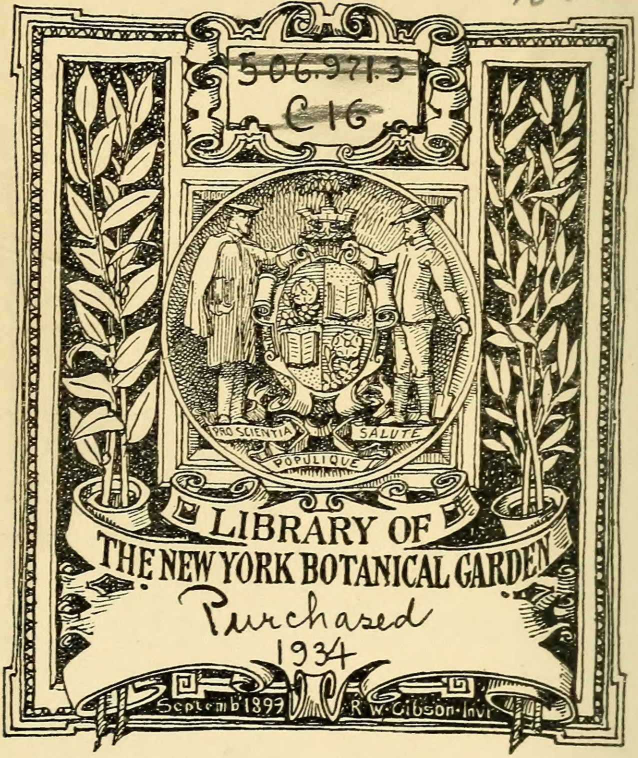

W. C. Egan

THE

CANADIAN

Naturalist and Geologist,

AND PROCEEDINGS OF THE

NATURAL HISTORY SOCIETY

OF MONTREAL,

CONDUCTED BY A COMMITTEE OF THE NATURAL HISTORY SOCIETY.

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1858.

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THE

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NATURALIST AND GEOLOGIST.

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ARTICLE I.—*Things to be observed in Canada, and especially in Montreal and its vicinity.* The introductory Lecture of the Popular Course of the Montreal Natural History Society, winter of 1857–8.—By the President.

There are in all places some things which every one sees, and other things which, though equally or more interesting, very few see. Every visitor to Montreal is likely to know something of our public works and buildings, our mountain and its scenery, our rapids, and many other prominent objects, interesting to naturalists no doubt, but equally so to other men. It is not necessary to refer to such things as these; and I propose this evening to direct your attention to some more obscure and less noteworthy objects, deserving attention from those among us who love the study of nature.

In order to receive much pleasure and some advantage from the study of natural history, it is not necessary to be a great naturalist. In this subject we do not repel the tyro with the harsh warning, drink deep or taste not. We hail every young inquirer as an aid, and are glad to have the smallest contributions which are the result of earnest and well directed inquiry. In truth a large proportion of the new facts added to natural science, are collected by local naturalists, whose reputation never becomes very extensive, but who are yet quoted by larger workers, and receive due credit for their successful efforts. A few men highly gifted and widely travelled, or thoroughly conversant with all the details of special subjects, are consulting naturalists, and the reducers into a more general and scientific form of the facts obtained from many quarters; but still the great majority of naturalists, and among them many of the most estimable and useful, are very limited in their field of actual observation.

We have several such men in Montreal, as well as a few of somewhat more extended reputation; and there are no doubt a number of young persons who might be induced to devote some portion of their leisure to such studies, did they know of a profitable field of enquiry. To such I have no doubt that the topics of this lecture will be of interest.

Good works of art are rare and costly, good works of nature are scattered broadcast around our daily paths; and are neglected only because their familiarity prevents us from observing their surpassing beauty and interest. Nor are all of these objects known even to naturalists. There are, more especially in these new countries, scarcely any objects that have been thoroughly investigated, and there are vast numbers that are quite unknown to science. I cannot in the space of one lecture point to even the greater number of these objects,—nor is it possible to conjecture the results which may attend inquiries prosecuted in new directions. It may, however, be possible to direct your attention to some leading departments of the great field of nature, that deserve your attention.

Let us inquire in the first place for the most promising local fields of inquiry in the domain of zoology.

To begin with the lower members of the animal kingdom, I am not aware that anything has been done with our spongillæ or fresh-water sponges. Such organisms must exist in our lakes and streams, and though very low and simple in their structure, much interest attaches to their growth, nutrition and reproduction. They are soft gelatinous structures, with an internal skeleton of silicious spicula, greenish in colour, and resembling some of the fresh water algæ which live with them. Dr. Bowerbank of London is preparing a monograph of the sponges, and informs me that he will be glad to receive specimens from our waters. Here then is an opening for a young naturalist. I quote the following from Dr. Bowerbank's printed circular, and shall be glad to receive and forward specimens:—

"The writer would also be particularly obliged by specimens of spongillæ, or fresh-water sponges, as he is engaged on a monograph of that tribe. They are found in rivers, lakes or tanks, and pools, attached to dead wood, rocks or stones, and are occasionally found surrounding the branches of trees, dipping into the water during periodical floods; and if they contain their granular, seed-like bodies, they are the more valuable. Dry them just as they come from the water. If it be deemed necessary to preserve parts or the whole of delicate specimens of either marine or fresh-water sponges in fluid, the best material is strong spirit, or water with a *considerable* excess of undissolved salt in it, but *never* alum. Jars or pickle and fruit bottles, well corked and sealed, or tied over with bladder, are the best vessels for the purpose."

Rising a little higher in the scale of life, little has been done with our fresh-water polyps, whether the simple hydra-like forms or the more complex fresh-water bryozoa. Great reputations have been made by the study of such creatures in Europe,—and in a land of streams and lakes like this, much could certainly be done in collecting new forms, and adding to our knowledge of the habits and range of organization of the fresh-water radiates. These animals should be sought in lakes and streams, especially on submerged wood, fresh-water shells, and the leaves of aquatic plants. They may easy be kept in water for examination, and careful drawings should be made of their forms and internal structures as seen under the microscope. It is difficult to preserve them ; but I would recommend immersion in glycerine or the method above given for sponges, as likely to succeed.

The mollusks also offer tempting fields of inquiry, more cultivated than those formerly noticed, but still having large promise. Many species of unio, alasmodon and anodon, exist in our river, most of them no doubt identical with species described by American naturalists, but some perhaps new, and many requiring more careful study as to their habits, reproduction, and the real limits of species and varieties. The univalve mollusks are also very numerous, both in the waters and on the land, and require study, more especially in relation to the animals as distinguished from the empty shells. Such studies demand patience and nicety, and would be greatly aided by vivaria, in which these creatures can be easily kept alive and examined at leisure. Mr. Billings, one of our members, has done some work in this field, portions of which have appeared in the *Canadian Naturalist.* Prof. Hall will bring before us this winter some interesting facts respecting the occurrence of pearls in the fresh-water mussels, and Mr. Bell of the Geological Survey has collected many species in the lower part of the river.

Many members of this Society have opportunities of collecting marine shells in the Gulf of St. Lawrence,—this is also a useful field of inquiry. Rear Admiral Bayfield has made large collections in the course of his survey. My own collection contains many species. More recently Mr. Bell exhibited to us a very interesting collection from the head of the Gulf between Gaspé and Quebec. I have no doubt that much may still be done, and these shells would be of great interest for comparison with those found fossil in the tertiary clays, long since deserted by the sea. While speaking of the marine fauna, I may add that the echinoderms, the zoophytes and crustaceans, also afford fields of much interest and promise, still very imperfectly cultivated.

Of the huge province of the articulates I am almost afraid to speak. There is work here for all the naturalists in Canada for the next century. Mr. Couper of Toronto has collected and identified several hundreds of species of coleoptera; and his collection, now in the McGill College, affords a good basis for any one desirous of commencing the study of these creatures. Mr. D'Urbain of our own Society has entered on the investigation of the butterflies. With the exception of what has been done for us by the Arctic explorers, and the naturalists of the United States, the other orders of Canadian insects are almost a terra incognita. In the mean time the country is suffering so seriously from the ravages of many of the insect tribes, that the attention of Government has been attracted to the subject, and the essays produced in answer to its call, by Prof. Hind and others, show that comparatively little examination of these creatures or inquiry into their habits has been made within the limits of the Province; nearly all the facts contained in these essays, having been collected from abroad though the value of the essays published, and the large number of competitors, show that we have persons qualified for the work. For hints very useful to the young naturalist, I may refer to the papers on collecting insects, and on the distribution of insects, by Mr. Couper, published in the *Naturalist.*

Who knows anything of the myriads of minute crustaceans and aquatic worms that swarm in our waters in summer. I have seen enough to be assured that their name is legion, but I am not aware that any one has collected or determined the species occurring here. The subject is a difficult one, but many of these creatures are exceedingly curious in structure and habits; and collections of facts and specimens might be made, by any one having time to devote to such pursuits.

Among the vertebrated animals, though there is little ground so completely untraversed as in some of the lower forms of life, much may still be done. In one department the late Prof. McCulloch and Prof. Hall long since set a good example, in collecting birds and other vertebrates, and preparing lists of those frequenting or rarely visiting this locality. The geographical distribution of the higher animals as illustrated by such collections and lists, is in itself a very important subject.

The fishes of our rivers afford a fertile subject of inquiry. Many of the smaller species are probably undescribed, and there are some of peculiar interest which deserve study in their habits and modes of life. I refer especially to the Lepidosteus* and the Amia,† those ancient forms of ganoid fishes which remind us so strongly of the antique species found fossil in the Palæozoic rocks, and a minute acquaintance with whose habits might throw most interesting light on the condition of the world in those bygone periods. Information on their spawning grounds, their haunts at different stages of growth, their food, their winter and summer resorts, their migrations, their peculiar instincts, if carefully collected, would be of inestimable value. Living specimens, which might be kept in vivaria and examined at leisure, would also be of great interest, and might be procured by many persons who have not themselves time or inclination for such studies. Agassiz, who has already so ably illustrated the structures and affinities of these animals, has invited collectors to contribute specimens for his great work now in progress; and any facts relating to the habits of these inhabitants of our waters, will be gladly received for this journal. I should add here, that Mr. Fowler, one of our members, has prepared a number of accurate and beautiful drawings of Canadian fishes, and can thus perpetuate for us the fleeting tints of our specimens.

Even the smaller quadrupeds of Canada are by no means well ascertained. The mice, the shrews, the bats, are very imperfectly known. There may be unknown species. There certainly are many unknown facts in distribution and habits. Mr. Billings has

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* Bony Pike, Gar Fish, Poisson armée.

† Marsh fish, Mud fish, Poisson de marais, Poisson Castor.

published in our journal an interesting summary of facts on Canadian quadrupeds; and much curious information exists in the work of Mr. Gosse, as well as in the standard works of Richardson & Audubon. I would especially invite attention to the mice and other small rodents, and the shrews. Only a few days ago a fine pair of specimens of the old Black Rat of Europe, which I did not know as a resident of Canada, were procured by Mr. Hunter, beautifully prepared by him, and presented by a friend to the College Cabinet, affording an illustration of the curious facts that may be learned even within the limits of our city.

I had almost forgotten to refer to the reptiles of Canada. The magnificent volumes of Professor Agassiz shew what may be done with one family, that of the tortoises. None of us, perhaps, can enter into the study in the manner in which this great naturalist has pursued it, but many may collect important facts and specimens. We do not yet know much about the numerous snakes, frogs, toads and newts of Canada, though many specimens exist in the collections of this Society, of Dr. M'Culloch, and of the University. Even a catalogue of the specimens in these collections would be valuable. Unattractive though these creatures may appear to the popular view, they afford more than most other animals evidences of the wonders of creative skill.

One little batrachian reptile I regard, as a geologist, with peculiar interest, and would commend to your notice. I refer to the Menobranchus, or Proteus,[‡] a creature most unattractive in aspect, but most singular in its habits and mode of life, and a representative of the earliest forms of air-breathing life introduced upon our planet. No gift would afford me greater pleasure than a few living specimens of this animal, which might enable me to become better acquainted with its mode of life, and thus better to appreciate the probable habits of some of its extinct congeners, whose bones I have disinterred from the carboniferous rocks. Some time ago a living specimen was procured by Mr. Hodgins of Toronto; but the few observations of its habits which he has recorded in the *Canadian Journal*, only stimulate the desire for further information.

It would be ungracious to leave the animal kingdom, without notice of Ethnology as a field of investigation. The remarkable collection of Mr. Kane, exhibited here during the meeting of the American Association last summer, must have strongly impressed

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[‡] Water—Azard.

your minds with the interest of the subject, as it relates to the Indian tribes. Mr. Kane was fortunate in having so able an expositor of his collection as Dr. Wilson; and I may add that Canada is fortunate in having an ethnologist so well fitted to lead in this department. Surely, some of our members might contribute something to this great subject. Specimens relating to it are not often laid before us. We received, however, last year, through the Bishop of Montreal, a curious ancient urn, which excited much interest. I have since been in correspondence with the gentleman who made known the discovery, and hope to obtain further information and specimens. On the return of his Lordship, who possesses the original notes on the subject, I trust this interesting relic will be figured and described in our Journal.

Plants afford as many local attractions as animals, but I shall occupy less time with the subject of Botany than with that of Zoology. A very large herbarium has been collected by the oldest living member of this Society, Professor Holmes; and as we now have it arranged by Professor Barnston, in the Cabinet of McGill College, it affords an invaluable means of reference to the student. Dr. Barnston is now engaged in preparing a catalogue of this and his own collections, which will, I trust, be published under the auspices of this Society; and it will then be for subsequent collectors to add to this already extensive list such species as may still remain undiscovered.

The Canadian Botanist should not, however, content himself with the mere determination of plants. I cannot doubt that much remains to be done in investigating the uses of native plants not now applied to practical purposes in the arts or in domestic life; and that as Canada becomes more populous, and agriculture less rude in its practice, the cultivation of many neglected plants fitted to contribute to minor practical uses, will be undertaken. Nor should our forests and the means for their preservation and restoration to such an extent as may be desirable for shelter and for the supply of wood, be neglected by scientific men. Rich gleanings, applicable to Canadian practice, may be made in this direction, from the expedients employed in European countries; and in a country in which one-third of the soil should probably remain in forest to supply the permanent demand for fuel and other uses, this subject is of great practical importance.

Another subject less practical, but profoundly interesting, is the geographical distribution of plants, so ably expounded by De Candolle, and on our side of the Atlantic by Professor Gray.

The curious facts respecting the geographical distribution of the Ranunculaceæ, so pleasantly stated by Mr. George Barnston, in an article in the last volume of the *Canadian Naturalist*, show how much can be done in this field. But it is not merely in relation to botany that this inquiry is of interest. Edward Forbes has shewn that great questions in geology are illustrated by it; and nowhere better than on the American Continent can it be studied in this aspect. Let us inquire respecting any plant, what are its precise geographical limits? To what extent do these depend on climate, elevation, exposure, soil. What inferences may be deduced as to the centre from which it originally spread, and what as to the changes in the extent of the land and the relative levels of land and sea that have occurred since its creation? Here are fertile subjects of inquiry, leading to the grandest conclusions in reference to the history of life upon our planet.

But I must turn for a moment from this great subject to the humbler members of the vegetable kingdom, no less curious than the higher, and less known. One of our number, the Rev. Mr. Kemp, has directed his attention to the fresh-water Algæ, and has contributed a valuable paper as the first result of his inquiries. Mr. Poe, another of our members, is an enthusiastic student of the Fungi, and other more minute and simple forms of plant life. A summary of what is known of these objects, as occurring in Canada, will be given to us by Mr. Poe in the present winter; and I have no doubt will excite some interest in these singular and anomalous structures, so curious in their habits and often so injurious to our property.

The Mosses, Lichens, Lycopodiaceæ, Ferns, and other allied families, offer many rewards to any diligent student; and the excellent arrangement and descriptions in Professor Gray's new edition of his Manual, give facilities heretofore within the reach of few. There may be Canadian botanists engaged in this study, but I have no evidence that this is the case. Our mountain and the neighbouring hills afford peculiar facilities for it; and I suspect that curious facts as to the distribution of these plants might be obtained, from their study on these isolated trappean eminences, in a limestone and alluvial country.

The naturalists and professional men of Montreal have devoted much attention to the microscope; and our city possesses many good instruments, daily increasing in number, and affording a most delightful and instructive means of scientific observation in all departments of Natural History. Among our members, Mr.

Poe and Mr. Murphy deserve especial mention, as having devoted much time and effort to the improvement and increase of our means of study in this department.

Geology presents on every side ample harvests to the inhabitants of this city. Our noble mountain,—the skeleton of an old silurian volcano, with its multitudinous trap-dykes of various age and composition, is itself a study capable of throwing new light on the phenomena of volcanic agency as manifested in those ancient periods. The stratified rocks at its base, full of fossils,—many of them no doubt undescribed, and, in some of their beds, actually made up of the comminuted fragments of shells and corals,—invite the attention of the most unobservant. Every block of building-stone from our quarries is a mass of animal debris, presenting under the microscope hundreds of beautiful forms bearing the impress of creative skill, though belonging to perished races of animals. Our worthy associate, Mr. Billings, now most usefully connected with the Geological Survey, is a brilliant example of reputation, and, what is better, accurate and extensive knowledge, gathered from the study of the Lower Silurian limestones.

I need scarcely remind you of the tertiary clays to which I had the pleasure of directing the attention of this Society at one of its late meetings. They have yielded in the past summer about thirty species of animal remains not previously known to exist in them; and many of these have been brought to light by the industry of our College students. Some even of the boys of the High School now have collections of these fossils, and have been successful in adding to the number of species. Much yet remains to be done in this field; and I look forward to the time when we shall have nearly complete lists of the shells peculiar to each level of the Peistocene sea, and to the present Gulf of the St. Lawrence, and an accurate knowledge of the position of the shores of each successive salt-water area, as the sea gradually left our noble valley. We shall then be in a position to offer a large contribution to the tertiary geology of America, and of the world.

With the present facilities for travelling, the whole geology of Canada lies before us; and we need not apprehend that Sir Wm. Logan will grudge us space in this large field. He has done, and is doing, a great work; but, even with his skill and energy, were he to live far beyond the allotted age of man, he would but find the number of openings for investigation increasing before him. He has well and effectually opened up an immense territory; but there is room in it for hundreds of geologists to earn reputation, by following on his track. He will thank you for anything that you can do in the accumulation of facts; that is, provided you do not embarrass him and oppose the interests of truth by those crude and hasty generalizations, or baseless hypotheses, in which unskilful and hasty observers are too prone to indulge, and which sometimes impose upon the credulity of the public to the serious injury of the science. No department of natural science presents greater temptations to such vagaries than geology, and none has suffered more seriously from their effect on the popular mind. No science is more grand in its ultimate truths, none more valuable in its practical results, than geology, when pursued in the spirit which characterises the head of our survey. None is more dangerous or misleading in the hands of pretenders.

The subject of geology I may remind you includes within itself many subordinate fields, which have been or are being successfully cultivated, by observers in various parts of Canada ; and here as in most other parts of America, geological investigations have been more eagerly and extensively pursued than other branches of natural science. The mineralogical researches of Dr. Holmes, and of Dr. Wilson of Perth, who, though not one of our citizens, has contributed much to our collection, and the geological observations of Dr. Bigsby, some of which relate to the vicinity of this city, preceded the work of the Provincial Survey, and not only made many important discoveries, but may be regarded as among the causes which led to the institution of that great enterprise, so successful and so creditable to the Province, Nor must I here omit the interesting paper on the Montreal mountain, long since contributed to this Society by our late Treasurer, Dr. Workman, a paper to which I all the more readily give prominence here, as I have had the pleasure of visiting some of the localities in company with its author, and as it was inadvertently omitted in the list of authorities referred to in the paper on that subject, which I lately read before this Society. Were it expedient to attempt extending such notices beyond the more immediate limits of our own sphere of operation, I might name many useful men who have variously distinguished themselves in this science, by way of encouragement to our embryo geologists. One name I cannot pass by, that of a man of much more than Canadian reputation, and of eminent usefulness in promoting the growth of Canadian geology, Prof. Chapman, of University College, Toronto, whose able papers and notices in the Canadian Journal we shall do well if we can approach in the journal of this Society. I shall farther take the liberty of mentioning the collection of the Rev. Mr. Bell, now in Queen's College, and that of Sheriff Dickson, of Kingston, from both of which I have derived much pleasure and instruction, and those of Dr. Van Cortlandt, and of the Silurian Society of Ottawa, and of our more venerable sister the Literary and Historical Society of Quebec, the study of which is a pleasure, I trust, yet in store for me.

I have probably sufficiently trespassed on your patience, and shall say little of the aids which intelligent public appreciation can render to meteorological investigations, such as those of Prof. Smallwood and Prof. Hall, or to the important chemical inquiries of Prof. Hunt. The results attained by these gentlemen are full of material for thought, and in many minor departments of their work I have no doubt they might be aided by local co-operation on the part of some of our members. If in no other way, we can aid these gentlemen by studying and expounding to the public the conclusions which they reach. Independently of their interest to science, now appreciated far beyond the limits of Canada, the tables of Prof. Smallwood and Prof. Hall, and the analyses of Prof. Hunt, are full of facts of immense practical value in agriculture and the arts of life. I had occasion, not long since, in connection with my lectures on agriculture to study the analyses of soils in the reports of the Geological Survey, and I am convinced that those analyses contain the germ of a revolution in Canadian agriculture, which will be effected so soon as they are thoroughly understood by the people.

Enough has been said to indicate some of the paths of inquiry open to the members of this Society. But, it may be asked, why should we leave our offices, our business, our social amusements, for such occupations. It is not necessary that we should do so. All of us have public, social, and private duties, that have prior claims on our attention. We must not neglect these; but, if we have a little leisure for rational amusement, I know none more agreeable or inspiring than the study of nature, or of some small department of it, such as the observer in his own locality can take time fully to master. Let him provide himself with, or secure access to, the best books in the department he may select, and this need not, in the first instance, be a very extensive one. Let him read, collect, observe, and note; and, in an incredibly short time, he will find a new world of beauty opening to him. Objects before unregarded will become friends, and will speak to him of the wonders of the Universe of God, until he will long to make known to others the utterances which have broken on his own inner ear, and rejoice in being able to add his mite to the treasury of our knowledge of nature.

I might here speak of the facilities which this city presents in access to books and collections. They are small in comparison with those in many cities of the old world. Yet they are not despicable. The collection of the Geological Survey, the collection and library of this Society, and those of our educational institutions, offer many aids to the student, as well as many objects deserving of farther study and explanation. The meetings of this Society also afford a valuable means of improvement and profitable intercourse; and our Journal, the *Canadian Naturalist*, has for one of its objects the introduction of inquirers to profitable fields of research. Already, in the two volumes published, there are valuable summaries of the facts most necessary to the student in many of the departments referred to in this lecture.

It is scarcely necessary to add that such studies as those which I have recommended, even if they afford no new facts or principles, are in themselves capable of yielding much rational pleasure; and that in this aspect of the subject the field of inquiry is much more extensive than in the former; since here we are not restricted to the absolutely unknown, but may find for ourselves quite as much interest and novelty in ground previously trodden by others, but new to us.

In conclusion, I may say on behalf of all those members of this Society engaged in the pursuit of any department of Natural History, that they will welcome with pleasure any inquirer fired with the true ardour of a naturalist; and that they will most thankfully avail themselves of, and honourably acknowledge any aid that they may receive in collecting the material of their investigations. Nor need this statement be limited to Montreal. My subject being local, I have confined myself chiefly to things and persons in our city; but there are men in other parts of Canada, and beyond its limits, working at these subjects; and while it is desirable that here we should rival them in these pursuits, no reason exists to prevent our emulation from being accompanied by mutual and friendly aid. In this spirit I close by asking pardon, if, in the above remarks, I have unwittingly omitted or done injustice to any labourer in the departments of science to which I have adverted.

J. W. D.

ARTICLE II.—*On the Metallurgy of Iron and the Processes of Chenot.*[*]

The new metallurgical processes of Adrien Chenot attracted in a particular manner the attention of the Jury at the Exhibition at Paris in 1855, and were the object of a special study by the Jurors of the first class, who awarded to the inventor the *Gold Medal of Honour*. M. Chenot there exhibited a series of specimens, serving to illustrate the processes which bear his name, and which have been the result of extraordinary labors on his part, continued through the last twenty-five years. As the industry of iron-smelting promises for the future to be one of great importance to Canada, it may be well to advert briefly to the history and theory of the metallurgy of iron, in order to explain the processes now in use, and to prepare the way for an exact understanding of those of Chenot.

The most ancient and simplest mode of obtaining iron from its ores is that practiced in the Corsican and Catalan forges, where pure ores are treated with charcoal in small furnaces, and by variations in the mode of conducting the process, are made to yield at once either malleable iron, or a kind of steel. But this method requires very pure ores, and a large expenditure of fuel and labour, while from the small size of the furnaces it yields but a limited quantity of iron. It is scarcely used except in the Pyrennees, Corsica, some parts of Germany, and northern part of the State of New York.

The high or blast-furnace, which converts the ore directly into cast metal, furnishes by far the greater part of the iron of commerce. This furnace may be described as consisting essentially of a crucible in which the materials are melted, surmounted by a vertical tube or chimney some thirty feet in height, in which the reduction of the ore is effected. Into this furnace a mixture of ore and fuel is introduced from the top, and the fire, once kindled, is kept up by a blast of hot or cold air, supplied by a proper apparatus, and admitted near the bottom of the furnace. The ores submitted to this process are essentially combinations of iron with oxygen, often containing besides water and carbonic acid, and always mingled with more or less earthy matter, consisting of

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[*] From the recently published volume of Reports of the Geological Survey of Canada for 1853-54-'55-'56. Pp. 392-404.

silica, alumina, &c. The water and carbonic acid, being readily volatile, are often expelled by a previous process of roasting. When these oxyds of iron are heated to redness in contact with charcoal, this material combines with the oxygen of the ore, and the iron is set free or reduced to the metallic state, after which by the further action of the combustible it is fused, and collects in a liquid mass in the crucible below. The earthy ingredients of the ore, with the ashes of the fuel, are also melted by the intense heat, and form a kind of glass or *slag*, which floats upon the surface of the molten metal, and from time to time both of these are drawn off from the crucible. It is very important to give to these earthy matters that degree of fluidity which shall permit their ready separation from the reduced and melted iron, and to attain this end, the different ores are generally mixed with certain ingredients termed fluxes, which serve to augment the fusibility of the slags. Limestone, sand, and clay may each of them be used for this object with different ores. It will be kept in mind that the fuel employed in the process of smelting, serves for two distinct objects: first, as a combustible to heat the materials, and secondly, as a reducing agent to remove the oxygen from the ore.

The contents of a blast furnace in action consist then of a great column of mingled ore and fuel, continually moving downward towards the crucible, and constantly replenished from the top, while a current of air and gases is continually traversing the mass in a contrary direction. The investigations by Leplay and Ebelman on the theory of this operation have prepared the way for the processes of Chenot, and we shall therefore state in a few words, the results of their researches. They have shown in the first place, that the direct agent in the reduction of the ore is a portion of the carbon of the fuel in a gaseous state, and secondly, that this reduction is effected at a temperature far below that required for the fusion of the metal. The oxygen of the air entering by the blast, is at first converted by combination with the ignited coal, into carbonic acid, in which an atom of carbon is combined with two atoms of oxygen, but as this gas, rising in the furnace, encounters other portions of ignited coal, it takes up another equivalent of carbon and forms carbonic oxyd gas, in which the two atoms of oxygen are combined with two of carbon. This gas is the reducing agent, for when in its upward progress it meets with the ignited oxyd of iron, the second atom of carbon in the gas takes from the iron two atoms of oxygen to form a new portion of carbonic acid, which passes on, while metallic iron remains.

The interior of the blast furnace may be divided into four distinct regions; the first and uppermost is that in which the mixture of ore and fuel is roasted; the water and volatile matters are there driven off, and the whole is gradually heated to redness. In the second region, immediately below the last, the already ignited ore is reduced to the metallic state by the ascending current of carbonic oxyd gas; the metal thus produced is however in the condition of malleable iron, nearly pure and very difficultly fusible; but in the third region it combines with a portion of carbon, and is converted into the fusible compound known as cast iron. In addition to this, small portions of manganese, aluminium and silicium, whose combinations are always present in the contents of the furnace, become reduced, and alloying with the iron, affect very much its quality for better or worse. Cast iron generally contains besides these, small portions of sulphur, phosphorus, and other impurities less important.

In the fourth and lowest region of the furnace, which is near to the blast, the heat becomes more intense, the carburetted metal melts, together with the earthy matters, and both collect at the bottom of the crucible upon what is called the hearth, from which the two are drawn off from time to time. The cast iron thus obtained is very fusible, but brittle, and is far from possessing those precious qualities which belong to malleable iron or steel.

To convert the cast metal into malleable iron, it is exposed to a process which is called *puddling*, and consists essentially in fusing it in a furnace of a peculiar kind, where the metal is exposed to the action of the air. The carbon, manganese, silicium, and other foreign matters, are thus burned away, and the once liquid metal is converted into a pasty granular mass, which is then consolidated under hammers or rollers, and drawn out into bars of soft malleable iron.

To convert into steel the soft iron thus obtained, it is heated for a long time in close vessels with powdered charcoal, a small quantity of which is absorbed by the iron, and penetrating through the mass changes it into steel. This process is known by the name of *cementation.* The change is however irregular and imperfect; it is therefore necessary to break up these bars of cemented or blistered steel, as it is called, and after assorting them according to their quality, either to weld them together, or to melt down each sort by itself in large crucibles. The metal is then made into ingots, and forms cast steel, which is afterwards wrought under the hammer and drawn out into bars.

Such is an outline of the long and expensive processes by which malleable iron and steel are obtained from the ores of iron. The reduction of the iron to the metallic state constitutes but a small part of the operation, and consumes comparatively but little fuel, but as we have already seen the reduced iron is first carburetted as it descends in the furnace, then melted by an intense heat into the form of cast iron, which is again fused in the puddling furnace before being converted into malleable iron, the transformation of which into cast steel requires a long continued heat for the cementation, and still another fusion.

In Derbyshire in England, there are consumed for the fabrication of one ton of cast iron, two tons and twelve quintals of ore, and two tons of mineral coal, while in Staffordshire two tons eight quintals of coal, and two tons seven quintals of ore are employed for the production of a ton of cast metal. In the furnaces of the Department of the Dordogne, in France, where charcoal is employed, two tons and seven quintals of ore, one ton and three quintals of charcoal are employed for a ton of iron. For the production of a ton of wrought iron in England about one ton and one-third of cast iron, and from two to two and a-half tons of mineral coal are consumed, while the same amount of the cast iron of the Dordogne requires to convert it into a ton of wrought iron, one ton and a-half of charcoal. Thus in England the fabrication of a ton of wrought iron, from poor ores yielding from thirty-eight to forty per cent. of metal, requires a consumption of about five tons of mineral coal, and in Dordogne a little over three tons of wood charcoal, which costs there about fifty-eight shillings currency the ton. The average price of charcoal in France, however, according to Dufrénoy, is about seventy-four shillings, while in Sweden it costs only about fourteen shillings, and in the Ural Mountains eleven shillings the ton. In France, much of the pig iron manufactured with charcoal is refined by the aid of mineral coal.

The questions of the price and the facility of obtaining fuel are of the first importance in the manufacture of iron. The ores of this metal are very generally diffused in the earth's surface, and occur abundantly in a great many places where fuel is dear. The iron which is manufactured either wholly or in part with wood-charcoal, is of a quality much superior to that obtained with mineral coal, and commands a higher price. One principal reason of this difference is that the impurities present in the coal contaminate the iron, but it is also true that the ores treated with mineral coal are for the greater part of inferior quality. Interstratified with the beds of coal in many parts of Great Britain, Europe and North America there are found beds of what is called *clay iron-stone*, or argillaceous carbonate of iron, yielding from twenty to thirty-five per cent. of the metal. This association of coal with the ore offers great facilities for the fabrication of iron, which is made in large quantities, and at very low prices from these argillaceous ores.

These poor ores will not admit of being carried far for the purpose of smelting, and it is not less evident that the large quantity of coal required for their treatment could not be brought from any great distance to the ores. As a general rule the richest and purest ores of iron belong to regions in which mineral coal is wanting, while the carboniferous districts yield only poorer and inferior ores. On this continent, which contains vast areas of coal-bearing rocks, the great deposits of magnetic and hematitic iron ores are chiefly confined to the mountainous district north of the Saint Lawrence, and the adjacent region of northern New York, to which may be added a similar tract of country in Missouri. In the old world it is in Sweden, the Ural Mountains, Elba and Algiers, that the most remarkable deposits of similar ores are met with ; and it is not, perhaps, too much to say, that if favourable conditions of fuel and labour were to be met with in these regions, these purer and more productive ores would be wrought to the exclusion of all others. But where charcoal is employed the forests in the vicinity of large iron furnaces are rapidly destroyed, and fuel at length becomes scarce. In a country like ours where there is a ready market for fire-wood near to the deposits of ore, the price of fuel will one day become such as to preclude their economic working by the ordinary processes. As the industrial arts progress, the consumption of fuel is constantly increasing, and its economic employ becomes an important consideration.

From these preliminaries it is evident that a great problem with regard to the manufacture of iron, is to find a process which shall enable us to work with a small amount of fuel, those rich ores which occur in districts remote from mineral coal. Such was the problem proposed by Adrien Chenot, and which in the opinion of the International Jury, he has in a great measure resolved.

To return to the blast furnace ; we have seen that the second and moderately heated region, is that in which the reduction of the ore is effected, and that the intense heat of the lower regions of the furnace only affects the carburation and fusion of the metal.

Mr. Chenot conceived the idea of a furnace which should consist only of the roasting and reducing regions; his apparatus is but the upper portion of an ordinary blast furnace, the carburetting and fusing regions being dispensed with. In this the ore is reduced at a low red heat, and the metal obtained in the form of a gray, soft, porous mass, constituting a veritable metallic sponge, and resembling spongy platinum. The furnace of Chenot is a vertical prismatic structure forty feet high, open at the top for the reception of the ore, and having below a moveable grate by which the charge can be removed; the bottom is susceptible of being closed air-tight. The lower part of the furnace is of iron plate, and is kept cool, but about mid-way the heat is applied for the reduction of the ore, and here comes in a most important principle, which will require a particular explanation, It is required to heat to moderate redness the entire surface of the rectangular vertical furnace throughout a length of several feet, a result by no means easy to be effected by the use of a solid combustible, but readily attained by a gaseous fuel such as is employed by Mr. Chenot.

We have already explained the theory of the production of carbonic oxyd. The possibility of employing this gas as a combustible was first suggested by Karsten, and in 1841 Mr. Ebelman of the School of Mines at Paris, made a series of experiments on the subject by the direction of the Minister of Public Works. The process employed by this chemist consisted essentially in forcing a current of air through a mass of ignited coal of such thickness that the whole of the oxygen was converted into carbonic oxyd; this escaping at an elevated temperature was brought into contact with the outer air, and furnished by its combustion a heat sufficient for all the ordinary operations of metallurgy. A consideration of great importance connected with this process is, that it permits the use of poor earthy coals, and other waste combustibles, which could hardly be employed directly, while by this method the whole of their carbonaceous matter is converted into inflammable gas. Wood and turf may be made use of in the same way, and the gas thus obtained will be mingled with a portion of hydrogen, and probably with some hydrocarburet; a similar mixture may be obtained with charcoal or anthracite, if a jet of steam be introduced into the generating furnace, a modification of the process which has however the effect of reducing the temperature of the evolved gases.

This mode of employing combustibles becomes of great importance in the process of Chenot, who generates the gas in small furnaces placed around the great prismatic tube, and conducts it into a narrow space between this and an outer wall; through this, by openings, a regulated supply of air is introduced for the combustion of the gas, by which the ore contained in the tube is raised to a red heat. The next step is to provide the reducing material which shall remove the oxygen from the ignited ore, and for this purpose we have already seen, that even in the ordinary smelting process carbonic oxyd is always the agent; but instead of the impure gas obtained from his furnaces, and diluted with the nitrogen of the air, M. Chenot prefers to prepare a pure gas, which he obtains as follows. A small quantity of carbonic acid gas, evolved from the decomposition of carbonate of lime, is passed over ignited charcoal, and thus converted into double its volume of carbonic oxyd gas; this is then brought in contact with ignited oxyd of iron, which is reduced to the metallic state, while the gas is changed into carbonic acid, ready to be converted into carbonic oxyd by charcoal as before. In this way the volume goes on doubling each time the two-fold operation is repeated. By introducing the carbonic oxyd thus obtained into the furnace charged with ignited iron ore, and withdrawing a portion of the gas at a higher level, for the purpose of passing it again over ignited charcoal in a smaller tube apart, the process may be carried on indefinitely, the carbonic acid serving as it were to carry the reducing combustible from the one tube, to the ore in the other.

A modification of this process consists in mingling the ore with an equal volume of small fragments of charcoal, and admitting a limited supply of air into the body of the apparatus, by openings at mid-height, the heat being as before applied from without. In this case the action is analogous to that which takes place in the ordinary blast furnace; carbonic oxyd and carbonic acid are alternately formed by the reactions between the oxygen of the air, the ore and the charcoal; but the supply of air being limited, and the temperature low, neither carburation nor fusion of the metal can take place, and five-sixths of the charcoal employed, remain unchanged and serve for another operation. This simpler way has the disadvantage that one-half of the furnace is occupied with charcoal, so that the product of metal is less than when the reducing gas is prepared in a separate generator. In either case the product is the same, and the iron remains as a soft porous substance, retaining the form and size of the original masses of ore. This metallic sponge is readily oxydized by moisture, and if prepared at a very low temperature, takes fire from a lighted taper, and burns like tinder, yielding red oxyd of iron. In order to avoid the inconvenience of this excessive tendency to oxydation, the metal is exposed in the process of manufacture to a heat somewhat greater than would be required for the reduction; this renders the sponge more dense, and less liable to oxydation in the air.

The part of the furnace below the action of the fire is so prolonged, that the reduced metal in its slow descent, has time to become very nearly cold before reaching the bottom. It is then removed at intervals, by an ingenious arrangement, which enables the operator to cut off, as it were, the lower portion of the mass, without allowing the air to enter into the apparatus. In the case where the ore has been mixed with charcoal, the larger masses of metal are now separated from it by a screen, and the smaller by a revolving magnetic machine.

This spongy metallic iron may be applied to various uses. If we grind it to powder and then submit it to strong pressure, coherent masses are obtained, which at a welding heat, contract slightly, without losing their form, and yield malleable iron. By this process of moulding, which may be termed a casting without fusion, the metal may be obtained in forms retaining all the sharpness of the mould, and possessing the tenacity, malleability and infusibility of wrought iron. The masses thus compressed have in fact only to be forged, to give wrought iron of the finest quality; and it is found that during the hammering, any earthy matters mechanically intermixed, are eliminated like the scoriæ of the iron from the puddling furnace.

