patiently, perhaps its exceeding strength enables it better to bear the shock. The oak usually manifests the effects of the contact. The Nort' American Indians have a tradition, which declares that the beech is never struck by lightning. Tiberius, the emperor of Rome, wore a wreath of laurel as a protection from lightning. Since tradition is usually founded in truth, we may infer that, so far as its authority extends, the affirmative is the true answer to this question.

Possibly the trees whose branches make a small angle with the trunk, are better conductors than those constructed with greater angles The angles of the branches of the beech and the elm are small; those of the oak, the apple, the locust, the sycamore and the pine are large. I have spent six years in the vicinity of a grove of Lombardy populars, but knew no instance of violence done to them by lightning or to the buildings which they shaded.

Has the maple, the willow, or the birch, been known to suffer from electricity?

Facts in relation to this question are few indeed, but what there are, led to the conclusion that some trees *are* better conductors of electricity than others.

5. Are the amount and operations of the electric fluid considerably affected by the growing and ripening harvest?

It may be regarded as an established fact, that a chemical change in the form of bodies is attended with the development of electricity.

Now in the production of electricity by the sulphate of copper battery, we have the decomposition of water and of the salt; and the formation of an oxide of copper, and a new salt, the sulphate of zinc; and in this process, abundant electricity is set at liberty.

M. Becquerel, by a series of experiments, has shown that between the plant and the soil flows an electric current, the soil being positive and the plant negative; that by the banks of a stream the phenomena are complex, the alkaline waters being negative, and acid waters positive. If so, then the deposit of the salts of soda-potash and ammonia in vegetables may be the cause of their negative electricity. And when a thunder cloud surcharged with positive electricity approaches the ripening harvests, the conditions become such as to favor a discharge of electricity between them.

Arago says, that wheat fields, after a thunder storm of sheet lightning, suffer from the breaking of the stalk and the dropping of the heads of wheat. That the growing and ripening harvest exercises an influence on the electrical condition of the air, may be affirmed on the same grounds that warrant our conclusion that trees and forests act in this way. Evidence on this subject is not abundant, and it is to be hoped that the facts and opinions just presented may stimulate other minds to other and more extensive researches.

For the Committee,

JACOB BATCHELDER, *Chairman.*

SCIENTIFIC GLEANINGS.

Twenty-eighth meeting of the British Association for the advancement of Science at Leeds, September 22nd, 1858.

The *Athenæum* informs us that the busy town and vicinity of Leeds manifested their appreciation of the honor of this meeting, and their estimation of Science and its most celebrated professors, by assembling on the evening of the 22nd September in such numbers in the magnificent New Hall of the town, as had never come together at any previous inaugural meeting of the Association. The Rev. Dr. Lloyd took the chair *pro formâ*, resigning it to Professor Owen, the President chosen for the year, whose distinguished and world-wide reputation added greatly to the interest of the meeting. In the forenoon the General Committee met and, having elected the officers of Sections, received the usual reports from its Council and Committees. From the Council Report it appears that the next meeting is to be held in the City of Aberdeen, and that Prince Albert has signified his willingness to accept the Presidency. The most interesting feature of this Annual Congress of the princes of Science is generally the opening address of the Chairman, which, on this occasion, is characterised by the sagacity, large-mindedness, and varied learning of its illustrious author. We therefore offer no apology to our readers for the space occupied by our large extracts from this most interesting and valuable production. It gives an able *resumé* of the scientific progress of the past year and the present tendencies of scientific research, and is especially interesting in the departments of Natural History, in which Prof. Owen is *facilé princeps*. We commend it to the careful perusal of our readers.

PROFESSOR OWEN'S INAUGURAL ADDRESS.

Gentlemen of the British Association,—We are here met, in this our twenty-eighth annual assembly, having accepted, for the present year, the invitation of the flourishing town and firm seat of British manufacturing energy, Leeds, to continue the aim of the Association, which is the promotion of Science, or the knowledge of the laws of Nature; whereby we acquire a dominion over nature, and are thereby able so to apply her powers as to advance the well-being of society and exalt the condition of mankind. It is no light matter, therefore, the work that we are here assembled to do. God has given to man a capacity to discover and comprehend the laws by which His universe is governed; and man is impelled by a healthy and natural impulse to exercise the faculties by which that knowledge can be acquired. Agreeably with the relations which have been instituted between our finite faculties and the phenomena that affect them, we arrive at demonstrations and convictions which are the most certain that our present state of being can have or act upon. Nor let any one, against whose prepossessions a scientific truth may jar, confound such demonstrations with the speculative philosophies condemned by the Apostle; or ascribe to arrogant intellect, soaring to regions of forbidden mysteries, the acquisition of such truths as have been or may be established by patient and inductive research. For the most part, the discoverer has been so placed by circumstances,—rather than by predetermined selection,—as to have his work of investigation allotted to him as his daily duty; in the fulfilment of which he is brought face to face with phenomena into which he must inquire, and the result of which inquiry he must faithfully impart. The advance of natural as of moral truth has been and is progressive: but it has pleased the author of all truth to vary the fashion of the imparting of such parcels thereof as He has allotted, from time to time, for the behoof and guidance of mankind. Those who are privileged with the faculties of discovery are, therefore, to be regarded as pre-ordained instruments in making known the power of God, without a knowledge of which, as well as of Scripture, we are told that we shall err. Great and marvellous have been the manifestations of this power imparted to us of late times, not only in respect of the shape, motions and solar relations of the earth, but also of its age and inhabitants.

AGE OF THE WORLD.

In regard to the period during which the globe allotted to man has revolved on its orbit, present evidence strains the mind to grasp such sum of past time with an effort like that by which it tries to realize the space dividing that orbit from the fixed stars and remoter nebulæ. Yet, during all those eras that have passed since the Cambrian rocks were deposited which bear the impressed record of creative power, as it was then manifested, we know, through the interpreters of these "writings on stone," that the earth was vivified by the sun's light and heat, was fertilized by refreshing showers and washed by tidal waves. No stagnation has been permitted to air or ocean. The vast body of waters not only moved, as a whole, in orderly oscillations, regulated, as now, by sun and moon, but were rippled and agitated here and there successively by winds and storms. The atmosphere was healthily influenced by its horizontal currents, and by ever-varying clouds and vapours rising, condensing, dissolving, and falling in endless vertical circulation. With these conditions of life, we know that life itself has been enjoyed throughout the same countless thousands of years; and that with life, from the beginning, there has been death. The earliest testimony of the living thing, whether shell, crust, or coral in the oldest fossiliferous rock, is at the same time proof that it died. It has further been given us to know, that not only the individual but the species perishes; that as death is balanced by generation, so extinction has been concomitant with creative power, which has continued to provide a succession of species; and furthermore, that as regards the varying forms of life which this planet has witnessed, there has been "an advance and progress in the main." Geology demonstrates that the creative force has not deserted this earth during any of her epochs of time; and that in respect to no one class of animals has the manifestation of that force been limited to one epoch. Not a species of fish that now lives, but has come into being during a comparatively recent period; the existing species were preceded by other species, and these again by others still more different from the present. No existing genus of fishes can be traced back beyond a moiety of known creative time. Two entire orders (Cycloids and Ctenoids) have come into being, and have almost superseded two other orders (Ganoids and Placoids), since the newest or latest of the secondary formations of the earth's crust. Species after species of land animals, order after order of air-breathing reptiles have succeeded each other; creation ever compensating for extinction. The successive passing away of air-breathing species may have been as little due to exceptional violence, and as much to natural law, as in the case of marine plants and animals. It is true, indeed, that every part of the earth's surface has been submerged; but successively, and for long periods. Of the present dry land different natural continents have different Faunæ and Floræ; and the fossil remains of the plants and animals of these continents respectively show that they possessed the same peculiar characters, or characteristic *facies*, during periods extending far beyond the utmost limits of human history. Such, gentlemen, is a brief summary of facts most nearly interesting us, which have been demonstratively made known respecting our earth and its inhabitants. And when we reflect at how late and in how brief a period of historical time the acquisition of such knowledge has been permitted, we must feel that vast as it seems, it may be but a very small part of the patrimony of truth destined for the possession of future generations.