But without overlooking the great advantage of this method of making malleable iron, and moulding it into the shapes required, it is especially as applied to the manufacture of steel, that the metallurgical methods of Chenot deserve attention. In the ordinary process, as we have already seen, the bars of malleable are carburetted by a prolonged heating in the midst of charcoal powder; but the operation is long and expensive, and the metal obtained by this mode of cementation is not homogeneous. Mr. Chenot avails himself of the porosity of the metallic sponge, to bring the carbon in a liquid state, in contact with the minutest particles of the iron. For this purpose he plunges the sponge into a bath of oil, tar, or melted resin, the composition of the bath varying according to the quality of the steel which it is desired to obtain. The sponge thus saturated, is drained, and heated in a close vessel. The oily or resinous matter is expelled, partly as a gas, but for the greater part distils over as a liquid, which may be again employed for cementation. A small portion of carbon from the decomposition of the oil rests however with the iron, and at the temperature of low redness, employed near the end of the distillation, appears to have already combined chemically with the metal. This treatment with the bath and distillation, may be renewed if the carbonization is not sufficient after one operation.

The cemented sponge is now ground to powder and moulded by hydraulic pressure into small ingots, which may be heated and directly wrought under the hammer, like the compressed iron sponge; the metal thus obtained may be compared to refined blistered steel. If however the cemented and compressed sponge be fused in crucibles, as in the ordinary process for making cast steel, the whole of the earthy impurities which may be present, rise to the surface as a liquid slag, which is easily removed, while the fused metal is cast into ingots. In this way, by cementation, and a single fusion, the iron sponge is converted into a cast steel, which is from the mode of its preparation, more uniform in quality than that obtained by the ordinary process, and which was found by the Jury to be of remarkable excellence.

Such is a brief outline of the methods invented by Adrien Chenot for the reduction of iron ores, and the fabrication of wrought iron and steel, constituting in the opinion of one eminently fitted to judge the case, (Mr. Leplay, of the Imperial School of Mines, and Commissary General of the Exhibition,) the most important metallurgical discovery of the age.

The peculiar condition of the iron sponge has enabled the inventor to make many curious alloys, some of which promise to be of great importance; by impregnating it with a solution of boracic acid, a peculiar steel is obtained, in which boron replaces carbon, and by a similar application of different metallic solutions various alloys are produced, whose formation would otherwise be impossible.

The processes of Mr. Chenot are now being applied to the fabrication of steel at Clichy, near Paris, where I had an opportunity of studying in detail the manufacture. The iron ore is imported from Spain, and notwithstanding the cost of its transport, and the high prices of labor and fuel in the vicinity of the metropolis, it appears from the data furnished by Mr. Chenot to the Jury, that steel is manufactured by him at Clichy, at a cost which is not more than one-fourth that of the steel manufactured in the same vicinity from the iron imported from Sweden. According to Mr. Chenot, at the works lately established on his system by Villalonga & Co., near Bilboa in Spain, they are enabled to fabricate the metallic sponge at a cost of 200 francs the ton, and the best quality of cast steel at 500 francs, or $100 the ton of 1000 kilogrammes, (2.200 pounds avoirdupois.) The conversion of the ore to the condition of sponge is, I was assured by Mr. Chenot, effected with little more than its own weight of charcoal.*

The differences in the nature of the steel made from various ores have long been well known, but until the recent experiments of Chenot, the subject was but very imperfectly understood. According to him the nature of the ore has much more to do with the quality of the metal than the mode of treatment, and he compares the different steels to the wines of different localities, which owe their varied qualities far more to the nature of the grapes, than to any variations in the mode of their fermentation. The process of cementation employed by Chenot furnishes, according to him, an exact measure of the capability of the iron to produce steel. The sponges of the iron from Sweden and the Ural Mountains, after taking up six per cent. of carbon, yield a metal which is still malleable, while that of Elba with four per cent., becomes brittle and approaches to cast iron in its properties. While the ores of Sweden and the Urals are famous for the excellent quality of their steel, the ore of Elba is known to yield a very superior iron, but to be unfit for the fabrication of steel; and Chenot concludes, from a great many observations, that the steel producing capacity of any iron is measured by the quantity of carbon which it can absorb before losing its malleability and degenerating into cast iron.

Desirous to avail myself of these researches of Mr. Chenot, I placed in his hands, in September, 1855, specimens of the different iron ores from Canada, which had been sent to the Exhibition at Paris, and engaged him to submit them to the process of reduction, and to test their capabilities for the production of steel. Mr. Chenot has also obtained remarkable alloys of chromium and titanium with iron, his processes enabling him to effect the direct reduction of chromic and titaniferous iron ores; specimens of these two ores from Canada were therefore furnished him, but the sudden and lamented death of Chenot, by an accident in the month

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* We have since the printing of this report learned that several large companies have been formed in France and Belgium for the use of Chenot's patents, and are now applying his processes on an extensive scale.
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of November following, deprives us for a time of the advantages of his experiments. His sons however are instructed in his processes, and have promised to undertake at an early day the examination of our Canadian ores. I am disposed to attach great importance to these investigations, from the hope that among our numerous deposits of iron ore, belonging in great part to the same geological formation as the iron ores of Scandinavia, there may be found some capable of yielding a steel equal to that of the Swedish iron. With the new and economical processes of Chenot a valuable steel ore will be sought for, even in a distant country, and may be advantageously transported to the localities where fuel and labour are most available.

One great condition for the successful application of these processes is, that the ores should be comparatively pure and free from earthy mixtures. We have already alluded to the impurity of the ores which are smelted in the coal districts of England, and even the ore brought by Chenot from Spain, and employed by him in his works at the gates of Paris, contains about ten per cent. of fixed, and as much volatile matter, it being a decomposed spathic iron. Many of the magnetic and hematite ores of Canada are almost chemically pure:* such are those of Marmora, Madoc, Hull, Crosby, Sherbrooke, MacNab and Lake Nipissing, which even if they should not prove adapted to the manufacture of superior steel, offer for the fabrication of metallic iron, by the processes of Chenot, very great advantages over the poorer ores, which in many parts of this continent are wrought by the ordinary processes.

The small amount of fuel required by the new methods, and the fact that for the generation of the gas which is employed as combustible, turf and other cheap fuels are equally available, are considerations which should fix the attention of those interested in developing the resources of the country. With the advantages offered by these new modes of fabrication, our vast deposits of iron ore, unrivalled in richness and extent, may become sources of national wealth, while by the ordinary method of working they can scarcely, at the present prices of iron and of labour, compete with the produce of much poorer ores, wrought in the vicinity of deposits of mineral coal.

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* See Mr. Billings on the Iron Ores of Canada. This Journal, vol II, p. 20.

ARTICLE III.—*Entomology.* No. I. By William Couper Toronto.

In concluding my Notes on the Distribution of Insects, Vol. II. p. 40, I promised to make some remarks on insects injurious to vegetation, more particularly the parasites that destroy the staff of life, and concerning which so much has been written of late.

Harris, one of the best English writers on American insects, in his history of the Dipterous Order, must have been unacquainted with the fact that many species of the two-winged flies pass the winter in a semi-torpid state. In the month of January of the present year, I discovered two species in society. One of these, belonging to the genus *Musca* apparently a cuckoo-fly, was found in an old decayed stump, that had originally been perforated by beetles of the genus *Monohammus.* Through the holes thus made the flies reached the interior. They were found in clusters of from thirty to forty; each portion occupied a dry crevice, and were in a semi-torpid state. I have placed two specimens in my cabinet, and a description will appear in another paper.

The other is a *Cecidomyiæ.* Its head, antennæ, thorax, and body are black; femoræ whitish; tibiæ black; wings have a bluish colour, rounded at tip. Length 1¼ lin. These insects take up their winter quarters in the stems of the *Rubus villosus* (a very common fruit-bearing plant in Upper Canada), made tubular by the larva of *Saperda* (Oberia) *tripunctata* having devoured the pith during the month of June of the preceding year. They occupied every stem examined, each containing about two hundred specimens, huddled together in a semi-torpid state. In many instances these insects enter holes made in the sides of the plant by other insects; in other examined specimens there were no side entrances, but an opening on top, which to all appearance had been originally the work of a *Saparda* or *Cephus*, as I found the larva of the last genus devouring the pith immediately beneath the torpid *Cecidomyiæ.*

Are they destructive insects? If so, with nothing to obstruct their exit, what can prevent their issuing forth in hundreds at any favourable season to produce millions? It is therefore advisable to destroy every medullary plant growing in the vicinity of cultivated lands, as it is an unmistakeable truth that they protect many minute insects from moisture and cold.

I do not wish to say it is a cereal parasite; but, when we discover so many instances of this kind among the Tipulidæ, we have every reason to suspect that the greater number of species of a like nature will look for winter quarters, particularly when we have before us examples of one animal forming a place of retreat for another. It therefore requires a close search to discover them. No one can make reliable observations without practice; it is the only way to arrive at a proper mode of studying the habits of insect life. Now that entomologists, both of Upper and Lower Canada, have no difficulty in communicating their observations, I trust that hereafter more attention will be paid to them with a view to their early publication. The knowledge obtained by an entomologist, unless rendered available to others, may be of no gain to science; at his death all his thoughts perish, and all his knowledge is lost for ever. "Who can calculate the loss sustained by the death of Edward Forbes? Simply, in his case, by the loss of undeveloped, half-formed ideas. But suppose—and such instances do occur—he had amassed stores of information, which he was treasuring up to form, at some distant day, a valuable scientific work; and suppose that every scrap of knowledge he was thus collecting were carefully kept to himself, not to be made known to others till the due period had arrived, is it not evident that the knowledge he thus obtained might be no real gain to science, for it might all be lost again?"

An entomologist may have a fund of information, and, without meaning to be selfish, may, from supineness, indifference, love of ease, or the *dolce far niente*, allow his information to be useless to others. We want no such men in the practice of entomology. What we want are men who think more of what is still left for them to do, than to extract what has already been done by others.

Of what benefit are entomological essays to the agricultural community? This question can be answered more than one way. However, it is very evident that unless a writer particularly on entomology, be practically acquainted with the science, his production can never command a higher name than a compilation; for a good reason, we find nothing new—we discover that no search has been made for material to establish new facts. An individual, therefore, can at any time select sufficient from former authors to issue an essay of 139 pages, this only exhibits a want of eutomological acuteness; and, as a work of reference, is of no more value than waste paper.

ART. IV.—*Remarks on the Geographical Distribution of Plants in the British Possessions of North America.* By GEORGE BARNSTON, Esq., Honorable Hudson's Bay Company.

Group—ALBUMINOSÆ.

Order—*Nymphœaceœ.*

This order, containing a very few genera, and these purely aquatic plants, is very ornamental to our small lakes and shallow rivers. A certain depth of water, and in the streams a sluggish current, are necessary for them. In such situations, their dark green and generally cordiform leaves are seen floating on the surface, and here and there a bright yellow or pure white cupshaped flower of considerable size will be seen to attract the eye, and gratify the beholder. Are these the offspring of the water? is the first enquiry of the untutored stranger. But a slight investigation sets queries at rest. The long pliant peduncles and leaf stalks are found to be attached to a massive root of some hardness and consistency, embedded in the oozy bottom.

The *Nymphœa odorata*, or white water lily, no stranger to Canada, is rarely seen in the regions north of the Province, but the *Nuphar lutea*, or yellow pond lily, is fond of the colder latitudes. Sir John Richardson brings it up to latitude 55°, or places in his first zone on the east side, and as far as 58° on the west side of the continent. In the longitude of lake Winipeg, 55° is certainly within its bounds, but it may be observed here that Sir John defines this zone of 45° to 55° as an isothermal one, not exactly one of latitude. It corresponds nearly with the strongly wooded district south of the lichen covered barren grounds, from which we may suppose it to be separated, by a line running from latitude 52° or 53°, on the Labrador peninsula, up to 58° or even 60°, in the longitude of 120°, or the neighbourhood of the Rocky Mountains. In this section of the country, viz: Lake Winipeg, the Nuphar lutea is particularly abundant. Its shining yellow flowers, less chaste and delicate than those of nymphæa, are everywhere to be seen on our shoal and muddy lakes, and they greet us at every turn of those winding streams, that drag their dull courses through the dark and continuous forests, that cover the Chippewa and Cree lands. A thick fringe of sedges and reeds may in these lazy rivers occupy the approach to the shore, but where the water deepens, the Nuphar lutea dots the expanse, its leaves and flowers clinging to the surface, as if they had been actually glued thereto. The dash of the paddle or stroke of the oar alone disturbs their quiet.

Order—*Sarraceniaceæ.*

One genus of plants constitutes this remarkable order. and it comprises only six species, confined almost entirely, I believe, to North America. We have but one species in the British possessions, the *Sarracenia purpurea.* It occurs every where, extensively diffused throughout the marshy and swampy wastes, as far as Bear's Lake north, and the Rocky Mountain West. Where timber is stinted in growth, and the moss is unshaded, it springs from its damp sphagnous bed in great perfection. Its vase-shaped leaf is attractive as a rare form of vegetable growth. Fairies might adopt it as a drinking cup. After rain it may be had nearly filled with water, and the goblet then tells many a tale of death, disaster and woe. Many small insects—often of the dipterous order, Chironomi, Tanypi, and other minute airy forms—retiring probably for shelter from the storm, in this house of refuge end their short day. Overwhelmed by some drop, to them a water spout, they may have died struggling in the abyss profound, or perhaps, having performed the great mission of their life, they may have tranquilly given up the ghost, within this deep funereal urn, by nature prepared for them, and chosen by themselves—*memorials even they* of their Great Creator's marvellous attributes, power and skill.

At the season when the flower of the Sarracenia purpurea is in full expansion, the plague of mosquitoes has commenced, and then 'tis only the most determined, zealous botanist who will penetrate into the swampy recesses, where this singular plant abides. In early winter when the frozen surface affords firm footing, and the snow has scarcely covered the ground, the sportsman crashes over its frosted and brittle cup that rises from the moss and seems to claim from him a more cautious step. It is but a leaf, yet a rare specimen of nature's incomprensible handywork, and therefore a vessel which her thoughtful admirers dislike to destroy.

Sir John Richardson in his excellent tables places this plant in the eastern prairies, as well as in the western district. He probably means that it is to be found in those outskirting woods and swamps that encroach in many places on the prairie lawns. We must not conclude that it occurs on those dry plains and grassy meadows, which, ocean-like, spread over the interior of the country.

Order—*Papaveraceæ.*

From the genus Papaver, the poppy, Jussieu, the reviver, if not the founder of the natural system of botany, drew the name for this order of plants, of which Torrey has given nine or ten genera, as pertaining to North America. These genera contain but one or two species each, with the exception of Eschscholtzia or Chryseis, of which there are five enumerated by him, natives of California. The milky juices of the Papaveraceæ may serve sometimes as a guide to the young collector, when he is at a loss in determining the place of a plant, possessed of two deciduous sepals, four cruciform petals, and hypogynous stamens.

The *Papaver nudicaule* is the most northern plant of the poppy kind. It is found by travellers along the whole extent of our northern coast from latitude 64° on the eastern side of McKenzie river, and from 68° on the western side to the ocean. We hear of it also on the islands of the Arctic Sea, in Greenland and Spitzbergen. It therefore closely encircles the great polar basin by an arc of 180° of longitude, or half the circumference of the whole arctic region. It was found as an alpine production by Drummond at great heights on the Rocky Mountains, from latitude 52° to latitude 55°. We have good reason to conclude, that following the great ridges northwards, this plant may keep its *climatal* altitude, descending by degrees in its elevation until it reach the coast level, thus keeping up a strict and decided connection along 20° of latitude, between its arctic and highest alpine habitats. This most interesting little plant, hardy yet slender, endures the storms, and braves all the inclement weather of the boreal regions, and like the Esquimaux, courts not the shelter of the woody district. It prefers the bleak coast and dreary barrens, indifferent to all the rude treatment it receives from the boisterous elements. It is decreed by nature that each of her subjects shall occupy a certain position on the earth's surface, and everything has been arranged and kindly fitted by her for such her purpose. This is the only poppy truly native of North America. Those species seen in uncultivated waste ground in Canada and the States have been introduced.

The *Sanguinaria Canadensis* or bloodroot, common in the milder parts of Canada, is not to be met with north of the Province. Torrey assigns it place as far south as Florida, and west to the Mississippi. In Canada the flowers rise as soon as the snow is gone, about the end of April; further south, March is the month it appears in. Lindley in his system (page 8) has called it the "Puccoon," which I suspect is a mistake, that name being given to another plant, the Batschia canescens, the root of which is used to *dye a red* by the native tribes. The root of the Sanguinaria having a red juice may have led the compiler to consider it the Puccoon.

There are soil and situations suitable for the Sanguinaria below Quebec, but I have not observed it so low down on the St. Lawrence, and certainly it does not pass below the Saguenay.

That beautiful genus, the Eschscholtzia of Chamisso, changed by Torrey to the name of Chryseis, is not known native, east of the Rocky Mountains. The five species now discovered all keep to the belt of country bordering on the Pacific, south of the river Columbia. In the valley of the Multnomah or Walhamet, on which is built the city of Oregon, the rich colour and brilliant *Chryseis californica* occurs, in latitude 43°, proceeding southward into California. In that still warmer land the closely allied species *C. crocea*, *C. cæspitosa*, *C. tenuifolia*, and *C. hyperoides*, beautify the plains and meadows. The Chryseis Californica was first discovered by Menzies, but afterwards described by the Russian naturalists accompanying Kotzbue. The other species were made known by Douglas, who was for a short time engaged botanizing California.

Although growing in a country where there is scarcely any winter frost, and where the summer heat is intense, this genus nevertheless appears to possess that hardiness that fits it to become an ornament to gardens even in the coldest parts of our Province. In latitude 54° north, it is cultivated as a hardy annual with the greatest care, and if left to itself, it becomes a weed in the borders, still retaining, however, undiminished beauty. The other genera of this order, existing native of North America are found south, and are never seen, unless in a cultivated state, within the British territory. The *Argemone Mexicana* and *Meconopsis diphylla* are both denizens of the Western States. The *Meconopsis heterophylla*, and *M. crassifolia*—with a single species each of the new genera, Dendromecon, Meconella, Platystigma and Platysteman,—hold ground still farther to the westward, in California and the Oregon.

With the exception of papaver nudicaule, all the plants of this order, just passed under review, prefer a mild climate, and the Sanguinaria, of which there is but one species, is the sole representative of the order in Canada. The southern half of the temperate zone holds the others.

Generally speaking, the constitution of the papaveraceæ may be said to be more sensitive and less able to bear change than the Ranunculaceæ to which they are closely allied. The area over which each species spreads itself is much more narrowly limited than with the Ranunculaceæ. The eastern species do not traverse the great water shed to the westward, neither do the western species cross to this side. We may therefore decidedly infer, that compared with the other order, they have less pliability of habit, and greater susceptibility under changes of climate. The Eschscholtzia, however, when cultivated, accommodates itself to very different temperatures and situations from those whence it was originally taken. As for our little northern poppy it takes a wide range in place, but a small one in temperature and climate.

Lindley says that two-thirds of the species of Papaveraceæ are found in Europe, yet of his total thirteen genera, we have produced seven, as occurring in North America. In fact this Continent possesses as nearly as many genera as Europe, but as most of them contain but one species, we need be little surprised at Europe having a greater number of individual species. In all other quarters of the globe Papaveraceæ are scarce.

Order—*Fumariaceæ.*

The Fumariaceæ are in many points akin to the Papaveraceæ, such as the number of deciduous sepals, the four cruciate petals, and usually one called capsules. They shew also a tendency to imitate some of the Ranunculaceæ in the spurred inflorescence and divided leaves. We have three genera existing in Canada, Dielytra, Adlumia and Corydales.

The first of these is familiar enough to our rusticating children in the pretty *Dielytra cucullata*, or Dutchman's breeches. At the confluence of the Ottawa with the St. Lawrence it is plentiful in different localities. From our north shores it extends south to Kentucky. It has never been seen in the central Prairies. Yet the Blue Mountains round which the south fork of Lewis and Clarke winds, is noted as one of its residences. Elsewhere west of the Rocky Mountains it has not, to my knowledge, been heard of. It may however occur in the volcanic ranges of mounts Hood and Rainier. A great distance indeed have these Cucullarias strayed from their kith and kin on the banks of the St. Lawrence.

The *Dielytra Canadensis*, or squirrel corn, very like the last, is its companion in Canada and the States, but does not trouble itself by travelling so far westward as the Cucullaria. Neither of them appear in the Hudson's Bay Company's Territories.

The *D. formosa* is a southern species, confined apparently to the States of Virginia and South Carolina. The *D. saccata* of Nuttall is the *D. eximia* of Hooker, and inhabits the shady woods of the Oregon.

The single species of the genus Adlumia I have never had the pleasure of collecting, although it be native of Canada. Like the Dielytras, it extends southwards into the States, but not to the northward of the Province.

Last to be mentioned as a genus of the Fumariaceæ inhabiting British North America is Corydalis. The *C. aurea* has a very extended range. It occurs throughout Canada to as far as Georgia, and westward from that to the Rocky Mountain, along the Arkansas and Missouri. It is seen occasionally on the canoe route into the far northwest, tufted among the spongy ground, where springs spread over upon the rocks along shore. In the useful tables of Sir John Richardson three species of Corydalis are assigned to the zone occupying the space from the Arctic circle to 72° north, or to the coast; this species must be one of these. Possibly it does not enter this zone until it gets westward to the banks of the Coppermine and McKenzie's Rivers. Drummond found it in the Rocky Mountains from 52° to 57° north latitude.

Corydalis glauca must be the other Corydalis that reaches the Arctic circle in the eastern district. It is a more common plant along our rivers than the *C. aurea*, and probably is as hardy. It is met with generally in more exposed situations, and in drier ground. It stretches from the north shore of the St. Lawrence, from below the entrance of the Saguenay, extending itself through Canada, and is met with as far south as North Carolina. In canoe travelling in the interior of the north it forms an agreeable object to the sight, often pendant upon the steeply inclined rocks, rising out of the debris and moss collected in their clefts, its variegated flowers and glaucous leaves, shewing to great advantage upon the sombre back ground.

The third Corydalis mentioned by Sir John as an Arctic species should be the *C. pauciflora* of Persoon. Kotzbue Sound is the locality given it. This is near the island of St. Lawrence in Behrings Straits, where Chamisso also noted it. Has it crept from the Asiatic continent by taking passage on some navigating drift stick, or has it had place on our continent before we were seperated from Asia by some mighty throe of the volcanic elements?

Two perennial species, one the *C. Scouleri* of Hooker, named after Dr. Scouler of Glasgow, who accompanied Douglas on his first voyage to the Columbia, and the other the *C. monophylla* of Nuttall, are confined to the northwest coast. The C. Scouleri is plentiful at the confluence of the Columbia with the Pacific, and extends in shady woods along the coast. If it be the same as the *C. pœnoiœ folia* of Siberia, why should it not also be found at the Russian settlements towards Sitka? Has the question as to the identity of these two plants been yet determined? The Corydalis macrophylla has been passed over by Douglass as being the same as the C. Scouleri. I know for a certainty he explored repeatedly the Wahlamet woods and prairies, especially about the falls, where the city of Oregon has since been founded, and he must have observed such a plant growing in abundance in that vicinity. If it be specifically different from the C. Scouleri, we are indebted to Mr. Nuttall's discrimination for an addition to the original American stock of this elegant genus.

Lindley in his list gives fifteen genera to the order Fumariaceæ, but only the three that I have gone over belong to North America. The Corydales take a much more extended range than the Dielytræ, and choose also more rocky ground. With them I close my remarks upon the first family or alliance of the large group of albuminose plants,—the RANALES of Lindley, from which he excludes the Sarraceniaceæ. I believe, however, that whatever relation Sarracenia as a genus may hold to other plants, its position as chosen for it by Torrey, between Nymphæaceæ and Papaveraceæ, will by most people be considered correct.

ARTICLE V.—*Report of the Geological Survey of Canada, 1853 to 1855. (494 pages 8vo., with 4to. Atlas of Maps.*

It is some compensation for the absence of regular reports of progress, caused by the occupation of Sir W. E. Logan with the exhibition of Canadian products in Paris, to find the accumulated reports of several years now issued in a respectable volume, with an amount of elaboration and illustration giving them a much more readable and permanent character than that which usually attaches to reports of progress. The present report is in effect a treatise on several important parts of the geology of Canada, illustrated with valuable and accurate maps, and embracing not only the usual accounts of the progress of the survey, but systematic descriptions of many important fossils, and carefully prepared essays on theoretical and practical points that have occurred during the work of the explorers in past years.

The portion of the volume relating to the personal explorations of the head of the survey, is occupied with the intricate and difficult subject of the structure of that great Laurentian district stretching along the whole northern side of the settled portion of Canada, and as we have long thought practically limiting the extension of population in this direction. This question must, however, depend on several points only to be ascertained by such labour as that at present being performed by the survey. The streams and valleys of a country such as that in question are sure to extend along its better parts; and the ordinary traveller passing along these, and knowing nothing of the intervening forest-clad ridges and table lands, except their effect as distant objects in the landscape, must form exaggerated ideas of the value of the country as a field for immediate settlement. On the other hand, he sees little of the mineral riches which may be present, and which in a different way may render such regions available.

The previous reports of Sir W. E. Logan have left on the minds of Geologists the conviction that all that part of Canada lying north of a line drawn from the S. E. angle of Georgian Bay to Kingston, and thence along the north side of the St. Lawrence to Labrador, consists mainly of gneissose rocks, like those of the highlands of Scotland and Scandinavia, with the exception of a triangular patch between the mouth of the Ottawa and the St. Lawrence, and a narrow stripe reaching thence as far as Quebec. In short, those great regions lying north of the river and great lakes, and of the lines above indicated, are mapped as consisting of the rock formations of which a specimen is seen in the Thousand Islands, and are presumably similar to these in their agricultural capabilities. Canada, for practical purposes, thus appears to consist of the Silurian regions lying south of the river and around the mouth of the Ottawa, and of the great Silurian and Devonian peninsula of the Upper Province. The remainder, though presenting cultivable valleys, may in the main be regarded as unproductive, and not likely for some time to enter into competition wlth the rich lands of the west.

It is very probable that these views may have had some connection with the selection of Ottawa as a seat of Government. Situated nearly at the apex of the triangular tract above referred to, it forms the last outpost to the northward, of the great Silurian plains of Canada, and might therefore be regarded as a favourable point for bringing the wealth and population of the more valuable parts of the province to bear on the improvement of the rocky and intractable Laurentian country. It seems inconceivable that any civilized Government in settling such a question should leave out of sight those geological conditions which determine beforehand the resources and population of countries. A glance at the beautiful little map attached to the essay prepared by Sir William and Mr. Hunt for the Paris exhibition, is sufficient to show that this important element of the question admits of no other interpretation than that which we have given; and taking this into account, it would be extreme folly to place the capital of a great and fertile country in the midst of a desolate region, apparently destined through all time to have a comparatively sparse and poor population, unless with some such view as that above hinted.

All this depends however, on the relative extent, within the Laurentian region, of rocks capable of affording fertile soils; and in the present report Sir W. E. Logan has addressed himself to this question. We shall give his results, so important to a correct estimate of this great subject, in his own words:—

" *Limestone and Lime-feldspars.*—The crystalline limestones of the Laurentian series are quite as good for all the economic purposes to which carbonate of lime is applied, as the earthy limestones of the fossiliferous formations. It is from the latter, however, that is obtained nine-tenths of the material used throughout the country, for the very good reason that more than nine-tenths of the works of construction, both public and private, are raised upon the fossiliferous rocks, and for such present works these rocks therefore afford the nearest sources of supply. Thus the inhabitants are well acquainted with the aspect of the fossiliferous limestones, and can easily recognise them, but very few of them understand the nature of the highly crystalline calcareous beds of the Laurentian series. Hence it is that settlers in the back townships, who have dwelt many years upon these rocks, have been accustomed, when in want of lime for the manufacture of potash, or the construction of their chimneys, to send to the fossiliferous deposits for it—the distance being sometimes thirty miles—when it might have been obtained at their own doors. In following out the calcareous bands of the gneiss district, in 1853, therefore, especial pains were taken to point out their character to the settlers, wherever exposures were met with; and in visiting some of the same localities last season, I had the satisfaction of finding lime-kilns erected, and lime burnt in four of them.

The fossiliferous rocks, in a large part of Canada, maintaining an attitude approaching horizontality, give a much more even surface than the corrogated series coming from beneath them, and this, combined with a generally good soil, renders them more favourable for agricultural purposes. It is over them, too, that the River St. Lawrence maintains its course, affording an unrivalled means of exit for the produce of the land, and of entrance for the materials that are to be received in exchange. It is only a natural result of these conditions that the area supported by the fossiliferous rocks should be the first settled. This area, however, constitutes only between 60,000 and 80,000 square miles, while the whole superfices of Canada comprehends 330,000 square miles. or about five times the amount.

Four-fifths of Canada thus stand upon the lower unfossiliferous rocks, and it becomes a question of some importance, before it has been extensively tested by agricultural experiments, to know what support this large area may offer to an agricultural population. An undulating surface, derived from the contorted condition of the strata on which it rests, will more or less prevail over the whole of this region ; but the quality of its soil will depend on the character of the rocks from which it is derived.

These rocks, as a whole, have very generally been called granite, by those travellers who with little more than casual observation have described them, without reference to geological considerations. The ruins of granite are known to constitute an indifferent soil from their deficiency in lime, and hence an unfavourable impression is produced in respect to the agricultural capabilities of any extended area, when it is called granitic. Such soils are however never wanting in those essential elements the alkalies, which are abundant in the feldspars of the granite.

In the reports of the survey, the Laurentian rocks have been described in general terms as gneiss, interstratified with important masses of crystalline limestone. The term gneiss, strictly defined, signifies a granite with its elements, quartz, feldspar and mica, arranged in parallel planes, and containing a larger amount of mica than ordinary granite possesses, giving to the rock a schistose or lamellar structure. When hornblende instead of mica is associated with quartz and feldspar, the rock is termed syenite, but as there is no distinct specific single name for a rock containing these elements in a lamellar arrangement, it receives the appellation of syenitic gneiss.

Gneiss rock then becomes divided into two kinds, granitic and syenitic gneiss, and the word gneiss would thus appear rather to indicate the lamellar arrangement than the mineral composition. Granitic and syenitic gneiss were the terms applied to these rocks in the first reports; but as granite and syenite are considered rocks of igneous origin, and the epithets derived from them might be supposed to have a theoretical reference to such an origin of the gneiss, while at the same time it appears to me that the Laurentian series are altered sedimentary rocks, the epithets, micaceous and hornblendic have been given to the gneiss, in later reports, as the best mode of designating the facts of mineral composition, and lamellar arrangement, without any reference whatever to the supposed origin of the rocks. When the general term gneiss therefore is used, it may signify both kinds, or either; and the epithets micaceous and hornblendic are applied to the rock to indicate that the mica greatly preponderates or excludes the hornblende, or the hornblende the mica.

In no part of the area included in this report is hornblende completely absent from the gneiss, and sometimes it predominates over the mica; hornblende contains from ten to fifteen per cent. of lime, so that the ruins of the rocks of the area, such as they have been described, whether gneiss, greenstone, syenite, or porphyry, would never give a soil wholly destitute of lime. Of this necessary ingredient, the lime feldspars would be a more abundant source. Different species of them from andesin to anorthite, may contain from about five up to twenty per cent. of lime, and the range of those Canadian varieties which have been analyzed by Mr. Hunt. is from seven to about fifteen per cent. The personal exploration which is the subject of the present report, has shewn, for the first time, that these lime feldspars occur in this province, and probably in other regions, in mountain ranges, belonging to a stratified deposit, and not in disseminated or intrusive masses. The breadth of these displayed in the district examined, demonstrates their importance; and the fact that the opalescent variety of labradorite was ascertained by Dr. Bigsby to exist, *in situ*, on an island on the east cost of Lake Huron, while the name of the mineral reminds us of its existence at the eastern extremity of the Province, sufficiently points out that the lineal range of the lime-feldspars will be co-extensive with Canada. We may therefore anticipate a beneficial result from their influence upon the soils, over the whole breadth of the province.

The ruins of the crystalline limestone constitute a most fruitful soil, so much so that the lots first cleared in any settled area of the Laurentian country, usually coincide with its range. In these limestones phosphate of lime is sometimes present in great abundance, and there is scarcely ever any large exposure of them examined, in which small crystals of the phosphate are not discernable by the naked eye. Mica and iron pyrites are present, to furnish other essential ingredients, and the easily disintegrating character of the rock readily permits its reduction to a soil. The effects of these limestones and lime-feldspars are not however confined to the immediate localities in which the beds are found, for boulders of them are met with transported to southern parts, even far on the fossiliferous rocks beyond; and there can be little doubt that their fragments are very generally mixed with the soils of the Laurentian country. Thus while the diversity of minerals in the different rocks of the series furnishes the ingredients required to constitute good soils, the agency of the drift has mingled them, and considering the resistance to disintegration offered by most of the rocks, with the exception of the limestome, the deficiencies that may exist will rather be in the quantity of soil covering the rocks in elevated parts, than in its quality where the materials have been accumulated."

The question of the agricultural value of the Laurentian district thus hinges on the proportion of limestone and lime-feldspar. but especially of the former, as it alone gives a deep and low-lying soil, containing the elements of fertility. The settlers, without knowing anything, of the causes, have discovered the relative value of these soils, and hence we are informed that the clearings stretch along the limestone valleys almost exclusively. These narrow belts, which we may roughly estimate as amounting, in the districts referred to in this report, to from one-sixth to one-tenth of the whole, may be regarded as of great agricultural value. Such portions of the intervening hilly country as have received a considerable share of calcareous debris, and are not too steep, rocky, or stony, to admit of cultivation, may, when labour becomes cheaper, be profitably converted into farms or sheep pastures. In the meantime, they will supply an enormous quantity of valuable timber. Gradually there will grow up in the glens of the Laurentian territory, a race of hardy Canadian hill-men, who, if sufficiently leavened by the elevating influences of Christianity and education, will be of inestimable value to the country, both in peace and war. For a long time, however, it is evident that the west must drain from this country its agricultural population, and that the lumberer will have it as his special patrimony.

The miner, however, has found his way thither, and will without doubt find remuneration for his toil. Among the useful minerals and rocks of the region, mentioned in this report, are magnetic iron ore, the most valuable of all the ores of that metal; plumbago; lead; mica for stove fronts, &c.; buhrstone, the well-known material of the French millstones; garnet, useful as a substitute for emery; marble and building stones of many varieties. The Labradorite of the lime-feldspar region is a beautiful ornamental stone, presenting fine opalescent reflections, and admits of being polished for a great variety of ornamental purposes. The time may come when hundreds of tons of this rock may be daily borne about on the persons of fair ladies, in brooches, bracelets, and other articles of bijouterie, greatly to the profit of the industrious lapidaries, who may locate themselves on the sunny sides of the ridges of lime-feldspar.

We have as yet said nothing as to the scientific value of the labors of Sir W. E. Logan in the Laurentian district. This subject has been already referred to in our notices of the American Association, at the last meeting of which two papers on these rocks were read. It is only necessary to add that the curious unravelling of the intricacies of these deposits, evidenced in the present report, displays great scientific skill, and will lead to most interesting deductions as to the original nature and arrangement of the sediments out of which these highly metamorphosed and strangely distorted rocks have been formed.

In the conclusion of his special portion of the Report, Sir William refers to his general geological map now in progress. We know that almost incredible pains and precaution have been taken to ensure absolute accuracy in the representation of Canada in this map. When published, accompanied as we trust it will be by a suitable letter-press description, embracing the substance of the reports of progress, it will mark an era in the scientific and industrial progress of Canada. Its internal evidence of accuracy, and the reputation of its author, will render it a standard authority in physical geography; and it will do much to spread throughout the world the reputation not only of the material resources of our country, but of the enlightenment and public spirit of its legislature and people.

The second part of the report includes a large amount of painstaking and accurate work done by Mr. Murray in the difficult region lying between Georgian Bay and the Ottawa, an unpromising country, consisting in great part of ridges of gneiss alternating with swamps, though containing pine, cedar, and other kinds of timber in considerable quantity. It bids fair also to be productive of iron and copper and the other minerals of the Laurentian and Huronian rocks.

The remainder of the report, consisting of the investigations of Mr. Richardson, Mr. Billings, and Prof. Hunt, contains so much matter both of commercial and scientific importance that we must defer its consideration to another number. J. W. D.

(*To be continued.*)

ARTICLE VI.—*A List of Indigenous Plants found growing in the Neighbourhood of Prescott, C. W., under the Nomenclature of Gray.* By B. BILLINGS, Jr.

RANUNCULACEÆ.

Clematis Virginiana,	Linn.	Common Virgin's Bower.
Anemone Virginiana,	Linn.	Tall Anemone.
" *Pennsylvanica,*	Linn.	Pennsylvanian Anemone.
Hepatica acutiloba,	De Candolle	Sharp-lobed Hepatica.
Thalictrum dioicum,	Linn.	Early Meadow-Rue.
" *Cornuti,*	Linn.	Tall Meadow-Rue.
Ranunculus abortivus,	Linn.	Small-flowered Crowfoot.
" *recurvatus,*	Poiret.	Hooked Crowfoot.
" *repens,*	Linn.	Creeping Crowfoot.
" *acris,*	Linn.	Tall Crowfoot.
Caltha palustris,	Linn.	Marsh Marigold.
Coptis trifolia,	Salisbury.	Three-leaved Goldthread.
Aquilegia Canadensis,	Linn.	Wild Columbine.
Actæa spicata, alba,	Michaux.	White Baneberry.

MENISPERMACEÆ.

Menispermum Canadense,	Linn.	Canadian Moonseed.

BERBERIDACEÆ.

Caulophyllum thalictroides,	Michaux.	Blue Cohosh.
Podophyllum peltatum,	Linn.	May-Apple.

NYMPHÆACEÆ.

Nymphæa odorata,	Aiton.	Sweet-scented Water-Lily.

PAPAVERACEÆ.

Sanguinaria Canadensis,	Linn.	Blood-root.

FUMARIACEÆ.

Dicentra Cucallaria,	De Candolle.	Dutchman's Breeches.
" *Canadensis,*	De Candolle.	Squirrel-Corn.

CRUCIFERÆ.

Nasturtium palustre,	De Candolle.	Marsh Cress.
Dentaria diphylla,	Linn.	Pepper-root.
Turritis stricta,	Graham.	*Straight Tower Mustard.
Erysimum cheiranthoides,	Linn.	Worm-seed Mustard.
Sisymbrium officinale,	Scopoli.	Hedge Mustard.
" *canescens,*	Nuttall.	Tansy Mustard.
Sinapis arvensis,	Linn.	Field Mustard.
Capsella bursa-pastoris,	Mœnch.	Shepherd's Purse.

VIOLACEÆ.

Viola blanda,	Wildenow.	Sweet White Violet.
" *cucullata,*	Aiton.	Common Blue Violet.
" *rostrata,*	Pursh.	Long-Spurred Violet.
" *Muhlenbergii,*	Torrey:	American Dog Violet.
" *pubescens,*	Aiton.	Downy Yellow Violet.

HYPERICACEÆ.

Hypericum perforatum,	Linn.	Common St. John's-wort.
" *corymbosum,*	Muhlenberg,	*Corymbed St. John's-wort.
" *Canadense,*	Linn.	*Canadian St. John's-wort.
Elodea Virginica,	Nuttall.	*Virginian Elodea.

CARYOPHYLLACEÆ.

Silene noctiflora,	Linn.	Night-flowering Catch-fly.
Agrostemma Githago,	Linn.	Corn-Cockle.
Stellaria media,	Smith.	Common Chickweed.
" *longifolia,*	Muhlenberg.	Stitchwort.
Cerastium viscosum,	Linn.	Larger Mouse-ear Chickweed.

PORTULACACEÆ.

Portulacca oleracea,	Linn.	Common Purslane.
Claytonia Caroliniana,	Michaux.	Broad-leaved Spring Beauty.

MALVACEÆ.

Malva rotundifolia,	Linn.	Common Mallow.

TILIACEÆ.

Tilia Americana,	Linn.	Basswood.

OXALIDACEÆ.

Oxalis stricta,	Linn.	Yellow Wood-Sorrel.

GERANICEÆ.

Geranium maculatum,	Linn.	Wild Cranesbill.

BALSAMINACEÆ.

Impatiens fulva,	Nuttall.	Spotted Touch-me-not.

ANACARDIACEÆ.

Rhus typhina,	Linn.	Staghorn Sumach.

NITACEÆ.

Nitis cordifolia,	Michaux.	Frost Grape.
Ampelopsis quinquefolia,	Michaux.	Virginian Creeper.

RHAMNACEÆ.

Ceanothus Americanus,	Linn.	New Jersey Tea.

CELASTRACEÆ.

Celastrus scandens,	Linn.	Climbing Bitter-sweet.

SAPINDACEÆ.

Acer Pennsylvanicum,	Linn.	Striped Maple.
" *spicatum,*	Lambert.	Mountain Maple.
" *saccharinum,*	Wang.	Sugar Maple.
" " *nigrum,*	Gray?	Black Sugar Maple.
" *rubrum,*	Linn.	Red Maple.

LEGUMINOSÆ.

Trifolium pratense,	Linn.	Red Clover.
" *repens,*	Linn.	White Clover.
" *procumbens,*	Linn.	Low Hop-Clover.
Robinia Pseudacacia,	Linn.	Common Locust.
Desmodium nudiflorum,	De Candolle.	*Naked-flowered Desmodium.
" *acuminatum,*	De Candolle.	*Acuminate-leaved Desmodium.
Vicia Cracca,	Linn.	Tufted Vetch.
Lathyrus palustris,	Linn.	Mars Vetchling.
Phaseolus perennis,	Walter.	Wild Bean.

ROSACEÆ.

Prunus Americana,	Marsh.	Wild Yellow or Red Plum.
" *Pennsylvanica,*	Linn.	Wild Red Cherry.
" *Virginiana,*	Linn.	Choke Cherry.
" *serotina,*	Ehrhart.	Wild Black Cherry.
Spiræa salicifolia,	Linn.	Common Meadow-Sweet.
" *tomentosa,*	Linn.	Hardhach.
Agrimonia Eupatoria,	Linn.	Common Agrimony.
Geum album,	Gmelin.	*White Avens.
" *strictum,*	Aiton.	*Yellow Avens.
" *rivale,*	Linn.	Water Avens.
Waldsteinia fragarioides,	Tratt.	Barren Strawberry.
Potentilla Norvegica,	Linn.	*Norway Cinquefoil.
" *Anserina,*	Linn.	Silver-Weed.
" *palustris,*	Scopoli.	Marsh Five-Finger.
Fragaria Virginiana,	Ehrhart.	*Wild Strawberry.
" *vesca,*	Linn.	*Common Strawberry.
Rubus odoratus,	Linn.	Purple Flowering-Raspberry.
" *triflorus,*	Richardson,	Dwarf Raspberry.
" *strigosus,*	Michaux.	Wild Red Raspberry.
" *occidentalis,*	Linn.	Black Raspberry.
" *villosus,*	Aiton.	Common or High Blackberry.

ROSACEÆ.

Rosa lucida,	Ehrhart.	Dwarf Wild-Rose.
Cratægus coccinea,	Linn.	Scarlet-fruited Thorn.
" *tomentosa punctata*,	Linn.	Black or Pear Thorn.
Pyrus arbutifolia, melanocarpa,	Linn.	Choke-berry.
Amelanchier Canadensis,	Torry & Gray.	Shad-bush.

ONAGRACEÆ.

Epilobium angustifolium,	Linn.	Great Willow-herb.
" *coloratum*,	Muhlenberg.	*Colored Willow-herb.
Œnothera biennis,	Linn.	Common Evening Primrose.
Ludwigia palustris,	Elliot.	Water Purslane.
Circæa Lutetiana,	Linn.	*Common Enchanter's Nightshade.
" *alpina*,	Linn.	*Alpine Enchanter's Nightshade.
Myriophyllum spicatum,	Linn.	*Spiked Water Milfoil.

GROSSULACEÆ.

Ribes Cynosbati,	Linn.	Wild Gooseberry.
" *floridum*,	Linn.	Wild Black Currant.

CRASSULACEÆ.

Penthorum sedoides,	Linn.	Ditch Stone-cross.

SAXIFRAGACEÆ.

Mitella diphylla,	Linn.	*Two-leaved Bishop's-cap.
" *nuda*,	Linn,	*Heart-leaved Bishop's Cap.
Tiarella cordifolia,	Linn.	False Mitre-wort.
Chrysosplenium Americanum,	Schweinitz.	Golden Saxifrage.

HAMAMELACEÆ.

Hamamelis Virginica,	Linn.	Witch-Hazel.

UMBELLIFERÆ.

Sanicula Canadensis,	Linn.	*Canadian Sanicle.
Pastinaca sativa,	Linn.	Common Parsnip.
Cicuta maculata,	Linn.	Spotted Cowbane.
" *bulbifera*,	Linn.	*Bulb-bearing Cowbane.
Sium lineare,	Michaux.	*Narrow-leaved Water Parsnip.
Cryptotenia Canadensis,	De Candolle.	Honewort.
Osmorrhiza brevistylis,	De Candolle.	Hairy Sweet Cicely.

ARALIACEÆ.

Aralia racemosa,	Linn.	Spikenard.
" *nudicaulis*,	Linn.	Wild Sarsaparilla.
" *Quinquefolia*,	Gray?	Ginseng.
" *trifolia*,	Gray?	Dwarf Ginseng.

CORNACEÆ.

Cornus Canadensis,	Linn.	Dwarf Cornel.
" *stolonifera*,	Michaux.	Red-Osier Dogwood.
" *alternifolia*,	Linn.	Alternate-leaved Cornel.

CAPRIFOLIACEÆ.

Linnæa borealis,	Gronovius.	Twin-flower.
Lonicera parviflora,	Lambert.	Small Honeysuckle.
" *ciliata,*	Muhlenberg.	Fly Honeysuckle.
Diervilla trifida,	Mœnch.	Bush Honeysuckle.
Sambucus Canadensis,	Linn.	Common Elder.
" *pubens,*	Michaux.	Red-berried Elder.
Viburnum nudum,	Linn.	Withe-rod.
" *Lentago,*	Linn.	Sweet Viburnum.
" *dentatum,*	Linn.	Arrow-wood.
" *acerifolium,*	Linn.	Maple-leaved Arrow-wood.
" *lantanoides,*	Michaux.	Hobble-bush.

RUBIACEÆ.

Galium asprellum,	Michaux.	Rough Bedstraw.
" *trifidum,*	Linn.	Small Bedstraw.
" *triflorum,*	Michaux.	Sweet-scented Bedstraw.
" *circæzans,*	Michaux.	Wild Liquorice.
" *latifolium,*	Michaux.	
" *boreale,*	Linn.	Northern Bedstraw.
Cephalanthus occidentalis,	Linn.	Button-bush.
Mitchella repens,	Linn.	Partridge-berry.

COMPOSITÆ.

Eupatorium purpureum,	Linn.	Trumpet-Weed.
" *perfoliatum,*	Linn.	Thoroughwort.
" *ageratoides,*	Linn.	White Snake-root.
Aster macrophyllus,	Linn.	*Large-leaved Aster.
" *cordifolius,*	Linn.	*Heart-leaved Aster.
" *miser,*	Linn., Aiton.	*Starved Aster.
" *tenuifolius,*	Linn.	*Slender-leaved Aster.
" *puniceus,*	Linn.	*Red-stalked Aster.
" *acuminatus,*	Michaux.	*Acuminate-leaved Aster.
Erigeron Canadense,	Linn.	Horse-weed.
" *Philadelphicum,*	Linn.	Fleabane.
" *annuum,*	Persoon.	Daisy Fleabane.
" *strigosum,*	Muhlenberg.	*Stigose Fleabane.
" *vernum,*	Torrey & Gray.	
Solidago bicolor,	Linn.	*Two-colored Golden-rod.
" *cæsia,*	Linn.	*Purple-stalked Golden-rod.
" *Muhlenbergii,*	Torrey & Gray.	*Muhlenberg's Golden-rod.
" *altissima,*	Linn.	*Tall Rough Golden-rod.
" *nemoralis,*	Aiton.	*Woolly-stalked Golden-rod.
" *Canadensis,*	Linn.	*Canadian Golden-rod.
" *serotina,*	Aiton.	*Late-flowering Golden-rod.
" *lanceolata,*	Linn.	*Bushy Golden-rod.
Inula Helenium,	Linn.	Common Elecompane.
Helianthus divaricatus,	Linn.	*Rough-leaved Sunflower.
" *decapetalus,*	Linn.	*Thin-leaved Sunflower.

COMPOSITÆ.

Bidens chrysanthemoides,	Linn.	Bur-Marigold.
" *bipinnata,*	Linn.	Spanish Needles.
Maruta Cotula,	De Candolle.	Common May-weed.
Achillea Millefolium,	Linn.	Common Yarrow.
Leucanthemum vulgare,	Lambert.	Ox-Eye Daisy.
Gnaphalium decurrens,	Ires.	Everlasting.
" *uliginosum,*	Linn.	Low Cudweed.
Antennaria margaritacea,	R. Brown.	Pearly Everlasting.
" *plantaginifolia,*	Hooker.	Plantain-leaved Everlasting.
Erecthites hieracifolia,	Rafinesque.	Fireweed.
Centaurea Cyanus,	Linn.	Bluebottle.
Cirsium lanceolatum,	Scopoli.	Common Thistle.
" *discolor,*	Sprengel.	Two-Coloured Thistle.
" *arvense,*	Scopoli.	Canada Thistle.
Lappa major,	Gærtner.	Common Burdock.
Hieracium Canadense,	Michaux.	Canada Hawkweed.
" *scabrum,*	Michaux.	Rough Hawkweed.
Nabalus albus,	Hooker.	Rattlesnake-root.
" *altissimus,*	Hooker.	Tall White Lettuce.
Taraxacum Densleonis,	Desfontaines.	Common Dandelion.
Lactuca elongata,	Muhlenberg.	Wild Lettuce.
Sonchus asper,	Villars.	Spring-leaved Sow-Thistle.

LOBELIACEÆ.

Lobelia cardinalis,	Linn.	Cardinal-flower.
" *inflata,*	Linn.	Indian Tobacco.

COMPANULACEÆ.

Companula aparinoides,	Pursh.	Marsh Bellflower.

ERICACEÆ.

Gaylussacia resinosa,	Torrey & Gray.	Black Huckleberry.
Vaccinium macrocarpon,	Aiton.	Common American Cranberry.
Chiogenes hispidula,	Torrey & Gray.	*Creeping Snowberry.
Gaultheria procumbens,	Linn.	Creeping Wintergreen.
Pyrola rotundifolia,	Linn.	Round-leaved Pyrola.
" *elliptica,*	Nuttall.	Slim-leaf.
" *secunda,*	Linn.	One-sided Pyrola.
Moneses uniflora,	Salisbury.	One-flowered Pyrolla.
Chimaphila umbellata,	Nuttall.	Prince's Pine.
Monotropa uniflora,	Linn.	Indian Pipe.

AQUIFOLIACEÆ.

Ilex verticillata,	Gray ?	Black Alder.
Nemopanthes Canadensis,	De Candolle.	Mountain Holly.

PLANTAGINACEÆ.

Plantago major,	Linn.	Common Plantain.

PRIMULACEÆ.

Trinitalis Americana,	Pursh.	Star-flower.
Lysimachia stricta,	Aiton.	*Upright Loosestrife.
" *ciliata,*	Linn.	*Ciliate Loosestrife.
Naumburgia thrysiflora,	Reichenb.	Tufted Loosestrife.

OROBANCHACEÆ.

Epiphegus Virginiana,	Barton.	Beech-drops.

SCROPHULARIACEÆ.

Verbascum Thapsus,	Linn.	Common Mullein.
Linaria Vulgaris,	Miller.	Toad-Flax.
Chelone glabra,	Linn.	Snake-head.
Mimulus ringens,	Linn.	Monkey-flower.
Veronica Anagallis,	Linn.	Water Speedwell.
" *Americana,*	Schweinitz.	American Brookline.
" *scutellata,*	Linn.	Marsh Speedwell.
" *serphyllifolia,*	Linn.	Thyme-leaved Speedwell.
Pedicularis Canadensis,	Linn.	Common Lousewort.

VERBENACEÆ.

Verbena hastata,	Linn.	Blue Vervain.
" *urticifolia,*	Linn.	White Vervain.
Phryma Leptostachya,	Linn.	Lopseed.

LABIATÆ.

Teucrium Canadense,	Linn.	American Germander.
Mentha Canadensis,	Linn.	Wild Mint.
Lycopus Virginicus,	Linn.	Bugle-weed.
" *Europæus, sinuatus,*	Linn.	*Common Water Hoarhound.
Lophanthus scrophulariæfolius,	Bentham.	*Purple Giant Hyssop.
Nepeta Cataria,	Linn.	Catnip.
Brunella vulgaris,	Linn.	Common Self-heal.
Scutellaria galericulata,	Linn.	*Common Skullcap.
" *lateriflora,*	Linn.	*Mad-dog Skullcap.
Galeopsis Tetrahit,	Linn.	Common Hemp-Nettle.
Strachys palustris, glabra,	Linn.	*Marsh Hedge Nettle.
Leonurus Cardiaca,	Linn.	Common Motherwort.

BORRAGINACEÆ.

Echium vulgare,	Linn.	Blue-weed.
Lythospermum officinale,	Linn.	Common Gromwell.
Echinospermum Lappula,	Lehmann.	Stickseed.
Cynoglossum officinale,	Linn.	Common Hound's-Tongue.
" *Morisoni,*	De Candolle.	Beggar's Lice.

CONVOLVULACEÆ.

Calystegia sepium,	R. Brown.	Hedge Bindweed.

SOLONACEÆ.

Solanum Dulcamara,	Linn.	Bittersweet.
" *nigrum,*	Linn.	Common Nightshade.

SOLONACEÆ.

Hyoscyamus niger,	Linn.	Black Henbane.
Datura Stramonium,	Linn.	Common Stramonium.

APOCYNACEÆ.

Apocynum androsæmifolium,	Linn.	Spreading Dogbane.

ASCLEPIADACEÆ.

Asclepias Cornuti,	Decaisne.	Common Milkweed.
" *phytolacoides,*	Pursh.	Poke Milkweed.
" *incarnata,*	Linn.	Swamp Milkweed.

OLEACEÆ.

Fraxinus Americana,	Linn.	White Ash.
" *pubescens,*	Lamarck.	Red Ash.
" *sambucifolia,*	Lamarck.	Black Ash.

ARISTOLOCHIACEÆ.

Asarum Canadense,	Linn.	Wild Ginger.

CHENOPODIACEÆ.

Chenopodium album.	Linn.	Lamb's Quarter.
Blitum capitatum,	Linn.	Strawberry Blite.

AMARANTACEÆ.

Amarantus hybridus,	Linn.	Green Amaranth.
" *albus,*	Linn.	

POLYGONACEÆ.

Polygonum amphibium aquaticum,	Linn.	Water Persicaria.
" " *terrestre,*	Linn.	
" *Persicaria,*	Linn.	Lady's Thumb.
" *Hydropiper,*	Linn.	Smart-weed.
" *acre,*	H. B. K.	Wild Smart-weed.
" *aviculare,*	Linn.	Knotgrass.
" *saggitatum,*	Linn.	Arrow-leaved Tear-Thumb.
" *Convolvulus,*	Linn.	Black Bind-weed.
" *cilinode,*	Michaud.	*Fringe-jointed Knotweed.
Rumex verticillatus,	Linn.	Swamp Dock.
" *Hydrolapathum,*	Hudson.	Great Water-Dock.
Rumex crispus,	Linn.	Curled Dock.
" *Acetosella,*	Linn.	Sheep Sorrel.

THYMELEACEÆ.

Dirca palustris,	Linn.	Leatherwood.

SANTALACEÆ.

Comandra umbellata,	Nuttall.	*Bastard Toad-flax.

EUPHORBIACEÆ.

Euphorbia Helioscopia,	Linn.	Sun Spurge.

URTICACEÆ.

Ulmus fulva,	Michaux.	Red Elm.
" *Americana,*	Linn.	White Elm.
" *racemosa,*	Thomas.	Corky White Elm.
Urtica gracilis,	Aiton.	Tall Wild Nettle.
" *urens,*	Linn.	Small Stinging-Nettle.
Laportea Canadensis,	Gandich.	Wood Nettle.
Pilea pumila,	Lindley.	Richweed.
Bœhmeria cylindrica,	Wildenow.	False Nettle.
Canabis sativa,	Linn.	Hemp.

JUGLANDACEÆ.

Juglans cinerea,	Linn.	Butternut.
Carya alba,	Nuttall.	Shell-bark Hickory.
" *amara,*	Nuttall.	Bitter-nut.

CUPULIFEREÆ.

Quercus macrocarpa,	Michaux.	Bur-Oak.
" *alba,*	Linn.	White Oak.
" *rubra,*	Linn.	Red Oak.
Fagus ferrugina,	Aiton.	American Beech.
Corylus rostrata,	Aiton.	Beaked Hazel-nut.
Carpinus Americana,	Michaux.	Hornbeam, Water Beech.
Ostrya Virginica,	Wildenow.	Hop-Hornbean, Iron-wood.

BETULACEÆ.

Betula papyracea,	Aiton.	Paper Birch.
" *excelsa,*	Aiton.	Yellow Birch.
" *lenta,*	Linn.	Cherry Birch.
Alnus incana,	Wildenow.	Speckled or Hoary Alder.

SALICACEÆ.

Salix discolor,	Muhlenberg.	Glaucous Willow.
" *rostrata,*	Richardson.	Long-beaked Willow.
" *fragilis,*	Linn.	Brittle Willow.
" *lucida,*	Muhlenberg.	Shining Willow.
" *pedicellaris,*	Pursh.	Stalk-fruited Willow.
Populus tremuloides,	Michaux.	American Aspen.
" *grandidentata,*	Michaux.	Large-toothed Aspen.
" *balsamifera,*	Linn.	Balsam Poplar.

Salix Babylonica, S. Babylonica annularis, and *Populus dilitata* and *P. Alba,* are cultivated species growing here as indigenous.

CONIFERÆ.

Pinus strobus,	Linn.	White Pine.
Albies balsamea,	Marshall.	Balsam Fir.
" *Canadensis,*	Michaux.	Hemlock Spruce.
Larix Americana,	Michaux.	American or Black Larch.
Thnja occidentalis,	Linn.	American Arbor Vitæ.

Taxus baccata, Linn. var. *Canadensis.* American Yew.

ARACEÆ.		
Calla palustris,	Linn.	Water Arum.
TYPHACEÆ.		
Typha latifolia,	Linn.	Common Cat-tail.
Sparganium ramosum,	Hudson.	*Branching Bur-Reed.
ALISMACEÆ.		
Alisma Plantago,	Linn.	Water Plantain.
Sagitaria variabilis,	Englemann.	*Common Arrowhead.
ORCHIDACEÆ.		
Orchis spectabilis,	Linn.	Showy Orchis.
Plantanthera Hookeri,	Lindley.	Smaller Two-leaved Orchis.
“ *fimbriata,*	Lindley.	Larger Purple-fringed Orchis.
Goodyera pubescens,	R. Brown.	*Rattlesnake Plantain.
Spiranthes cernua,	Richardson.	*Nodding Ladies' Tresses.
Corallorhiza innata,	R. Brown.	*Vernal Coral-root.
“ *multiflora,*	Nuttall.	*Large Coral-root.
Cypripedium parviflorum,	Salisbury.	Smaller Yellow Lady's Slipper.
IRIDACEÆ.		
Iris versicolor,	Linn.	Larger Blue Flag.
Sisyrinchium Bermudiana,	Linn.	Blue-eyed Grass.
SMILACEÆ.		
Smilax herbacea,	Linn.	Carrion-Flower.
Trillium erectum,	Linn.	Purple Trillium.
“ *grandiflorum,*	Salisbury.	Large White Trillium.
“ *erythrocarpum,*	Michaud.	Painted Trillium.
Medeola Virginica,	Linn.	Indian Cucumber-root.
LILIACEÆ.		
Polygonatum biflorum,	Elliott.	Smaller Solomon's Seal.
Smilacina racemosa,	Desfontaines.	False Spikenard.
“ *bifolia,*	Ker.	*Two-leaved Smilacina.
Clintonia borealis,	Rafinesque.	*Large-flowered Clintonia.
Allium tricoccum,	Aiton.	Wild Leek.
Erythronium Americanum,	Smith.	Yellow Adder's-tongue.
MELANTHACEÆ.		
Uvularia grandiflora,	Smith.	Large-flowered Bellwort.
Streptopus roseus,	Michaux.	*Rose Twisted Stalk.
JUNCACEÆ.		
Juncus effusus,	Linn.	Common or Soft Rush.
“ *Balticus,*	Wildenow.	*Baltic Rush.
“ *scirpoides,*	Lamarck.	
“ *nodosus,*	Linn.	*Knotty Rush.
“ *tenuis,*	Willdenow.	*Slender Rush.
“ *bufonius,*	Linn.	*Toad Rush.

CYPERACEÆ.

Cyperus inflexus,	Muhlenberg.	*Dwarf Odorous Galingale.
Dulichium spathaceum,	Persoon.	*Dulichium.
Eleocharis obtusa,	Schultes.	*Obtuse Spike Rush.
" *palustris*,	R. Brown.	*Common Spike Rush.
Scirpus lacustris,	Linn.	Bulrush.
" *Eriophorum*,	Michaux.	Wool-Grass.
Eriophorum Virginicum,	Linn.	*Rusty Cotton-Grass.
" *gracile*,	Koch.	
Carex crinita,	Lamarck.	*Fringed Sedge.
" *lacustris*,	Wildenow,	*Lake Sedge.
" *hystricina*,	Wildenow.	*Porcupine Sedge.
" *tentaculata*,	Muhlenberg.	*Long-pointed Sedge.
" *intumescens*,	Rudge.	*Swollen Sedge.
" *lupulina*,	Muhlenberg.	*Hop-like Sedge.
" *rostrata*,	Schweintz.	*Beaked Sedge.
" *cylindrica*,	Schweintz.	*Cylindrical Sedge.

GRAMINEÆ.

Leersia oryzoides,	Swartz.	Rice Cut-Grass.
Phleum pratense,	Linn.	Timothy.
Agrostis vulgaris,	With.	Red-Top.
" *alba*,	Linn.	White Bent-Grass.
Oryzopsis melanocarpa,	Muhlenberg.	*Black-fruited Mountain Rice.
Glyceria Canadensis,	Trinius.	Rattlesnake-Grass.
" *nervata*,	Trinius.	*Nervel Mana-Grass.
" *aquatica*,	Smith.	Reed Meadow-Grass.
" *fluitans*,	R. Brown.	*Common Manna-Grass.
Poa serotina,	Ehrhart.	False Red-Top.
" *pratensis*,	Lion.	Common Meadow-Grass.
" *compressa*,	Linn.	Blue Grass.
Bromus secalinus,	Linn.	Chess.
Triticum repens,	Linn.	Couch-Grass.
Hordeum jubatum,	Linn.	Squirrel-Tail Grass.
Gymnostichum Hystrix,	Schreber.	Bottle-brush Grass.
Phalaris arundinacea,	Linn.	Red Canary-Grass.
" *Canariensis*,	Linn.	Canary-Grass.
Panicum capillare,	Linn.	*Hair-stalked Panic-Grass.
" *dichotomum*,	Linn.	*Hairy Panic-Grass.
" *Crus-galli*,	Linn.	Barnyard-Grass.
Setaria glauca,	Palisot de Beauvois.	Foxtail.
" *viridis*,	Palisot de Beauvois,	Green Foxtail.

EQUISETACEÆ.

Equisetum arvense,	Linn.	*Field Horse-tail.
" *sylvaticum*,	Linn.	*Wood Horse-tail.
" *hyemale*,	Linn.	Scouring Rush.
" *scirpoides*,	Michaux.	*Smallest Rough Horse-tail.

FILICES.

Polypodium Dryopteris,	Linn.	*Three-branched Polypody.
Pteris aquilina,	Linn.	Common Brake.
Adiantum pedatum,	Linn.	Maidenhair.
Asplenium thelypteroides,	Michaux.	*Thelypteris-like Spleenwort.
" *Filix fœmina,*	R. Brown.	Female Spleenwort.
Cystopteris bulbifera,	Bernhardi.	*Bulb-bearing Bladder-Fern.
Aspidium Thelypteris,	Swartz.	*Marsh Shield-Fern.
" *spinulosum,*	Swartz.	*Dilated Shield-Fern.
" *cristatum,*	Swartz.	*Crested Shield-Fern.
" *acrostichoides,*	Swartz.	*Terminal Shield-Fern.
" *marginale,*	Swartz.	*Marginal Shield-Fern.
Onoclea sensibilis,	Linn.	*Sensitive Fern.
Osmunda regalis,	Linn.	Flowering Fern.
Osmunda Claytoniana,	Linn.	*Interrupted Flowering Fern.
Osmunda cinnamonea,	Linn.	Cinnamon Fern.
Botrychium Virginicum,	Swartz.	Rattlesnake Fern.

LYCOPODIACEÆ.

Lycopodium lucidulum,	Michaux.	*Shining Club-Moss.
" *annotinum,*	Linn.	*Interrupted Club-Moss.
" *dendroideum,*	Michaux.	Ground-Pine.
" *clavatum,*	Linn.	Common Club-Moss.

MUSCI.

Sphagnum acutifolium,	Ehrhart.
Trichostomum vaginans,	Sullivant.
Tetraphis pellucida,	Hedwig.
Polytrichum juniperinum,	Hedwig.
Timmia megapolitana,	Hedwig.
Bryum pyriforme,	Hedwig.
Mnium offine,	Bland.
Funaria hygrometrica,	Hedwig.
Cryphœa glomerata,	W. P. Schimper.
Pylaisæa intricata,	Bryol Europ.
Platygyrium repens,	Bryol Europ.
Climacium dendroides,	Weber & Mohr.
Hypnum tamariscinum,	Hedwig.
" *uncinatum,*	Hedwig.

HEPATICÆ.

Madotheca platyphylla,	Dumort.
Marchantia polymorpha,	Linn.

The orders *Cyperaceæ*, *Graminæ*, *Musci*, and *Hepaticæ*, as also the genus *Salix*, would require a suplementary list, which I intend to supply at some future time.

ART. VII.—*Professor Owen on the Classification of the Mammalia.*

None of our living Naturalists displays a greater mastery over those general truths that relate to the difficult subject of classification, than Professor Owen, and we are especially indebted to him for asserting that predominance of the brain and nervous system, in indicating the real affinities of animals, which is one of the leading truths of modern Zoology. The nervous system is the primary material element in the animal, that which marks more than any other its grade of intelligence and consequent rank in nature. It is thus the basis of the animal frame; and though less obvious than the skeleton and other superadded structures, is really that which has moulded their form and proportions. No one ground of arrangement will suffice to express all those grades of relationship impressed on animals by their Maker, and perceptible by us; but some are more general and important than others; and we have long thought that the nervous system bears to the whole the relation of a grand dominant end to which all others have been bent and made subservient.

In an elaborate paper communicated to the Linnean Society, Professor Owen has applied this principle of arrangement to the mammals; and we commend the following extracts, giving a sketch of his views, to all of our readers who take an interest in Zoology.

Primary Divisions of the Mammalia.—The question or problem of the truly natural and equivalent primary groups of the class *Mammalia* has occupied much of my consideration, and has ever been present to my mind when gathering any new facts in the anatomy of the Mammalia, during dissections of the rarer forms which have died at the Zoological Gardens, or on other opportunities.

The peculiar value of the leading modifications of the mammalian brain, in regard to their association with concurrent modifications in other important systems of organs, was illustrated in detail in the Hunterian Course of Lectures on the Comparative Anatomy of the Nervous System, delivered by me at the Royal College of Surgeons in 1842. The ideas which were broached or suggested, during the delivery of that course, I have tested by every subsequent acquisition of anatomical knowledge, and now feel myself justified in submitting to the judgment of the Linnean Society, with a view to publication, the following fourfold primary division of the mammalian class, based upon the four leading modifications of cerebral structure in that class.

The brain is that part of the organization which, by its superior development, distinguishes the Mammalia from all the inferior classes of VERTEBRATA; and it is that organ which I now propose to show to be the one that by its modifications marks the best and most natural primary divisions of the class.

In some mammals the cerebral hemispheres are but feebly and partially connected together by the 'fornix' and 'anterior commissure;' in the rest of the class a part called 'corpus callosum' is added, which completes the connecting or 'commissural' apparatus.

With the absence of this great superadded commissure is associated a remarkable modification of the mode of development of the offspring, which involves many other modifications; amongst which are the presence of the bones called 'marsupial,' and the non-development of the deciduous body concerned in the nourishment of the progeny before birth, called 'placenta;' the young in all this 'implacental' division being brought forth prematurely, as compared with the rest of the class.

This first and lowest primary group, or subclass, of Mammalia may be termed, from its cerebral character, *Lyencephala*,—signifying the comparatively loose or disconnected state of the cerebral hemispheres. The size of these hemispheres (fig. 1, A) is such that they leave exposed the olfactory ganglions (*a*), the cerebellum (C), and more or less of the optic lobes (B); their surface is generally smooth; the anfractuosities, when present, are few and simple.

The next well-marked stage in the development of the brain is where the corpus callosum (indicated in fig. 2, by the dotted lines *d*, *d*) is present, but connects cerebral hemispheres as little advanced in bulk or outward character as in the preceding subclass; the cerebrum (A) leaving both the olfactory lobes (*a*) and cerebellum (C) exposed, and being commonly smooth, or with few and simple convolutions in a very small proportion, composed of the largest members of the group. The mammals so characterized constitute the subclass *Lissencephala*, (fig. 2).

In this subclass the testes are either permanently or temporarily concealed in the abdomen: there is a common external genito-urinary aperture in most; two precaval veins ('superior' or 'anterior venæ') terminate in the right auricle. The squamosal in many, retain their primitive separation as distinct bones. The orbits have not an entire rim of bone. Besides these more general characters by which the Lissencephala, in common with the Lyencephala, resemble Birds and Reptiles, there are many other remarkable indications of their affinity to the Oviparous Vertebrata in particular orders or genera of the subclass. Such, *e. g.*, are the cloaca, convoluted trachea, supernumerary cervical vertebræ and their floating ribs, in the 3-toed Sloth ; the irritability of the muscular fibre, and persistence of contractile power in the Sloths and some other Bruta ; the long, slender, beak-like edentulous jaws and gizzard of the Anteaters ; the imbricated scales of the equally edentulous Pangolins, which have both gizzard and gastric glands like the proventricular ones in birds ; the dermal bony armour of the Armadillos like that of loricated Saurians ; the quills of the Porcupine and Hedgehog ; the proventriculus of the Dormouse and Beaver ; the prevalence of disproportionate development of the hind-limbs in the *Rodentia* ; coupled, in the Jerboa, with confluence of the three chief metatarsals into one bone, as in birds ; the keeled sternum and wings of the Bats ; the aptitude of the *Cheiroptera*, *Insectivora*, and certain *Rodentia* to fall, like Reptiles, into a state of true torpidity, associated with a corresponding faculty of the heart to circulate carbonized or black blood :—these, and the like indications of co-affinity with the *Lyencephala* to the Oviparous air-breathing Vertebrata, have mainly prevailed with me against an acquiescence in the elevation of different groups of the Lissencephala to a higher place in the Mammalian series, and in their respective association, through some single character, with better-brained orders, according to Mammalogical systems which, at different times, have been proposed by zoologists of deserved reputation. Such, *e.g.*, as the association of the long-clawed *Bruta* with the *Ungulata*, and of the shorter-clawed Shrews, Moles and Hedgehogs, as well as the Bats, with the *Carnivora* ; of the Sloths with the *Quadrumana* ; of the Bats with the same high order ; and of the *Insectivora* and *Rodentia* in immediate sequence after the Linnean ‘ Primates,’ as in the latest published ‘ System of Mammalogy,’ from a distinguished French author.

The third leading modification of the Mammalian cerebrum is such an increase in its relative size, that it extends over more or less of the cerebellum ; and generally more or less over the olfactory lobes. Save in very few exceptional cases of the smaller and inferior forms of *Quadrumana* (fig. 3) the superficies is folded into more or less numerous gyri or convolutions,—whence the name *Gyrencephala*, which I propose for the third subclass of Mammalia (fig. 4.)

In this subclass we shall look in vain for those marks of affinity to the *Ovipara*, which have been instanced in the preceding subclasses. The testes are, indeed concealed, and through an obvious adaptive principle, in the Cetacea ; but, in the rest of the subclass, with the exception of the Elephants, they pass out of the abdomen, and the Gyrencephalous quadrupeds, as a general rule, have a scrotum. The vulva is externally distinct from the anus. With the exception, again, of the Elephants, the blood from the head and anterior limbs is returned to the right auricle by a single precaval trunk. The mammalian modification of the Vertebrate type attains its highest physical perfection in the *Gyrencephala*, as manifested by the bulk of some, by the destructive mastery of others, by the address and agility of a third order. And, through the superior psychological faculties—an adaptive intelligence predominating over blind instinct—which are associated with the higher development of the brain, the *Gyrencephala* afford those species which have ever formed the most cherished companions and servitors, and the most valuable sources of wealth and power, to Mankind.

In Man the brain presents an ascensive step in development, higher and more strongly marked than that by which the preceding subclass was distinguised from the one below it. Not only do the cerebral hemispheres (figs. 5 & 6, A) overlap the olfactory lobes and cerebellum, but they extend in advance of the one, and further back than the other (fig. 6, c). Their posterior development is so marked, that anatomists have assigned to that part the character of a third lobe ; it is peculiar to the genus *Homo*, and equally peculiar is the ' posterior horn of the lateral ventricle,' and the ' hippocampus minor,' which characterize the hind lobe of each hemisphere. The superficial grey matter of the cerebrum, through the number and depth of the convolutions, attains its maximum of extent in Man.

Peculiar mental powers are associated with this highest form of brain, and their consequences wonderfully illustrate the value of the cerebral character ; according to my estimate of which, I am led to regard the genus *Homo*, as not merely a representative of a distinct order, but of a distinct subclass of the Mammalia, for which I propose the name of ' *Archencephala*,' (fig. 6).

Prosessor Owen then proceeds to subdivide his primary groups into orders. We can only give extracts bearing upon groups of special interest.

LYENCEPHALA.

In the Lyencephalous Mammalia some have the 'optic lobe' simple, others partly subdivided, or complicated by accessory ganglions, whence they are called 'bigeminal bodies.' The Lycene phala with simple optic lobes are 'edentulous' or without calcified teeth, are devoid of external ears, scrotum, nipples, and marsupial pouch: they are true 'testiconda;' they have a coracoid bone extending from the scapula to the sternum, and also an epicoracoid and episternum, as in Lizards; they are unguiculate and pentadactyle, with a supplementary tarsal bone supporting a perforated spur in the male. The order so characterized is called 'MONOTREMATA,' in reference to the single excretory and generative outlet, which, however, is by no means peculiar to them among Mammalia. The Monotremes are insectivorous, and are strictly limited to Australia and Tasmania.

The MARSUPIALIA are Mammals distinguished by a peculiar pouch or duplicature of the abdominal integument, which in the males is everted, forming a pendulous bag containing the testes; and in the females is inverted, forming a hidden pouch containing the nipples and usually sheltering the young for a certain period after their birth: they have the marsupial bones in common with the Monotremes; a much-varied dentition, especially as regards number of incisors, but usually including 4 true molars; and never more than 3 premolars: the angle of the lower jaw is more or less inverted.

With the exception of one genus, *Didelphys*, which is American, and another genus *Cuscus*, which is Malayan, all the known existing Marsupials belong to Australia, Tasmania, and New Guinea. The grazing and browsing Kangaroos are rarely seen abroad in full daylight, save in dark rainy weather. Most of the Marsupialia are nocturnal. Zoölogical wanderers in Australia, viewing its plains and scanning its scrubs by broad daylight, are struck by the seeming absence of mammalian life; but during the brief twilight and dawn, or by the light of the moon, numerous forms are seen to emerge from their hiding-places and illustrate the variety of marsupial life with which many parts of the continent abound. We may associate with their low position in the mammalian scale the prevalent habit amongst the Marsupialia of limiting the exercise of the faculties of active life to the period when they are shielded by the obscurity of night.

LISSENCEPHALA.

The Lissencephala or smooth-brained Placentals form a group which I consider as equivalent to the Lyencephala or Implacentals; and which includes the following orders, *Rodentia*, *Insectivora*, *Cheiroptera* and *Bruta*. The RODENTIA are characterized by two large and long curved incisors in each jaw, separated by a wide interval from the molars; and these teeth are so constructed, and the jaw is so articulated, as to serve in the reduction of the food to small particles by acts of rapid and continued gnawing, whence the name of the order. The orbits are not separated from the temporal fossæ. The testes pass periodically from the abdomen into a temporary scrotum, and are associated with prostatic and vesicular glands. The placenta is commonly discoid, but is sometimes a circular mass (Cavy), or flattened and divided into three or more lobes (Lepus). The Beaver and Capybara are now the giants of the order, which chiefly consists of small, numerous, prolific and diversified unguiculate genera, subsisting wholly or in part on vegetable food. Some Rodents, *e. g.* the Lemmings, perform remarkable migrations, the impulse to which, unchecked by dangers or any surmountable obstacles, seems to be mechanical. Many Rodents build very artificial nests, and a few manifest their constructive instinct in association. In all these inferior psychical manifestations we are reminded of Birds. Many Rodents hibernate like Reptiles. They are distributed over all continents.