SCIENTIFIC PROGRESS.

In reviewing the nature and results of our proceedings during the last twenty-seven years, and the aims and objects of our Association, it seems as if we were realizing the grand Philosophical Dream or Prefigurative Vision of Francis Bacon, which he has recounted in his 'New Atlantis.' In this noble Parable the Father of Modern Science imagines an Institution which he calls "Solomon's House," and informs us by the mouth of one of its members that "The end of the Foundation is Knowledge of Causes and Secret Motions of Things; and enlarging of the bounds of Human Empire to the effecting of all things possible." As one important means of effecting the great aims of Bacon's "six days college," certain of its members were deputed as "merchants of light," to make circuits or visits of divers principal cities of the kingdom." This latter feature of the Baconian organization is the chief characteristic of the "British Association;" but we have striven to carry out other aims of the 'New Atlantis,' such as the systematic summaries of the results of different branches of science, of which our published volumes of 'Reports' are evidence; and we have likewise realized, in some measure, the idea of the "Mathematical House" in our establishment at Kew. The national and private observatories, the Royal and other Scientific Societies, the British Museum, the Zoological, Botanical, and Horticultural Gardens, combine in our day to realize that which Bacon foresaw in distant perspective. Great, beyond all anticipation, have been the results of this organization, and of the application of the inductive methods of interrogating nature. The universal law of gravitation, the circulation of the blood, the analogous course of the magnetic influence, which may be said to vivify the earth, permitting no atom of its most solid constituents to stagnate in total rest; the development and progress of Chemistry, Geology, Palæontology; the inventions and practical applications of Gas, the Steam-engine, Photography, Telegraphy:—such, in the few centuries since Bacon wrote, have been the rewards of the faithful followers of his rules of research. (He dwelt on the importance of direct observations as illustrated in the history of Astronomy—referred to the discovery of Galileo, the application of his discovery by Kepler and Horrocks, and continued.) Without stopping to trace the concurrent progress of the science of motion, of which the true foundatiens were laid, in Bacon's time, by Galileo, it will serve here to state that the foundations were laid and the materials gathered for the establishment by a master-mind, supreme in vigour of thought and mathematical resource, of the grandest generalization ever promulgated by science—that of the universal gravitation of matter according to the law of the inverse square of the distance. The same century in which the "Thema Cœli" of Lord Verulam and the 'Nuncius Sidereus' of Galileo saw the light, was glorified by the publication of the 'Philosophiæ Naturalis Principia Mathematica' of Newton. Has time, it may be asked, in any way affected the great result of that masterpiece of human intellect? There are signs that even Newton's axiom is not exempt from the restless law of progress. The mode of expressing the law of gravitation as being "in the inverse proportion of the square of the distances" involves the idea that the force emanating from or exercised by the sun must become more feeble in proportion to the increased spherical surface over which it is diffused. So indeed it was expressly understood by Halley. Prof. Whewell, the ablest historian of Natural Science, has remarked that "future discoveries may make gravitation a case of some wider law, and may disclose something of the mode in which it operates." The difficulty, indeed, of conceiving a force acting through nothing from body to body has of late made itself felt; and more especially since Meyer of Heilbronn first clearly expressed the principle of the "conservation of force." Newton though apprehending the necessity of a medium by which the force of gravitation should be conveyed from one body to another, yet appears not to have possessed such an idea of the uncreateability and indestructibility of force as that which, now possessed by minds of the highest order, seems to some of them to be incompatible with the terms in which Newton enunciated his great law, viz., of matter attracting matter with a force which varies inversely as the square of the distance. The progress of knowledge of another from of all-pervading force, which we call, from its most notable effect on one of the senses, "Light," has not been less remarkable than that of gravitation. Galileo's discovery of Jupiter's satellites supplied Römer with the phenomena whence he was able to measure, in 1676, the velocity of light. Descartes, in his theory of the rainbow, referred the different colours to the different amount of refraction, and made a near approximation to Newton's capital discovery of the different colours entering into the composition of the luminous ray, and of their different refrangibility. Hook and Huyghens, about the same period, had entered upon explanations of the phenomena of light conceived as due to the undulations of an ether, propagated from the luminous point spherically, like those of sound. Newton, whilst admitting that such undulations or vibrations of an ether would explain certain phenomena, adopted the hypothesis of emission as most convenient for the mathematical propositions relative to light. The discoveries of achromatism, of the laws of double refraction, of polarization circular and elliptical, and of dipolarization, rapidly followed: the latter advances of optics, realizing more than Bacon conceived might flow from the labours of the "Perspective House," are associated with and have shed lustre on the names of Dollond, Young, Malus, Fresnel, Biot, Arago, Brewster, Stokes, Jamain, and others.

MAGNETISM AND ELECTRICITY.

Some of the natural sciences, as we now comprehend them, had not germinated in Bacon's time. Chemistry was then alchemy; Geology and Palæontology were undreamt of: but Magnetism and Electricity had begun to be observed, and their phenomena compared, and defined, by a contemporary of Bacon, in a way that claims to be regarded as the first step towards a scientific knowledge of those powers. It is true that, before Gilbert ('De Magnete,' 1600), the magnet was known to attract iron, and the great practical application of magnetized iron—the mariner's compass—had been invented, and for many years before Bacon's time had guided the barks of navigators through trackless seas. Gilbert, to whom the name "electricity" is due, observed that that force attracted light bodies, whereas the magnetic force iron only. About a century later the phenomena of repulsion as well as of attraction of light bodies by electric substances were noticed: and Dufay, in 1733, enunciated the principle, that "electric bodies attract all those that are not so, and repel them as soon as they are become electric by the vicinity of the electric body." The conduction of electric force, and the different behaviour of bodies in contact with the electric, leading to their division, by Desaguliers, into conductors and non-conductors, next followed. The two kinds of electricity, at first by Dufay, their definer, called "vitreous" and "resinous,"—afterwards, by Franklin, "positive" and "negative,"—formed an important step, which led to a brilliant series of experiments and discoveries, with inventions, such as the Leyden jar, for intensifying the electric shock. The discovery of the instantaneous transmission of electricity through an extent of not less than 12,000 feet, by Bishop Watson, together with that of the electric state of the clouds, and of the power of drawing off such electricity by pointed bodies, as shown by Franklin, was a brilliant beginning of the application of this science to the well-being and needs of mankind. Magnetism has been studied with two aims; the one, to note the numerical relations of its activity to time and space, both in respect of its direction and intensity; the other, to penetrate the mystery of the nature of the magnetic force. In reference to the first aim, my estimable predecessor adverted, last year, to the fact, that it was in the committee-rooms of the British Association that the first step was taken towards that great magnetic organization which has since borne so much fruit. Thereby it has been determined that there are periodical changes of the magnetic elements depending on the hour of the day, the season of the year, and on what seemed strange intervals of about eleven years. Also, that besides these regular changes there were others of a more abrupt and seemingly irregular character—Humboldt's "magnetic storms"—which occur simultaneously at distant parts of the earth's surface. Major-General Sabine, than whom no individual has done more in this field of research since Halley first attempted "to explain the change in the variation of the magnetic needle," has proved that the magnetic storms observed diurnal, annual, and undecennial periods. But with what phase or phenomenon of earthly or heavenly bodies, it may be asked, has the magnetic period of eleven years to do! The coincidence which points to, if it does not give, the answer, is one of the most remarkable, unexpected, and encouraging to patient observers. For thirty years a German astronomer, Schwabe, had set himself the task of daily observing and recording the appearance of the sun's disc, in which time he found the spots passed through periodic phases of increase and decrease, the length of the period being about eleven years. A comparison of the independent evidence of the astronomer and magnetic period coincides both in its duration and in its epochs of maximum and minimum with the same period observed in the solar spots.