The transition from the Marsupials to the Rodents is made by the Wombats; and the transition from the Marsupials is made, by an equally easy step, through the smaller Opossums to the INSECTIVORA. This term is given to the order of small smooth-brained Mammals, the molar teeth of which are bristled with cusps, and are associated with canines and incisors; they are unguiculate, plantigrade, and pentadactyle, and they have complete clavicles. The testes pass periodically from the abdomen into a temporary scrotum, and are associated with large prostatic and vesicular glands: like most other *Lissencephala*, the Insectivora have a discoid or cup-shaped placenta. Their place and office in South America and Australia are fulfilled by Marsupialia; but true Insectivora exist in all the other continents.

The order CHEIROPTERA, with the exception of the modification of their digits for supporting the large webs that serve as wings, repeat the chief characters of the Insectivora; but a few of the larger species are frugivorous and have corresponding modifications of teeth and stomach. The mammæ are pectoral in position, and the penis is pendulous in all Cheiroptera. The most remarkable examples of periodically torpid Mammals are to be found in the terrestrial and volant Insectivora. The frugivorous Bats differ much in dentition from the true Cheiroptera, and would seem to conduct through the Colugos or Flying Lemurs, directly to the Quadrumanous order. The Cheiroptera are cosmopolitan.

The order Bruta, called *Edentata* by Cuvier, includes two genera which are devoid of teeth ; the rest possess those organs, which, however, have no true enamel, are never displaced by a second series, and are very rarely implanted in the premaxillary bones. All the species have very long and strong claws. The ischium as well as the ilium unites with the sacrum ; the orbit is not divided from the temporal fossa. I have already adverted to the illustration of affinity to the oviparous Vertebrata which the Three-toed Sloths afford by the supernumerary cervical vertebræ supporting false ribs and by the convolution of the windpipe in the thorax ; and I may add that the unusual number—three and twenty pairs—of ribs, forming a very long dorsal, with a short lumbar region of the spine in the Two-toed Sloth, recalls a lacertine structure. The same tendency to an inferior type is shown by the abdominal testes, the single cloacal outlet, the low cerebral development, the absence of medullary canals in the long bones in the Sloths, and by the great tenacity of life and long-enduring irritability of the muscular fibre, in both the Sloths and Anteaters.

The order Bruta is but scantily represented at the present period. One genus, *Manis* or Pangolin, is common to Asia and Africa ; the *Orycteropus* is peculiar to South Africa ; the rest of the order, consisting of the genera *Myrmecophaga*, or true Anteaters, *Dasypus* or Armadillos, and *Bradypus* or Sloths, are confined to South America.

GYRENCEPHALA.

In next proceeding to consider the subdivisions of the Gyrencephala, we seem at first to descend in the scale in meeting with a group of animals in that subclass, having the form of Fishes ; but a high grade of mammalian organization is masked beneath this form. The Gyrencephala are primarily subdivided, according to modifications of the locomotive organs, into three series, for which the Linnean terms may well be retained ; viz. *Mutilata*, *Ungulata* and *Unguiculata*, the maimed, the hoofed, and the clawed series.

These characters can only be applied to the Gyrencephalous subclass ; *i. e.* they do not indicate natural groups, save in that section of the Mammalia. To associate the Lyencephala and Lissencephala with the unguiculate Gyrencephala into one great primary group, as in the Mammalian systems of Ray, Linnæus and Cuvier, is a misapplication of a solitary character akin to that which would have founded a primary division on the discoid placenta or the diphyodont dentition. No one has proposed to associate the unguiculate Bird or Lizard with the unguiculate Ape ; and it is but a little less violation of natural affinities to associate the Monotremes with the Quadrumanes in the same primary (unguiculate) division of the Mammalian class.

The three primary divisions of the Gyrencephala are of higher value than the ordinal divisions of the Lissencephala ; just as those orders are of higher value than the representative families of the Marsupials.

The *Mutilata*, or the maimed Mammals with folded brains, are so called because their hind-limbs seem, as it were, to have been amputated ; they possess only the pectoral pair of limbs, and these in the form of fins : the hind end of the trunk expands into a broad, horizontally flattened, caudal fin. They have large brains with many and deep convolutions, are naked, and have neither neck, scrotum, nor external ears.

The first order, called CETACEA, in this divison are either edentulous or monophyodont, and with teeth of one kind and usually of simple form. They are testiconda and have no 'vesiculæ seminales.' The mammæ are pudendal ; the placenta is diffused ; the external nostrils—single or double—are on the top of the head, and called spiracles or "blow-holes." They are marine, and, for the most part, range the unfathomable ocean ; though with certain geographical limits as respects species. They feed on fishes or marine animals.

The second order, called SIRENIA, have teeth of different kinds, incisors which are preceded by milk-teeth, and molars with flattened or ridged crowns, adapted for vegetable food. The nostrils are two, situated at the upper part of the snout ; the lips are beset with stiff bristles ; the mammæ are pectoral ; the testes are abdominal, as in the Cetacea, but are associated with vesiculæ seminales. The Sirenia exist near coasts or ascend large rivers ; browsing on fuci, water plants or the grass of the shore. There is much in the organization of this order that indicates its affinity to members of the succeeding division.

In the *Ungulata* the four limbs are present, but that portion of the toe which touches the ground is incased in a hoof, which blunts its sensibility and deprives the foot of prehensile power. With the limbs restricted to support and locomotion, the Ungulata have no clavicles; the fore-leg remains constantly in the state of pronation, and they feed on vegetables.

The third division of the *Gyrencephala* enjoy a higher degree of the sense of touch through the greater number and mobility of the digits, and the smaller extent to which they are covered by horny matter. This substance forms a single plate, in the shape of a claw or nail, which is applied to only one of the surfaces of the extremity of the digit, leaving the other, usually the lower, surface possessed of its tactile faculty; whence the name *Unguiculata*, applied to this group, however, is more restricted and natural than the group to which Linnæus extended the term. All the species are 'diphyodont,' and the teeth have a simple investment of enamel.

The first order, Carnivora, includes the beasts of prey, properly so called. With the exception of a few Seals, the incisors are $\frac{3-3}{3-3}$ in number; the canines $\frac{1-1}{1-1}$, always longer than the other teeth, and usually exhibiting a full and perfect development as lethal weapons; the molars graduate from a trenchant to a tuberculate form, in proportion as the diet deviates from one strictly of flesh to one of a more miscellaneous kind. The clavicle is rudimental or absent; the innermost digit is often rudimental or absent; they have no vesiculæ seminales; the teats are abdominal; the placenta is zonular. The Carnivora are divided, according to modifications of the limbs, into 'pinnigrades,' 'plantigrades' and 'digitigrades.' In the Pinnigrades (Walrus, Seal-tribe) both fore and hind feet are short, and expanded into broad, webbed paddles for swimming, the hinder ones being fettered by continuation of integument to the tail. In the Plantigrades (Bear-tribe) the whole or nearly the whole of the hind foot forms a sole, and rests on the ground. In the Digitigrades (Cat-tribe, Dog-tribe, &c.) only the toes touch the ground, the heel being much raised.

It has been usual to place the Plantigrades at the head of the Carnivora, apparently because the higher order, Quadrumana, is plantigrade; but the affinities of the Bear, as evidenced by internal structure, *e. g.* the renal and genital organs, are closer to the

Seal-tribe; the broader and flatter pentadactyle foot of the plantigrade is nearer in form to the flipper of the Seal than is the more perfect digitigrade, retractile clawed, long and narrow hind foot of the feline quadruped, which is the highest and most typical of the Carnivora.

The next perfection which is superinduced upon the unguiculate limb is such a modification in the size, shape, position, and direction of the innermost digit, that it can be opposed, as a thumb, to the other digits, thus constituting what is properly termed a 'hand.' Those Unguiculates which have both fore and hind limbs so modified, or at least the hind limbs, form the order QUADRUMANA.

ARCHENCEPHALA.

The structural modifications in the genus *Homo*,—the sole representative of the *Archencephala*,—more especially of the lower limb, by which the erect stature and bipedal gait are maintained, are such as to claim for MAN ordinal distinction on merely external zoological characters. But as I have already argued, his psychological powers, in association with his extraordinarily developed brain, entitle the group which he represents to equivalent rank with the other primary divisions of the class *Mammalia* founded on cerebral characters. In this primary group Man forms but one genus, *Homo*, and that genus but one order, called BIMANA, on account of the opposable thumb being restricted to the upper pair of limbs. The testes are scrotal; their serous sac does not communicate with the abdomen; they are associated with vesicular and prostatic glands. The mammæ are pectoral. The placenta is a single, subcircular, cellulo-vascular, discoid body.

Man has only a partial covering of hair, which is not merely protective of the head, but is ornamental and distinctive of sex. The dentition of the genus *Homo* is reduced to thirty-two teeth by the suppression of the outer incisor and the first two premolars of the typical series on each side of both jaws, the dental formula being:

$$i.\ \frac{2-2}{2-2},\ c.\ \frac{1-1}{1-1},\ p.\ \frac{2-2}{2-2},\ m.\ \frac{3-3}{3-3}=32.$$

All the teeth are of equal length, and there is no break in the series; they are subservient in Man not only to alimentation, but to beauty and to speech.

The human foot is broad, plantigrade, with the sole not inverted as in *Quadrumana*, but applied flat to the ground; the leg bears vertically on the foot; the heel is expanded beneath; the toes are short, but with the innermost longer and much larger than the rest, forming a 'hallux' or great toe, which is placed on the same line with, and cannot be opposed to, the other toes; the pelvis is short, broad, and wide, keeping well apart the thighs; and the neck of the femur is long, and forms an open angle with the shaft, increasing the basis of support for the trunk. The whole vertebral column, with its slight alternate curves, and the well-poised, short, but capacious subglobular skull, are in like harmony with the requirements of the erect position. The widely-separated shoulders, with broad scapulæ and complete clavicles, give a favourable position to the upper limbs, now liberated from the service of locomotion, with complex joints for rotatory as well as flexile movements, and terminated by a hand of matchless perfection of structure, the fit instrument for executing the behests of a rational intelligence and a free will. Hereby, though naked, Man can clothe himself, and rival all native vestments in warmth and beauty; though defenceless, Man can arm himself with every variety of weapon, and become the most terribly destructive of animals. Thus he fulfils his destiny as the supreme master of this earth, and of the lower Creation.

In these endeavours to comprehend how Nature has associated together her mammalian forms, the weary student quits his task with a conviction that, after all, he has been rewarded with but an imperfect view of such natural association. The mammalian class has existed, probably from the triassic, certainly from the lower olitic period; and has changed its generic and specific forms more than once in the long lapse of ages, during which life-work has been transacted on this planet by animals of that high grade of organization. Not any of the mammalian genera of the secondary periods occur in the tertiary ones. No genus found in the older eocenes (plastic and septarial clays, &c.) has been discovered in the newer eocenes. Extremely few eocene genera occur in miocene strata, and none in the pliocene. Many miocene genera of Mammalia are peculiar to that division of the tertiary series. Species indistinguishable from existing ones begin to appear only in the newer pliocene beds. Whilst some groups, as *e. g.* the Perissodactyles and omnivorous Artiodactyles, have been gradually dying out, other groups, as *e. g.* the true Ruminants, have been augmenting in genera and species.

In many existing genera of different orders there is a more specialized structure, a greater deviation from the general type, than in the answering genera of the miocene and eocene periods; such later and less typical Mammalia do more effective work by their more adaptively modified structures. The Ruminants, *e. g.* more effectually digest and assimilate grass, and form out of it a more nutritive and sapid kind of meat, than did the antecedent more typical or less specialized non-ruminant Herbivora.

The monodactyle Horse is a better and swifter beast of draught and burthen than its tridactyle predecessor the miocene *Hipparion* could have been. The nearer to a Tapir or a Rhinoceros in structure, the further will an equine animal be left from the goal in contending with a modern Racer. The genera *Felis* and *Machairodus*, with their curtailed and otherwise modified dentition and short strong jaws, become, thereby, more powerfully and effectively destructive than the eocene *Hyœnodon* with its typical dentition and three carnassial teeth on each side of its concommitantly prolonged jaws could have been.

Much additional and much truer insight has, doubtless, been gained into the natural grouping of the Mammalia since palæontology has expanded our survey of the class; but our best-characterized groups do but reflect certain mental conceptions, which must necessarily relate to incomplete knowledge, and that as acquired at a given period of time. Thus the order which Cuvier deemed the most natural one in the class *Mammalia* becomes the debris of a group, known at a subsequent period to be a more natural order.

We cannot avoid recognizing, in the scheme which I now submit, the inequality which reigns amongst the groups, which our present anatomical knowledge leads us to place in one line or parallel series as orders. I do not mean mere inequality as respects the number and variety of families, genera, and species of such orders, because the paucity or multitude of instances manifesting a given modification or grade of structure in no essential degree affects the value of such grade or modification.

The order *Monotremata* is not the less ordinally distinct from the *Marsupialia*, because it consists of but two genera, nor is the order *Bimana* from that of *Quadrumana*, because it includes only a single genus. So likewise the anatomical peculiarities of the *Proboscidia*, *Sirenia*, and *Toxodontia* call, at least, for those general terms, to admit of the convenient expression of general propositions respecting them; and some of these general propositions are of a value as great as the organic characters of more expanded orders.

There are residuary or aberrant forms in some of the orders, which, to the systematist disagreeably, compel modifications of the characters that would apply to the majority of such orders. The flying Lemurs (*Galeopitheci*), the rodent Lemurs (*Cheiromys*), the slow Lemurs (*Loris*, *Otolicnus*), forbid any generalization as to teeth or nails in the *Quadrumana*, whilst they continue associated with that order by the character of the hinder thumb; which, by the way, they possess in common with the pedimanous Marsupials. The large, volant, frugivorous Bats (*Pteropus*) are equally opposed to the application of a common dental character to the *Cheiroptera*. They are associated with the insectivorous Bats on account of the common external form arising out of the modification of their locomotive organs for flight, just as the Dugongs and Manatees are associated with the *Cetacea* on account of their resemblance to Fishes arising out of the same modification of the locomotive system for an aquatic existence. The herbivorous *Cetacea* are now separated from the piscivorous *Cetacea* as a distinct order; and with almost as good reason we might separate the frugivorous from the insectivorous *Cheiroptera*; the cases are very nearly parallel.

Nature, in short, is not so rigid a systematist as Man. There are peculiar conditions of existence which she is pleased shall be enjoyed by peculiarly modified mammals; these peculiarities break through the rules of structure which govern the majority of species existing and subsisting under the more general conditions of existence, to which the larger groups of Mammalia are respectively adjusted.

One class of organs seems to govern one order, another class another order; the dental system, which is so diversified in the *Marsupialia* and *Bruta*, is as remarkable for its degree of constancy in the *Rodentia* and *Insectivora*. But, as a general rule, the characters from the dental, locomotive, and placental systems are more closely correlated in the Gyrencephalous orders than in those in the inferior subclasses of the Mammalia.—*Journal Linnean Society.*

ARTICLE VIII.—*On a method of Preparing and Mounting Hard Tissues for the Microscope;* by CHRISTOPHER JOHNSTON, M.D.*

Having for several years occupied my leisure moments with what are usually denominated "microscopical studies," I beg leave to offer, as the result of successful experience, a simple and certain method of preparing and mounting *hard tissues*, such as bone, teeth, shells, fossilized wood, &c.

I am aware that treatises upon the microscope give a few indications for making sections and embalming them in Canada balsam; but they are unsatisfactory either by reason of their brevity or their want of precision. Specimens may be procured ready-made from the hands of Topping, Bourgogne and others, but while they are expensive, persons in remote situations are obliged to purchase by catalogue without the opportunity of selection. Besides, it is oftentimes difficult or else impossible to obtain series of particular objects, so that the student must either limit his researches or "prepare" for himself: in the latter case he may increase his number of objects indefinitely, and supply himself with many such as are not attainable from abroad, and divided in any direction he may require.

A microscopic section should be as thin as the structure of the object will allow, of uniform thickness, and polished on both sides, whether it be mounted in the dry way or in balsam. To meet these requirements I proceed as follows :—

Being provided with

1. A coarse and a fine 'Kansas hone, kept dressed *flat* with fine emery;

2. A long fine Stub's dentist's file;

3. A thin dividing file and fine saw;

4. Some Russian isinglass boiled, strained, and mixed with alcohol sufficient to form a *tolerably* thick jelly when cold;

5. A small quantity of Canada balsam;

6. Slides: 7. Clover glass.

8. One ounce of chloroform; 9. One of F.F. aqua ammonia.

10. Some fragments of thick plate (mirror) glass 1 inch square or 1 by 2 inches; and finally,

11. An ounce of "dentist's silex," and

12. Thin French letter paper, of which 500 or more leaves are required to fill up the space of an inch: I examine the object and decide upon the plane of the proposed section.

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* From *Silliman's Journal.*

Coarse approximative sections may be obtained with the saw or dividing file (excepting silicified substances), but these instruments are not applicable to longitudinal sections of small human or other teeth, small bones, &c. Take now the object in the fingers if sufficiently large, and grind it upon the coarse hone with water, to which add "silex" if necessary, until the surface coincides with the intended plane. Wash carefully: finish upon the finer hone; and polish upon soft linen stretched upon a smooth block.

If the object be too small to admit of immediate manipulation it should be fastened upon a piece of glass with isinglass—or what is better, upon thin paper well glued with the same substance upon glass; and a piece of thick paper or visiting card, perforated with a free aperture for the object, must be attached to the first paper. This is the *guard*, down to which the specimen must be ground with oil: and its thickness and the disposal of the object require the exercise of good judgment. Hot water will release everything; and chloroform remove the grease from the specimen, which, like that ground with water, is ready for the second part of the process.

2d. Carefully cover the surface of a piece of the plate glass with thin French letter paper; next apply a paper *guard*, as before stated, but not thicker, for teeth and bone, than $\frac{1}{500}$th inch; then trace a few lines with a lead pencil upon the first paper in the little space left in the *guard* so that the increasing transparency of a specimen being prepared may be appreciated; and finally moisten the "space" with isinglass to the extent of the object, which must be delicately brushed over on the ground surface and at the *edges* with tolerably thin isinglass before it is cemented in its place. Gentle pressure should now be employed, and maintained with a wire spring, or thread wound round about.

In two or three hours the second side may be ground in oil; silex may be employed at first, or even a file; but these means must not be persevered in, and the operation must be completed upon the bare hone. When the second side shall have been wiped with chloroform it may be polished with a bit of silk upon the finger; and after *spontaneous* separation from the paper in hot water the specimen ought to be well washed on both sides with a camel's hair pencil and soap water, dropped into cold water, and thence extracted to dry. After immersion in chloroform for a moment, and examination for the removal of possibly adherent particles, the *section* may be declared suitable for mounting.

Before proceeding to this step, a few precautions are necessary about particular sections. Transverse sections of teeth or bone should be dried, after the preliminary washing, between glass, in order to avoid the disadvantage of warping. Very porous parts, such as cancellated bone, or fragile bodies, such as the poison fang of serpents, require that the whole structure, or the canals, be saturated with glue and dried. Sections may now be cut with a saw, ground in oil, and cemented to the holding-glass subsequent to immersion in chloroform.

Mounting.—Spread a sufficient quantity of old Canada balsam, or of that thickened by heat (not boiling), upon a slide, and, when cold, impose the section. Have ready a spatula bearing a quantity of equally inspissated balsam warmed until it flows, with which cover the specimen, and then immediately warm the slide, being careful to employ the least possible heat. Now carefully depress the section and withdraw every air bubble with a stout needle set in a handle towards the ends of the slide: put on the cover glass, slightly warmed, not flat, but allowing one edge to touch the balsam first, press out superfluous balsam, and the specimen is safe. The slide may now be cleaned with a warm knife, spirits of wine, and ammonia.

This communication would be incomplete without some very important hints concerning "cover glass." It is easy to clean small covers, but very thin glasses or large ones, one or two inches in length, are not so safely handled. All danger of breaking is, however, avoided by placing a cover upon a large clean slide, and wiping one side only with a bit of linen damp with aqua ammonia, and then with a dry piece. The other side may be cleaned after the mounting.

In the next place, all preparers are aware of the difficulty attending the use and application of large covers. I beg leave to assure the inexpert that the following method will insure success. Having prepared the cover glass, and superposed it, let it first be gently pressed downwards at many points, with the flat end of a lead pencil: it will be found, however, almost impossible to flatten it without breaking, consequently too much balsam will overlie and underlie the section. Let now a piece of thin paper be laid over the cover and upon this a thick slide; if a moderate heat be applied to both the slides, over and beneath the specimen, direct pressure evenly exerted with the finger (or spring clothespins) will force out all unnecessary balsam, and leave the section and the protecting cover perfectly flat and unbroken.

The reader will not deem me too prolix when he attempts his first preparation, or when, after having followed the plans so scantily given in the books, he feels the need of something precisely definite. It is certain that neither Canada balsam nor gum mastic will retain the first ground side of a specimen upon a slide long enough to enable the preparer to reduce it to the requisite thinness, and with both these substances *heat* must be employed, which is objectionable because most objects are thereby warped or cracked; and furthermore the paper *guard*, which I hold to be indispensable for limiting and equalizing the thinness of a section, is not mentioned in treatises, in which, if known to the author, such a measure should be noticed. But it is possible to fasten agate, fossil wood, &c. with hot gum shellac, so that they may be ground upon both sides with a water stone; but even in these instances invidious cracks may endanger or destroy the beauty of a choice preparation.

I am confident that my specimens are second to none in any respect: and the highly creditable performances of friends, to whom I have given the method forming the subject of this communication, lead me to believe that with the facilities it affords the observers of our country will need no Topping for objects within their reach, and I beg leave to add that the profitable pleasure I have enjoyed induces me, through the American Journal of Science, to invite participation.

ARTICLE IX.—*General Position and Results of Geology.* (From the Anniversary Address of the President of the Geological Society of London, 1857.)

Let me now close my address by a few observations necessarily occurring to my mind, as the result of these investigations. First, then, it appears to me, we are steadily progressing towards a knowledge of the material structure of the crust of the earth, and of the modifications it has undergone in the long course of ages; and such a knowledge seems essential to the right appreciation of many of the phenomena connected with the variations in the fauna and flora of the surface of the earth. In regard to the natural history of the earth, every day produces new genera and new species in every great section of geological formations; and yet this new evidence does not appear to approximate these sections together, or to bind them more into one great whole, so long as the test applied be identity of species, though unquestionably, if all the formations be taken together, every new discovery seems to supply a link, and to bring the organic elements of formations, widely apart as to time, into connection as parts of one great and harmonious organic system. How then are we to account for this separation in time of the elements of a creation? Are we still, with Cuvier, to suppose that it has resulted from successive destructions of a partially constructed creation and successive renewals, each new creation supplying deficiencies in the preceding one, but producing others by leaving out some of the elements of the last; the creations, therefore, remaining imperfect? Or are we to suppose, with Blainville, that the work of creation was originally complete, and that the gaps now visible are due to the gradual dropping-out of certain of the links in the course of countless ages? Or are we to consider, with Lamarck and many others, that the present is only the development, through various successive stages, of the past, and that the limits of possible variation and transmutation of species, either by imperceptible steps of gradation or by periodic and sudden changes, regulated by the original law of creation, have not yet been determined? To one or other of these theories we must necessarily recur, and so far as the wisdom and power of the Great Creator are concerned, neither can augment or diminish it; for, admitting that creative power must have been exercised, it is indifferent whether it acted in the mode of Cuvier, or in that of Blainville, or in that of Lamarck. In every case the image of the whole must have been in the creative mind, and the wisdom equal, whether the creation was formed as a whole, and members of it were allowed to perish at certain intervals, corresponding to the successive physical conditions of the earth; or, the whole creation being mentally determined by the Creator, those portions of it only which corresponded to the conditions of the earth's crust at each epoch were called successively into existence, various classes and genera attaining therefore the highest development under circumstances best suited to the requirements of their organization; or, the final result having been conceived by creative intelligence, and certain members only of the great whole called into existence, like points on the circumference of a circle, and imbued with such a power of vital development, as should cause them in successive ages to fill up the whole space with an infinite variety of organic beings. The great discovery of Von Baer, of the existence of lower forms in the embryo-state of higher animals, has been supposed by speculative philosophers to favour the theory of development; but it does no more than prove that, whilst the animal is obliged to live under conditions different from those of his complete organization, no new form of organization is adopted, but simply one of those belonging to animals who ordinarily live under such conditions; and, though the perfect animal has passed through such changes, the successive developments exhibited during the embryonic life of an animal, or during the period of a few weeks or months, or perhaps a year, can neither be taken as a proof of a separate individual existence, under either of the embryonic types, nor represent the changes which the same animal, as a species, may have really passed through in countless ages: on the contrary, it is more reasonable to suppose that this involved structure was adopted at the first creation of each of these species, and indicates only the simplicity and harmony of natural laws. If, however, the organic creation was effected as one great whole, and gradually diminished by the dropping-out of many of its links, either by generic or by specific death, how can we account for the total absence in the deposits of early times of any traces of the now living animals which were then co-existent with those of whom such abundant records have been preserved? To me it seems impossible to adopt such a theory without combining with it that of development. For not only must certain forms of organization have disappeared, but others must have so varied as no longer to be recognized as identical with those which have been revealed to us in the stony tablet of the earth.

I have already, more than once, alluded to the theory of colonies, proposed by M. Barrande, and I cannot deny myself the pleasure of once more recurring to it, and pointing out its great importance. Whilst then regretting, more than condemning, that ill-judged zeal, which, seeking to restrict the inquiries of man, by insisting that he shall take all his opinions of creation from that one book given unto man for a totally different object, I cannot but observe that the real history of the creation given in the Bible affords a wholesome caution to all those who endeavour to explain every act of the Creator as if He had been a man. Except as regards man, creation is not described as a work of manufacturing ingenuity, but as an act of infinite power: let the earth, let the sea, let the air bring forth things of their kind, was the fiat of the Almighty; and I cannot but think, that at each portion of the earth this fiat led to the production of genera and species suitable to the conditions of each, and to the appearance, therefore, in different localities, of species representative of, but rarely identical with, each other. On such a principle, how easy is it to understand that the colonies of M. Barrande should, although not identical with those species which had pre-existed in a locality, still have co-existed with them! Absolute identity would indeed be more opposed to the laws of creation than the slight variations we observe in closely allied species.

Let me too for a moment refer to that theory which would ascribe the destruction of species to the agency of man, and has sought to bestow upon the human race an antiquity far greater than that usually assigned to it. Doubtless the actual number of years of the existence of the human race might be multiplied ten, or a hundred-fold, and yet the problem left unsolved. Man, as a species, in a natural state, is restricted in his development by the hardships of life, and the difficulty of obtaining subsistence. So far from being an agent of destruction, beyond those limits which render the existence of the Carnivora compatible with the existence of the Ruminantia and other harmless animals, he, perhaps, of all animals, is the most feeble and defenceless; and it is only when he has become a civilized species that his race is capable of great development, and he becomes a really destroying agent. The ordinary history of the world is sufficient to prove this statement; and, if we compare the wide forest and prairie lands of America as they were 200 years ago, when the wild Indian tribes only killed for subsistence, and used for that purpose only the simple weapons which barbaric ingenuity had enabled them to form, with their present state, when civilized man has not only invaded their lands, but supplied the still uncivilized natives with the weapons of civilization, not merely to supply the wants of their own existence, but also to minister to the luxury of civilized man, —we shall see that the actual destruction of species, so far as the agency of man is concerned, could never have occurred, to any appreciable extent, had not that extraordinary phasis in man's existence—civilization—occurred; and I will add, that even civilized man would have required a vast extension of time to work out the destruction of species, had not the invention of gunpowder supplied him with an agent of almost unlimited power of destruction; and further, that, even provided with it, he has made but small progress indeed in the destruction of species. The Creation is, and must ever be, a mystery to man, and yet it is a speculation worthy of the exercise of the highest intelligence. Placed on the earth, it is our privilege to study everything connected with it, and we should be neglecting the highest endowments of our race were we not to do so; nor let us be tempted to scoff at or condemn those who, possessed perhaps of a higher intelligence than our own, see further than we do, and adopt theories which appear to us absurd, sometimes only from our own inferiority; and above all, let us avoid that fatal error of connecting the results of scientific inquiry with the articles of religious belief. In attempting to discuss two widely different subjects at the same time, we must necessarily stumble. The speculation of a plurality of inhabited worlds, for example, is to the philosopher a proper mental exercise, though incapable of any positive solution; for, even supposing organic life to be compatible with every possible variation of physical conditions—a postulate at variance with the conditions of existence present on the earth, where life is limited on the one hand by the increase of pressure under the water, and on the other by its decrease in the air,—what more can we do than guess or speculate in the dark? Why then should we rashly connect such a speculation with the creed of the philosopher and the faith of the Christian, or assume the dream of the philospher to be a proper measure of the Creator's wisdom? Let us then continue, as we have hitherto done, to pursue our investigations into the history of the earth, under all its various stages, unbiassed by any preconceived opinions, and unshackled by the dread of offending those who will not study the works of creation, but, remaining ignorant of them, consider that they are thereby the better fitted for discussing the Divine attributes. At all events, let us make truth, and truth alone, our aim, supporting our own appreciations of it when we have reason for so doing, but treating with calmness and forbearance the opinions of others who may differ from us: it is from such differences of opinion that we may expect ultimately to discover truth, sublimed from the dross of error which must ever be mingled with it in all those reasonings of man which cannot be actually based on mathematical principles, or reduced to positive demonstration.—*Journal of Geol. Society.*

A Premium Essay on Practical and Scientific Agriculture, by Prof. G. C. Swallow, State Geologist, Missouri.

This Essay has been published by the Missouri District Agricultural Society, and is prefixed to the Report of their Second Annual Fair. In looking over this report we are struck with the vigour and wisdom of our Western cousins. They have awarded $5466 in premiums to competitors for excellence in every conceivable department of agriculture and of arts which contribute to the comfort and elegance of civilized life. The Essay opens very appropriately with a few words in praise of a rural life, and its happy moral influences. The learned Professor then defines what scientific and practical agriculture is. He shows that geology and chemistry are the sciences, a knowledge of which is of most importance to the agriculturalist. The application of these sciences to the agriculture of the State of Missouri he also treats with brevity, point and skill. The following account of the geological formations upon which the soil of this State depends, may be interesting to many of our readers.

As the most essential properties of the soils of Missouri depend upon tbe Geological Formations on which they rest, this science is destined to give us material aid in understanding the nature and durability of our soils, and in determining the best method of developing their resources and preventing that deterioration so detrimental to agricultural pursuits.

The alluvial bottoms of our large rivers usually furnish a light sandy calcareous soil, which contains more or less of the clay and humus deposited in the beds of those ancient lakes and sloughs, now converted into rich savannas by the accumulated sediment and decayed vegetable matter. This soil possesses in an eminent degree all the properties essential to the highest degree of fertility. The fine sands and humus render it light and porous; the humus gives it the power to imbibe and retain moisture; its sand and dark color prepare it to receive the heat of the sun; while the clay and vegetable mould enable it to absorb carbonic acid and other fertilizing gases from the atmosphere.

These alluvial deposits have rendered this soil as durable as it is productive, by furnishing a loose subsoil, rich in all the elements of fertility. A soil thus productive and durable and so admirably adapted to the productiou of our great staples—hemp, corn and tobacco—and covering an area of more than four millions of acres, is destined to exert a vast influence over the future wealth and prosperity of our State.

But this variety of soil is surpassed in value and extent by that based upon the silicious marls of the bluff, where that formation is best developed, as in Platte, Lafayette, Jackson, Buchanan, Clay, Saline, Chariton, Howard and several other counties of the State,—The light porous character and composition of these marls, and the intermingled vegetable matter, constitute a soil unsurpassed in fertility and adaptation to many of our most important crops. It covers an area of, at least, six millions of acres.

In a still larger portion of the State the excess of clay in the Bluff formation renders the soil less pervious to water and atmospheric influences. While this variety is somewhat inferior in nature to that last described, still it may be rendered almost as productive by a judicious system of subsoiling and clovering.

The Magnesian Limestone, so abundant in the great basin of the Osage and its tributaries, on the Gasconade and in the mining region of the South east, together with the intercallated sandstones and chert beds and overlaying clays, form a soil at once light, warm and rich in lime, silex, potash and magnesia. These ingredients with its location on the sunny slopes and hill-sides of those dry, salubrious regions, give it a peculiar adaptation to the culture of the grape.

In treating of practical agriculture the essayist warns the farmer against the fatal mistake of exhausting the soil, and enforces by cogent reasons the necessity of " subsoiling, deep, thorough and frequent tilling, and the addition of vegetable matter by clovering or other means, as the best method of preparing the soil to sustain the frequent droughts incident to the climate, and to retain the moisture from the excessive rains which fall during certain seasons of the year. Altogether the Essay in a short compass, contains most valuable suggestions for the direction of the farmer in those parts, and for the emigrant who may settle in the magnificent lands of the West.

The late meeting of the American Association for the advancement of science in this city has brought us into hearty sympathy with many eminent students of natural science in the United States; and none more worthy of esteem than the author of this Essay. Having seen their faces in the flesh, and having had living evidence of the warmth of their hearts, the ardour of their zeal and the thoroughness of their attainments, we are now better prepared to appreciate their valuable labours and to follow with interest the course of their important researches and discoveries.

A. P. K.

Illustrative Scientific and Descriptive Catalogue of the Achromatic Microscopes manufactured by J. & W. Grunow & Co., New Haven, Conn., U. S. Price 30 cents. Pp. 104.

We have lately received a valuable pamphlet with the above very unassuming title. It is, in point of fact, a concise and well-written treatise on the theory of the microscope, its mechanical construction, its accessory apparatus, and its use, each section being copiously illustrated with good wood engravings, and having a price-list attached. From personal experience we can cordially recommend the Messrs. Grunow as careful and able workmen. Their instruments are superior to those of the French, and nearly equal to the best of English makers; indeed, nothing we have seen can surpass their rack-work and lever-stage movements.

We regret to see them advertising two grades of object-glasses —first and second class; the latter at little over half-price. Surely such artists ought to confine themselves to their best work. We note with some surprise the absence of a Micro-Photographic apparatus among the accessory instruments, in view of the attention which microscopists have lately been giving to that mode of illustrating their objects. We regret too that the Messrs. Grunow should have seen fit to give no credit to those English makers, the forms of whose stands they have copied. Their prices appear high, but good workmanship must always be expensive. The following comparison may be of use to intending purchasers in Canada. The instruments are nearly equal in point of excellence. Messrs. Grunow's stand is somewhat heavier, but Messrs. Powell & Lealand's Glasses are, in our opinion, superior :—

	Grunow & Co.'s prices in N. H.	Powell & Lealand's Sterling prices in London.
	STUDENT'S LARGER MICROSCOPE, NO. 4, A.	LEVER-STAGE MICROSCOPE.
Microscope Stand and Eye-pieces..	$70 00	
Mahogany Case	15 00	
¼-inch Object Glass	30 00	
1-inch " "	18 00	
Bull's-eye Condenser	6 00	
Frog Plate	5 00	
Three Dark Wells	3 00	
Diaphragm Plate	5 00	
Lieberkuhn's	6 00	£18 14 0
Polariscope	20 00	2 10 0
Animalcule Cage	2 00	0 6 0
Steel Disc (Drawing)	4 00	0 12 0
Forceps	3 00	0 10 0
Cobweb-Micrometer Eye-piece	30 00	4 4 0
	$217 00	£26 16 0

A few typographical errors have been overlooked, but as they are not likely to mislead any one we pass them by. D. A. P.

The Aquavivarium.—We had it in view to write an article on the Aquavivarium before the advent of spring, giving short instructions for its formation and successful management, and indicating some Canadian plants and animals, that would form interesting objects of study. But in this both time and materials have failed us, and for the present we confine ourselves to the enumeration of a few of the numerous works which have lately appeared in Britain, to the best of which we refer those of our readers who may wish to study natural history, under its most charming form.

The Aquarium; an unveiling of the wonders of the deep sea. With coloured plates and wood engravings. By Philip H. Gosse, A.L.S., &c. 1 vol., post 8vo. London: John Van Voorst. Price 17s.

We give the first place to Mr. Gosse's beautiful volume, as we believe that gentleman in conjunction with Mr. Warrington, may fairly claim to be the discoverer of the Aquarium, and to his writings we chiefly attribute its great popularity, and the rapid improvement in its universal application which has lately taken place. We consider this work unnecessarily expensive, and as it treats only of the marine forms, it is not available for an inland latitude.

Common objects of the sea shore, including hints for an aquarium. By Rev. J. G. Wood. London: Routledge & Co. 1857. 1 vol., 12 mo., pp. , with 13 plates. Colored 3s. 6d., plain 1s.

A marvel of cheapness, fluently written, and well illustrated. The author is a superficial observer, and adds nothing to what was previously known. As its name indicates, this book is also marine.

Handbook to the Aquarium. By F. S. Merton. London: Whiteley & Co. Price 1s.

The *Athenæum* says, "This book is a very dear shilling's worth, and the highest compliment we can pay it is to say that it is less full of errors than most of the popular books on the Aquarium. It is to be regretted that so good an opportunity for cultivating natural history should be rendered almost useless, by a set of books written by persons who know nothing of natural history, and who cannot spell or write their own language." We have not ourselves seen the book, but have no doubt at all of the correctness of the above estimate of its merits.

Ocean and River Gardens; a history of the marine and fresh-water Aquaria. By H. NOEL HUMPHREYS. 1 vol., 12mo., with 18 colored plates. pp. 219. Price 10s. 6d. London: S. Low & Co.

The *Athenæum's* remarks above quoted, apply with even more force to this work, than to the one for which they were intended. It would be hard to find within any pair of boards devoted to natural history a greater number of erroneous views, unscientific descriptions, and errors of all sorts, than are perpetrated by our author under the cloak of a pretended scientific knowledge, and a grandiloquent style. Mr. Humphries had better return to his illuminated missals and his coins, and leave natural history to original observers; he may be a numismatologist and probably a colourist, but assuredly he is no naturalist.

Popular History of the Aquarium of marine and fresh-water Animals and Plants. By GEORGE BRETTINGHAM SOWERBY, F. L. S. 1 vol., 16 mo. pp. 327, with 20 colored plates. London: Lovell Reeve. Price half a guinea.

We anxiously waited more than a year for this book, with high expectations as to the value of the observations of an accomplished natural history draughtsman, upon the objects of his pencil. We regret to say that in it we have been grievously disappointed. A great part of the book is taken from the writings of other men. Gosse, Harvey and Forbes, being largely drawn upon, and even Hugh Miller occasionally quoted. And his original observations, meagre as they are, are so filled with errors, that were it not for the plates, which are for the most part excellent, we would feel bound to pronounce the book worthless. As it is we can recommend no one to invest so much money in so little science.

The Aquavivarium, fresh and marine. By E. LANKASTER, M.D. a small 12 mo. vol., pp. 71, with plates and wood engravings. London: Hardwick. Price 1s. 6d.

Exclusive of the writings of Mr. Gosse, this little book is to our mind worth more than all that has been published on the subject to which it relates, that has come under our observation. We cordially recommend it to our readers. It treats chiefly of the fresh-water tank, (therefore all the more valuable to us,) in five chapters.—I. First Principles. II. History of. III. How to form. IV. Plants for. V. Animals for. His VI. and last chapter is devoted to the marine department. We quote his preface in full; the whole treatise is equally pithy and to the point.

"Having taken considerable interest in the domestic culture of plants and animals in water, and written the article "Aquavivarium" for the English Cyclopædia, I was induced, at the request of the publisher, to put together the following remarks. I have done so in the hope that they will in some manner contribute to make the prevailing taste for establishing domestic Aquavivaria subservient to the teaching of Natural History, and the study of God's works."

Rustic Adornments for Homes of Taste. By SHIRLEY HIBBERD. 1 vol., 12 mo., with plates. London: Groombridge.

The Book of the Aquarium and water-cabinet ; or instructions on the formation and management of collections of Fresh-water and Marine Life. By SHIRLEY HIBBERD. 1 vol., 12 mo., pp. 148, with plates. London: Groombridge.

Plain Instructions for the Management of the Aquarium. Edited by J. BISHOP, assisted by other gentlemen. London: Dean & Son.

We only give the titles of these works, the two former aim to be popular and practical, the latter we have not seen.

D. A. P.

A HINT TO AGRICULTURAL SOCIETIES.—If Agricultural Societies throughout the country would hold out annual prizes for exhibition of collections of insects possessing merit, it would be some inducement to young Canadian entomologists who are at present devoting much time to the study. Farmer's sons and others could then go to work in a practical manner, giving us yearly observations and discoveries in their respective branches of entomological study, therefore producing beneficial results, and more satisfactory to the country than paying large sums of money for a repetition of facts already known.—*U. C. Paper.*

Dr. John Forbes Royle.—Science has sustained a loss in the death of Dr. Royle, which took place at his residence, Heathfield Lodge, Acton, Middlesex, on the 2d of January. He had been for many weeks in ill-health, but his death was sudden at last. Dr. Royle was educated in London for the medical profession, and was a pupil of the late Dr. Anthony Todd Thomson, from whom he seems to have acquired that taste for the study of botany which afterwards distinguished him. Having passed his medical examinations, he entered into the service of the East India Company, and was for many years stationed in the Himalaya, where he had great opportunities afforded him of studying, not only the plants of that district, but of the whole empire. He was appointed superintendent of the East India Company's Botanic Garden at Saharempore,—a position which gave him the largest possible opportunity for studying the indigenous Flora of Hindústan. The result of his labours was given to the world in a magnificent work, entitled 'Illustrations of the Botany and other branches of Natural History of the Himalayan Mountains, and of the Flora of Cashmere' This work was published, in folio, with plates, in 1833, and at once gave to the author a European reputation as a botanist. In this work Dr. Royle gave the result of his researches into the medical properties of a large number of plants, as well as the history of drugs used in Europe, whose origin was unknown. In 1857 he published an essay 'On the Antiquity of Hindoo Medicine,' a work displaying much learning and research. On the opening of King's College, London, as a medical school, the knowledge of drugs and plants possessed by Dr. Royle pointed him out as a fit person to hold the Chair of Materia Medica, a position which he filled till the year 1856. Whilst lecturing on this subject he published his 'Manual of Materia Medica,' a book which is now used as a text-book on the subject in medical schools. His extensive knowledge of the natural history of India made him a valuable contributor to the periodical scientific literature, and he was a contributor to 'The Penny cyclopædia,' and Kitto's 'Dictionary of the Bible,' and other works. He took an active interest in promoting a knowledge of the material resources of India, and in 1840 produced a work which perhaps will be read with more interest now than when it was published, 'On the Productive Resources of India.' During the period of the Russian War, Dr. Royle drew attention to India as a source of the various fibrous materials used in the manufacture of cordage, clothing, paper, &c., by a lecture delivered before the Society of Arts in 1854. This lecture was afterwards expanded into a valuable work 'On the Fibrous Plants of India,' which was published in 1855. In the Preface to this work he announced that he was employed in a general work on 'The Commercial Products of India,' which, we believe, has not yet appeared. Dr. Royle was a Member of the British Association for the Advancement of Science, at whose meetings he often read papers, two of which deserve especial mention, one 'On the Cultivation of Cotton,' and another 'On the Cultivation of Tea in the East Indies.' He took an active interest in the last subject, and his efforts have been attended with complete success, as tea, rivalling that from China, is now produced in abundance in the Himalaya. For a short time he held the office of Secretary to the British Association for the Advancement of Science. He took an active interest in the developement of the plan of the Great exhibition of 1851, and the success which attended the exhibition of the Department of Indian Products was due, in a great measure, to his efforts. He was a Fellow of the Royal Linnean and Geological Societies, and at the time of his death held an appointment in connexion with the East India Campany in London.—*Athaneum.*

CANADIAN INSTITUTE.—We see by the Toronto papers that a costly and very beautiful service of plate has been procured to be presented to Dr. Daniel Wilson, who has gratuitously edited the *Canadian Journal* for the past two years. The cost was $480. From the report of the Institute it appears that the journal is now sent to the scientific societies of Paris, Copenhagen, Stockholm, &c , and that several articles that have appeared in its pages have been translated and reprinted in some of the leading scientific journals of Europe. It is gratifying to mark the progress of Canada in science and literature.—*Athaneum.*

The University of St. Andrew has conferred its degree of LL.D. on Mr. James Scott Bowerbank. This is a graceful and well-earned compliment. As the founder of the Palæontographical Society, and a museum of unique fossil specimens, and a laborious investigator in many departments of Natural History and Geology, every one will recognise Mr. Bowerbank's claim for such an honour, and the judgment displayed by the University that has conferred it.—*Athaneum*

PERMIAN FOSSILS IN KANSAS, AND ELSEWHERE IN AMERICA.—We have received, nearly at the same time, published notices by Mr. Meek and Dr. Haydon of Albany, and by Professor Swallow of Missouri, on the discovery in a bed of limestone at Smoky Hill Fort, and other places in Kansas, of fossil shells, clearly indicating that this bed represents the Permian system of Sir R. I. Murchison, the newest member of the Palæozoic series, and one of the links heretofore wanting to give completeness to the chain of geological formations in Western America. We observe that a controversy exists between the gentlemen above named as to the priority of discovery or the right of announcing it. As both of the parties have sufficiently established reputations, independently of this discovery, we would recommend to them to leave the honor to Major Hawn and Dr. Cooper, who actually disinterred these interesting remains, and to co-operate in the description of the fossils and the prosecution of farther researches.

We observe in the November number of *Silliman's Journal*, that the fossils collected by Professor Emmons in North Carolina are leading to the conclusion, that the well-known red sandstones of Connecticut, New Jersey, etc., are of somewhat older date than geologists have recently supposed—that they may be Lower Triassic or even Permian. This is of some geological interest in British America, as it would bring these deposits into parallelism with the great areas of red sandstone in Prince Edward Island and Nova Scotia, known to be later than the coal period, and respecting which the writer several years since* stated his opinion, founded on fossil plants and reptilian remains, that they were probably Permian or Lower Triassic, a view which then seemed scarcely compatible with the received age of the similar sandstones in the United States.

The most interesting part of the discoveries of Prof. Emmons, rendered still more interesting by the probability that these rocks are older than the American geologists have hitherto supposed, is, that among these fossils appears a small mammal, probably the oldest known, the Dromatherium Sylvestre (Emmons). This is the first evidence of Mammalian life obtained from the Secondary rocks in America; and if the views above mentioned are correct, older than the Microlestes of the German Trias, the oldest fossil mammal heretofore found. J. W. D.

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* Journal Ac. Nat. Sci. Phila., vol. 2, and Proc. vol. vii; and Acadian Geology.

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MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF DECEMBER, 1857.

Latitude, 45 degrees 33 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	29·817	29·754	29·898	46·0	46·0	35·5	·245	·282	·210	·92	86	·90	S. S. E.	W. S. W.	W. S. W.	7·92	5·60	10·00	0·160		Rain.	C. C. Str. 4.	C. Str. 10.
2	871	783	680	34·7	40·8	35·3	·203	·227	·203	90	·85	90	W. S. W.	S. W.	S. by E.	9·03	3·83	0·27			C. Str. 8.	C. C. S.	C. C. Str. 8.
3	623	814	902	33·0	30·4	22·4	·189	·160	120	89	·86	82	W.	W. N. W.	W. N. W.	16·13	6·03	23·36		0·50	" 10.	C. Str. 10.	C. Str. 10.
4	890	901	30·014	21·0	24·0	13·0	·104	·097	·083	·78	·65	·82	N. W.	W.	N. W. by N.	33·12	1·10	9·30			C. C. Str. 6.	" 1.	Clear. Aurora Borealis
5	30·031	30·111	177	6·5	20·0	5·0	·051	·083	·046	·87	63	84	N. W. by N.	N. E. by E	S. E. by E.	1·63	0·93	1·63			Clear.	Clear	" " "
6	060	29·884	29·678	3·6	14·0	21·0	·044	·089	·092	·86	·84	·67	N. E. by E.	N. E. by E.	E.	5·23	2·97	8·67	Inapp.	0·03	"	C. C. Str. 10.	Sleet.
7	29·590	634	310	34·0	43·5	33·3	·178	·241	·187	·83	·79	·89	S. W.	W. by S.	S. W.	16·21	10·17	11·23			C. Str. 6.	Cir. 2,	Clear.
8	713	754	987	32·5	43·3	32·9	·187	·233	·178	·89	·79	·86	S. W.	W. by N.	W. N. W.	4·51	3·02	3·30			Clear.	Clear.	Clear. Aurora Borealis.
9	831	643	378	26·0	31·0	37·7	·112	·171	·226	70	89	91	N. E. by E.	N. E. by E.	S. S. E.	7·63	8·51	6·51	0·240	0·10	"	Sleet.	Rain.
10	370	375	604	35·5	37·5	23·0	·210	·207	106	90	84	73	S. W. by W.	S. W. by W.	W. N. W.	9·33	7·35	16·81			C. Str. 4.	C. Str. 6.	C. C. Str. 4.
11	990	30·030	30·279	11·1	12·3	9·2	·063	·068	·069	·67	·67	·77	N. W. by N.	N. W. by N.	W.	23·33	8·72	10·51			Clear.	C. C. Str. 4.	Clear.
12	30·326	262	232	9·0	20·8	21·6	·068	·098	·093	·70	·73	·74	W.	W.	W. S. W.	8·73	7·50	5·42			C. Cir. 4.	C. Str. 4.	"
13	187	29·914	29·818	27·0	39·0	34·6	·128	·214	·187	·76	·84	·85	W. S. W.	S. W.	S. W.	18·30	8·06	13·98			Clear.	Light Cirri. 2.	"
14	29·815	820	30·018	33·1	40·1	35·2	·187	·210	·186	·90	·79	·83	S. W. by W.	S. W. by W.	W. by N.	7·80	4·92	3·08			C. C. Str. 8.	C. Str. 10.	C. Str. 10.
15	30·198	30·260	185	19·1	24·1	20·2	·091	·091	089	73	·65	·68	N. E. by E.	N. E. by E.	N. E. by E.	14·22	3·93	2·47			C. Str. 10.	C. C. Str. 4.	Clear.
16	082	154	131	19·6	31·1	24·7	·091	·152	·135	·73	·78	86	N. E. by E	N. N. W.	N. E. by E.	5·42	0·82	0·01		1·10	Snow.	C. Str. 6.	C. Str. 10.
17	29·981	29·901	29·888	25·0	35·6	32·5	·107	·192	·192	·70	·83	·87	N. E. by E.	S. by W.	S. by W.	1·00	0·01	0·01			C. Str. 10.	" 6.	" 10.
18	650	350	340	32·2	34·4	34·0	·191	·203	·205	·93	91	·95	N. E. by E	N. E. by E.	N. W. by W	2·90	8·31	3·28	0·876		" 10.	Rain.	Rain.
19	810	950	30·147	22·5	18·8	12·0	·102	·103	·075	·80	·78	·74	W.	W.	W. N. W.	12·73	14·30	15·77	0·074		" 8.	C. Str. 10.	C. Str. 9.
20	30·272	30·254	346	9·1	11·3	7·7	·065	·066	·067	·73	·68	·71	N. W.	W.	W. S. W.	9·80	4·11	0·73			" 10.	" 8.	Clear. Aurora Borealis.
21	199	100	29·937	7·4	30·5	17·0	·051	·145	·096	·87	78	83	S. E.	S. E.	E. by N.	2·90	1·05	2·31			Clear.	Clear.	C. Str. 8.
22	29·479	29·275	357	20·3	27·0	22·1	·114	·137	·096	·87	·82	70	N. E. by E.	N. by E.	W. by N.	7·42	6·06	9·10		3·74	Snow.	Snow.	" 10.
23	388	206	198	13·0	25·3	24·0	·083	·123	·135	·82	·79	·90	S. W.	S. E.	S. W.	17·55	2·22	3·13		1·04	C. Str. 8.	C. Str. 10.	Snow.
24	347	683	974	20·1	12·4	0·1	·114	·068	·038	·87	·67	·85	W.	N. W.	W. S. W.	19·51	15·70	13·99		0·10	" 4.	" 4.	Clear.
25	30·003	908	854	—10·7	8·2	—0·4	·022	·065	·034	·78	·68	·74	W. by N.	S. by W.	N. E. by E.	0·01	0·00	0·00			Clear.	" 10.	Cir. Cum. 6. Lunar Halo.
26	29·820	809	904	—3·5	3·0	1·4	·051	038	036	83	73	86	N. E. by E	N. E. by E.	N. E. by E.	0·23	2·32	0·00			C. Str. 8.	" 8.	C Str. 10.
27	30·098	30·138	30·002	—13·0	7·2	3·0	·018	·040	031	·74	70	83	N. E. by E.	S. E.	E. N. E.	0·36	0·03	0·22			Clear.	C. C. Str. 4.	Cir. Cum. 6. Lunar Halo.
28	29·655	29·595	29·840	0·0	35·7	27·0	·050	·192	·146	·79	·83	·88	N. E. by E.	W. S. W.	W.	1·40	0·37	11·28		0·20	Snow.	Cirr. Str. 8.	" 4.
29	869	820	909	19·5	28·2	20·5	·107	·135	·086	·83	·78	·70	S. E. by S.	N. E. by E.	N. W. by N.	0·80	1·62	0·75			C. Str. 10.	" 10.	" 5.
30	800	680	656	12·5	26·0	28·0	·070	·129	·144	·73	·80	·83	N. E. by E.	N. E. by E.	E. by S.	0·31	2·06	3·15		2·10	" 10.	C. C. Str. 10.	Snow.
31	170	28·880	183	30·3	25·0	30·1	·178	·123	·160	·92	·79	·86	E. by N.	N. E. by E.	W. by S.	12·21	2·30	8·21		17·00	Snow.	Snow.	Snow.

REPORT FOR THE MONTH OF JANUARY, 1858.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2. p. m.	10 p. m.
1	29·531	29·470	29·827	14·4	25·3	21·5	·075	·123	·084	72	·76	·60	S. S. E.	E. by N.	S. W.	17·88	0·08	3·72		2·90	C. Str. 10.	Snow.	Clear.
2	916	741	700	10·7	24·9	26·5	·082	·138	·146	·88	·74	·88	S. by W.	S. W.	W. by S.	5·37	0·78	14·30			Clear.	Clear.	"
3	788	416	438	8·0	16·0	12·0	·056	·087	·070	79	78	·73	S. W. by S.	S. by E.	N. by E.	4·00	0·23	13·53		4·00	C. C. Str. 4.	Snow.	C. Str. 10.
4	225	070	211	10·9	42·0	38·0	·082	·225	·217	88	·79	·86	S. by W.	W. by S.	W. by S.	2·00	12·82	20·62			C. Str. 8.	C. C. Str. 4.	Clear.
5	656	714	995	11·2	9·6	—5·0	072	·079	·031	·78	·88	·83	N.	N.	E.	23·11	0·76	7·07			Clear.	Clear.	" Aurora Borealis.
6	947	852	816	—6·0	2·8	2·0	·029	·047	·044	·81	·84	·84	N. E. by E.	N. E. by E.	N. E. by E.	17·85	12·22	17·40			C. C. Str. 6.	C. Str. 10.	Snow.
7	954	30·057	30·338	3·2	14·6	—1·6	·069	·038	·023	·79	·70	·85	W.	W.	N. W. by W	13·72	4·00	5·70		0·38	C. Str. 10.	Clear.	Clear.
8	30·587	536	563	—10·2	8·9	—0·3	·059	·039	·026	·78	·82	·83	W. by N.	W. S. W.	S. S. W.	9·26	3·06	4·73			Clear.	"	" Aurora Borealis.
9	29·963	29·916	29·808	—8·0	2·0	13·0	·051	·093	·050	·79	·95	·92	E. by N.	W. N. W.	W. N. W.	2·73	1·82	1·45			"	"	"
10	30·147	30·213	30·289	3·7	20·1	0·0	·094	·050	·042	·85	·72	·84	N. W.	W. S. W.	E.	18·75	0·57	0·76			"	"	" Faint Aur. Borealis
11	29·937	29·357	29·356	28·0	40·3	39·5	·153	·245	·226	·88	·92	·92	S. by E.	S. by E.	S. S. W.	20·66	10·37	10·12	0·381		Rain.	C. Str. 10.	Rain.
12	580	30·002	30·238	27·0	23·0	8·6	·146	·087	·058	·88	·60	·80	W.	W. by N.	S. W. by W.	18·09	23·63	7·36			C. C. Str. 8.	Cirr. 4.	Clear.
13	30·065	29·912	29·948	—4·2	24·0	18·0	·031	·100	·087	·79	·74	·84	E. N. E.	W. by S.	W. by S.	3·60	7·46	3·65		0·90	Clear.	C. Str. 4.	" Aurora Borealis.
14	146	30·130	30·270	10·6	35·1	14·7	·062	·170	·070	·86	·81	·82	W. S. W.	W. S. W.	E. by N.	3·00	1·12	0·00			"	Clear.	"
15	292	151	034	4·7	13·9	15·0	·043	·070	·074	·75	82	·81	E.	N. E. by E.	N. E. by E.	5·93	10·66	6·61		1·30	C. C. Str. 8.	C. Str. 10.	Snow.
16	29·412	29·215	29·480	31·2	31·0	30·1	·162	·102	·143	·89	·89	·79	N. E. by E.	N. E. by E.	N. W.	12·17	6·10	1·10	0·12	1·10	Rain.	Rain.	"
17	766	729	944	10·1	14·6	4·2	·057	·070	·046	99	·82	84	N. W.	W. S. W.	S. S. W.	16·03	9·07	4·37		1·20	Str. 2.	Clear.	Clear. Aurora Borealis.
18	966	854	967	—10·2	12·2	4·1	·022	·051	·041	76	63	74	S. by W.	W. S. W.	S. by W.	0·03	0·00	0·27			Cir. Str. 4.	Cirr. Str. 4.	"
19	30·018	936	987	—9·2	13·2	2·2	·054	·067	042	78	80	84	S by W.	S. E. by E.	E.	0·92	0·05	0·00			" 6.	C. Str. 10	C. Str. 10.
20	29·995	997	30·036	—9·3	18·4	14·7	022	·075	·064	76	70	70	S. S. E.	S. S. E.	S. by W.	0·02	0·31	1·21			Str. 4.	" 4.	" 10.
21	932	880	100	15·6	37·1	19·3	·072	·192	·034	75	82	71	S. W.	W. by N.	N. by E.	8·55	15·43	10·35			C. Str. 8.	" 5.	" 4.
22	30·601	30·617	697	—9·7	9·2	—10·7	·020	042	017	64	·59	57	N. N. E.	S. E. by E.	S. E. by S.	10·27	0·93	0·35			Clear.	Clear.	Clear.
23	675	355	405	—18·7	1·0	—5·5	013	030	024	63	·69	64	N. E. by E.	N. E. by E.	N. E. by E.	0·02	0·02	7·11			"	"	"
24	405	254	313	—9·0	22·4	14·0	024	·084	059	74	·71	65	N. E. by E.	N. E. by E.	N. E. by E.	0·50	0·10	0·00			"	Light Cirri.	Cum. 5.
25	154	087	035	21·4	40·0	33·2	·089	·212	·175	72	·83	84	N. by E.	S. S. E.	S. S. E.	0·02	0·11	1·17	0·076		C. Str. 10.	Rain.	Rain.
26	29·723	29·511	29·503	34·6	43·2	37·1	·185	·202	·208	90	·84	96	S. by E.	S. E. by E.	S. by E.	0·06	1·77	9·36	0·174		Rain. 0.	"	C. Str. 10.
27	570	614	751	32·4	38·7	21·5	·169	·212	·112	·84	·82	·93	S. by E.	S. S. E.	N. E. by E.	12·63	12·07	8·57	Inapp.		Str. 2.	"	" 10.
28	745	709	755	19·0	19·9	15·3	·090	·084	·070	78	·71	·70	N. E. by E.	N. E. by E.	N. E. by E.	11·65	16·59	8·02			C. Str, 10.	C. Str. 10.	" 10.
29	801	664	705	13·4	22·0	18·6	·067	·098	092	81	·74	·90	N. E. by E.	N. E. by E.	N. W.	21·28	9·40	5·35			" 10.	" 10.	" 10.
30	643	579	796	18·0	21·9	6·4	·081	·082	·042	77	·62	·66	N. N. W.	W. N. W.	W. N. W.	8·90	10·75	22·31			" 10.	" 10.	Cirr. 2.
31	917	953	30·080	—10·1	5·0	—4·6	·017	·031	·029	·57	·56	·82	W. N. W.	W. S. W.	W. S. W.	32·12	10·20	5·95			Clear.	Clear.	Clear.

REMARKS FOR DECEMBER, 1857.

Barometer.......
- Highest, the 20th day, 30·340 inches.
- Lowest, the 31st day, 28·880 "
- Monthly Mean, 29·743 inches.
- Monthly Range, 1·466 "

Thermometer...
- Highest, the 1st day, 46°0.
- Lowest, the 27th day, —13°2.
- Monthly Mean, 14°96.
- Monthly Range, 59°2.

Greatest intensity of the Sun's rays, 59°0.
Lowest point of terrestrial radiation, —13°5.
Mean of humidity, ·800.

Rain fell on 5 days, amounting to 1·350 inches; it was raining 32 hours and 30 minutes.

Snow fell on 10 days, amounting to 26·81 inches; it was snowing 68 hours 50 minutes.

Most prevalent wind, N. E. by E. Least prevalent wind, E.
Most windy day, the 24th day; mean miles per hour, 16·40.
Least windy day, the 25th day, miles per hour, 0·00.
Aurora Borealis visible on 3 nights.
Lunar Haloes visible on 2 nights.
The Electrical state of the atmosphere has indicated moderate intensity.
Ozone was in rather large quantity.

REMARKS FOR JANUARY, 1858.

Barometer. ......
- Highest, the 22nd day, 30·697 inches.
- Lowest, the 4th day, 29·070 "
- Monthly Mean, 29·907 inches.
- Monthly Range, 1·627 "

Thermometer.
- Highest, the 26th day, 45°4.
- Lowest, the 23rd day, —18°7.
- Monthly Mean, 13°76.
- Monthly Range, 62°1.

Greatest intensity of the Sun's rays, 51°9.
Lowest point of terrestrial radiation, —19°2.
Mean of humidity, ·786.

Rain fell on 5 days, amounting to 0·751 inches; it was raining 34 hours and 40 minutes.

Snow fell on 7 days, amounting to 11·78 inches; it was snowing 34 hours and 35 minutes.

Most prevalent wind, N. E. by E. Least prevalent wind, E.
Most windy day, the 12th day; mean miles per hour, 16·36.
Least windy day, the 18th day; mean miles per hour, 0·10.
Aurora Borealis visible 5 nights. Zodiacal Light very bright.
Parhelia and Mock Suns visible on 2 days.
The Electrical state of the atmosphere has indicated moderate intensity.
Ozone was in rather large quantity.

Day of Month.
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MONTHLY METEOROLOGICAL REGISTER, AT MONTREAL, (LATITUDE 45° 30′ N., LONGITUDE 73° 36′ W.,) FOR THE MONTH OF DECEMBER, 1857.

HEIGHT ABOVE THE LEVEL OF THE SEA, 57·07 FEET.

BY A. HALL, M. D.

Day of Month.	Barometer, Corrected and reduced to Fah., 32°.			Temperature of the Air.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction and Force of the Wind, from 0, Calm, to 10, Violent Hurricane.			Amo'nt of Rain in Inches.	Amo'nt of Snow in Inches.	Clouds and their Proportion, in Numbers, from 0, Cloudless, to 10, perfectly Overcast.			Observations.
	7 a. m.	2 p. m.	9 p. m.	7 a m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.	
1	29·974	29·907	29·914	40·5	43·0	37·8	·225	·209	·157	·91	·75	·71	S 2	S W 2	S W 4	0·29	....	Nim. 10	Cu. St. 7	Cu. St. 9	
2	969	948	798	36·5	41·0	38·0	·170	,212	·165	·80	·82	·72	S W 2	S W 1	S W 1	....	....	Nim. 10	Cu. St. 8	Cu. St. 8	
3	749	850	30·016	36·0	29·9	24·0	·120	·123	·094	61	·77	73	W S W 2	W S W 1	W S W 1	....	Inap.	Nim. 10	Cu. St. 10	Cu. St. 10	
4	30·057	30·054	106	23·0	24·0	15·0	·073	·077	·040	59	60	46	N W 1	W N W 1	N N W 2	....	Inap.	Cu. St. 10	Strat. 6	0 0	Bright Zodiacal Light. Diffused Auroral Light.
5	170	212	258	9·0	12·0	12·0	·051	·045	·045	65	60	60	N E 1	N E 1	N E 1	....	....	Strat. 1	Cir. 1	0 0	" " " " " "
6	249	344	29·723	7·0	17·0	30·3	·045	·047	·148	64	50	89	N E 1	N N E 1	N N E 2	....	....	0 0	Cu. St. 10	Nim. 10	
7	29·632	29·803	946	39·0	42·0	37·2	·195	·199	·157	82	74	71	S W 4	W 2	W 4	Inap.	Inap.	Cu. 4	0 0	0 0	Bright Zodiacal Light.
8	829	910	30·156	36·0	43·0	32·0	·191	·186	·143	90	67	79	W S W 2	W 2	S 1	....	....	Cu. St. 10	Strat. 1	0 0	Zodiacal Light.
9	30·111	773	29·495	29·4	33·8	39·0	·123	·168	·216	77	89	91	W 3	S 1	S 1	....	....	Cu. St. 10	Nim. 10	Nim. 10	
10	29·521	510	678	39·0	37·0	27·0	·216	·136	·093	91	62	63	W 2	W 2	W 2	Inap.	1·20	Nim. 10	Cu. St. 10	Nim. 10	
11	30·096	30·247	30·389	15·0	15·5	11·0	·063	·031	·028	67	37	39	N N W 2	N W 2	N W 2	....	....	Cu. St. 9	Cu. 6	0 0	Zodiacal Light. [of the 13th.
12	441	471	388	12·0	23·0	25·5	·045	·098	·100	60	72	74	W 2	W 2	W 4	....	....	Cir. St. 8	Cu. [illegible]	0 0	Faint Zodiacal Light. High Wind at its maximum between 5 & 6 A. M.
13	219	091	29·938	23·6	37·0	36·0	·123	·178	·156	77	81	75	S W 7	S W 6	S W 4	....	....	Cu. 9	Cir. Cu. 8	Cu. St. 3	
14	29·925	29·966	30·134	39·0	40·5	37·5	·173	·197	·171	73	78	76	W 2	W 1	W 3	....	....	Cu. St. 10	Cu. St. 10	Cu. St. 9	
15	30·397	30·478	312	23·0	25·2	23·0	·106	·100	·106	86	74	86	N E 2	N E 2	N N E. 3	....	....	Cu. St. 10	Cir Strat. 6	Cu. St. 10	
16	227	238	274	23·5	30·5	27·5	·123	·142	141	100	84	93	N 2	N 2	N 2	....	1·20	Nim. 10	Nim. 10	Cu. St. 10	
17	119	034	104	28·2	38·0	35·0	·153	208	·183	100	97	90	Calm.	Calm.	Calm.	....	....	Nim. 10	Nim. 10	Nim. 10	
18	29·794	29·443	29·418	34·0	37·0	37·5	·196	·221	·221	100	100	100	N 2	N N E 2	N N E 2	0·31	....	Nim. 10	Nim. 10	Nim. 10	
19	909	30·128	30·300	22·5	19·5	15·8	·118	·097	·059	100	92	65	W N W 2	W 2	W 2	1·30	Inap.	Nim. 10	Nim. 10	Nim 10	
20	30·421	462	491	12·5	14·6	12·0	·060	·046	·045	80	55	60	N W 2	W 3	W 2	....	Inap.	Cu. St. 10	Cu. 7	0 0	Faint Zodiacal Light. Aurora, with streamers.
21	412	216	062	17·4	27·2	20·0	·072	·093	·091	75	63	85	S 1	S 1	S 1	....	....	Cu. St. 10	Cir. 3	Nim 10	
22	29·640	29·469	29·434	24·2	29·0	28·0	·129	·160	·117	100	·100	76	N N E 1	N N E 1	N N E 1	....	4·00	Nim. 10	Nim. 10	Cu. St. 10	
23	502	341	30·263	14·0	25·0	28·0	·051	·082	·117	63	61	76	W 2	S 3	S 2	....	1·50	Strat. 3	Nim. 10	Nim. 10	
24	541	806	127	24·7	15·0	9·0	·105	·040	·022	80	46	35	N W 3	N N W 3	N N W 3	....	3·50	Nim. 10	Cu. St. 8	0 0	Auroral Light.
25	30·120	30·057	29·958	4·5	11·5	7·0	·005	·036	·017	9	49	29	W N W 1	W N W 3	W N W 1	....	....	Strat. 0·5	Nim. 10	Nim. 10	
26	29·929	29·920	30·059	0·6	6·0	6·0	·020	·029	·029	43	51	51	N E 3	N N E 2	N N E 2	....	....	Cu. St. 10	Cu. St. 10	Cu. St. 10	
27	30·267	30·194	144	— 2·0	5·0	4·9	·006	·013	·013	12	23	23	N E 3	N E 3	N E 2	....	....	0 0	Cu. St. 9·5	Cu. St. 10	Lunar Halo.
28	29·453	29·728	29·955	+ 20·0	35·0	30·6	·091	·183	·124	85	90	73	S W 1	W S W 1	W 1	....	4·50	Nim. 10	Cu. St. 9	0 0	Lunar Corona.
29	986	941	30·009	26·4	28·9	23·4	·099	·117	·051	69	76	40	W S W 1	W N W 1	N W 1	....	Inap.	Cu. St. 10	Cu. St. 10	Cu. St. 8	
30	978	808	29·742	21·2	28·0	32·0	·096	·153	·181	85	100	100	N 1	N W 1	N W 1	....	....	Cu. St. 10	Nim. 10	Nim. 10	
31	971	28·994	999	31·3	27·0	31·0	·174	·147	·155	100	100	89	E N E 2	N N E 2	W 3	....	15·00	Nim. 10	Nim. 10	Nim. 10	

REPORT FOR THE MONTH OF JANUARY, 1858.

	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.	
1	29·727	29·612	29·983	18·0	28·0	25·0	·067	·153	·117	·68	·100	·87	S W 2	S W 2	W N W 1	....	5·00	Strat. 4	Nim. 10	0 0	Lunar Corona.
2	30·123	879	796	15·0	28·0	30·0	·055	·099	·130	·64	·61	·73	W S W 2	W S W 2	S W 2	....	2·00	Cu. St. 3	0 0	Strat. 1	Zodiacal Light.
3	29·033	448	492	12·5	20·9	16·3	·030	·080	·074	41	71	83	N W 2	N W 3	S W 2	....	0·50	Cu. St. 10	Nim. 10	Cu. St. 5	
4	380	160	311	26·0	40·0	39·0	·111	203	·173	81	82	73	S W 4	W S W 4	W S W 4	....	1·75	Cu. St. 10	Strat. 3	Cu. St. 4	
5	882	897	30·106	20·0	10·0	5·0	·091	·045	·013	85	68	23	N 2	N E 2	N E 4	....	....	0 0	0 0	0 0	Faint Zodiacal and Auroral Lights.
6	30·053	938	29·893	— 0·2	6·0	5·0	·048	·029	·041	85	51	74	N E 3	N N E 4	N N E 4	....	....	Cu. St. 10	Nim. 10	Nim. 10	
7	040	30·214	30·486	+ 6·3	11·0	6·4	·043	·028	·029	75	39	51	W 2	N W 2	N W 2	....	5·75	Nim. 10	Strat. 4	Strat. 2	
8	687	708	579	1·0	7·0	2·3	·022	·038	·020	45	85	43	W N W 1	W N W 1	W S W 1	....	....	Cu. St. 9	Cir. 2	0 0	Brilliant Aurora. Faint Zodiacal Light.
9	181	29·914	29·993	16·0	25·0	31·0	·059	·082	155	65	61	89	S 3	S S W 3	N W 1	....	....	Cu. St. 10	Nim. 10	0 0	Faint Zodiacal Light. Meteor perpendicularly from Auryga at 11·45 p.m
10	254	30·394	30·316	19·0	19·4	18·8	·055	·065	·087	53	62	84	N W 1	W 1	W 6	....	Inap.	0 0	0 0	0 0	
11	29·914	29·518	29·362	33·0	39·8	40·0	·188	·216	·213	100	91	100	S 6	S 4	S W 4	Inap.	Inap.	Nim. 10	Nim. 10	Nim. 10	Auroral Bank.
12	558	30·094	30·352	35·0	24·2	17·0	·162	·094	·063	80	73	67	S W 6	W 1	W 1	0·11	....	Nim. 10	0 0	0 0	Faint Zodiacal Light.
13	30·255	29·954	052	5·0	18·0	26·0	·013	·036	·105	23	36	75	N 4	N E 3	W S W 2	....	....	Cu. St. 7	Cir. 8	Cu. St. 4	Faint Zodiacal Light.
14	217	30·292	396	24·6	30·0	23·4	·088	·111	·088	67	67	67	W 2	W 1	W 1	....	Inap.	Cu. St. 4	0 0	0 0	Faint Zodiacal Light.
15	456	222	29·996	11·0	16·0	17·8	·042	·059	·098	59	65	100	W 1	N E 1	E 1	....	....	Cu. St. 9	Nim. 10	Nim. 10	
16	29·584	29·419	540	35·0	30·0	32·5	·204	·167	·181	100	100	100	E 1	N E 2	N E 2	Inap.	2·50	Nim. 8	Nim. 10	Nim. 10	
17	835	969	30·043	17·8	14·0	10·0	·078	051	·025	83	63	37	N E 1	N E 3	N E 2	0·11	0·50	Cu. St. 10	Cu. 3	0 0	Auroral Bank.
18	30·030	998	054	3·8	11·3	9·7	·024	·036	·039	47	49	57	N N E 1	N E 1	N N E 1	....	....	0 0	Strat. 2	0 0	Faint Auroral Light.
19	139	30·117	111	3·0	11·2	10·6	·022	·042	·039	45	59	57	N E 1	N E 1	N E 1	....	....	Fog.	Cu St. 10	Cu. St. 10	
20	102	114	161	6·0	16·0	21·0	·029	·047	·074	51	50	64	N E 2	N E 2	N E 1	....	Inap.	Cu. St. 10	Cu. St. 8	Cu. St. 10	
21	051	29·855	231	25·5	37·0	20·0	·111	·154	·043	81	71	40	N 1	N E 3	N E 2	....	....	Cu. St. 8	Cir. 6	Cu. St. 2	Faint Auroral Light.
22	715	30·776	797	— 1·4	1·0	— 0·3	·028	·014	·023	68	34	53	N 3	N 3	N 3	....	....	0 0	0 0	0 0	Faint Auroral Bank.
23	731	580	531	—13·0	4·0	+ 5·8	·018	·024	·029	42	47	51	N 2	N 2	N 1	....	....	0 0	0 0	0 0	Imperfect Lunar Halo, with Central Corona.
24	512	416	345	+ 0·3	34·0	23·0	·017	·077	·106	39	60	86	N 1	N 1	S 1	....	....	Strat. 1	Cir. St. 8	Cir. St. 8	Faint Solar Halo at 2 p. m.
25	279	201	101	32·2	38·0	37·0	·175	·229	·221	94	100	100	S 1	S 1	S 1	....	....	Nim. 10	Nim. 10	Nim. 10	
26	29·851	29·525	29·583	39·5	43·4	30·0	·235	·254	·239	97	92	100	S S W 1	S S W 1	S W 1	0·27	....	Nim. 10	Nim. 10	Nim. 6	
27	037	713	830	35·5	34·0	25·0	·177	·155	·100	85	79	74	W S W 1	N 1	N 1	0·03	....	Cu St. 6	Nim. 10	Nim. 10	
28	868	829	873	20·8	21·9	17·0	·085	·070	063	78	64	67	N E 4	N E 3	N E 3	0·02	....	Cu. St. 10	Cu. St. 10	Cu. St. 10	
29	853	774	757	16·0	24·0	22·0	·059	·077	·101	65	60	86	E N E 2	E N E 2	E N E 2	....	Inap.	Nim. 10	Nim. 10	Cu. St. 10	
30	734	701	635	20·9	25·0	13·0	·080	·100	·048	71	74	62	W N W 1	W N W 2	N W 3	....	....	Cu. St. 10	Cu. St. 10	Cu. St. 9	
31	30·010	30·098	30·210	— 3·0	1·2	2·0	·012	·017	·020	32	39	43	W 7	W 3	W 1	....	....	0 0	0 0	Cir. 1	

REMARKS FOR DECEMBER, 1857.

Barometer. . .... Highest, the 20th day: 30·491 inches
Lowest, " 31st " 28·994 "
Monthly mean, 29·9703 inches.
Monthly range, 1·497 "

Thermometer. . Highest, 1st day: 47°0.
Lowest, 27th " —5°0.
Monthly mean, 25°05.
Monthly range, 52°0.

Greatest intensity of the sun's rays, 86°7.
Warmest day was the 1st, its mean temperature being 40°43.
Coldest " " 27th, " " " 2°63.
Mean of humidity, ·719.

Rain fell on 5 days during 47 hours 30 minutes, amounting to 1·90 inches. Snow fell on 13 days during 81 hours 30 minutes, amounting to 30·9 inches in depth. The latter melted and added to the rain afforded a total of the former equivalent to 8·86 inches.

The most prevalent wind was the W.
The least prevalent wind was E. N. E. and E.
No record of wind from the E. S. E., S. E., S. S. E., and S. S. W.
The most windy day was the 13th.
The most windy hour between 5 and 6 A. M. of the 13th.
There was one calm day, the 17th.
There was no cloudless day.
Ozone was in moderate proportion.