A few weeks ago, during a visit of inspection to our establishment at Kew, I observed the successful operation of the photoheliographic apparatus in depicting the solar spots as they then appeared. The continued regular record of the macular state of the sun's surface, with the concurrent magnetic observations now established over may distant points of the earth's surface, will ere long establish the full significance and value of the remarkable, and, in reference to the observers, undesigned, coincidence above mentioned. Not to trespass on your patience by tracing the progress of Magnetism from Gilbert to Oersted, I cannot but advert to the time, 1807, when the latter tried to discover whether electricity in its most latent state had any effect on the magnet, and to his great result, in 1820, that the conducting wire of a voltaic circuit acts upon a magnetic needle, so that the latter tends to place itself at right angles to the wire. Ampère, moreover, succeeded, by means of a delicate apparatus, in demonstrating that the voltaic wire was affected by the action of the earth itself as a magnet. In short, the generalization was established, and with a rapidity unexampled, regard being had to its greatness, that *magnetism and electricity are but different effects of one common cause.* This has proved the first step to still grander abstractions, —to that which conceives the reduction of all the species of imponderable fluids of the chemistry of our student days, together with gravitation, chemicity, and neuricity, to interchangeable modes of action of one and the same all-pervading life-essence. Galvani arranged the parts of a recently-mutilated frog so as to bring a nerve in contact with the external surface of a muscle, when a contraction of the muscle ensued. In this suggestive experiment the Italian philosopher, who thereby initiated the inductive inquiry into the relation of nerve force to electric force, concluded that the contraction was a necessary consequence of the passages of electricity from one surface to the other by means of the nerve. He supposed that the electricity was secreted by the brain, and transmitted by the nerves to different parts of the body, the muscles serving as reservoirs of the electricity. Volta made a further step by showing that, under the conditions or arrangements of Galvani's experiments, the muscles would contract, whether the electric current had its origin in the animal body, or from a source external to that body. Galvani erred in too exclusive a reference of the electric force producing the contraction to the brain of the animal: Volta in excluding the origin of the electric force from the animal body altogether. The determination of "the true" and "the constant" in these recondite phenomena, has been mainly helped on by the persevering and ingenious experimental researches of Matcucci and Du Bois Reymond. The latter has shown that any poins of the surface of a muscle is positive in relation to any point of the divided or transverse section of the same muscle; and that any point of the surface of a nerve is positive in rèlation to any point of the divided or transverse section of the same nerve. Mr. Baxter, in still more recent researches, has deduced impor ant conclusions on the origin of the muscular and nerve currents has been due to the polarized condition of the fibre, and the relation of that condition to changes nerve or muscular which occur during nutrition. From the present state of neuro-electricity, it may be concluded that nerve force is not identical with electric force, but that it may be another mode of motion of the same common force: it is certainly a polar force, and perhaps the highest form of polar force:

> A motion which may change, but cannot die;
> An image ef some bright eternity.

CHEMISTRY, PHOTOGRAPHY.

The present tendency of the higher generalizations of Chemistry seems to be towards a reduction of the number of those bodies which are called "elementary"; it begins to be suspected that certain groups of so-called chemical elements are but modified forms of one another; that such groups as chlorine, iodine, bromine, fluorine, and as sulphur, selenium, phosphorus, boron, may be but allotropic forms of some one element. Organic Chemistry becomes simplified as it expands; and its growth has of late proceeded, through the labours of Hofmann, Berthelot, and others, with unexampled rapidity. An important series of alcohols and their derivatives, from amylic alcohol downwards; as extensive a series of ethers, including those which give their peculiar flavour to our choicest fruits; the formic, butyric, succinic, lactic, and other acids, together with other important organic bodies, are now capable of artificial formation from their elements, and the old barrier dividing organic from inorganic bodies is broken down. To the power which mankind may ultimately exercise through the light of synthesis, who may presume to set limits? Already natural process can be more economically replaced by artificial ones in the formation of a few organic compounds, the "valerianic acid," for example. It is impossible to foresee the extent to which Chemistry may not ultimately, in the production of things needful, supersede the present vital agencies of nature, "by laying under contribution the accumulated forces of past ages, which would thus enable us to obtain in a small manufactory, and in a few days, effects which can be realized from present natural agencies only when they are exerted upon vast areas of land, and through considerable periods of time." Since Niepce, Herschel, Fox, Talbot, and Daguerre laid the foundations of Photography, year by year some improvement is made,—some advance achieved in this most subtle application of combined discoveries in Photicity, Electricity, Chemistry, and Magnetism. Last year M. Poitevin's production of plates in relief, for the purpose of engraving by the action of light alone, was cited as the latest marvel of Photography. This year has witnessed photographic printing in carbon by M. Pretschi. Prof. Owen continued by alluding to the application of photography for obtaining views of the moon, of the planets, of scientific and other phenomena.

ATLANTIC TELEGRAPH.

After referring to the discoveries in Electro magnetism, the lecturer continued.—Remote as such profound conceptions and subtle trains of thought seem to be from the needs of everyday life the most astounding of the practical augmentation of man's power has sprung out of them. Nothing might seem less promising of profit than Oersted's painfully-pursued experiments, with his little magnets, voltaic pile, and bits of copper wire. Yet out of these has sprung the electric telegraph! Oersted himself saw such an application of his convertibility of electricity into magnetism, and made arrangements for testing that application to the instantaneous communication of signs through distances of a few miles. The resources of inventive genius have made it practicable for all distances; as we have lately seen in the submergence and working of the electro-magnetic cord connecting the Old and the New

World. On the 6th of August 1858, the laying down of upwards of 2,000 nautical miles of the telegraphic cord, connecting Newfoundland and Ireland, was successfully completed; and on that day a message of thirty-one words was transmitted in thirty-five minutes, along the sinuosities of the submerged hills and valleys forming the bed of the great Atlantic. This first message expressed—"Glory to God in the highest: on Earth Peace, Goodwill towards Men." Never since the foundations of the world were laid could it be more truly said, "The depths of the sea praise Him!" More remains to be done before the far-stretching engine can be got into full working order; but the capital fact, viz., the practicability of bringing America into electrical communication with Europe has been demonstrated; consequently, a like power of instantaneous interchange of thought between the civilized inhabitants of every part of the globe becomes only a question of time. The powers and benefits thence to ensue for the human race can be but dimly and inadequately foreseen.

ZOOLOGY.

After referring to the labours of Ray, Linnæus, Jussieu, Buffon, and Cuvier, he said: To perfect the natural system of plants has been the great aim of botanists since Jussieu. To obtain the same true insight into the relations of animals has stimulated the labours of zoologists since the writings of Cuvier. To that great man appertains the merit of having systematically pursued and applied anatomical researches to the discovery of the true system of distribution of the animal kingdom; nor, until the Cuvierian amount of zootomical science had been gained, could the value and importance of Aristotle's 'History of Animals' be appreciated. There is no similar instance, in the history of Science, of the well-lit torch gradually growing dimmer and smouldering through so many generations and centuries before it was again fanned into brightness, and a clear view regained, both of the extent of ancient discovery, and of the true course to be pursued by modern research. Rapid and right has been the progress of Zoology since that resumption. Not only has the structure of the animal been investigated, even to the minute characteristics of each tissue, but the mode of formation of such constituents of organs, and of the organs themselves, has been pursued from the germ, bud, or egg, onward to maturity and decay. To the observation of outward characters is now added that of inward organization and developmental change; and Zootomy, Histology and Embryology combine their results in forming an adequate and lasting basis for the higher axioms and generalizations of Zoology properly so called. Three principles, of the common ground of which we may ultimately obtain a clearer insight, are now recognized to have governed the construction of animals:—unity of plan, vegetative repetition, and fitness for purpose. The independent series of researches by which students of the articulate animals have seen, in the organs performing the functions of jaws and limbs of varied powers, the same or homotypal elements of a series of like segments constituting the entire body, and by which students of the vertebrate animals have been led to the conclusion, that the maxillary, mandibular, hyoid, scapular, costal and pelvic arches, and their appendages sometimes forming limbs of varied powers, are also modified elements of a series of essentially similar vetebral segments,—mutually corroborate their respective conclusions. It is not probable that a principle which is true for *Articulata* should be false for *Vertebrata:* the less probable since the determination of homologous parts becomes the more possible and sure in the ratio of the perfection of the organization.