N. B.—The rain and snow guages are noticed each morning at 10 a.

REMARKS FOR JANUARY, 1858.

Barometer. .. ... Highest, the 22nd day, 30·797 inches.
Lowest, " 4th " 29·160 "
Monthly mean, 30·0226 inches.
Monthly range, 1·497 "

Thermometer. . Highest on the 26th day, 49°0.
Lowest " 23rd " —14°0.
Monthly mean, 18°83.
Monthly range, 63°.

Greatest intensity of the sun's rays, 79°.
Warmest day was 26th; its mean temperature, 40°63.
Coldest day was 23rd; " " —1·06.
Mean of humidity, ·6786.

Rain fell on 6 days during 56 hours 50 minutes. It snowed on 12 days during 52 hours 15 minutes. Of the former there fell 0·54 inches in depth; of the latter 17·95 inches. This melted and added to the former yielded a total of 3·81 inches rain in depth.

The most prevalent wind was the N. E.
The least " E.
No record of wind from N. N. W., E. S. E., S. E., and S. S. E.
The most windy day was the 11th.
The most windy hour between 4 and 5 a. m. of same.
There was no calm day.
Cloudless days occurred on 5th, 10th, 22nd, 23rd and 31st.
Ozone was in moderate proportion.

N B.—The rain and snow guages are noted each morning at 10 a. m.

Geological Survey of Canada.

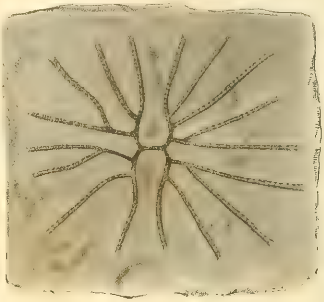
Sir W. E. Logan. Director.

(Graptolithus)

Lower Silurian *Hudson River Group*

2

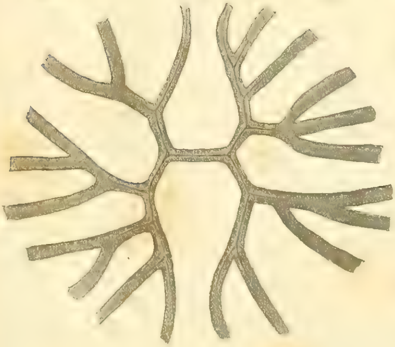
3



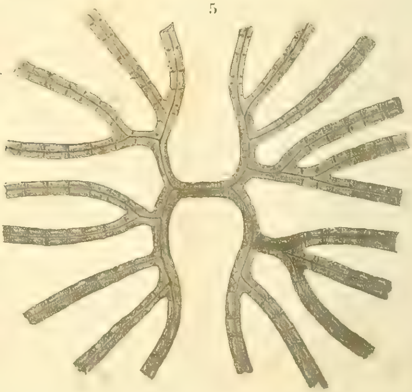
1

6

4



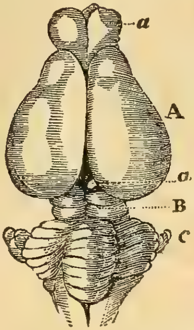
5



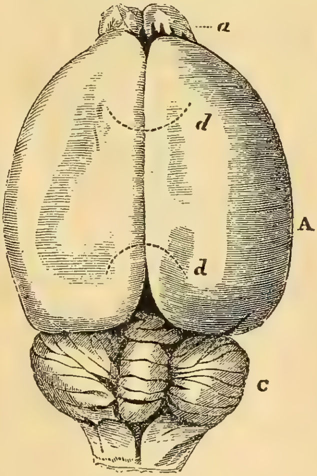
F.B.Meek.Del^t James Hall. Descrp^t J.E.Gavit Sc.

PLATE TO ILLUSTRATE PROFESSOR OWEN'S ARTICLE ON THE CLASSIFICATION OF THE MAMMALIA. Page 52, Vol. III.

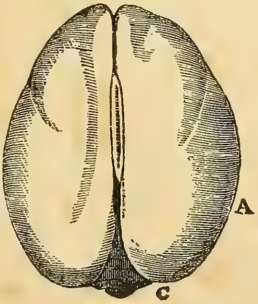
1.—Brain of Opossum.



2.—Brain of Beaver.

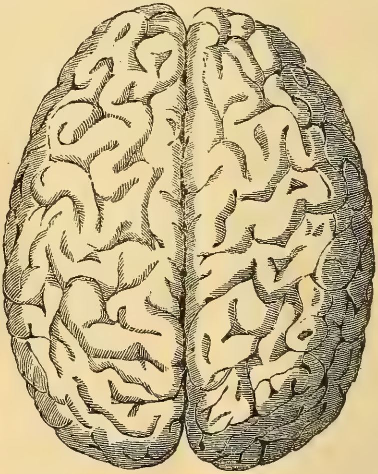


3.



4.—Chimpanzee.

5.—Negro.



6.—Side view Negro.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

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ARTICLE X.—*Geological Survey of Canada. Reports of Progress for the Years* 1853–1856.

(SECOND ARTICLE.)

In the previous article, the able Report of Mr. Murray, Assistant Geologist, was passed over with a very short notice. the region traversed by him being of comparatively small geological interest. It is however a region of some economical importance. Lying in the route which many Canadian public men have marked out as probably destined to be one of the great lines of communication between the Upper Lakes and the Ocean, the country between Lake Huron and the Upper Ottawa may by its topographical facilities or difficulties, or by its fertility or sterility, aid or oppose the establishment of such communication, while, by its mineral or other productions, it may offer inducements to enterprise that may give it other claims than those of a mere way of transit. Based almost entirely on rocks of the Laurentian system, it presents a rugged though not very elevated surface, and abounds in lakes, streams, and swampy hollows; and its soils, with the exception of those on the bands of limestone and other calcareous rocks, must on the whole be of inferior quality. Its agricultural capabilities alone therefore cannot be regarded as likely to promote its speedy settlement. We must not however follow the practice too common in new countries, of absolutely condemning every region that is not naturally as level as a meadow and as fertile as a garden. There can be no doubt, that, in the present state of this country, the narrow glens and scattered alluvial flats of a hilly and broken region are not likely to be very inviting to settlers; but if other inducements than those of agriculture alone can be offered, such districts may be profitably occupied. The river alluvia and the sheltered valleys of such regions are often very fertile; the black peaty swamps, when drained, afford inexhaustible crops of grass; and the stony hillsides are well adapted for orchards, and yield good pasturage. Experience shows also that the energy and force of character of the population of such districts rise to meet the difficulties that surround them; and thus these regions become nurseries of the patriotic feeling and of the mental and bodily energy, that are too apt to die out on the more fertile plains. If therefore by placing the seat of government on the confines of the Laurentian region, by opening new lines of traffic, or by developing the mineral resources that may be present, an effectual stimulus can be given to the settlement of these vast wastes, the object is well worthy of the attention of Canadian statesmen.

Into the consideration of the two first of these means of improvement it is not the province of the Geological Survey directly to enter, but the last falls within its scope. Unfortunately the present state of the district presents many obstacles to its exploration, but everywhere Mr. Murray met with indications of magnetic iron ore, which probably occurs in workable quantity in many places, while abundance of wood for its reduction exists in the territory. The Huronian formation also, which has proved so productive of copper on the shores of Georgian Bay, is extensively distributed, and small quantities of copper ore were found in it in several places. On this subject Mr. Murray says:—

> "The existence of the ores of copper and iron, which are known to be more or less characteristic of the Huronian rocks, invests the geographical distribution of the formation with much economic importance. These ores were repeatedly observed in the region explored last season, and, although nowhere seen in large amount or to a large extent, the indications were sufficient to establish their pretty general distribution. Small specks and patches of the yellow sulphuret of copper were frequently found in the blackish and dark-gray slates, on the lower lakes of the Maskanongi; and at the southern turn of these lakes there is a quartz vein of from six to eight feet wide, with copper pyrites, cutting slate conglomerate and an intrusive mass of compact

flesh-red feldspar. In the feldspathic dyke, small narrow veins of specular iron ore occur, which appear to run either parallel with the dyke or slightly oblique to it, and the quartz vein and its subordinate *droppers* cut across both. Were this vein as conveniently situated as those of somewhat similar character on Lake Huron, it is fully as well worthy of trial as many that were selected by explorers there, some years ago, upon which to found claims for mining locations."

Mr. Richardson was fortunate in having as his field for exploration the remarkable and interesting island of Anticosti, which he found to consist of limestones representing the middle formations of the Silurian period, and dipping to the southward, giving a high and bold outline by their outcropping edges to the north coast, while at the south they dip gently, with a low shore, under the waters of the Gulf of St. Lawrence. These rocks are arranged by Mr. Richardson in six divisions, of which the following may serve as a general summary in ascending order:

		ft.	in.
(A)	Grey limestone and argillaceous limestone, with greenish shale and conglomerate limestone, the highest bed containing some very singular impressions or animal tracks	229	0
(B)	Gray, greenish-gray, and reddish-gray limestone, with shale and limestone conglomerate. In one of the limestones occurs a singular trunk-like fossil named *Beatricea* by Mr. Billings, along with corals and marine shells	730	0
(C)	Argillaceous limestones, argillo-arenaceous shales, coral limestones. *Beatricea* occurs in these also	306	3
(D)	Ash-gray and reddish-gray limestones, bituminous limestones and shales, and measures unseen. Some of the limestones contain *Pentamerus*	480	0
(E)	Gray and drab argillaceous and bituminous limestones, abounding in *Pentamerus*, *Atrypa reticularis*, *Calymene Blumenbachii*, and many other mollusks and trilobites	550	0
(F)	Gray and yellowish granular limestone, with quantities of crinoidal remains and corals	69	0

Mr. Billings, on the evidence of the fossils, refers divisions A and B to the Hudson River groups, many of the most characteristic fossils of which are contained in them; but the presence of the genera *Catenipora*, *Favosites*, and *Ascoceras* indicates an approach to the Upper Silurian. Divisions C and D afford several additional Upper Silurian forms; and in divisions E and F the prevailing forms are those of the Clinton group of the New York geologists. Great palæontological interest attaches to these rocks, in consequence of the numerous new species contained in them; and in a geological point of view they are especially important as affording a regular succession of fossiliferous beds connecting the Lower and the Upper Silurian in America into one great system. In New York, and in other parts of Canada beside that under notice, the continuity of the series is broken by the intervention of the Oneida conglomerate and the Medina sandstones, and even locally by unconformability. To Anticosti the physical changes which led to the spreading out of great beds of sand and pebbles at the close of the Lower Silurian did not extend. In this favored spot therefore of the old Silurian world, we have the records of the slow changes of organic life which went on independently of the direct action of these physical changes, including probably the introduction of many species which were not able to extend themselves over the sandy bottoms which prevailed at the time under a great part of the ocean then representing America.

On the one hand these Anticosti formations point to the local character of those physical changes which form breaks in the series of stratified deposits, as compared with the more general extension of animal life and its comparative permanence. On the other hand, they show that, perhaps very gradually and slowly, the extinction of some species and the introduction of others were proceeding, even in this comparatively undisturbed locality. Such facts still leave unsettled the great question, to what extent these changes were determined by the plan of succession established by the Creator in organic life, and to what extent by the new conditions of existence established by the operations of his physical laws. That both were in harmony we cannot doubt, but their precise relations are only beginning to be elucidated by the accumulation of new facts like those above referred to, and by the careful examination of each form of life included in these transitional deposits, in connection with the evidences of physical change which they afford.

Among the new fossils from Anticosti, one of the most curious is that already mentioned under the generic name *Beatricea*, proposed by Mr. Billings, who describes two species, *B. nodulosa* and *undulata.* They are rough cylindrical trunks, one specimen obtained being ten feet in length and eight inches to six and a half inches in diameter. They consist of carbonate of lime, presenting concentric rings, like the growth-rings of exogenous trees, in the transverse section, and in the centre is a cylindrical tube crossed by transverse septa. At first sight they resemble exogenous trunks with chambered piths, like the West Indian *Cecropia peltata*. Taking their probably marine habitat into account, we are struck by the general resemblance of their structure to that of the rare and curious *Arthrocladia villosa* of the deeper parts of the Atlantic. These may however be mere analogies, and the appearance of the fossils also suggests affinities to the transversely septated corals, such as *Cyathophyllum* and *Zaphrentis*. The real nature of the fossil can only be settled by its minute structure, which has not yet been examined. In the mean time Mr. Billings regards it as a plant.

The tracks referred to in the section are also very curious objects, and appear to occur only in one thin bed. They consist of two parallel rows of semi-circular pits, arranged alternately, about half an inch apart. The pits are each about half an inch in diameter. Their alternate arrangement and their great depth prevent them from being attributed to marine worms. They rather resemble the marks which might be made in soft mud by the longitudinally cleft feet of some gasteropodous mollusks, as for instance the *Phasianellæ*. Possibly some of the gasteropods which have left their shells in these beds, may have had the cleft foot and the ambling gait of that genus.

Since however the creatures that lived in Anticosti in the Silurian era, may not be so interesting to many of our readers as the question, What lives or can live in it now? we give nearly in full Mr. Richardson's very intelligent notes on the appearance and productions of the island :—

"The south side of the island, in its general aspect, is low ; the most elevated points close on this coast are at the mouth of Jupiter River, where cliffs rise on the east side to the height of from eighty to a hundred feet ; and on the west side to a hundred and fifty feet. On no other part of the south coast were they observed to rise more than from thirty to sixty feet, but the general height above the sea is from ten to twenty feet.

From the south-west end, the hills inland are more elevated than they are to the eastward ; in general they rise gradually and more continuously from the shore, attaining the height of from a hundred and fifty to two hundred and fifty feet, at about the distance of from one to three miles. From this however are to be excepted certain localities on the coast, where plains are met with having a superficial area of from a hundred to a thousand acres underlaid by peat partly bare of vegetation, but over considerable spaces, supporting a heavy growth of wild grass from four to five feet high.

From a position a few miles east of South-west Point to Wreck Bay, which is at the east end of the island, between Heath Point and East Point, the elevation of the coast above high water is from seven to fifteen feet, with the exception of the neighbourhood of South Point and Cormorant Point, which rise to the height of from twenty to thirty feet on the shore; but very little rise takes place inland for from one to three miles, and this flat surface is bounded to the north by a gradual slope, rising to the height of from one hundred to two hundred feet, probably becoming more elevated still further inland. The low country is a succession of peat plains, occasionally bare, but often covered with wild grass; the whole being varied with strips and clumps of trees, as well as dotted with small lakes, on which ducks, geese, and other wild fowl breed in considerable numbers.

The whole of the north side of the island is a succession of ridge-like elevations of from 200 to 500 feet above the sea, separated by depressions. From English Head, three miles east from the West Cliff, a distance of fifty-eight miles in a straight line, each successive ridge and valley occupies a breadth of from four to six miles; the ridges form a somewhat rounded end, facing the sea on the north; their rise is first well marked at from a quarter of a mile to a mile from the shore, and in about a mile more inland they attain their greatest elevation; continuing this elevation to the south and widening, they narrow the intermediate valley, until, as far as known, the country becomes in appearance of a gently undulating character. The run of the valleys with some exceptions is from S. 10° W. to S. 30° W.

Macastey Ridge or Mountain, eleven miles east from the west end, rises upwards of four hundred feet at about a mile inland. High Cliff, eighteen miles further east, is probably 500 feet, one quarter of a mile from the shore; these are in some respects the most conspicuous ridges. High Cliff is a bold head-land, while Macastey Mountain is separated by a broader valley than usual from its neighbour to the east, and is higher than any other to the west. Macastey Mountain is a conspicuous object when viewed even from the south side of the island, in the neighbourhood of Ellis, or Gamache Bay; sailing up this natural harbour, it is observed in front a little to the right about five or six miles distant.

The succession of ridge and valley from English Head all the way to West Cliff, is regular and characteristic, and produces a pleasing and beautiful effect. From West Cliff to Observation Bay, a distance of about twenty miles, there is a similar succession, but on this part the ridges rise to their full elevation nearer to the shore. West Cliff rises immediately over the sea to an elevation of between 200 and 400 feet. Charleton Point has an elevation of 100 feet over the sea, and a quarter of a mile inland rises to between 300 and 400 feet; from Charleton Point to Observation Bay the coast is somewhat lower, Observation Bay forming an indentation on the coast of a mile and a quarter deep, and five miles across; from the head of this bay a well marked valley bears S. 10° W.

From Observation Bay to Gull Cape, a distance of fifty-three miles, the cliffs become prominent on the coast, rising almost perpendicularly at the points to the height of from 100 to 300 feet; and the indentations are more numerous, producing more sharply defined valleys.

Between Bear Head and Cape Robert, a distance of five miles and a-half, the greatest indentation from a straight line is about a mile and a-half; but this is subdivided into Easton Bay, Tower Bay, and White Bay, the last being the largest.

Salmon River Bay, east from Cape Henry, is five miles wide, and its greatest depth is one mile. Salmon River runs through a well-marked valley, of which the general bearing up-stream is S. 65° W. for nearly six miles, where a transverse valley, in the bearing N. 77° W. and S. 77° E. (about parallel with the coast) meets it, and gives it two streams running from opposite directions. From the middle of the valley the land gradually rises on each side to the height of from 400 to 450 feet, and the bed of the valley must rise pretty fast ;- for though the current of the stream is without leaps, it is rather rapid.

Prinsta Bay, further east, is an indentation of about one mile in depth, with a width of a mile and a-half; perpendicular cliffs surround this bay to the height of from 100 to 150 feet, except at the very head, where two creeks cut through the rock. On the west side of Prinsta Bay is Cape James, 150 feet in height; and on the east is Table Head. Table Head has a face of from 150 to 160 feet perpendicular, and gains almost at once an additional height, from the summit of which there is a gradual descent on the opposite side, the surface forming on that side a rough outline to the valley through which Fox River passes to Fox Bay, which affords the second important harbour on the Island. The upward course of the valley of the Fox River is N. 72° W.

From Fox Point on the west side of the bay to Gulf Cape, upwards of a mile on the east side, there is a distance of six miles, in which the coast is low, Fox Point, the highest part of this, not being more than from thirty to forty feet above the sea.

From Gulf Cape to Wreck Bay, a distance of eleven miles, the cliffs are in general perpendicular, and from 100 to 130 feet, while the surface back from them gives, as far as observed, a slightly rolling country.

Excepting the valley of Jupiter River, there are no well-defined valleys on the south side of the island.

In respect to the soil of the Island, the plains on the south side, as has been stated, are composed of peat, but the general vegetation of the country is supported by a drift composed for the most part of a calcareous clay, and a light grey or brown colored sand. The elements of the soil would lead to the conclusion of its being a good one, but the opinion of most persons, guided by the rules derived from the description of timber which grows on it, would not be favorable, as there is almost a complete absence, as far as my obesrvation went, of the hard-wood trees supposed to be the sure indication of a good settling country.

The most abundant tree is spruce, in size varying from eight to eighteen inches in diameter, and from forty to eighty feet in length. On the north coast, and in some parts of the south, it is found of good size in the open woods close by the beach, without any intervening space of stunted growth. The stunted growth was occasionally met with on the north side; but it is only on the tops of cliffs, and other places exposed to the heavy coast winds, where spruce, or any other tree on the island, is stunted. In these situations there is oftentimes a low, dense, and almost impenetrable barrier of stunted spruce, of from ten to twenty feet across, and rarely exceeding a hundred feet; beyond which open woods and good comparatively large timber prevails.

Pine was observed in the valley of the Salmon River, about four miles inland, where ten or twelve trees that were measured gave from twelve to twenty inches in diameter at the base, with heights varying from sixty to eighty feet. White and yellow birch are common in sizes from a few inches to two feet in diameter at the base, and from twenty to fifty feet high. Balsam-fir was seen, but it was small and not abundant. Tamarack was observed, but it was likewise small and scarce. One of our men, however, who is a hunter on the island, informed me he had seen groves of this timber north from Ellis, or Gamache Bay, of which some of the trees were three feet in diameter, and over a hundred feet in height. Poplar was met with in groves, close to the beach, on the north side of the island.

Of fruit-bearing trees and shrubs, the mountain-ash, or rowan, was the largest; it was most abundant in the interior, but appeared to be of the largest size close on the beach, especially on the north side, where it attains the height of forty feet, with long extending and somewhat slender branches, covered with clusters of fruit. The high cranberry (*Viburnum opulus*) produces a large and juicy fruit, and is abundant. A species of gooseberry bush from two to three feet high is met with in the woods, but appears to thrive best close to the shingle, on the beach, where strips of two or three yards across and half-a-mile long were occasionally covered with it. The fruit is very good, and resembles in taste the garden berry; it is smooth and black colored, and about the size of a common marble. The shrub appeared to be very prolific. Red and black currants are likewise abundant. There appear to be two kinds of each, in one of which the berry is smooth, resembling both in taste and appearance that of the garden; the other rough and prickly, with a bitter taste.

Strawberries are found near the beach. In size and flavor they are but little inferior to the garden fruit. They are most abundant among the grass in the openings, and their season is from the middle of July to the end of August. Five or six other kinds of fruit-bearing plants were observed, some of which might be found of value. The low cranberry was seen in one or two places in some abundance, but I was informed that it was less abundant than in many other past seasons. The raspberry was rarely met with.

The most surprising part of the natural vegetation was a species of pea which was found on the beach, and in open spaces in the woods; on the beach the plant, like the ordinary cultivated field-pea, often covered spaces from a-quarter of an acre to an acre in extent. The stem and the leaf were large, and the pea sufficiently so to be gathered for use. The straw when required is cut and cured for feed for cattle and horses during the winter.

But little is yet known of the agricultural capabilities of the island. The only attempts at cultivation that have been made are at Gamache Bay, South-west Point, and Heath Point. South-west Point and Heath Point are two of the most exposed places in the Island; and Gamache Bay, though a sheltered position, has a peat soil: the whole three are thus unfavourable.

On the 22nd July potatoes were well advanced, and in healthy condition at Gamache Bay; but a field under hay, consisting of timothy, clover, and natural grass, did not shew a heavy crop. At South-west Point, Mr. Pope had about three acres of potatoes planted in rows three feet apart. He informed me he expected a yield of 600 bushels, and at the time of my arrival on the 5th of August, the plants were in full blossom, and covered the ground thoroughly. Judging from the appearance, they seemed the finest patch of potatoes I had ever seen. About half-an-acre of barley was at the time commencing to ripen. It stood about four feet high, with strong stalk and well-filled ear. I observed oats in an adjoining patch. These had been late sown, being intended for winter feed for cattle. Their appearance indicated a large yield.

On the day of my arrival at Heath Point, the 23rd August, I accompanied Mr. Julyan about a mile from the light-house, to a piece of ground composed of yellowish-brown loam, which he had cleared in the wood, and planted in about the middle of June with potatoes and peas. Of the potatoes he procured a bucket-full of good size and middling good quality. The peas were in blossom, yet a few pods were found to be fit for use. In this patch I discovered three ears of bald wheat, the seed of which had been among the peas when sown. They were just getting into blossom, and probably would ripen. The ear was an average size, and the straw about three and a-half feet high.

I observed frost only once; it was on the 18th September, but not sufficiently severe to do injury to growing crops; and I was informed by Mr. Julyan that the lowest temperature of the previous winter was only seven degrees of Fahrenheit below zero. On the coast, as might be expected, the atmosphere is damper, and the temperature from ten to fifteen degrees below that of the interior, during June, July, August, and September, and probably May and October.

During the three months of my stay on the island, fogs prevailed for ten days, five of which were the 31st July and the 2nd, 3rd, 4th, and 5th of August, while we were at South-west Point. Mr. Pope told me it was an unusual occurrence. I observed that frequent openings in the fog were seen towards the land, leading to the idea that it was less dense in the interior.

I observed some cattle at South-west Point, belonging to Mr. Pope and Mr. Corbet. They appeared to be in good condition, although they had been left to provide for themselves in the wood openings, or along the shore. A horse belonging to Mr. Pope was in equally good condition.

Gamache or Ellis Bay and Fox Bay are the only two harbors on the island that are comparatively safe in all winds. The former is eight and a-half miles from West-end Lighthouse, on the south side; the latter is fifteen miles from Heath Point Lighthouse, on the north side. From Cape Eagle to Cape Henry, across the mouth of Gamache Bay, the distance is two miles, with a breadth of deep water of three quarters of a mile, extending up the bay a mile and a-half, while the depth of the indentation is two miles and a-half. Fox Bay is smaller, and has less depth of water than Gamache Bay. The distance across its mouth is a mile and a-half, with half a mile of deep water in the centre, extending up the bay nine-tenths of a mile; the whole depth of the indentation being one mile and two-tenths. These two harbours occur in the same geological formation, while the rock presents a very regular and comparatively level surface, over which a road could be easily constructed from one harbour to the other, the distance being 120 miles. By such means the whole island would be brought to within a moderate distance of a road having a natural harbour at each end.

The wild animals met with on the island, as far as I am aware, are the common black bear, the red, the black, and the silver fox, and the marten. Bears are said to be very numerous, and hunters talk of their being met with by dozens at a time; but on my excursion I only observed one at Ellis Bay, two near Cormorant Point, and one in the neighbourhood of Observation Cape. I came upon the last one on a narrow strip of beach at the foot of a high and nearly vertical cliff. Seen from a distance, I took the animal for a burnt log, and it was only when within fifty yards of him that I perceived my mistake. He appeared to be too busily engaged in making his morning meal, on the remains of a seal, to pay any attention to me; for although, with a view of giving him notice to quit, I struck my hammer upon a boulder that was near, and made other noises which I conceived might alarm him, he never raised his head to show that he was aware of my presence, but fed on until he had finished the carcase, obliging me, having no rifle, to remain a looker-on for half-an-hour. When nothing of the seal remained but the bones, the bear climbed in a leisurely way up the face of the naked cliff, which could not be many degrees out of the perpendicular, throwing down as he passed considerable blocks of rock, and disappeared over the summit, which was not less than a hundred feet above the sea.

Foxes and martens are very abundant. The marten was frequently heard during the night in the neighbourhood of our camp, and foxes were seen on several occasions. Of the silver-grey fox, the skin of which frequently sells for from twenty-five to thirty pounds currency, from four to twelve have been obtained by the hunters every winter. Mr. Corbet the lessee of the island employs several men during that season to hunt these animals for their fur, and I understand he makes some profit by the trade.

I heard of no animals of any other description, with the exception of wild fowl, and I saw no frogs nor reptiles of any description, and I was informed by the hunters that there were none."

The portion of the Report specially due to Mr. Billings contains the notices of Anticosti fossils to which we have already referred, and also descriptions of a number of new species found in other parts of Canada. In the *Crinoids* and *Cystideans*, in particular, large additions are made to our knowledge, and these will be rendered still more valuable when the engravings of fossils, now we believe in progress in Great Britain, are published. To the *Cephalopoda* also Mr. Billings has directed much attention, and has described many new forms.

Mr. Hunt's portion of the Report embraces so much matter, both of scientific and practical interest, that we must confine ourselves to notices of a few subjects. Analyses of mineral waters are given in considerable numbers; but we prefer considering those of the two greatest drains of the Canadian territory, the St. Lawrence and the Ottawa :—

" The plan proposed for supplying the city with water from one of these rivers, having made a knowledge of their chemical composition a matter of considerable interest, I proceeded, agreeably to your desire, to make a careful analysis of their waters. The results, independent of their local value, are important, as showing the composition of two immense rivers which drain so large a portion of the continent.

The time chosen for collecting the waters was in the month of March, before the melting of the snows had commenced. The river waters were then unaffected by the rains and the drainings of the surface, which tend to make their composition variable during the summer season.

The water of the Ottawa was collected on the 9th of last March at the head of the lock at Ste. Anne, where the position and the rapid current assured me the water of the river free from all local impurities. The river was here unfrozen, owing to the rapidity of the current, and its temperature was found to be 33° F., that of the air being the same.

The water, which was free from all sediment or suspended matter, had a pale amber-yellow color, very distinct in masses of six inches. When heated this color deepens, and by boiling there separates a bright brown precipitate, which, when the volume of the water is reduced to one-tenth, is seen to consist of small brilliant iridescent scales. These are not gypsum, of which the water does not contain a trace, but consist of carbonates, with silica and organic matter. Meanwhile the water becomes more highly colored, and now exhibits an alkaline reaction with test papers.

The recent water, mingled with hydrochloric acid and a salt of baryta remains clear for a time, but after an hour a faint turbidness appears indicating a trace of sulphate. With nitrate of silver and nitric acid, a slight milkiness from the presence of chlorids is perceptible. The amounts of sulphuric acid and chlorine were determined onportions of two or four litres of the water reduced by evaporation to a small volume, and acidulated. The precipitate obtained by the addition of a few drops of nitric acid and nitrate of silver, was scanty and reddish colored. After twelve hours of repose it was collected, dissolved from the filter by ammonia, and the pure chlorid of silver thrown down by a large excess of nitric acid, while the silver-salt of an organic acid remained in the solution.

When the precipitate obtained during the evaporation of the water is boiled with a dilute solution of potash, the organic matter is dissolved, and the akaline solution assumes a bright brown color which becomes paler on the addition of acetic acid; acetate of copper produces no precipitate in the liquid thus acidulated; but on adding carbonate of ammonia and heating the mixture, a minute white flocculent precipitate separates, having the characters of crenate of copper. Another portion of the precipitate by evaporation was dissolved in hydrochloric acid, and decolorized by boiling with chlorate of potash; on evaporating the solution a portion of silica separated, and the liquid gave with ammonia a colorless precipitate, which was chiefly composed of alumina; re-dissolved in hydrochloric acid however, it gave with a sulphocyanid, evidence of the presence of oxyd of iron, and with molybdate of ammonia an abundant yellow precipitate indicating phosphoric acid. The aluminous precipitate heated on silver foil with caustic potash gave a slight but decided reaction of manganese.

When the concentrated water, with its precipitate, was evaporated to dryness in a platinum capsule with excess of hydrochloric acid, and the residue treated with acidulated water, a large amount of silica was obtained, equal to one-third of all the solid matters present. This silica was white after ignition, and perfectly pure. A portion of the water was evaporated to one-fortieth and filtered; the residue being farther evaporated to one-fourth, deposited on the platinum capsule an opaque film, which was but imperfectly soluble in hydrochloric acid. The concentrated liquid was dark brown and alkaline, reddening turmeric paper; it was now evaporated to dryness, ignited and treated with water. The soluble portion was strongly alkaline to test papers, and perceptibly so to the taste. The residue insoluble in water was treated with strong hydrochloric acid, which dissolved a portion of lime without effervescence, and left a residue of pure silica; the acid solution contained no magnesia.

The dried residue from the evaporation of this water is of a deep brown color, when ignited, the organic matter which it contains burns like tinder, diffusing an agreable vegetable odour, and leaving a little carbon. The water was not examined for nitrates; but the absence of any deflagration during the ignition of the residue, showed that if present they were in very small amount. The season moreover at which the water was collected (being at the end of a winter of four months of unremitting frost), would not be favorable to the formation of nitrates

The following numbers are deduced from the means of two or more concordant determinations made upon quantities of two and four litres of the Ottawa, and calculated for ten litres or 10·000 grammes.

Carbonate of lime,	0·2480	grms.
" " magnesia,	·0696	"
Chlorine,	·0076	"
Sulphuric acid,	·0161	"
Silica,	·2060	"
Chlorid of sodium,	·0607	"
" " potassium,	·0293	"
Residue dried at 300° F.,	·6975	"
" ignited,	·5340	"

The amounts of silica remaining dissolved in the water evaporated to one-twentieth and one-thirtieth, were found to be 0·019 and 0·020 for four litres, giving for the ten litres a mean of 0·046 grammes of silica thus retained in solution. The amount of lime remaining dissolved in this quantity of the water thus evaporated, was equal to 0·023 of carbonate of lime.

The chlorine and sulphuric acid present in this water are sufficient to neutralize only about one-half of the alkaline bases present. The remaining portion may be regarded as existing in combination either with silica or with the organic acids present; and it is probably in a similar state of combination that a portion of the lime remains dissolved in the evaporated water.

In the following table the lime and the excess of alkalies are however represented as carbonates, and we have for 10·000 parts,

Carbonate of lime,	0·2480
" " magnesia,	·0696
Silica,	·2060
Chlorid of potassium,	·0160
Sulphate of potash,	·0122
" " soda,	·0188
Carbonate of soda,	·0410
Alumina and oxyd of iron, (traces)	
Manganese and phosphoric acid, "	
	0·6116

The water of the St. Lawrence was collected on the 30th of March, on the south side of the Pointe des Cascades (Vaudreuil). The rapid current had here left an opening in the ice, from which the water was taken at a distance of six feet from the shore. It was clear and transparent, and, unlike the water of the Ottawa, exhibited no color in vessels several inches in diameter. The recent water gives a considerable precipitate with salts of baryta, and a slight one with nitrate of silver. When boiled it lets fall a white crystalline precipitate which adheres to the sides of the vessel, unlike the deposit from the Ottawa water. A little yellow flocculent matter appears suspended in the concentrated liquid, which is only slightly colored, and the dried residue contains much less organic matter than that from the last mentioned water. The residue from two litres, when dissolved in hydrochloric acid, sufficed to give distinct reactions of iron and maganese. The ammoniacal precipitate from this solution was in great part soluble in potash, and was alumina. From a second portion of two litres a precipitate of phosphate was obtained by molybdate of ammonia, less abundant however than from the same quantity of the water from the Ottawa The determinations were made as in the previous analysis, and gave for 10,000 parts,

Carbonate of lime,..................................	0·8033
" " magnesia,............................	·2537
Chlorine,..	·0242
Sulphuric acid,....................................	·0687
Silica,..	·3700
Chlorid of potassium,..............................	·0220
" " sodium,................................	·1280
Residue dried at 300° F.,..........................	1·6780
" ignited,................................	1·5380

When evaporated to one-fortieth this water still contains in solution a portion of silica and some lime. The silica thus dissoved was found equal to 0·075, and the lime to 0·050 of carbonate of lime for 10,000 parts. The proportions of sulphuric acid and chlorine are much larger than in the Ottawa water, but were found not quite sufficient to saturate the whole of the alkaline bases present. The small portion of lime is probably held in solution by the concentrated water in the form of silicate, which, as is well known, possesses a certain degree of solubility; while from the insolubility of the silicate of magnesia, this base is completely separated during the evaporation.

I subjoin the calculated results for 10,000 parts of the St. Lawrence water, the lime and magnesia and the slight excess of alkalies being represented as carbornates.

Carbonate of lime,................................	0·8083
" " magnesia,.........................	·2537
Silica,...	·3700
Chlorid of potassium,.............................	·0220
" " sodium,.............................	·0225
Sulphate of soda,..........................	·1229
Carbonate "	·0061
Alumina, phosphoric acid,..................(traces.)	
Oxyds of iron and manganese,............. "	
	1·6055

The ignition of the dried residue expels a portion of carbonic acid from the earthy carbonates, and hence the calculated results exceed the weight of the residue, besides which considerable portions of the lime and magnesia are combined with silica, and not with carbonic acid as in the calculated table.

The comparison of the water of these two rivers shows the following differences:—The water of the Ottawa, containing but little more than one-third as much solid matter as the St. Lawrence, is impregnated with a much larger portion of organic matter derived from the decomposition of vegetable remains, and a large amount of alkalies uncombined with chlorine or sulphuric acid. Of the alkalies determined as chlorids, the chlorid of potassium in the Ottawa water forms 32 per cent. and in that of the St. Lawrence only 16 per cent., while in the former the silica equals 34 per cent., and in the latter 23 per cent. of the mineral matters. The Ottawa drains a region of crystalline rocks, and receives from these by far the greater part of its waters; hence the salts of potash liberated by the decomposition of these rocks are in large proportion. The extensive vegetable decomposition, evidenced by the organic matters dissolved in the water, will also have contributed a portion of potash. It will be recollected that the proportion of potash salts in the chlorids of sea-water and saline waters generally, does not equal more than two or three per cent. As to the St. Lawrence, although the basin of Lake Superior, in which the river takes its origin is surrounded by ancient sandstones and by crystalline rocks, it afterwards flows through lakes whose basins are composed of palæozic strata which abound in limestones rich in gypsum and salt, and these rocks have given the waters of this river that predominance of soda, chlorine, and sulphuric acid which distinguishes it from the Ottawa. It is an interesting geographical feature of these two rivers that they each pass through a series of great lakes, in which the waters are enabled to deposit their suspended impurities, and thus are rendered remarkably clear and transparent.

The presence of large amounts of silica in river waters is a fact only recently established, by the analyses by H. Ste. Claire Deville of the rivers of France.* The silica of waters had generally been entirely or in great part overlooked, or had, as he suggests, from the mode of analysis adopted, been confounded with gypsum. The importance in an agricultural point of view of such an amount of dissolved silica, where river waters serve for the irrigation of the soil, is very great; and geologically it is not less significant, as it marks a decomposition of the silicious rocks by the action of water holding in solution carbonic acid, and the organic acids arising from the decay of vegetable matter. These acids combining with the bases of the native silicates, liberate the silica in a soluble form. In fact silica is never wanting in natural waters, whether neutral or alkaline, although proportionately much greater in those surface waters which are but slightly charged with mineral ingredients. The alumina, whose presence is not less con-

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* Annales de Chimie et de Physique, 1848, vol. xxiii., p. 32.

stant, although in smaller quantity, equally belongs to the soluble constituents of the water. The quantity of silica annually carried to the sea in solution by the St. Lawrence and similar rivers, is very great, and doubtless plays an important part in the silicification of organic remains, and in the formation of silicious deposits, both directly and through the intervention of silicious infusorial animals.

As regards the question of a supply of water for the city of Montreal, it is to be remarked that the composition of these waters will be subject to considerable changes with the different seasons. The waters from the melting of the snows and autumual rains, will give to the river a character somewhat different from that presented after the long droughts of summer, or after several months of continued frost, when we may suppose that the water will contain the largest amount of soluble matters.

The waters of the St. Lawrence meeting those of the Ottawa below Vaudreuil, the two flow side by side, and may, as is well known, be distinguished by their difference in color. The clear greenish-blue of the larger river contrasts strongly with the amber-brown color of its tributary. The agitation of the current however gradually mingles the two streams; and even the brown water along the front of the island of Montreal is already mixed with a considerable portion of the St. Lawrence water, as will be evident from the analyses given below. As but a portion of the Ottawa enters the channel of the St. Lawrence at the head of the island, and as the volume of the former river is very variable, it happens that the proportions of the mixture at a given point in front of the island are subject to considerable changes. At the close of the summer and winter seasons the waters of the Ottawa are comparatively low, and then it may be observed that the water supplied by the City Water Works is but slightly colored, the water of the St. Lawrence predominating; while during the spring floods its deep color shows the larger proportion of Ottawa water. It hence follows that the purity of our supply of water is in an inverse ratio with its color, and that in obtaining an uncolored water we exchange a small proportion of organic matter for a much larger amount of calcareous salts."

Several years ago Mr. Hunt announced the remarkable fact, that shells of the genus *Lingula* consist in great part of phosphate of lime. He has since analysed several additional species, with the same results; and also the recent *L. ovalis*, which was found to contain 61 per cent. of earthy matter, consisting of,—

" Phosphate of lime	85.79
Carbonate "	11.75
Magnesia	2.80
	100.34

This is very nearly the composition of calcined human bones." Similar characters are found in fossil and recent *Orbicula*, and also in *Conularia*, a shell probably belonging to the *Pteropoda*, a very different group of mollusks. On the other hand, species of *Atrypa*, *Leptæna*, and other genera belonging, like *Lingula*, to the *Brachiopoda*, were found to have the composition of ordinary shells. This selection of phosphate of lime by some of the lower animals, no doubt points to peculiarities in their food and habits, to which both zoologists and geologists would do well to direct their attention.

The present Report contains a collected and condensed statement of the valuable remarks of Mr. Hunt on the composition and origin of metamorphic rocks. To attempt any summary of them would be unjust to their author; but we earnestly commend them to the careful study of all geologists who desire to understand the chemical principles involved in the conversion of sediments deposited in water into crystalline and metamorphic masses,—a very important subject, hitherto too much neglected.

Mr. Hunt's Report also contains several essays on highly important practical points. Two of these, on the manufacture of Iron and on the extraction of Salts from sea-water, have been transferred to this Journal; and there are others equally valuable, on Magnesian Mortars and the manufacture of Magnesia from Canadian rocks, on the preparation of Plumbago, and on Peat and the products from it.

This Report, from its more compact and readable form, will be more extensively read and consulted than any of the previous Reports of Progress; and with the accompanying maps, it will still further establish and extend the reputation of the Canadian Survey for accurate and able work.

J. W. D.

ART. XI.—*On the Extraction of Salts from Sea-Water.*[*]

The manufacture of salt from the ocean has, from an early period, been a most important branch of industry for the south of Europe. Without reverting to high antiquity, we may cite the salines of Venice, to which that republic owed the commencement

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[*] From the Reports of the Geological Survey of Canada for 1853–56, pp. 404–419.

of its greatness and its wealth. The lagoons which surrounded that city were enclosed, and set apart for the breeding of fish, and for the manufacture of salt. Making a monopoly of this staple of life, the policy of Venice was to obtain possession of all those salines which could compete with her, and we find the Venetians destroying such as they could not make use of, and ex acting from the neighbouring princes, treaties to the effect that they would not re-establish the suppressed salines. It was only two or three centuries later that this powerful republic ordered, in the interest of her commerce, the suppression of the salines of her own lagoons, and augmented the produce of those of Istria and of the Grecian Islands, which had become hers by right of conquest, still retaining in her own hands the trade in salt for all southern Europe. But with the downfall of Venitian power, we find the salines of Provence and Languedoc growing into importance, while those of Venice had fallen into decay, so that when the Emperor Napoleon I. created the kingdom of Italy, he had recourse to a French engineer from Marseilles to re-establish the salines of Venice, which are now once more organised on a vast scale.

It is however in France, and especially upon the shores of the Mediterranean, that we shall find the most extensive salines, and the most intelligent system of working these great sources of national wealth. On the western coast of France, the salt marshes of Brittany and La Vendée are wrought to a considerable extent, but the cool, moist and rainy climate of these regions is much less favorable to this industry than that of the southern shores of the empire, where dry and hot summers offer great facilities for the evaporation of the sea-water, which is effected in all the salines of which we have spoken, by the sun and wind, without artificial heat.

The salt-works of the lake of Berre, near Marseilles, were those whose products attracted the most attention at the Exhibition, not only on account of the excellent method there pursued for the manufacture of sea-salt, but from the fact that the important processes of Mr. Balard for the extraction of potash, sulphates and other valuable materials from the mother liquors, are there applied on a large scale. Having had occasion to examine carefully these products in the course of my duties as Juror at the Exhibition, and having afterwards visited the saline of Berre, I propose to give here some account of its construction and mode of operation, as well as of the method employed for the working of the mother liquors. I have to express my great obligations to my distinguished colleague, Mr. Balard, of the Academy of Sciences, who most kindly furnished me with every information respecting the processes of his invention which are there applied, and also Mr. Agard, the enlightened and scientific director of the saline.

The first condition for the establishment of a salt work is a low, broad, level ground on the border of the sea, which can be protected by dykes from the action of the tides, and as these are considerable on the Atlantic coast and insignificant in the Mediterranean, the arrangements required in the two regions are somewhat different. In both cases however the high tides are taken advantage of to fill large and shallow basins with the sea-water, which there deposits its sediments, becomes warmed by the sun's rays and begins to evaporate. From these reservoirs it is led by a canal to a series of basins from ten to sixteen inches in depth, through which it passes successively, and where by the action of the sun and wind the water is rapidly evaporated, and deposits its lime in the form of sulphate. It then passes to another series of smaller basins where the evaporation is carried to such a point that the water becomes a saturated brine, when its volume being greatly diminished, it is transferred to still smaller shallow basins called *salting-tables*, where the salt is to be deposited. In the salines of the Atlantic coast, the different basins are nearly on the same plane, and the water flows from one series to the other as its level is reduced by evaporation. In the large establishments of the Mediterranean, the system is different; the basins are constructed at different levels, and the waters having passed through one series, are raised by wooden tympans or drums from eight to sixteen feet in diameter (moved by steam or horse power), and conducted into the other basins. These differences of level establish a constant current, and in this way greatly promote the evaporation.

But in whatever manner the process is conducted, the concentrated brines, making 25°of Beaumé's areometer, are finally conducted to the salting tables, where they begin to deposite their salt in the form of crystalline crusts, which are either collected with rakes as soon as they form, or as at Berre, allowed to accumulate at the bottom, until they form masses six or eight inches in thickness. The concentration of the brines must be carefully watched, and their density never allowed to exceed $28^{o}5$, otherwise a deposit of sulphate of magnesia would be formed, rendering the sea-salt impure. The mother liquors, as they are called, are run off so soon as they have reached the above density, and reserved for operations to be detailed further on. When the salt has attained a sufficient thickness, it is broken up and piled upon the sides of the basins in large pyramids, which are covered with clay on the western coast of France, but left unprotected during the summer season, in the dry climate of the south. In these heaps, the salt undergoes a process of purification; the moisture from the clay or from occasional rains penetrates slowly through the mass, removing the more soluble foreign matters, and leaving the salt much purer than before. In the south, it is taken directly from these heaps and sent into the market, but in the less favorable conditions presented on the western coast, the thin layers of salt there collected are more or less soiled with earthy matters, and for many uses require a process of refining before they are brought into commerce. For this purpose two methods are employed; the one consists in simply washing the crude salt with a concentrated brine, which removes the foreign salts, and a large portion of the earthy impurities The other more perfect, but more costly process, consists in dissolving the impure salt in water, and adding a little lime to precipitate the salts of magnesia always present, after which the filtered brine is rapidly boiled down, when a fine-grained salt separates, or is more slowly evaporated to obtain the large-grained cubic salt which is used in the salting of provisions. The masses of coarsely crystalline salt from the salines of the south have no need of these refining processes.

In practice, the evaporation of the brines for sea-salt at Berre is carried as far as 32°, and the salt separated into three qualities, Between 25° and 26° the brine deposits one-fourth of its salt, which is kept apart on account of its great purity, and sold at a higher price than the rest. In passing from a density of 26° to 28°5, sixty per cent. more of salt of second quality are deposited, and from this point to 32° the remaining fifteen per cent. are obtained, somewhat impure and deliquescent from the magnesian salts which it contains, but preferred for the salting of fish, on account of its tendency to keep them moist. The average price of the salt at the salines is one franc for 100 kilogrammes, (220 pounds avoirdupois,) while the impost upon it was until recently, thirty times that sum, and is even now ten francs the 100 kilogrammes.

The waters of the Mediterranean contain, according to the analysis of Usiglio, about three per cent. of common salt, while those of the Atlantic contain from 2.5 to 2.7 per cent. In the waters of the Mediterranean there are besides, about 6.8 per cent. of sulphates and chlorids of calcium, magnesium and potassium. The quantity of water which it is necessary to evaporate in order to obtain a small amount of salt, thus appears to be very great, but under favorable circumstances this is a small consideration, as will appear from the following fact. The saline of Berre is situated upon a small lake, communicating with the ocean, but fed by streams of fresh water, so that while the waters of the open sea have a density of 3°5, those of the lake have only 1°5, or scarcely half the strength of sea water. Nevertheless, the advantages of the position offered by the shores of the lake for the establishment of a saline, are sufficient to compensate for the deficiency of salt in the water, and to make of Berre one of the most flourishing salines of the south of France. The evaporating surfaces here cover 3,300,000 square metres, equal to 815 English acres; of this area one-tenth is occupied with the salting tables, but with sea-water, where less evaporation is required to bring the brine to the crystallizing point, one sixth of the area would be thus occupied. The amount of salt annually produced at the saline of Berre is 20,000,000 of kilogrammes.

Owing to the dilution of the water of the lake of Berre, the proportion of salt there manufactured is small when we consider the area, and compare the produce with that of other salines where pure sea-water is evaporated. According to Mr. Balard, 2,000,000 square metres may yield 20,000,000 kilogrammes annually; and Mr. Payen states that the same amount of salt is produced at Baynas from a superficies of 1,500,000 metre. As a cubic metre of sea-water contains about 25 kilogrammes of salt, the evaporation required to produce the above amount corresponds to 800,000 cubic metres, equal in the second estimate given above, to a layer of water 0.40 metre, or 15¾ English inches in thickness.

The plan hitherto adopted in the salines of the European coasts, has been to commence the evaporation of the sea-water with the spring time of each year; in this way some three or four months elapsed before a sufficiently large amount of strong brine was accumulated to enable the manufacturer to commence the deposition of salt on the salting tables, and as this latter operation can only be carried on in fine weather, the rainy season of autumn soon came to interrupt the process, so that during a large part of the year the labours of the salines were suspended. The enlightened director of the works of Berre, Mr. Felicien Agard, has however introduced a very important improvement in the management of the salines, by means of which he carries on the works throughout the whole year, and is enabled to increase the produce by 50 per cent. During the months of the autumn, the evaporation, which is still carried on, though more slowly, enables him to obtain brines marking 8°, 10°, and even 20°. These are stored away in large pits, where the depth of liquid being considerable, the diluting effect of the spring rains is but little felt, and at the commencement of the warm season these brines are raised into the evaporating basins, so that the summer's labours are commenced with concentrated liquors, and the salt is all harvested in the months of August and September.

In selecting the site for a saline it is of great importance to choose a clayey soil, an earth of this character being required to render the basins and dykes impervious to water. In the saline of Berre, a coriaceous fungous plant, to which botanists have given the name *Microcoleus corium*, was observed to vegetate upon the bottom of the basins, and this being carefully protected, has finished by covering the clay with a layer like felt, which protects the salt from contamination by the earth, and enables it to be collected in a state of great purity.

The conditions of exposure to sun and wind offered by the locality chosen for a saline are also to be carefully considered, for upon these will of course greatly depend the rapidity of evaporation. The salines of the lagoons of Venice, to which we have already alluded, have recently been re-organised by Baron S.M. Rothschild and Mr. Chas. Astric, and cover an area nearly twice that of Berre. The tides of the Adriatic are considerable, and from the lowness of the ground, the labour of constructing the basins and dykes could only be carried on at low water. The moist and rainy climate of Venice also offers serious obstacles to the manufacture of salt ; to overcome these, two plans are adopted. The salting tables are so arranged that in case of heavy rains, the concentrated brines can be rapidly run off into deep reservoirs, while other reservoirs of saturated brine at higher levels serve not only to feed the salting tables, but to cover with a thick layer those tables which may contain a large amount of salt, and thus protect them from the atmospheric waters.

We may mention here a process which, although unknown in France, is applied in Russia on the borders of the White Sea, and may, perhaps, be advantageously employed on our own shores. It consists in applying the cold of winter to the concentration of the sea-water. At a low temperature a large quantity of ice separates but all the saline matters rest in the liquid portions, so that by separating the ice, a concentrated brine is obtained, which may afterwards be evaporated by the summer's sun or by artificial heat.

Treatment of the Bittern or Mother Liquors.—The waters which have reached a density of 32° in the salting tables, have already deposited the greater part of their common salt, and now contain a large amount of sulphate and hydrochlorate of magnesia, together with a portion of chlorid of potassium. The admirable researches of Mr. Balard have taught us to extract from these mother liquors, sulphate of soda, and salts of magnesia and potash, so that although formerly rejected as worthless, these liquors are now almost as valuable as the salt of which they are the residue.

The production of sulphate of soda, which is directly employed in the manufacture of glass, and as a manure, and still more largely as a material for the fabrication of carbonate of soda, is the most important object of the working of the mother liquors. Immense quantities of sulphate of soda are now prepared in France and England by decomposing sea-salt with sulphuric acid, which is manufactured with sulphur obtained chiefly from foreign sources. In view of this immense consumption of sulphur, it becomes important, especially in time of war when this substance is required for the fabrication of gunpowder, to find some source of sulphate of soda other than the decomposition of sea-salt by sulphuric acid. This process is besides objectionable from the vast amount of hydrochloric acid disengaged, which in most localities cannot be entirely consumed, and is very pernicious to both animal and vegetable life in the vicinity.

It had already been observed that under certain conditions the reaction between sulphate of magnesia and chlorid of sodium could give rise to sulphate of soda ; and Mr. Balard has shown that by taking advantage of this decomposition, the sulphate of soda can be advantageously prepared from the bittern of the salting tables.

When the liquors of 32° are evaporated by the summer's heat, they deposit during the day a portion of common salt ; but the coolness of the nights causes the separation of crystals of sulphate of magnesia, and the quantity of this latter salt goes on increasing as the evaporation advances toward 35°. This mixture of salts (A) is carefully collected, and reserved for the manufacture of the sulphate of soda.

When the bittern at 35° is still further evaporated by the heat of the sun, it deposits a mixture which is called *sel d'eté*, and contains a large amount of potash. By a second crystallization of this product, a double sulphate of potash and magnesia is obtained, which holds 24 per cent. of potash; but this mode of treating the mother liquors of 35° is less advantageous than the following, which is now adopted. The liquors are placed in large basins and preserved until the first frosts, when at the temperature of 35° or 40° Farenheit, they deposit the greater part of their sulphate of magnesia in large crystals. This sulphate, which is pure Epsom salt, is either sold to the apothecaries, or used to prepare sulphate of soda by the process about to be described. When the sulphate of magnesia has been thus separated, the liquid is run off into large reservoirs, and preserved until the next summer, when it is again evaporated in shallow basins by the sun's rays. It now deposits a large amount of a fine granular salt, which is a double chlorid of potassium and magnesium. This double salt can only be crystallized from solutions containing a large quantity of chlorid of magnesium, and when re-dissolved in pure water gives pure chlorid of potassium by evaporation. The double chlorid is raked up from the tables and placed in piles on the earth, where the moisture causes the salt to decompose; the magnesian salt deliquescing drains off, and the chlorid of potassium remains behind.

The mother liquors having acquired a density of 38°, have deposited all their potash, and are now evaporated by artificial heat to 44°; during this evaporation they still deposite a portion of common salt mixed with sulphate of magnesia (B), and on cooling, the liquid becomes a solid mass of hydrated chlorid of magnesium, which may be employed to furnish caustic and carbonated magnesia by decomposition. When calcined in a current of steam, it is completely decomposed into hydrochloric acid and an impure magnesia, still containing some sulphates and chlorids, which may be removed by water.

By mingling in proper proportions the solution of chlorid of magnesium at 44° with brine at 24°, nearly the whole of the sea-salt is precipitated in the form of minute crystals of great pureness and beauty; the mother liquors are then removed by washing with a saturated brine, and in this way a very fine quality of table salt may be advantageously manufactured,

During these successive concentrations the volume of the water has become greatly diminished, 10,000 gallons of sea-water reduced to 25°, (the point at which it begins to deposit salt,) measure only 935 gallons; at 30°, 200 gallons; at 31°, 50 gallons; and at 34°, are reduced to a volume of only 30 gallons.

Preparation of Sulphate of Soda.—For this process the cold of autumn and winter is required. The mixtures of sea-salt and sulphate of magnesia, (A and B.) together with the pure sulphate of magnesia obtained from the mother liquors at 32°, are dissolved in water heated to 95° F., with the addition of such a quantity of common salt as shall make the proportions of the two salts equal to 80 parts of chlorid of sodium to 60 of anhydrous sulphate of magnesia. The warm saturated solution is exposed in shallow basins to a cold of 32° F., when it deposits 120 parts of hydrated sulphate of soda, equal to 54 of anhydrous sulphate, or three-fourths of the sulphuric acid of the mixture. In theory, about equal weights of the two salts are necessary for their mutual decomposition, but an excess of common salt diminishes the solubility of the sulphate of soda, and thus augments the product. From the residual liquid, which contains chlorid of magnesium mixed with common salt and a portion of sulphate of magnesia, the latter salts may be separated by evaporation. The sulphate of soda is converted into carbonate of soda by the usual process of calcination with carbonate of lime and coal.

The Potash Salts.—The chlorid of potassium obtained by the process already indicated, is decomposed by sulphuric acid, and the resulting sulphate at once converted into carbonate of potash by a process similar to that employed for the manufacture of carbonate of soda. The carbonate of potash thus prepared is free from sulphate and chlorid, as well as from silica and alumina, and those metallic impurities which like iron and manganese, are always present in the salt obtained from wood-ashes, and render the potashes of America and Russia unfit for the fabrication of fine crystal glass. The double sulphate of potash and magnesia may be at once decomposed like the sulphate of potash, by limestone and coal, and both it and the chlorid may be directly employed in the fabrication of potash-alum, a salt which contains nearly ten per cent. potash, and of which five thousand tons are annually manufactured in France. The high price of the salts of potash has led the manufacturers of alum to replace this alkali wholly or in part by ammonia, but the potash salts from sea-water will furnish potash so cheaply as to render the use of ammonia no longer advantageous.

The greater part of chlorid of potassium as yet produced in the salines in the south of France is now however, employed chiefly in the Imperial manufactories of saltpetre or nitrate of potash. The nitrate of soda which is so abundant in some parts of South America, is decomposed by chlorid of potassium, yielding common salt, and pure nitrate of potash for the fabrication of gunpowder.

Yield of the Mother Liquors.—According to a calculation of Mr. Balard the proportion of sulphate in sea-water corresponds to a quantity of anhydrous sulphate of soda equal to one-eighth that of the common salt, but on a large scale the whole of this cannot be economically extracted; the saline of Baynas yields annually besides 20,000 tons of sea-salt, 1550 tons of dried sulphate of soda, or 7·75 per cent., instead of the 12·50 per cent. indicated by theory. Estimating the yield at 7·0 per cent. according to Payen, the cost of the sulphate will be 30 francs the ton, which will make the cost of the crude carbonate of soda 50 francs, while it brings in France from 80 to 120 francs the ton.

The amount of chlorid of potassium obtained is equal to one-hundredth, or to 200 tons for the above amount of sea-salt, and the value of this salt is 360 francs the ton. By its decomposition it will yield 185 of pure carbonate of potash, which sells for 1000 or 1100 francs the ton. Thus it appears that for 20,000 tons of sea-salt, worth at 10 francs the ton, 200,000 francs, there is obtained chlorid of potassium for the value of 72,000 francs. The potash being a secondary product from the residues of the processes for sea-salt and sulphate of soda, is obtained almost without additional cost. It has been shown by careful calculations that the sulphate of soda and the potash from the waters of the Mediterranean, will alone repay the expense of extraction, the sea-salt first deposited, being re-dissolved and carried back to the ocean. A powerful company is now erecting works on a great scale in the vicinity of Marseilles, where the marshes of the Camargue offer a great extent of waste lands, valueless for cultivation, but well adapted for this manufacture. Here it is proposed to evaporate the sea-water solely for the sake of the sulphates, the potash and the magnesia which it contains. Basins which are already covered with a layer of sea-salt, are very advantageously employed for the evaporation of the mother liquors, from the ease with which the potash and magnesia salts may be collected from it in a state of purity.

The amount of salt produced in France in 1847 was about 570, 000 tons, of which 263,000 were from the salt-marshes of the Mediterranean, 231,000 from those of the western coast, and 76,000 from salt-springs and a mine of rock-salt; there were employed in these 16,650 workmen. If we estimate the produce of the salt marshes in round numbers at 500,000 tons, the amount of chlorid of potassium to be obtained from the mother liquors, at one per cent., will be 5000 tons, and that of the sulphate of soda at seven per cent. will be 35,000 tons. The amount of sulphate of soda annually manufactured in France is 65,000 tons, requiring for this purpose 54,000 tons of sea-salt, and nearly 14,000 tons of sulphur, which is completely lost in the manufacture of carbonate of soda.* If now the mother liquors from an area twice as great as is now occupied by all the salines in France, were wrought with the same results as at Baynas, they would yield besides 70, 000 tons of sulphate of soda, or more than is required for the wants of the country, 10,000 tons of chlorid of potassium, equal to 9,250 tons of pure carbonate of potash, a quantity far greater than is consumed in France, and would enable her to export potash salts. According to Mr. Balard the consumption of potash in France amounted in 1848 to 5,000 tons, of which 3,000 were imported, and 1,000 tons extracted from the refuse of the beetroot employed in the manufacture of sugar.

The production of the two alkalies, potash and soda, offers some very interesting relations. Previous to the year 1792, soda was obtained only by the incineration of sea-weed and maritime plants, but it was at that epoch, when France was at war with the whole of Europe that her necessities led to the discovery of a mode of ex-

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* The soda manufactory of Chaunay, established in connection with the glass works of St. Gobain, consumes above 5,000 tons of sulphur yearly, and the immense establishment of Tennant, at St. Rollox, near Glasgow, employs annually 17,000 tons of salt, 5,550 of sulphur, and 4,500 tons of oxyd of manganese. It produced in 1854, 12,000 tons of soda-ash, 7,000 of crystallized carbonate of soda, besides 7,000 tons of chlorid of lime, prepared with the chlorine obtained by decomposing the waste hydrochloric acid from the soda process by the oxyd of manganese. The cost of sulphur in England in 1854 was about twenty-five dollars the ton.

tracting soda from sea-salt. Obliged for the purposes of war to employ all the potash which the country could produce, for the manufacture of saltpetre, it became necessary for the fabrication of soaps and glass to replace this alkali by soda, and therefore to devise some more abundant source of it than was afforded by sea-weed. It was then that the Government having offered a prize for the most advantageous method of extracting the soda from sea-salt, Leblanc proposed the process above alluded to, which consists in converting the chlorid of sodium into sulphate, and decomposing this salt by calcining it with a proper mixture of ground limestone and coal, thus producing carbonate of soda and an insoluble oxy-sulphuret of calcium. This remarkable process, perfect from its infancy, has now been adopted throughout the world, "and those who thought to annihilate the industry of France were soon obliged to borrow from her those great resources which French science had invented." (*Payen*, *Chimie Industrielle*, p. 209.)

Soda has now replaced potash to a very great extent in all those arts where it can without prejudice be substituted for the latter; potash is however indispensable for the manufacture of fine crystal and Bohemian glass, for the fabrication of saltpetre, as well as for the preparation of various other salts employed in the arts. The country people in France having been accustomed to employ the crude American potash for the bleaching of linen, were unwilling to make use of the purer soda-ash, and the result is that a great part of what is sold as American potash in France, is nothing more than an impure caustic soda, coloured red with sub-oxyd of copper, and fused with an admixture of common salt, which serves to reduce its strength, and give it the aspect of the crude potash of this country.

But notwithstanding the soda from sea-salt is now replacing potash to so large an extent, the supply of this alkali is scarcely adequate to the demand, and the consequence is that while the price of soda has greatly diminished, that of potash has of late years considerably augmented, and it has even been proposed to extract this alkali from feldspar and granitic rocks, by processes which can hardly prove remunerative. The rapid destruction of the forests before the advancing colonization of this continent, threatens at no distant day to diminish greatly the supplies of this as yet important production of our country, and it was therefore a problem of no small importance for the industrial science of the future, to discover an economical and unfailing source of potash. The new process of Mr. Balard appears to fulfil the conditions required, and will, for the time to come, render the arts independent of the supplies to be derived from vegetation.

In more ways than one, this result will be advantageous for our country ; the importance of potash salts as a manure, is now beginning to be understood, and it is seen that the removal from the land in the shape of ashes, of the alkali which during a century has been taken up from the earth and stored in the growing forest, is really an unwise economy, for the same alkali restored to the soil becomes a fertilizer of great value. It is to be feared too that in many parts of the country, the colonist wishing to render the forest available as an immediate source of gain, has thought rather to cut down and burn the wood for the sake of its ashes, than to cultivate the land thus cleared. The effect of this short-sighted policy in thus destroying our forests, is already beginning to be seriously felt in some parts of our country, where the early settlers looking upon the forest as their greatest enemy, sought only to drive back its limits as fast and as far as possible, and have thus left the borders of the St. Lawrence nearly destitute of wood, so that the cultivator is often obliged to bring from a distance of many miles that fuel, which in a country like ours, is such an important necessary of life, and now commands in our large towns a high price, which is annually increasing. But apart from their value as sources of fuel, the importance of occasional forests in breaking the force of winds, and tempering both the cold blasts of winter, and the heat and dryness of the summer, should not be overlooked in a country which like ours, is exposed to great extremes of temperature. The unwise policy which formerly levelled with an unsparing hand the forests of Provence, has rendered portions of that country almost a desert, exposed to the strong winds which descend from the Alps. Future generations may plant forests where we are now destroying them.

But to return from this digression ; it is worthy of consideration whether the extraction of salt from sea-water, for the internal consumption of the province, as well as for the supply of the immense fisheries on our coasts, might not be made a profitable branch of industry. The shores of the lower St. Lawrence, or of the Bay of Chaleurs, would probably afford many favorable localities, for the establishment of salines ; the heat of our summers which may be compared to those of the south of France, would produce a very rapid evaporation, while the severe frosts of our winters might be turned to account for the concentration of the water by freezing, as is practised in northern Russia. Experiments would enable us to determine how far the concentration can be carried during the winter months, and whether this process could be advantageously employed during the cold season, in preparing strong brines for the summer. The sulphates of magnesia and soda, and the potash salts, would find a ready market in England, if the consumption of carbonate of soda and soda-ash in the province should not be found sufficient to warrant the establishment of furnaces for the manufacture of these alkalies in the country.

In the construction of a saline it would be necessary to choose a locality where there is a considerable extent of nearly level surface between the lines of high and low water. High embankments would be necessary to protect the evaporating ground against the tides of our coasts, but these once constructed, the high tides would enable us to fill reservoirs at such an elevation as would carry the water by its own gravity through a series of basins, and thus dispense, in a great measure at least, with the elevating machines employed in the salines of the Mediterranean.

I have given these suggestions, and have entered into many details of the process of working the salines, from a conviction of the great importance of this industry as now developed in France, and from a hope that some persons may be induced to inquire whether these processes may not be economically applied upon our own coasts.

T. S. H.

ARTICLE XII. — *Contributions to Meteorology, reduced from Observations taken at St. Martins, Isle Jesus, County of Laval, Canada East.* By Charles Smallwood, M.D., L.L.D., Professor of Meteorology, University of McGill College.

These observations extend over the past year (1857). The geographical co-ordinates of the place are, latitude 45° 32′ north, and longitude 75° 36′ west from Greenwich. The cisterns of the barometers are 118 feet above the mean sea-level. The instruments are standard ones, and are verified at suitable seasons. The results are reduced from tri-daily observations, taken at

6 A.M., 2 P.M., and 10 P.M., (by which the civil day is divided into 3 equal divisions of 8 hours each,) and the observations are subjected to the usual corrections for the construction of instruments and for temperature. The self-registering principle has been applied to some of them; and it is matter of regret that more of our observations are not thus supplied, for how *scientifically* incorrect must be observations on the currents of the wind, for example, (and which subject is at the present time forming an important point for meteorological investigation in all parts of the world,) unless something better than the mere empirical formula of tenths is adopted? However vigilant the observer may have been, it is not possible that he can approach even to an approximate estimate of its force or velocity.

Atmospheric Pressure.—The highest reading of the barometer during the year was at 10 P.M. on the 20th December; and indicated 30.346 inches, and the lowest occurred also in December, on the 31st day, and indicated 28.880 inches, giving a range for that month of 1.466 inches. The average mean range for some years gives the greatest amount in January, next in December. *July*, for a like period, gives the *least* range; and July the past year (1857) gave a range of 0.569 inches, which is rather less than the average for some years. The *mean* annual pressure was 29.758 inches, which gives 0.082 inches more than the annual mean of the last seven years. The atmospheric pressure for January was 29.915 inches, for February 29.915 inches, for March 29.718 inches, for April 29.691 inches, for May 29.682 inches, for June 29.615 inches, for July 29.754 inches, for August 29.723 inches, for September 29.842 inches, for October 29.824 inches, for November 29.681 inches, and for December 29.743 inches.

The greatest barometric range within twenty-four hours with a rising column, was 0.679 inches, on the 8th of February; and the greatest range with a falling column was 0.877 inches, on the 27th February. Both these variations occurred at Toronto; the latter happened twenty-four hours sooner there.

The *Symmetrical Wave of November* was marked by its usual fluctuations. The final trough terminated at noon on the 23rd day.

Temperature.—The mean temperature for the year was 40.57 degrees, which shows it 0.99 degrees colder than the mean annual temperature of the last seven years. The month of January was scarcely ever equalled for the low reading of the thermometer, and indicated 9.21 degrees lower than the mean temperature of January for the last seven years, and is the coldest January on record here. The mean temperature of the month was 4.05 degrees.

February was the warmest February on record, the mean temperature being 21.61 degrees, and 8.30 degrees higher than the mean of February for the last seven years. The highest temperature observed in February was 46.1 degrees, which exceeds by 5 degrees the mean highest temperature of the month of February for the last seven years.

The lowest temperature was observed on the 18th January, and was —31.8 degrees (below zero), and the highest reading of the thermometer was on the 14th of July, indicating 98 degrees; making a yearly range of 130.5 degrees, which is less by 6.2 degrees than the greatest absolute range for the past seven years. July was the warmest month, the mean temperature being 71.57 degrees, which is 3.21 degrees less than the mean annual temperature for July for the last seven years. The mean temperature for each month was as follows: January 4.05 degrees, February 21.61, March 23.79, April 37.19, May 51.90, June 61.44, July 71.57, August 65.07, September 57.47, October 44.19, November 33.69, and December 14.96.

The cold terms of January were felt generally in Canada, and through the Eastern and the Northern States. On the 18th January, at Missisquoi, the thermometer attained a minimum of 42 degrees below zero. This fact was kindly furnished me by Mr. J. C. Baker. At Sherbrooke, my friend Dr. Johnston writes me, the greatest cold observed was on the morning of the 24th January, when the mercury in the thermometer was frozen, in those instruments using it; and Professor Miles of Lennoxville College observed his spirit thermometer at 44 degrees below zero; while at Missisquoi on the 24th Mr. Baker's record showed a temperature of 24 degrees below zero, and at this place on the 24th day the mercury stood at 29.6 degrees below zero; the spirit thermometer stood also at the same temperature. At Watertown, N. Y., on the 18th, the temperature was 36 degrees below zero; and on the 24th, at the same place, frozen mercury was carried about in a vial for exhibition. At Harvard College, at 7 A.M. on the 24th, the thermometer indicated a temperature of 16°— (below zero), at Albany it reached 30°—, at

Providence it reached 32°—, at Quebec 39°.5—; while more south the weather was somewhat moderate, but was accompanied by very heavy snow-storms.

In Montreal the record of my friend Dr. Hall indicated on the 18th a temperature of only 20°— (below zero); on the 23d, 27°—; and on the 24th, 25.7—.

The *Mean of Humidity* for the year was 0.822, and indicated 0.008 of moisture above the average of the last seven years. The mean humidity for January was 0.925, for February 0.850, for March 0.826, for April 0.821, for May 0.753, for June 0.786, for July 0.800, for August 0.848, for September 0.823, for October 0.859, for November 0.871, and for December 0.800. Complete saturation occurred but at one observation during the year.

Rain fell on 105 days. It rained 556 hours 8 minutes, and amounted to 48.251 inches on the surface. This depth exceeds by 5.147 inches the mean yearly amount of the last seven years. On 19 days, the rain was accompanied by thunder and lightning.

Snow fell on 50 days. It snowed 273 hours 15 minutes, and amounted to 86.98 inches on the surface. This amount shows a decrease of 8.78 inches from the mean of the last seven years.

The greatest amount of rain fell in October, and indicated 6.823 inches; the least amount in January, and was inappreciable.

The greatest amount of snow fell in December, and reached 26.81 inches. The least amount fell on the 29th September, being the first snow of the autumn. The last snow in spring fell on the 27th of April.

Evaporation.—The amount of water evaporated from the surface during the months of April, May, June, July, August, September, and October amounted to 20.245 inches, which amount represents very nearly the average of the last seven years. The amount of ice evaporated during the remaining months gives an equivalent of 9.57 inches of evaporation from the surface. The monthly amount of evaporation bears a striking proportion to the humidity of the air, and to the velocity and the direction of the wind.

Winds.—The most prevalent wind during the year was the Westerly, and the least was the East. The whole amount of wind for the year was 54,425.10 miles, which shows an increase of 1,363.47 miles over the amount of last year. The mean velocity for the year was 6.18 per hour. The most windy hour was from 2 to 3 A.M. on the 25th of November, when the wind reached a velocity of 49.89 miles. January was the most windy month, and July the calmest. The mean velocity for the year exceeds by 1.10 miles the mean velocity of the Toronto anemometric observations. The N. E. by E. wind shows a great amount in miles, owing to its velocity being greater than the winds from any other point of the compass with the exception of the westerly.

The greatest intensity of the sun's rays for the year was 122°; and the lowest point of terrestrial radiation was 32°.4— (below zero).

The amount of *Dew* during the year was less than the usual average.

There were 31 days perfectly cloudless, which gives 26 more cloudy days than the mean amount of cloudy days during the last seven years. There were 113 nights suitable for astronomical purposes.

The winter of 1856 fairly set in on the 14th December.

The Song Sparrow (*Fringilla melodia*), the harbinger of spring, first made its appearance on the 25th March. Swallows (*Hirudo rufa*) first seen 19th April. Frogs (*Rana*) first seen 22nd April. Shad (*Alosa*) first caught 24th May. Fire-flies (*Lampyrus corusca*) first seen 19th June. Snow-birds (*Phlectrophanes nivalis*) first seen 22nd December, 1856. (Very few were seen during the past winter, 1857–8.)

Crows wintered here.

Ozone.—The amount of ozone during the year has shown a little increase on the amount of last year.

Atmospheric Electricity.—The amount present has been somewhat below the usual average. The electricity of serene weather has indicated very feeble intensity; and during the summer thunder-storms the amount has been varied both in intensity and kind. Maximum intensity 360°, in terms of Volta's No. 1 Electrometer.

A suitable instrument for collecting atmospheric electricity of *small expense*, is still a thing to be desired, to obviate the use and consequent expense of collecting and insulating lamps, which require constant attention. I have one constructed on the plan of Romershausen, but have not yet used it sufficiently to test its collecting powers.

The *Aurora Borealis* was visible at observation-hour on 24 nights; and *Lunar Halos* were visible at the same hour on 6 nights. The *Zodiacal Light* was unusually bright at the evening observations, but the morning observations did not show any such increased brightness.

St. Martin, Isle Jésus, 3d April, 1858.

ARTICLE XIII.—*On the Packing of the Ice in the River St. Lawrence.*—By Sir W. E. Logan.

(From the Proceedings of the Geological Society of London, for June 15, 1842; vol. iii., p. 766.)

The island of Montreal stands at the confluence of the rivers Ottawa and St. Lawrence, and is the largest of several islands splitting up these mighty streams, which cannot be said to be thoroughly mingled until they have descended some miles below the whole cluster. The rivers first come in contact in a considerable sheet of water called Lake St. Louis, which separates the upper part of the island of Montreal from the southern main. But though the streams here touch, they do not mingle. The waters of the St. Lawrence, which are beautifully clear and transparent, keep along the southern shore, while those of the Ottawa, of a darker aspect, though by no means turbid, wash the banks of the island; and the contrast of colour they present strongly marks their line of contact for many miles.

Lake St. Louis is at the widest part about six miles broad, with a length of twelve miles. It gradually narrows towards the lower end, and the river as it issues from it becoming compressed into the space of half a mile, rushes with great violence down the Rapids of Lachine, and, although the stream is known to be upwards of eight feet deep, it is thrown into huge surges of nearly as many feet high as it passes over its rocky bottom, which at this spot is composed of layers of trap extending into floors that lie in successive steps.

At the termination of this cascade the river expands to a breadth of four miles, and flows gently on, until it again becomes cramped up by islands and shallows opposite the city of Montreal. From Windmill Point and Point St. Charles above the town, several ledges of rock, composed of trap lying in floors, which in seasons of low water are not much below the surface, shoot out into the stream about 1000 yards; and similar layers pointing to these come out from Longueuil on the opposite shore. In the narrow channel between them, the water, rushing with much force, produces the *Sault Normand*, and cooped up a little lower down by the island of St. Helen and several projecting patches of trap, it forms St. Mary's Current.

The interval between St. Helen and the south shore is greater than that between it and Montreal; but the former is so floored and crossed by hard trap rocks that the St. Lawrence has as yet produced but little effect in wearing them down, while in the latter it has cut out a channel between thirty and forty feet deep, through which the chief part of its waters rush with a velocity equal to six miles per hour. It is computed that by this channel alone upwards of a million of tons flow past the town every minute.

Between this point and Lake St. Peter, about fifty miles down, the river has an average breadth of two miles, and proceeding in its course with a moderate current, accelerated or retarded a little according to the presence or absence of shoals, it enters the lake by a multitude of channels cut through its delta, and forming a group of low flat alluvial islands.

The frosts commence about the end of November, and a margin of ice of some strength soon forms along the shores of the river and around every island and projecting rock in it; and wherever there is still water it is immediately cased over. The wind, acting on this glacial fringe, breaks off portions in various parts, and these proceeding down the stream constitute a moving border on the outside of the stationary one, which, as the intensity of the cold increases, is continually augmented by the adherence of the ice-sheets which have been coasting along it; and as the stationary border thus robs the moving one, this still further outflanks the other, until in some part the margins from the opposite shores nearly meeting, the floating ice becomes jammed up between them, and a night of severe frost forms a bridge across the river. The first ice-bridge below Montreal is usually formed at the entrance of the river into Lake St. Peter, where the many channels into which the stream is split up greatly assist the process.