MICROSCOPIC INVESTIGATIONS.

The microscope is an indispensable instrument in embryological and histological researches, as also in reference to that vast swarm of animalcules which are too minute for ordinary vision. I can here do little more than allude to the systematic direction now given to the application of the microscope to particular tissues and particular classes chiefly due, in this country, to the counsels and example of the Microscopical Society of London. A very interesting application of the microscope has been made to the particles of matter suspended in the atmosphere; and a systematic continuation of such observations by means of glass slides prepared to catch and retain atmospheric atoms, promises to be productive of important results. We now know that the so-called red-snow of Arctic and Alpine regions is a microscopic single-celled organism which vegetates on the surface of snow. Cloudy or misty extents of dust-like matter pervading the atmosphere, such as have attracted the attention of travellers in the vast coniferous forests of North America, and have been borne out to sea, have been found to consist of the "pollen" or fertilizing particles of plants, and have been called "pollen showers." M. Daneste, submitting to microscopic examination similar dust which fell from a cloud at Shanghai, found that it consisted of spores of a confervoid plant, probably the *Trichodesmium erythræum*, which vegetates in, and imparts its peculiar colour to the Chinese Sea. Decks of ships, near the Cape de Verde Islands, have been covered by such so-called "showers" of impalpable dust, which, by the microscope of Ehrenberg, has been shown to consist of minute organisms, chiefly "Diatomaceæ." One sample collected on a ship's deck 500 miles off the coast of Africa exhibited numerous species of freshwater and marine diatoms bearing a close resemblance to South American forms of those organisms. Ehrenberg has recorded numerous other instances in his paper printed in the 'Berlin Transactions'; but here, as in other exemplary series of observations of the indefatigable miscroscopist, the conclusions are perhaps not so satisfactory as the well observed data. He speculates upon the self-developing power of organisms in the atmosphere, affirms that dust showers are not to be traced to mineral material from the earth's surface, nor to revolving masses of dust material in space, nor to atmospheric currents simply; but to some general law connected with the atmosphere of our planet, according to which there is a "self-development" within it of living organisms, which organisms he suspects may have some relation to the periodical meteorolites or aërolites. The advocates of progressive development may see and hail in this the first step in the series of accending transmutations. The unbiassed observer will be stimulated by the startling hypothesis of the celebrated Berlin Professor to more frequent and regular examinations of atmospheric organisms. Some late examinations of dust showers clearly show them to have a source which Ehrenberg has denied. Some of my hearers may remember the graphic description by Her Majesty's Envoy to Persia, the Hon. C. A. Murray, of the cloud of impalpable red dust which darkened the air of Bagdad, and filled the city with a panic. The specimen he collected was examined by my successor, at the Royal College of Surgeons, Prof. Quekett, and that experienced microscopist could detect only inorganic particles, such as fine quartz sand, without any trace of Diatomaceæ or other organic matter. Dr. Lawson has obtained a similar result from the examination of the material of a showers of moist dust or mud which fell at Corfu, in March, 1857: it consisted for the most part of minute angular particles of a quartzose sand. Here, therefore, is a field of observation for the miscroscopist, which has doubtless most interesting results as the reward of persevering research.

To specify or analyze the labours of the individuals who of late years have contributed to advance Zoology by the comprehensive combination of the various kinds of research now felt to be essential to its right progress, would demand a proportion of the present discourse far beyond its proper and allotted limits. Yet I shall not be deemed invidious if I cite one work as eminently exemplary of the spirit and scope of the investigations needed for the elucidation of any branch of natural history. That work is the monograph of the Chelonian Reptiles (tortoises, terrapenes and turtles) of the United States of America, published last year at Boston, U. S., by Prof. Agassiz.

GEOGRAPHICAL DISTRIBUTION OF PLANTS.

Observations of the characters of plants have led to the recognition of the natural groups or families of the vegetable kingdom, and to a clear scientific comprehension of that great kingdom of nature. This phase of botanical science gives the power of further and more profitable generalizations, such as those teaching the relations between the particular plants and particular localities. The sum of these relations, forming the geographical distrubutions of plants, rests, pe'haps at present necessarily, on an assumption, viz., that each species has been created, or come into being, but once in time and space; and that its present diffusion in the result of its own law of reproduction, under the diffusive or restrictive influence of external circumstances. These circumstances are chiefly temperature and moisture, dependent on the distance from the source of heat and the obliquity of the sun's rays, modified by altitude above the sea-level, or the degree of rarefaction of the atmosphere and of the power of the surface to wastefully radiate heat. Both latitude and altitude are further modified by currents of air and ocean, which influence the distribution of the heat they have absorbed. Thus large tracts of dry land produce dry and extreme climates, while large expanses of sea produce humid and equable climates. Agriculture affects the geographical distribution of plants, both directly and indirectly. It diffuses plants over a wider area of equal climate, augments their productiveness, and enlarges the limits of their capacity to support different climatal conditions. Agriculture also effects local modifications of climate. Certain species of plants require more special physical conditions for health; others more general conditions; and their extent of diffusion varies accordingly. Thus the plants of temperate climates are more widely diffused over the surface of the globe, because they are suited to elevated tracts in tropical latitudes. There is, however, another law which relates to the original appearance, or creation, of plants, and which has produced different species flourishing under similar physical conditions, in different regions of the globe. Thus the plants of the mountains of South America are of distinct species, and for the most part of distinct genera from those of Asia. The plants of the temperate latitudes of North America are of distinct species, and some of distinct genera, from those of Europe. The Cacteæ of the hot regions of Mexico are represented by the Euphorbiaceæ in parts of Africa having a similar climate. The surface of the earth has been divided into twenty five regions, of which I may cite as examples that of New Zealand, in which Ferns predominate, together with generic forms, half of which are European, and the rest approximating to Australian, South African, and Antarctic forms; and that of Australia, characterized by its Eucalypti and Epacrides, chiefly known to us by the researches of the great botanist, Robert Brown, the founder of the Geography of Plants.

DISTRIBUTION OF MARINE LIFE.

Organic Life, in its animal form, is much more developed, and more variously, in the sea, than in its vegetable form. Observations of marine animals and their localities have led to attempts at generalizing the results; and the modes of enunciating these generalizations or laws of geographical distribution are very analogous to those which have been applied to the vegetable kingdom, which is as diversely developed on land as in the animal kingdom in the sea. The most interesting form of expression of the distribution of marine life is that which parallels the perpendicular distribution of plants. Edward Forbes has expressed this by defining five bathymetrical zones, or belts of depth, which he calls, —1, Littoral, 2, Circumlittoral; 3, Median; 4, Infra-median; 5, Abyssal. The life-forms of these zones vary, of course, according to the nature of the sea-bottom; and are modified by those primitive or creative laws that have caused representative species in distant localities under like physical conditions,—species related by analogy. Very much remains to be observed and studied by naturalists in differnt parts of the globe, under the guidance of the generalizations thus sketched out, to the completion of a perfect theory. But in the progress to this, the results cannot fail to be practically most valuable. A shell or a sea-weed, whose relations to depth are thus understood, may afford important information or warning to the navigator. To the geologist the distributions of marine life according to the zones of depth, has given the clue to the determination of the depth of the seas in which certain formations have been deposited.

DISTRIBUTION OF TERRESTRIAL LIFE.

Had all the terrestrial animals that now exist diverged from one common centre within the limited of period a few thousand years, it might have been expected that the remoteness of their actual localities from such ideal centre would bear a certain ratio with their respective powers of locomotion. With regard to the class of birds, one might have expected to find that those which were deprived of the power of flight, and were adapted to subsist on the vegetation of a warm or temperate latitude, would still be met with more or less associated together, and least distant from the original centre of dispersion, situated in such a latitude. This, however, is not only not the case with birds, but is not so with any other classes of animals. The Quadrumana or order of apes, monkeys and lemur, consist of three chief divisions—Catarhines, Platyrhines, and Strepsirhines. The first family is peculiar to the "Old World"; the second to South America; the third has the majority of its species and its chief genus (Lemur), exclusively in Madagascar. Out of twenty-six known species of Lemuridæ, only six are Asiatic, and three are African. Whilst adverting to the geographical distribution of Quadrumana, I would contrast the peculiarly limited range of the orangs and chimpanzees with the cosmopolitan power of mankind. The two species of orang (Pithecus) are confined to Borneo and Sumatra; the two species of chimpanzee (Troglodytes) are limited to an intertropical tract of the western part of Africa. They appear to be inexorably bound by climatal influences regulating the assemblage of certain trees and the production of certain fruits. Climate rigidly limits the range of the Quadrumana latitudinally; creational and geographical causes limit their range in longitude. Distinct genera represent each other in the same latitudes of the New and Old Worlds; and also, in a great degree, in Africa and Asia. But the development of an orang out of a chimpanzee, or reciprocally, is physiologically inconceivable. The order of Ruminantia is principally represented by Old World species, of which 162 have been defined; whilst only 24 species have been discovered in the New World, and none in Australia, New Guinea, New Zealand, or the Polynesian Isles. The cameleopard is now peculiar to Africa; the musk-deer to Africa and Asia; out of about fifty defined species of antelope, only one is known in America, and none in the central and southern divisions of the New World. Palæontology has expanded our knowledge of the range of the giraffe; during Miocene or old Pliocene periods, species of Cameleopardalis roamed in Asia and Europe. Geology gives a wider range to the horse and elephant kinds than was cognizant to the student of living species only. The existing Equidæ and Elephantidæ properly belong, or are limited to, the Old World; and the elephants to Asia and Africa, the species of the two continents, being quite distinct. The horse, as Buffon remarked, carried terror to the eye of the indigenous Americans, viewing the animal for the first time, as it proudly bore their Spanish conqueror. But a species of Equus, co-existed with the Megatherium and Megalonyx, in both South and North America, and perished apparently with them, before the human period. Elephants are dependent chiefly upon trees for food. One species now finds conditions of existence in the rich forests of tropical Asia; and a second species in those of tropical Africa. Why, we may ask, should not a third be living at the expense of the still more luxuriant vegetation watered by the Oronooko, the Essequibo, the Amazon, and the La Plata, in tropical America? Geology tells us that at least two kinds of elephant (*Mastodon Andium* and *M. Humboldti*) formerly did derive their subsistence along with the great Megatherioid beasts, from that abundant source we may infer that the general growth of large forests, and the absence of deadly enemies, were the main conditions of the former existence of elephantine animals over every part of the globe.

Ethnology.

But, with regard to the alleged conformity between the geographical distribution of man and animals, which has of late been systematically enunciated, and made by Agassiz, in Gliddon & Nott's 'Varieties of Mankind,' the basis of deductions as to the origin and distinction of the human varieties, many facts might be cited, affecting the conformity of the distribution of man with that of the lower animals and plants, as absolutely enunciated in some recent works. Nor can we be surprised to find that the migratory instincts of the human species, with the peculiar endowment of adaptiveness to all climates, should have produced modifications in geographical distribution to which the lower forms of living nature have not been subject. Ethnology is a wide and fertile subject, and I should be led far beyond the limits of an inaugural discourse were I to indulge in an historical sketch of its progress. But I may advert to the testimony of different witnesses—to the concurrence of distinct species of evidence—as to the much higher antiquity of the human race, than has been assigned to it in historical and genealogical records.

Mr. Leonard Horner discerned the value of the phenomena of the annual sedimentary deposits of the Nile in Egypt as a test of the lapse of time during which that most recent and still operating geological dynamic had been in progress. In two Mémoirs communicated to the Royal Society in 1855 and 1858, the result of ninety-five vertical borings through the alluvium thus formed are recorded. In the excavations near the colossus of Rameses II. at Memphis, there were 9 feet 4 inches of Nile sediment between 8 inches below the present surface of the ground and the lowest part of the platform on which the statue had stood. Supposing the platform to have been laid in the middle of the reign of that king, viz, 1361 B. C. such date added to A. D. 1854 gives 3,215 years during which the above sediment was accumulated; or a mean rate of increase of 3½ inches in a century. Below the platform there were 32 feet of the total depth penetrated; but the lowest 2 feet consisted of sand, below which it is possible there may be no true Nile sediment in this locality, thus leaving 30 feet of the latter. If that amount has been deposited at the same rate of 3½ inches in a century, it gives for the lowest part deposited an age of 10,285 years before the middle of the reign of Rameses II., and 13,500 years before A. D. 1854. The Nile sediment at the lowest depth reached is very similar in composition to that of the present day. In the lowest part of the boring sediment at the colossal statue in Memphis, at a depth of 39 feet from the surface of the ground, the instrument is reported to have brought up a piece of pottery. This, therefore, Mr. Horner infers to be a record of the existence of man 13,371 years before A. D. 1854:—"Of man, moreover, in a state of civilization, so far, at least, as to be able to fashion clay into vessels, and to know to harden them by the action of a strong heat."

Prof. Max Müller has opened out a similar vista into the remote past of the history of the human race by the perception and application of analogies in the formation of modern and ancient, of living and dead languages. From the relations traceable between the six Romance dialects, Italian, Wallachian, Rhætian, Spanish, Portuguese, and French, an antecedent common "mother-tongue" might be inferred, and, consequently the existence of a race anterior to the modern Italians, Spanish, French, &c., with conclusions as to the lapse of time requisite for such divisions and migrations of the primitive stock, and for the modifications which the mother-language had undergone. History and preserved writings show that such common mother-race and language have existed in the Roman people and the Latin tongue. But Latin, like the equally "dead" language Greek, with Sanscrit, Lithuanian, Zend, and the Gothic, Sclavonic, and Celtic tongues, can be similarly shown to be modifications of one antecedent common language whence is to be inferred an antecedent race of men, and a lapse of time sufficient for their migration over a tract extending from Iceland in the north-west to India in the south-east, and for all the above-named modifications to have been established in the common mother "Arian" tongue.

THE GOVERMENT AND SCIENCE.

In reference to the relations now subsisting between the State and Science, my first duty is to express our grateful sense of such measure of aid, co-operation and countenance as has been allotted to scientific bodies, enterprises and discoveries. More especially to acknowledge how highly we prize the sentiments of the Sovereign towards our works and aims, manifested by spontaneous tribute to successful scientific research, in honourable titles and royal gifts, and above all, in the gracious expressions accompanying them, with which Her Majesty has been pleased to distinguish some of our body. Happy are we, under the present benignant reign, to have, in the Royal Consort, a Prince endowed with exemplary virtues, and with such accomplishments in Science and Art as have enabled His Royal Highness effectually, and on some memorable occasions, in the most important degree, to promote the best interests of both. We rejoice, moreover, in the prospect of being honoured and favoured at a future meeting by the Presidency of the Prince Consort; and that, ere long, this Association may give the opportunity for the delivery of another of those

"Addresses," pregnant with deep thought, good sense, and right feeling, which have placed the name of Prince Albert high in the esteem of the intellectual classes, and have engraven it deeply in the hearts of the humblest of Her Majesty's subjects.

On the part of the State, sums continue to be voted in aid of the means independently possessed by the British Museum and the Royal Society, whereby the Natural History Collections in the first are extended and the more direct scientific aims of the latter institution are advanced. The Botanical Gardens and Museum at Kew, and the Museum of Practical Geology in Jermyn Street, are examples of the national policy in regard to Science, of which we can hardly over-estimate the importance. Most highly and gratefully also do we appreciate the co-operation of the "Board of Trade" with our meteorologist, by the recent formation of the department for the collection of meteorological observations made at sea. But not by words only would, or does, Science make return to Goverments fostering and aiding her endeavours for the public weal. Every practical application of her discoveries tends to the same end as that which the enlightened statesman has in view. The steam-engine in its manifold applications, the crime-decreasing gas-lamp, the lightning conductor, the electric telegraph, the law of storms, and rules for the mariner's guidance in them, the power of rendering surgical operations painless, the measures for preserving public health, and for preventing or mitigating epidemics,—such are among the more important practical results of pure scientific research with which mankind have been blessed and States enriched. They are evidence unmistakeable of the close affinity between the aims and tendencies of Science and those of true State policy. In proportion to the activity, productivity, and prosperity of a community is its power of responding to the calls of the Finance Minister. By a far-seeing one, the man of science will be regarded with a favourable eye, not less for unlooked-for streams of wealth that have already flowed, but for those that may in future arise, out of the applications of the abstract truths to the discovery of which he devotes himself. This may, indeed, demand some measure of faith on the part of the practical statesman. For who that watched the philosophic Black experimenting on the abstract nature of Caloric could have foreseen that his discovery of latent heat would be the stand point of Watt's invention of a practically operative steam engine! How little could the observer of Oersted's subtle arrangements for converting electric into magnetic force have dreamt of the application of such discovery to the rapid interchange of ideas now daily practised between individuals in distant cities, countries, and continents! Some medical contemporaries of John Hunter, when they saw him, as they thought, wasting as much time in studying the growth of a deer's horn as they would have bestowed upon the symptoms of their best patient, compassionated, it is said, the singularity of his pursuits. But by the insight so gained into the rapid enlargement of arteries, Hunter learned a property of those vessels which emboldened him to experiment on a man with aneurism, and so to introduce a new operation which has rescued from a lingering and painful death thousands of his fellow-creatures. Our great inductive physiologist, in his dissections and experiments on the lower animals, was "taking light what may be wrought upon the body of man." The production of Chloroform is amongst the more subtle experimental results of modern Chemistry. The blessed effects of its proper exhibition in the diminution of the sum of human agony are indescribable. But that divine-like application was not present to the mind of the scientific chemist who discovered the anæsthetic product, any more than was the gas-lit town to the mind ot Priestley, or the condensing engine to that of Black.

REVIEWS AND NOTICES OF BOOKS.

PAMPHLETS ON BRITISH AMERICA.

Nova Britannia.—A. Morris, M.A. Nova Scotia as a field for Emigration.—P. S. Hamilton. Report of Messrs. Childe, McAlpine and Kirkwood on the Harbour of Montreal.

Nothing more enlarges men's minds than the belief that they form units, however small, in a great nationality. Nothing more dwarfs them than exclusive devotion to the interests of a class, a coterie, or a limited locality. Hence it is to every philosophical mind a cheering feature of our British American literature, that it dwells so much on union of separate provinces, and establishment of friendly and profitable intercourse between them.

Physically considered, British America is a noble territory, grand in its natural features, rich in its varied resources. Politically, it is a loosely united aggregate of petty states, separated by barriers of race, creed, local interest, distance, and insufficient means of communication. As naturalists, we hold to its natural features as fixing its future destiny, and indicating its present interests, and regard its local subdivisions as arbitrary and artificial. It is from this point of view, and not with reference to the controverted points agitated in the public press, that we regard the publications named at the head of this article, and which we refer to as specimens of many similar works.

Mr. Morris, lecturing to a popular audience, and desirous of stating important facts in such a manner, as to fix them on the minds of his hearers, is at once statistical, patriotic, and prophetic. Facts and figures relating to extent of territory, population, revenues, actual products, form the groundwork of the lecture, and on these are built broad views of the duties of the people of British North America, and glowing anticipations of the results of the union of all the British territory, from Newfoundland to Vancouver's Island, in one great nationality. The lecturer sees in the future a fusion of races, a union of all the existing provinces with new provinces to grow up in the west, and a railway to the Pacific. The design of the lecture is excellent, and its facts seem to have been carefully collected. The success which has attended its publication by Mr. Lovell, shows the popular nature of the subject, and the effective manner in which it has been treated.

Mr. Hamilton's pamphlet is published by authority of the Provincial Parliament of Nova Scotia, and contains a condensed statement of the wealth and resources of that colony, which may be commended to any one desirous of knowing the actual material value of these Lower Colonies, now claiming alliance with Canada. The Acadian provinces, though hitherto overshadowed by the greater growth of Canada and the Western States, have in their extent of fertile land, their mineral riches, their fisheries and their trade, an importance which may fairly entitle them to stand side by side with either Lower or Upper Canada, and it does not require any gift of prophecy to discern that their resources, more especially their coal, their iron, and their maritime situation, must eventually render them the seats of a dense population, more wealthy and more influential in the world's destinies than the more purely agricultural and more secluded population of the West.

The Report of the Harbour Engineers, shows that Montreal now turns her enquiring eyes along the whole length of the St.

Lawrence and its great lakes, and that the bold and successful enterprise of deepening Lake St. Peter, has led to demands for larger accommodation for shipping than she can now supply. The manner in which the Harbour Commissioners of this city have identified themselves with the commerce of the whole of the St. Lawrence valley, is one of those large minded efforts that are at once creditable and profitable, and, in the present report, we have the broad views of the chairman, Mr. Young, as well as the calculations of the Engineers. Others, we imagine, beside practical mercantile men, must regard with interest the curious calculations in this report of the shortest and cheapest way in which a barrel of flour, from the new lands of the West, can reach the mouths of hungry artisans in the old world, whose children may, at some future time, come out to swell the tide of Canadian population, by the same route along which they now send the products of their skilful and busy hands, to add to the comforts, and sustain the labour of the settler. All honour as well as profit to the men who thus plan and toil by developing the capabilities of our great river, to make man a true citizen of the world, and to diffuse through all lands, the rich bounties of Providence.

For such effort, British America itself affords wide scope. In the far East, the sealer of Newfoundland is battling with the Arctic ice, and the fisherman preparing to realise his harvest from the sea. Along the white shore of Nova Scotia the ocean is dotted with sails hastening to the Labrador fisheries, and the coast is alive with busy preparations for the labors that are to make the warehouses of Halifax groan with the treasures of the deep. Inland, the farmer is mending his dyke, or ploughing his upland, or pruning the interminable orchards of the Annapolis valley. Gypsum is tumbling into the holds of ships along the shores of the Bay of Fundy, and the coal miner has heaped up at Pictou, Sydney, and Cumberland, the produce of his winter's toil in the bowels of the earth. Farther west, in the forests of New Brunswick and Canada, the lumberer has gathered from the banks of innumerable streams, his rafts of timber and mill logs, which thousands of mills are cutting into useful forms. Farther west still, the miner of Georgian Bay and Lake Superior is laboriously searching for or dressing his rich copper ores. Farther still, the trapper has collected his winter stock of peltries, in solitudes in which even the sound of the lumberer's axe has not been heard. Over all these broad regions, through 50 degrees of longitude, from Cape

Scattari to the Saskatchewan, the farmer scatters his seed over a genial soil. Let us thank God, who has given this great heritage to the British people, and strive to unite all its various populations in the bonds of a common patriotism, which, because itself so large, will be certain not to exclude other nations from its sympathies.

We have not attempted to quote, but refer our readers to the pamphlets themselves, which, owing to the tardy appearance of this notice, occasioned by the pressure of other matters, most of them will probably have been already seen, in advance of our review.

Humble Creatures: the Earth-worm and the Common House-fly. In Eight Letters; by JAMES SAMUELSON, assisted by J. B. HICKS, M.D., Lond., F.L.S., &c.; with Microscopic Illustrations by the Authors. London: John Van Voorst. Montreal: B. Dawson & Son.

In a series of eight letters we have a most able and interesting treatment of the subjects under consideration in this book. It is written by men who have given serious attention to scientific studies. No one can say that it has been "got up," as too many little books of natural history are in these days from the researches and witness of others. Although there is nothing very new or original in what it narrates of the structure, habits and reproduction of these animals, there is yet about the statement of the facts a clearness and freshness which are the sure indications of personal observation and research. The subject is not treated in a purely scientific way, but, by the use of familiar words, the wonderful structure and functions of the Worm and the Fly are made clear to the understanding of the young. In this attempt the authors have avoided that feebleness and imbecility which frequently marks books intended for young persons. The style is pure, simple and manly, and the discussion of the subjects merits even the attention of the scientific.

The introduction says:—"Not only do these humble creatures merit our attention on the ground that they rank amongst the valuable works of Nature, but also as affording useful lessons in the education of our minds; for unless we carefully examine and endeavour to comprehend the character and attributes of the lower animals, we remain children in the knowledge of Nature."

We do not need to travel far for interesting examples in Natural History, by an investigation into whose structures and habits we may be delighted with beautiful forms and instructed by the forcible illustrations of the Creator's wisdom which they afford. These writers introduce us to two of the commonest of animal existences,—the Earth-worm (*Lumbricus terrestris*), and the House-fly (*Musca domestica*). They tell us of their rank and standing in the ascending order of life; of their nervous system, with its curious ramifications; of their complex organs of vision and nutriment; the circulation of their fluids, and their curious respiratory organs; with their processes of reproduction and development. Each particular is described with sufficient minuteness to enable an ordinary reader to comprehend it, and yet with sufficient generality to be free from prolixity or tedium. We would not only recommend this book to the young to awaken and stimulate in them a taste for the pursuits of Natural History, but we would also recommend it to those whose studies have already embraced this department of knowledge as a delightful fragment of scientific literature. The illustrations are excellent, in drawing and execution; the whole book is got up with that care and beauty for which its publisher is so favourably known.

The Practical Naturalist's Guide; containing instructions for collecting, preparing, and preserving specimens in all departments of Zoology. Intended for the use of students, amateurs, and travellers. By JAMES B. DAVIES, Assistant Conservator Natural History Museum, Edinburgh, &c., &c. Edinburgh: Maclachlan & Stewart. Montreal: B. Dawson & Son.

This book is written with a view to promote the collection, preparation and careful classification of private collections of objects for the illustration of Natural History. The chief intention of the writer is to supply, within a small compass, so much knowledge as will enable the student and amateur, as also the traveller in foreign countries, to collect the animals by which he is surrounded, to prepare them in such a way that they can at any time be rendered available for the purposes of science, and to preserve, arrange and catalogue them with neatness and precision. This aim the author has most effectively carried out. The information which the book contains is of the most practical kind. Methods of manipulation are reduced to their utmost simplicity, and all its directions may, with a little care and practice, be easily followed. We recognise in it the hand of a real, earnest worker in zoological science. The book is invaluable to the student and amateur.

MISCELLANEOUS.

(TO THE EDITORS OF THE CANADIAN NATURALIST.)

Is the Onion Indigenous in the North West of Canada?

It would tend much to increase the practical value of your journal if your subscribers were from time to time to communicate such facts relating to any department of the natural history of the Province, as may come within their observation; and, therefore, I transcribe the following extract from a letter lately received from Mr. W. J. Morris, of Perth, C. W. He says:—"A friend sent me from Lake Temiscameng, a small package of wild onions, from a place called by the voyageurs "*Le Jardin du Diable.*" It is on the side of a steep hill. The onions, though small, are precisely the same as the cultivated kind. They grow in a damp, black sand, covered with a thick bed of moss. I suppose they must have been at first sown by the early French Jesuits; or, are they indigenous? I have planted them in my garden." I incline to the belief that the first supposition is the correct one, viz: that the onion is indigenous in the North Western Territories; and this view is corroborated by the ensuing extract from McKenzie's "Journal of a Voyage through the North West." In vol. 2, page 224, of this interesting narrative, he says:—

"On the banks of the river (i. e. the McKenzie River) there was great plenty of wild onions, which, when mixed up with our pemmican, was a great improvement of it; though they produced a physical effect on our appetites, which was rather inconvenient to the state of our provisions."

Though this seems conclusive, yet perhaps some of your readers may be able to settle the point with positiveness.

While on this subject, I may also note that I recently found a red currant, identical in appearance and flavour with the garden fruit, but a little smaller, growing wild in the woods on the shores of the Lower St. Lawrence, at Kacouna. The leaf was of a lighter green, and more sharply defined, than that of the cultivated plant. It would be worth propagating from. There is also in the same locality a very large, rough, unpleasantly-flavoured red currant, and a hairy black currant, resembling in appearance and growth the gooseberry, but of an unpleasant flavour. A smooth, well-tasted gooseberry, is also very plentiful. The sands are covered with clumps of a spreading pea, with large purple blossoms, which is very productive. A very large Triticum (I suppose) is also abundant, which bears a well-filled grain, and is called by the residents "wild rye." The leaves are broad, and dark-green. It grows in patches, and is perennial. A plant of it has been growing in my garden for two years past in this city, but is troublesome from the number of shoots it sends up in the Spring.

Montreal, August, 1858. M.

NOTE BY EDITORS.—In addition to the *Allium Canadense* or wild garlic of Canada, and the *A. Schoenopiarum* or wild chives, collected in Canada by Mrs. Shephard and Lady Dalhousie, but which we have not yet seen here, several species of Allium are mentioned by Richardson as found in the North West. We cannot, however, give any opinion as to whether the specimens above referred to belong to any of these indigenous species, without specimens.

MONUMENT TO HUGH MILLER AT CROMARTY.—At the usual monthly meeting of the Natural History Society, which was held at the Rooms of the Society, on the evening of the 25th instant, amongst other business transacted, there was read by Alexander Morris, Esq., a letter from W. Gordon Mack, Esq., of this city, but at present in Scotland, directing the attention of scientific men and of the admirers of the late Hugh Miller, to the proposal to erect a monument to his memory at his native place, Cromarty. The letter stated that inquiries had been made, by members of the Committee charged with erecting the monument, (which is now in progress), if the people of Canada were interested in his writings, and would respond to an appeal to aid this effort; and that Mr. Mack had been requested to forward a subscription-list to Montreal. The letter further mentioned the following interesting particulars:—

"The monument is to be erected in Cromarty, his native town, on a site that is described as exceedingly beautiful. Some time ago he was requested to select a site for a monument to Mr. Thompson, the surgeon who so greatly distinguished himself at the Alma. He selected the place which has now been chosen for his own, as the other is being put up at Forres. You will easily see how very appropriate the site is, and, from all I can hear, it is a lovely spot."

The Society, having considered this proposal, agreed to recommend it to the support of the members of the Society, and appointed Messrs. Alex. Morris and J. C. Becket of this city, a Committee, to whom contributions for this object may be handed.

We are confident that many will warmly respond to this appeal. We are not called upon to pronounce an eulogium on Hugh Miller. Few events have called forth more real sympathy and true sorrow than did his sad and tragic death; and we are persuaded that many in Canada will gladly avail themselves of this opportunity to place a few Canadian stones on his monumental pile. It is desired that the collection should be general, and subscriptions, from a dollar upwards, will be welcomed, if transmitted to either of the gentlemen named.

THE NATURAL HISTORY SOCIETY OF MONTREAL.—The readers of the "*Canadian Naturalist*," and citizens generally, are aware that the members of the Natural History Society, having long felt the utter inadequacy of their present building to the purposes required, determined some time ago to erect a building with a Lecture Room, large enough to accomodate their audiences, a Library for their books, and a Museum which would contain the large and constantly increasing collection of Fossils, preserved Fauna and Indian Antiquities; that the Trustees of the McGill College property, with a liberality which does them credit, made an offer of a building site in the finest part of the city on terms almost amounting to a free gift; and that this offer was gladly accepted.

The building is now in course of erection on the corner of Cathcart and University Streets. It is a plain but neat and commodious structure, 94 x 45 feet,—the style Grecian, with Doric porticoes.* The two fronts are of white brick, the back of red. But white bricks cost money and so do red ones; and timbers even in this timber country have a price,—and this the building Committee already feel very forcibly. The Government of the country has hitherto not dealt with the Society in a spirit of liberality, affording no more support to this institution, whose importance is generally recognized, than is given to country Societies without a local habitation or a name. This necessitates, on the part of the Society, most vigorous action, and a Committee has been appoint-

* A full description with wood cut will appear in next number of the Naturalist.

ed to solicit subscriptions from the citizens. That they will meet with encouragement, we do not doubt. A Society which has done so much to beget and encourage a taste for nature; which assists so much in the investigation of this widely extended science, and which, from the very nature of things is necessarily so far in advance of our national state, will not, we are confident, be allowed to suffer from want of proper support.

TO OUR REVIEWERS.

The Editors of this Journal are always thankful for the notices with which they may be favoured by the newspaper-press, and are willing to profit by the hints whether of friendly or hostile critics. They may, however, be allowed to say that they have sometimes been distressed by statements which convey to the public—unintentionally no doubt—very imperfect or incorrect ideas of their meaning. A remarkable instance of this has occurred with reference to an article in our June number on the Bowmanville Coal question. In that article we endeavoured to vindicate Prof. Chapman and Sir W. E. Logan from the charges which had been urged against them; and by a careful investigation of all the possibilities that remain of the occurrence of coal in Canada, to show that none of these applied to the current statements respecting Bowmanville, and consequently that the pretended discovery must be rejected. Our explanations may have been less clear than we had supposed, but it certainly was with some surprise that we found one of our contemporaries stating that the possibilities referred to were urged in defence of the supposed discovery; and that we had blamed Sir W. E. Logan for excess of caution when we said that he is "too cautious to hazard any conjecture as to the occurrence of fossil fuel in a country where facts palpable to the Geologist have inscribed everywhere a negation of its presence." With still greater astonishment we found that only a few weeks ago we were accused of attacking our Provincial Geologist as guilty of rashness, an opposite and we are sure still more undeserved charge. Personally we feel that we have good reason to complain, that after fully committing ourselves against the so-called discovery, at a time when it was very generally credited, we should now be blamed as if we had taken an opposite course. But as Canadians we feel more deeply aggrieved, that through what we must regard as the culpable carelessness of our reviewers, an impression should be spread abroad that there was any controversy between scientific men here on the subject. In the interest of truth, therefore, and of our common country, we ask the gentlemen who have thus misrepresented us, to re-examine the position taken by this Journal, and to do justice to its statements.

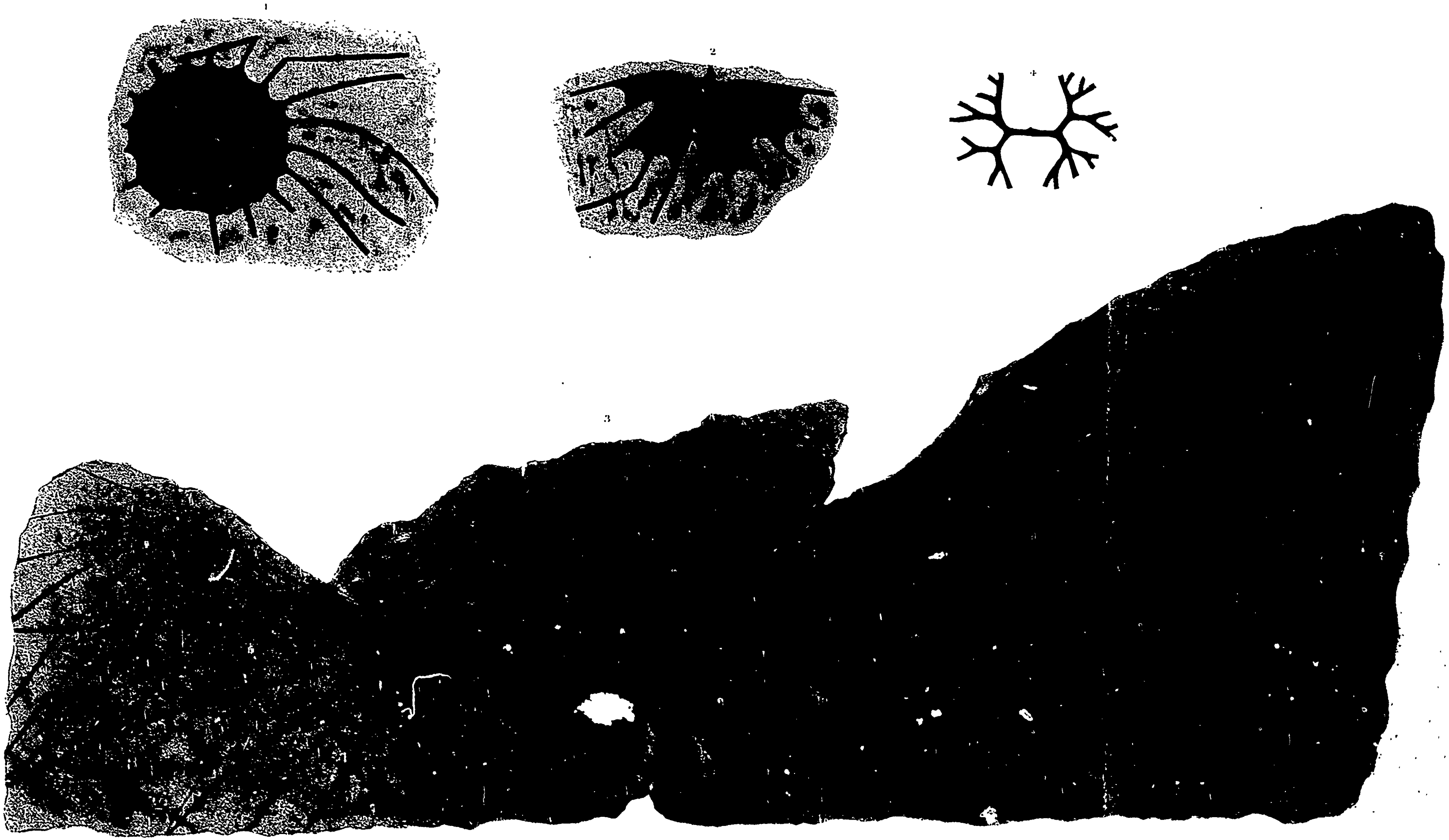
Geological Survey of Canada.

Sir W E Logan Director

Pl 2

Graptolithus

Lower Silurian | *Hudson River Group*



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