As soon as this winter barrier is thrown across (generally towards Christmas) it of course rapidly increases by stopping the progress of the downward-floating ice, which has by this time assumed a character of considerable grandeur, nearly the whole surface of the stream being covered with it; and the quantity is so great, that to account for the supply, many, unsatisfied with the supposition of a marginal origin, have recourse to the hypothesis that a very large portion is formed on and derived from the bottom of the river, where rapid currents exist. But whatever its origin, it now moves in solid and extensive fields, and wherever it meets with an obstacle in its course, the momentum of the mass breaks up the striking part into huge fragments that pile over one another; or if the obstacle be stationary ice, the fragments are driven under it and there closely packed. Beneath the constantly widening ice-barrier mentioned, an enormous quantity is thus driven, particularly when the barrier gains any position where the current is stronger than usual. The augmented force with which the masses there move, pushes and packs so much below, that the space left for the river to flow in is greatly diminished, and the consequence is a perceptible rise of the waters above, which indeed from the very first taking of the bridge gradually and slowly increase for a considerable way up.

There is no place on the St. Lawrence where all the phenomena of the taking, packing and shoving of the ice are so grandly displayed as in the neighbourhood of Montreal. The violence of the currents is here so great, and the river in some places expands to such a width, that whether we consider the prodigious extent of the masses moved or the force with which they are propelled, nothing can afford a more majestic spectacle, or impress the mind more thoroughly with a sense of irresistible power. Standing for hours together upon the bank overlooking St. Mary's Current, I have seen league after league of ice crushed and broken against the barrier lower down, and there submerged and crammed beneath; and when we reflect that an operation similar to this occurs in several parts from Lake St. Peter upwards, it will not surprise us that the river should gradually swell. By the time the ice has become stationary at the foot of St. Mary's Current, the waters of the St Lawrence have usually risen several feet in the harbour of Montreal, and as the space through which this current flows affords a deep and narrow passage for nearly the whole body of the river, it may well be imagined that when the packing here begins the inundation rapidly increases. The confined nature of this part of the channel affords a more ready resistance to the progress of the ice, while the violence of the current brings such an abundant supply, and packs it with so much force, that the river, dammed up by the barrier, which in many places reaches to the bottom, attains in the harbour a height usually twenty, and sometimes twenty-six feet above its summer level; and it is not uncommon between this point and the foot of the current within the distance of a mile, to see a difference in elevation of several feet, which undergoes many rapid changes, the waters ebbing or flowing according to the amount of impediment they meet with in their progress, from submerged ice.

It is at this period that the grandest movements of the ice occur. From the effect of packing and piling and the accumulation of the snows of the season, the saturation of these with water, and the freezing of the whole into a solid body, it attains the thickness of ten to twenty feet, and even more; and after it has become fixed as far as the eye can reach, a sudden rise in the water, occasioned no doubt in the manner mentioned, lifting up a wide expanse of the whole covering of the river so high as to free and start it from the many points of rest and resistance offered by the bottom, where it had been packed deep enough to touch it, the vast mass is set in motion by the whole hydraulic power of this gigantic stream. Proceeding onward with a truly terrific majesty, it piles up over every obstacle it encounters; and when forced into a narrow part of the channel, the lateral pressure it there exerts drives the *bordage* up the banks, where it sometimes accumulates to the height of forty or fifty feet. In front of the town of Montreal there has lately been built a magnificent revêtement wall of cut limestone to the height of twenty-three feet above the summer level of the river. This wall is now a great protection against the effects of the ice. Broken by it, the ice piles on the street or terrace surmounting it, and there stops; but before the wall was built, the sloping bank guided the moving mass up to those of gardens and houses in a very dangerous manner, and many accidents used to occur. It has been known to pile up against the side of a house more than 200 feet from the margin of the river, and there break in at the windows of the second floor. I have seen it mount a terrace garden twenty feet above the bank, and crossing the garden enter one of the principal streets of the town. A few years before the erection of the revêtement wall, a friend of mine, tempted by the commercial advantages of the position, ventured to build a large cut-stone warehouse 180 feet long and four or five stories high, closer than usual upon the margin of the harbour. The ground-floor was not more than eight feet above the summer level of the river. At the taking of the ice, the usual rise of the water of course inundated the lower story, and the whole building becoming surrounded by a frozen sheet, a general expectation was entertained that it would be prostrated by the first movement. But the proprietor had taken a very simple and effectual precaution to prevent this. Just before the rise of the waters he securely laid against three sides of the building, at an angle of less than 45°, a number of stout oak logs a few feet asunder. When the movement came the sheet of ice was broken and pushed up the wooden inclined plane thus formed, at the top of which meeting the wall of the building, it was reflected into a vertical position, and falling back, in this manner such an enormous rampart of ice was in a few minutes placed in front of the warehouse as completely shielded it from all possible danger. In some years the ice has piled up nearly as high as the roof of this building. Another gentleman, encouraged by the security which this warehouse apparently enjoyed, erected one of great strength and equal magnitude on the next water lot, but he omitted to protect it in the same way. The result might have been anticipated. A movement of the ice occurring, the great sheet struck the walls at right angles, and pushed over the building as if it had been a house of cards. Both positions are now secured by the revêtement wall.

Several movements of the grand order just mentioned occur before the final setting of the ice, and each is immediately preceded by a sudden rise of the river. Sometimes several days and occasionally but a few hours will intervene between them; and it is fortunate that there is a criterion by which the inhabitants are made aware when the ice may be considered at rest for the season, and when it has therefore become safe for them to cut their winter roads across its rough and pinnacled surface. This is never the case until a longitudinal opening of considerable extent appears in some part of St. Mary's Current. It has embarrassed many to give a satisfactory reason why this rule, derived from the experience of the peasantry, should be depended on. But the explanation is extremely simple. The opening is merely an indication that a free sub-glacial passage has been made for itself by the water, through the combined influence of erosion and temperature, the effect of which, where the current is strongest, has been sufficient to wear through to the surface. The formation of this passage shows the cessation of a supply of submerged ice, and a consequent security against any further rise of the river to loosen its covering for any further movement. The opening is thus a true mark of safety. It lasts the whole winter, never freezing over even when the temperature of the air reaches 30° below zero of Fahrenheit; and from its first appearance the waters of the inundation gradually subside, escaping through the channel of which it is the index. The waters seldom if ever however fall so low as to attain their summer level; but the subsidence is sufficiently great to demonstrate clearly the prodigious extent to which the ice has been packed, and to show that over great occasional areas it has reached to the very bottom of the river. For it will immediately occur to every one, that when the mass rests on the bottom its height will not be diminished by the subsidence of the water, and that as this proceeds, the ice, according to the thickness which it has in various parts attained, will present various elevations after it has found a resting-place beneath, until just so much is left supported by the stream as is sufficient to permit its free escape. When the subsidence has attained its maximum, the trough of the St. Lawrence therefore exhibits a glacial landscape, undulating into hills and valleys that run in various directions, and while some of the principal mounds stand upon a base of 500 yards in length, by a hundred or two in breadth, they present a height of ten to fifteen feet above the level of those parts still supported on the water.

On the banks of the St. Lawrence, in the neighbourhood of Montreal, there is an immense collection of boulders, chiefly from rocks of igneous origin, and among them syenite greatly abounds. They are of all sizes, but many are very large, and multitudes must be tons in weight. From their appearance above the surface in shallow parts of the river it is very probable the bed of it teems with them also; and it is remarked by the inhabitants that the positions of these boulders, both in the river and on the banks, frequently appear changed after the removal of the ice in the spring. I spent several days in the autumn of last year examining the boulders along shore, all the way from Montreal to Lachine, a distance of nine miles; and on again looking at them in the spring I missed some which had particularly attracted my attention, but as I had not mapped their positions I may inadvertently have passed them over. But when we consider the manner in which the ice packs and subsequently moves, it cannot fail to appear a very probable agent in transporting these blocks. Closely jammed together down to the very bottom of the river over such extensive areas as have been mentioned, and there solidified by severe frosts around the projecting materials that present themselves to its grasp, the ice must seize a multitude of the loose boulders below; and not only will these be carried away, occasionally to very considerable distances, when it breaks up in the spring, but firmly set in their glacial matrix, they will, when in the course of the movements that occur, such masses as hold them are forced over shallow places, act as gravers to register in parallel grooves on the face of such rocks as they encounter, a memento of their progress as they pass along.

The boulders in the middle of the river may at once be occasionally carried to considerable distances; but it can scarcely be so with such as are stationed at or near the borders. For though these may become packed and imbedded in marginal ice, and by the force of a general movement or *shove*, as it is termed by the inhabitants, be driven obliquely up the bank, as soon as this ceases they will there be left; and as these general movements occur only three or four times during a season, and are never of long continuance, and even where the marginal ice is driven up the bank the friction it suffers soon causes succeeding portions to pile over one another, it is evident the boulders would not be carried by it to any very great distance. When a break-up occurs in the spring, it is the great body of ice in the middle of the river that is carried away, which, separating from the grounded portion on the margin, leaves this to be melted down by the increasing temperature of the season. The movements of succeeding winters may push marginal boulders farther and farther on, but they must at the same time have a tendency to carry all within a certain range gradually nearer to the bank, and at last place them in a position at the very limit of their influence. And it is certainly the case, that in the neighbourhood of Montreal there are in many places along the borders of the river collections of boulders sufficiently great to induce the supposition that their presence may be accounted for in this manner.

It is not however only on the immediate banks of the St. Lawrence that boulders abound. They are more or less spread over the whole island of Montreal, and over the plains on the opposte side of the river. I do not pretend to have ascertained their distribution with the precision necessary to permit the expression of an opinion as to the causes which placed them, but I may state that they appeared to me more abundant in the upper part of the island than in the lower, and that proceeding down the valley of the St. Lawrence they ceased altogether not many miles below the island in question: and it may be further remarked, that they did not seem of less weight at the limit of their range than elsewhere.

ARTICLE XIV.—*Geological Gleanings.*

Prof. Wyman on Carboniferous Reptiles.—Silliman's Journal, No. 74.—One result of the progress of geological inquiry is that of carrying back the higher forms of life farther and farther into geological time. Mammals are now represented by a number of secondary species, and the reptiles, in their amphibian forms, occur in the Palæozoic series as far back as the upper Devonian. Still the multiplication of such instances serves only farther to convince us that we are nearing the periods of the introduction of these forms, for the reptiles of the coal period are all amphibian, and therefore among the lower members of the class, though high among these lower members, while the Mesozoic mammals are chiefly marsupial, and otherwise deficient in the more speciallized characters of the higher members of that group.

"One of the most interesting subjects presented to the palæontologist for investigation, is that relating to the determination of the period when the Creator gave forms to organized beings, and placed them in definite relations with the earth and its atmosphere, and made them living things. But the history of geology shows, that generalizations as to the time and circumstances of the creation of given animal forms have approached precision, only as the depths of the ancient lakes and oceans have been faithfully explored, and the shores and dry lands which co-existed with them have been accurately examined.

"It was during the deposition of the Oolite that reptilian life reached its culminating point; below this, the deeper explorations are carried, the less numerous are the remains of reptiles found to be, and it has been assumed within a few years even, that their creation took place during the triassic period. The coal formations had been largely examined, thousands of fishes and still lower animals had been discovered, before the first traces of reptiles came to light in the remains of Apateon and Archegosaurus. After these, there were found the footprints and other remains of other reptiles, discovered or described by Goldfuss, Burmeister, Dr. King, Sir C. Lyell, Mr. Lea, H. Von Meyer, Profs. Dawson, Owen, H. D. Rogers, and E. Hitchcock. The Telerpeton, discovered by Dr. Mantell, was obtained from the upper layers of the Elgin sandstones; and these some of the leading English geologists have referred to the Old red. Doubts have recently arisen as to their real age, so that, in the present state of knowledge we cannot refer reptile life to a period older than the Coal. However, in view of our as yet imperfect knowledge of the Old red fauna, the question may still be raised whether we have even now reached the period of primoidal reptiles."

The reptiles of the Devonian are still limited to the little *Telerpeton Elginense* discovered by Dr. Mantell; but in the carboniferous period new forms have within the last few years rapidly increased in number. The coal measures of Germany, of the United States, of Nova Scotia and Great Britain, had between 1844 and 1854 afforded bones or other remains of seven species referred to five genera, and less distinct evidence perhaps indicating several additional species. Prof. Wyman has now described remains found by Prof. Newberry and Mr. Wheatley in the Ohio coal field, of three additional species of smaller size than some of those previously discovered, but one of them having its anterior limbs and vertebral column preserved along with the skull. To this species Prof. Wyman gives the name of *Raniceps Lyellii.* Like so many ancient animals it combines in one species characters now distributed between two groups, agreeing with the Anourous batrachians, (frogs, &c.,) in the form of the head, length of lower jaws, and absence of ribs, and with the *Urodela* (Newts, &c.,) in "the regular convex border of the lower jaw, and in the separation of the bones of the fore arm." The other species, though too imperfect for detailed description, are regarded as deviating still more widely from known forms and probably of higher rank in nature than the ordinary batrachia.

"If farther investigations should prove them to be the remains of Batrachians, with which they have some affinities, then we shall have a type of which there is no living representative. If they belong to a group higher in the series, they become still more interesting, and give evidence of the existence in the coal formation of animals hitherto referred to later periods."

The former of these suppositions is perhaps the more probable, as the sauriod characters of the batrachians hitherto found in the coal measures, point to the general assumption by the batrachians of that early period of structures, afterwards restricted by the Creator to nobler members of the class.

Dr. Falconer on Extinct Elephantine Animals. Jour. Geol. Society of London, No. 52.—Only two species of elephants exist in the modern world, but in the later tertiary era there must have been at least twenty-six species, and these were extensively distributed over North America, Europe, and Northern Asia, as well as India. What an addition it would be to the modern fauna, were these alone of all the great multitude of perished species restored to life, and thus widely diffused. These species, however, were not contemporaneous even in the tertiary period. Thirteen are stated to belong to the Miocene tertiary, one to the Miocene and Pliocene, eight to the Pliocene, and four to the Post Pliocene. It would thus appear that the Miocene period in which these giant proboscideans first appear, gives us also the greatest number of species. To the Miocene also belong two species of another great proboscidean, the Dinotherium.

The extinct elephants have hitherto been arranged in two genera only. 1. *Mastodon* (Cuvier), having the teeth comparatively simple, and divided on the crown into broad mammillæ or tubercles, arranged in transverse ridges. All the species of this genus are extinct. 2. *Elephas* (Lin.), having the teeth very complex, and the crown with numerous thin tranverse ridges, filled in with cement. The two recent elephants belong to this genus, as well as the well known extinct mammoth. Dr. Falconer divides the Mastodons into two sub-genera, as follows :—1. *Trilophodon* having three ridges on each of the true molars. 2. *Tetralophodon*, having 4 or more, rarely 5 ridges. The genus Elephas he divides into three sub-genera. 1. *Stegodon* with 7 to 8 ridges, obtuse like those of the mastodons. 2. *Loxodon* with 7 to 8 ridges, more elongated and acute than in the Mastodon. 3. *Euelephas* having 12 to 18 acute and thin-plated ridges. The genus Trilophodon includes our American Mastodons, which are the latest representatives of this form, and extend to the Post Pliocene period. The Tetralophodons occur principally in the Miocene, and none of them in the new world. The genus *Stegodon* is Miocene, and hitherto found only in India. The genus *Loxodon* is represented by one Miocene and two Pliocene species, and by the recent African

Elephant. *Eulephas* includes the semi-Arctic mammoth, and several other species of Post Pliocene, Pliocene, and Miocene date, as well as the existing Indian Elephant. Dr. Falconer will follow up this subject by descriptions of all the species occurring in Great Britain.

Prof. Hall's New Volume on the Palæontology of New York.—Silliman's Journal.—" We have received some sheets of Prof. James Hall's forthcoming (third) volume on the Palæontology of New York; and learn that it is making rapid progress towards completion. The volume will include the fossils of the Lower Helderberg Rocks or the upper part of the Upper Silurian, and the Oriskany Sandstone, generally regarded as Devonian. The author remarks that the sub-divisions of the Lower Helderberg beds (into Upper Pentamerus limestone and Tentaculite or water limestone) are distinguishable only for a short distance, while the formation as a whole reaches widely from the north-east to the south-west. The Oriskany Sandstone appears in some places to pass into the Helderberg rocks below, and in Maryland some of the fossils of the latter beds occur in it; and they may yet prove to blend intimately. But the separation of them in successive groups, is fully justified by their physical condition in the State of New York.

" In the south-west, the Oriskany sandstone contains many Crinoids similar in genera to those of the Lower Helderberg limestones. Among the peculiar forms in both, is the genus *Edriocrinus* (Hall)—a crinoid which is sessile in its young state and firmly attached to other bodies by the base of its cup, but becomes free as it advances and gradually loses all evidence of a cicatrix; the base becoming rounded and smooth, or very rarely preserving a depression or pit near the centre, which marks the original point of attachment."

Wollaston Medals.—At the Annual Meeting of the Geological Society, a Wollaston medal was awarded to the veteran Palæontologist, Herman Von Meyer, of Frankfort-on-Maine, and a second, with the balance of the fund, to Prof. James Hall, State Geologist of New York. We have much pleasure in recording this deserved recognition of Prof. Hall's long, able, and to a great extent unrequited labours, in American geology and palæontology.

Distribution of Animals in Australasia.—Many facts in the distribution of animals and plants, point to ancient differences of level which have disconnected lands or seas formerly united. In Silliman's Journal we find some facts of this kind, in relation to Australia, New Guinea, and the Aru Islands, from a paper by Mr. Wallace in the American Magazine of Natural History. Shallow seas we are told, about 30 to 40 fathoms in depth, connect all these islands.

"But there is another circumstance still more strongly proving this connexion: the great island of Aru, 80 miles in length from north to south, is traversed by three winding channels of such uniform width and depth, though passing through an irregular, undulating, rocky country, that they seem portions of true rivers, ough now occupied by salt water, and open at each end to the entrance of the tides. The phenomenon is unique, and we can account for their formation in no other way than by supposing them to have been once true rivers, having their source in the mountains of New Guinea, and reduced to their present condition by the subsidence of the intervening land."

Nearly one half of the Passerine birds of New Guinea hitherto described are contained in the author's collections made in Aru, and a number also of species in the other tribes.

The author farther observes on the absence of the peculiar East Indian types. "In the Peninsula cf Malacca, Sumatra, Java, Borneo and the Philippine Islands, the following families are abundant in species and in individuals. They are everywhere *common birds*. They are the *Buceridæ*, *Picidæ*, *Bucconidæ*, *Trogonidæ*, *Meropidæ*, *Eurylaimidæ;* but not one species of all these families are found in Aru, nor, with two doubtful exceptions, in New Guinea. The whole are also absent from Australia. To complete our view of the subject, it is necessary also to consider the Mammalia, which present peculiarities and deficiencies even yet more striking. Not one species found in the great islands westward inhabits Aru or New Guinea. With the exception only of pigs and bats, not a genus, not a family, not even an order of mammals is found in common. No Quadrumana, no Sciuridæ, no Carnivora, Rodentia, or Ungulata inhabit these depopulated forests. With the two exceptions above mentioned, all the mammalia are *Marsupials;* while in the great western islands there is not a single marsupial! A kangaroo inhabits Aru (and several New Guinea), and this, with three or four species of *Cuscus*, two or three little rat-like marsupials, a wild pig and several bats, are all the mammalia I have been able either to obtain or hear of."

Fossil plants of Pennsylvania Coal Field.—We are glad to observe that M. Lesquereux and Professor Rogers have commenced the publication of the new species of coal plants from Pennsylvania. 106 new species have been described in the Journal of the Boston Society of Natural History. The results of comparison with European species are, that out of 200, 100 " are identical with species already recognized in the European coal-fields, and some 50 of them shew differences so slight that a fuller comparison with better specimens may result in their identification likewise." This is a result very similar to that previously deduced by Mr. Bunbury and Sir C. Lyell from the comparison of specimens from Nova Scotia and other parts of America, with the European forms. The coal flora of the whole Northern hemisphere was remarkably uniform, indicating great facilities for extensive migrations of plants from west to east, along with a very equable climate. The geographical forms corresponding to such conditions would be very different from those now existing.

Supposed remains of Domestic Animals in Post-Pliocene Deposits in South Carolina.—Prof. Holmes of Charleston College has published a paper on this subject, which has attained some celebrity, owing to its introduction into that eccentric piece of ethnology, the "Indigenous races of the earth." The nature of the points maintained by Prof. Holmes may be learned from the following sentences:—

"Now the evidence herein to be adduced will shew that among the fossils in South Carolina from beds of this age—Post Pleiocene—some of which are exposed at Ashley Ferry, Goose Creek, Stono, John's Island, and other localities, a number have been found apparently belonging to animals having specific characters in common, with recent or living species not considered indigenous to this country, such as the horse, hog, sheep, ox, etc.

"A large collection of fossils from this interesting formation were submitted by me about three years ago, to Prof. Leidy, of Philadelphia, the eminent palæontologist, for determination; of these a number were returned with the remark, that they appeared to belong to recent species which had become accidental occupants of the same bed with the true fossils. I held the opposite opinion, and believed that these relics were indeed true fossil remains, as they were obtained not only from the banks and deltas of rivers, but a large number from excavations several feet below the surface, and at a distance from any stream, creek, pond, bog or ravine;

and in some cases from excavations below the high sandy land of cotton fields."

Professor Leidy's explanation of the occurrence of these remains is as follows:—

"The interesting collection of remains of vertebrated animals, which form the subject of the following pages, for the most part have been submitted to the inspection of the author, by Professor Holmes and Capt. A. H. Bowman, U. S. A., who collected them from the eocene, post-pleiocene, and recent geological formations, in the vicinity of Charleston, South Carolina.

"The collections of these gentlemen consist of a most remarkable intermixture of remains of fishes, reptiles and mammals, of the three periods mentioned; and in many cases perhaps we may err in referring a particular species to a certain formation, more especially in the case of the fishes. The remains usually consist of teeth often well preserved, but frequently in small fragments, more or less water worn; and most of the fossils are stained brown or black.

"By far the greater portion of the fossil remains are obtained from the post-pleiocene deposit of the Ashley river, about ten miles from Charleston. The country in this locality is composed of a base of whitish eocene marl, containing remains of *squalodon —sharks and rays*—above which is a stratum of post-pleiocene marl, about one foot in thickness, overlaid by about three feet of sand and earth mould.

"The post-pleiocene marl contains great quantities of irregular water worn fragments of the eocene marl rock from beneath, mingled with sand, blackened pebbles, water-rolled fragments of bones, and more perfect remains of fishes, reptiles and mammals, belonging to the post-pleiocene and eocene fossils.

"On the shores of the Ashley river, where the post-pleiocene and eocene formations are exposed, the fossils are washed from their beds, and become mingled with the remains of recent indigenous and domestic animals, and objects of human art, so that when a collection is made in this locality, it is sometimes difficult to determine whether the animal remains belong to the formations mentioned or not. Generally, however, we have been able to ascertain where the fossils belong, which we have had the opportunity of examining, from the fact that the greater number were obtained from the deposits referred to in digging into them some distance from the Ashley river.

"The collections contain remains of the horse, ox, sheep, hog and dog, which I feel strongly persuaded, with the exception of many of those of the first-mentioned animal, are of recent date, and have become mingled with the true fossils of the post-pleiocene and eocene formations, where these have been exposed on the banks of the Ashley river and its tributaries. In regard to the remains of the horse, from the facts stated in the accounts given of them in the succeeding pages, I think it will be conceded that this animal inhabited the United States during the post-pleiocene period, contemporarily with the *mastodon*, *megalonyx*, and the great broad-fronted bison."

In the subsequent part of his paper, Prof. Leidy proceeds to state the grounds on what he distinguishes the modern horse from the really extinct species, which with its allies of the genus *Hipparion*, did certainly inhabit post-pleiocene America, but had become extinct before its colonization by man—a very remarkable fact to which the researches of Prof. Holmes have added farther confirmation.

Prof. Holmes, dissenting from Dr. Leidy's view as to the recent origin of the bones of the sheep, hog, dog, ox, and common horse found with the undoubted fossils, proceeds to state his reasons for believing them to be post-pleiocene. He attempts to show that some of the bones are scarcely better preserved than those of extinct animals found with them, and argues from the state of preservation of shells, and the per centage of these known to be recent, as well as the fact of some species still existing in a wild state in America, having left their bones in these deposits. These arguments, however, afford merely presumptive proof, and are liable to many solid objections ; and he does not attempt to show, what alone could establish his position, that the disputed bones have actually been found in undisturbed tertiary beds. Since, therefore, the evidence fails in this essential point, we cannot accept the conclusions of Prof. Holmes; but must believe this to be one of these cases, rather numerous in the history of American tertiary geology, in which comparatively modern relics have been mixed with those of more ancient date. We were somewhat surprised to find in the end of the paper a letter from Prof. Agassiz, in which that eminent naturalist appears fully to endorse its conclusions. Comparing the confident tone of this letter with the evident weakness of the case as stated by Prof. Holmes, it is scarcely possible to avoid the inference that the great zoologist is too ready to grasp at any semblance of fact, that tends to support that strange doctrine of the diverse origin of the individuals of the same species, with which in a manner so unworthy of his acute mind, he endeavors to cut the knot of the difficulties in the geographical distribution of animals and plants, the legitimate solution of which forms one of the most interesting problems of geology and its allied sciences.

The following is a list of species collected by Prof. Holmes, which is sufficiently interesting, independently of those which *may* be the debris of modern beef and mutton :—

Extinct Species.—Mastodon, Megatherium, Megalonyx, Glyptodon, Mylodon and Hipparion, 2 species.

Not now found on the Atlantic Coast, but indigenous to North America.—Bison, Tapir, Peccary, Beaver, Musk-rat, and Elk.

The Deer, Racoon, Opossum, Rabbit and the following Domestic Animals—Horse, Hog, Sheep, Dog and Ox are not distinguishable from the living species.

Devonian and Carboniferous Rocks of Ireland.—The progress of Geology is continually sweeping into one, groups of rocks heretofore distinct, and it is becoming a most exciting question where will the breaks in geological time be ultimately left, or will there be any breaks. Our geological chronology is like that of the old Assyrian empire, where a few detached kings stand out on the page of history broadly separated by intervals of time ; but just as new monuments are disinterred, new names fill up the gaps, and it is only as the list approaches completion that we can know how and where one dynasty rudely or quietly displaced another.

In Ireland a group of yellow and red sandstones, intervening between the carboniferous and silurian systems, have been variously referred to the former, and to the Devonian period. Some of the Irish Geologists even appear desirous of including the whole, and with them the greater part of the Old Red of Scotland, among the carboniferous rocks. The case is thus stated by Mr. Griffiths :—

"No difficulty hence arises in regard to the position of the Old Red series in the south of Ireland, it having been clearly ascertained to conform to the Carboniferous strata above, while resting unconformably upon the Silurian series beneath. The only question that will arise regarding it is, as to what system it will of right belong. And here I must enter upon an explanation of the principle of subdivision by which I have been hitherto influenced. Finding, in the course of my geological researches, that certain rocks below the lowest beds of the lower Carboniferous Limestone conformed to them, and contained the same fossils, I was led to add them to the Carboniferous system, the boundary at the base of the Mountain Limestone, as it had until then been termed, being found to be far too limited. These lower rocks I was ultimately led to consider as divisible into two groups, the upper of which I proposed to call Carboniferous Slate, and the lower, Yellow Sandstone. In respect to this latter and lower of the two series, it became a question as to where the line of division between them and the red beds lying conformably beneath should be drawn; and the discovery of certain plants, apparently of Carboniferous type, and at present known as *Sphenopteris Hibernica*, *Lepidodendron minutum* and *Griffithii* (the last of which was discovered by Dr. Carte in the course of the last year), led to the adoption of the lines of boundary which have been published on the last, as well as on previous editions of my geological Map.

" Subsequently, through the researches of my friends, Professors Haughton and Jukes, as well as those of myself, imperfect casts of these plants were found very far beneath the boundary which I had originally adopted, and hence the extent of the district which I had allotted to these lower Carboniferous rocks will be found much too circumscribed. The principle, however, upon which I set out, remains intact, and as often contended for, both by Professor Haughton and myself, in numerous papers, I would again say, that the base of the Carboniferous system will extend to any zone of these plants, no matter at what depth, or in connexion with what rocks soever, found. That this may have the effect of sweeping the whole of the fish beds of Scotland, with the similar rocks of Glamorganshire in Wales, hitherto considered to be Devonian, into the Carboniferous system, I am not prepared to deny, as it is only a natural inference from the principle which I have laid down. It is true that I have preserved the established territories of the Old Red Sandstone on my Map, curtailing it only of the Plant or Yellow Sandstone beds, as I was not prepared to risk a controversy, merely upon the grounds of the well-known conformity between the two series, without a sufficiency of fossil evidence,—statements founded upon the hypothesis, no matter how well grounded soever they may appear, but upon less than indisputable scientific principles, being still open to the charge of being mere speculation or guess; and especially as I found that up to the present time it has been as much as I could do to defend the innovations which I had already made, even though the Irish geologists generally, and especially Mr. Haughton and Mr. Jukes, who, I trust, will favour us with their views, have all arrived at similar conclusions.

"No means that could have been adopted to ascertain the age of these plants have been neglected; and besides the attention paid to their examination by Professor Haughton, I have consulted M. Adolphe Brongniart, as already mentioned, whose opinion may be seen in a translation of a letter which I lately communicated at one of the Scientific Meetings of the Royal Dublin Society. I may observe, that as I was not looking for plants with a view of including the Old Red Sandstone within my line of boundary, I did not originally discover them so low down as my friend Mr. Jukes has since done; besides that colour being the order of the day, I limited my researches mainly to the yellow beds, discontinuing my search upon reaching the underlying red beds. But I shall be ever ready to hear with pleasure of their discovery to the very bottom of these rocks, and to recognise them, with Mr. Jukes' and Mr. Haughton's concurrence, on my Geological Map, as a group of the Carboniferous system. I may here observe, that I do not wish to be understood as aiming at a subversion of the Devonian system, whether occurring in Devonshire or elsewhere, my present observations being strictly limited to the Old Red Sandstone of the south of Ireland."

It may be doubted if the evidence above given is sufficient fully to establish the conclusions reached, though it shews a remarkable extension of the coal flora. Both in America and Europe rocks containing plants of carboniferous genera are known to be associated with Devonian animal remains. The species, however, are different, and perhaps we should conclude rather that the peculiar type of flora having its largest development in the coal measures, is that of the palæozoic period generally, than that we should extend the carboniferous system downward as far as this peculiar flora extends. Plants closely allied to those of the carboniferous system have been found by the Canadian Survey in beds as low as the horizon of the Oriskany Sandstone, the base of the Devonian in America, and under marine fossils, altogether distinct from those of the carboniferous limestones.

Earthquakes in Italy.—In these quiet regions, we do not readily realise the shaky character of those portions of the world in which the earth's internal forces are still acting, making themselves felt at the surface. A letter from an eminent living geologist, who revisited Naples and Sicily in the past winter, informs us that after an interval of 28 years, both Vesuvius and Etna presented great and marked differences of aspect; and it would only be in accordance with past experience, if the recent earthquakes have permanently, if we may use the word, changed the levels of land and water in portions of the Neapolitan territory. The following extracts from the *Athenæum* forcibly describe the effects of these disturbances:—

"The phenomena which preceded and have followed the disastrous earthquake which has struck such a panic throughout this kingdom, have a remarkable and a separate interest from that of the afflicting details of the suffering occasioned by it, as many things occurred to show that before the event there was great subterranean agitation going on. Similar indications of existing agitation now continually manifest themselves. That Vesuvius has been in a state of chronic eruption for nearly two years, and the wells at Resina for the last few months nearly dried up, I have already noted; that the kingdom has been in this interval, in various parts, alarmed by minor shocks of earthquake, may not be so generally known, but such is the fact, and to those signs of impending danger the Official Journal of the 30th of December adds the following:—"The Syndic of Salandro (one of the communes which has suffered much from the recent scourge) reports that for nearly a month at about two miles distance from the town a gas has been observed to issue from a water-course; the temperature of it was about that of the sun. A few days since, too, from another similar fosse, the same kind of gas issued. These exhalations were observed only in the morning however; during the rest of the day they were not perceptible. On the 22d of December, they ceased altogether, and there was an expectation that hot mineral springs would burst forth from that spot." The Official Journal of the 2d of January relates another remarkable fact. In the territory of Bella, about two miles from the town, the earthquake on the night of the 16th of December, levelled the neighboring hills, rolled the earth over and over, and formed deep valleys. Half an hour before the shock, a light as bright as that of the moon was seen to hover over the whole country, and a fetid exhalation like sulphur was perceived. On the morning following the shocks, which were accompanied by loud rumblings, a large piece of land, full 600 moggia (a *moggia* is something less than an acre), and at about the same distance from the town, was found encircled by a trench of from ten to twenty palms in depth, and the same in width. A letter from Vallo, now lying before me, and written much in detail, speaks of "those two terrible shocks," and of the innumerable minor shocks which have continued from the 16th of December up to the present time—the letter being written on the 29th of December. "A few minutes before the first shock," adds the writer, "a hissing sound was heard in the river, as if vast masses of stones were being brought down by a torrent. It is to be noted, too, that all the dogs in the neighborhood howled immediately before the first awful shock."

"Let us visit some of the ruined places at the centre of the disaster;—and I will speak in the words of a gentleman who has just returned: "I found the country seamed with fissures, which had at first been wide, but which gradually closed. The ground was heaving during the whole time of my visit to Polla. Once a beautifully situated township, with 7,000 souls, it is now half in ruins, and the survivors were sitting or walking about, telling us of their misery, and lamenting more that there were no hands to take out the dead or rescue the living. Two country people were groping amongst the stones of a building; one found a body, and throwing a stone towards the face called the attention of the other, 'That perhaps is some relation of yours,' but the body was not recognized. I tried to get food at a *trattoria*, the only house standing, at the corner of a street; but the proprietor, who was by our side, repulsed me, and refused to go in, saying that the moon has just entered the quarter, and we should have another earthquake. In most of these places, as in Naples, the deep, heavy rumblings which preceded and accompanied the earthquake have been much dwelt upon." On the night of the 26th December, the little town of Sasso, near Castelabbate, consisting of one long street, was separated in two by the sudden opening of a fissure through its entire length, each side remaining separated from the other by a considerable interval—and so it stands. On the 28th and 29th of December, both in Sala and Potenza, strong shocks were felt, followed by many others of a less intense character, and these still continue. The consequences will be that even those houses which were only cracked will give way, and those which were feeble will be reduced to ruins. In Naples, too, the shocks continue producing vibrations of the doors and windows; and in one instance, I have heard ringing of the bells. The common report is, that since the 16th of December we have had eighty-four shocks in the capital. It is not at all improbable if every vibration is counted as one, and if the great subterranean agitation, which is now going on, be taken into account. Every one looks really with anxiety to Vesuvius, and prays, not for curiosity only, for an eruption. The indications of so desirable a result seem to be on the increase. A person who resides at Resina says, that on the night of the 29th, from 10 P.M. to 5 A.M. of the 30th ult., the whole town was in a state of continued vibration. Every three minutes a sound was heard as of a person attempting to wrench the doors and windows out of their places, followed by a quiver. The next morning the mountain was observed to vomit forth much smoke and a cloud of ashes. Friends, too, who reside at Capo di Marte, near the city, speak of the deep thunders which they hear from the mountain in the stillness of the night. The same phenomena are observed at Torre del Greco. I must, also, advert to the manifest lowness of the sea, which seems today to have receded from the land. I noticed this fact in my last letter, and tried to explain it as consequent upon the neap tides: but the same thing continues; and unless it has been occasioned by the long continuation of a land wind, the conclusion is inevitable that there has been an upheaving of soil. It would be rash, however, to come speedily to so important a decision. How this state of things will terminate, it is impossible to say; but that some great change is pending, there is but too much reason for supposing."

"Some English gentlemen who have just returned from the scene of disaster give the following interesting though harrowing details:—"Before arriving at Pertosa, we found the houses on either side of the road thrown to the ground; the landlord of a tavern now abandoned told us that he had the good fortune to escape with his wife, but that his child and servant had been both killed. He himself bore the marks of a heavy blow on his face. The population of this place was about 3,000, and 143 bodies only had been dug out on the 1st of January; whilst 200 more were known to be missing. The whole town was destroyed, with the exception of six houses, which were in a falling state. Between Pertosa and Polla the strength and caprice of the earthquake were made manifest in a remarkable way. Crossing a deep ravine, we found the road on the opposite side carried off 200 feet distant from its former position : the mountain above it had been cleft in two, revealing to a great depth the limestone caverns in the bowels of the earth. The ground was seamed with fissures ; and we could put our arms into them up to the shoulders. Polla has a population of 7,000 persons :—1,000 had fallen victims, of whom 567 had been dug up and buried ; the work of disinterment was continuing slowly, but the stench here and elsewhere, from the bodies, was insufferable. Three shocks of an earthquake were felt on this day, January 1. The first was very early in the morning ; the second about half-past 12. When we were standing on the ruins of a church, the ground began to heave under our feet and the subterranean thunders to roll. We immediately fled from the spot, but were nearly overwhelmed as the wall of a bell-tower fell close upon our heels, and a leaning house, in an inclining state, came down within twenty feet of us. The frightened people immediately formed a procession, and headed by the priests, bearing the crucifix and an image of the Madonna, lashed themselves with ropes as they walked. On leaving the town, we rested on the wall of a bridge just outside, where some priests begged us to rise, saying we were in danger, for the ground was continually trembling. Whilst sitting there, we felt the third shock, and required no other hint." At the last moment I add, from official documents, that upwards of 30,000 are returned as dead, and 250,000 living in the open air."

Habits of the Beaver.—To include an account of these among geological notices, is hardly an anachronism, since over a large part of the continent the beaver is an extinct animal, and it is rapidly becoming so wherever European colonization penetrates. The following interesting notes are from the Journal of the Academy of Natural Sciences, Philadelphia :—

"Mr. Harris observed, in relation to the specimens of cottonwood and chips cut by beavers, presented this evening, that they had been obtained by him from the Missouri River, between Fort Union, at the mouth of the Yellowstone, and Fort Clark, at the Mandan Village. He added, that in returning from a trip up the Missouri to the mouth of the Yellowstone, in company with the late J. J. Audubon and party, in the month of September, 1843, our Mackinaw boat was moored for the night on the right bank of the river, under shelter of timber on the bank, which was here about twenty feet above the water at its then rather low stage.

Our guide and pilot in descending the river, Prevost, who was an old trapper, hired by Mr. A. at St Louis for the trip, soon discovered signs of the beaver, and presently a newly constructed beaver-house about one hundred yards above the boat. It was too late to examine the premises, and after cutting wood, building a fire, and cooking our supper, we turned in for the night. Very early in the morning, before breakfasting, we hastened to examine what had been the object of more than one expedition on the Yellowstone, and which had, heretofore baffled our search. Prevost assured us that the noise and smell of smoke, and cooking from our camp, must have driven the beaver to a place of safety soon after our landing the night before, and that we could only gratify our curiosity by the inspection of the building; whereas, had daylight permitted, we might, at first landing, have proceeded quietly and stopped the covered outlet from the house to the water, and thus secured the inmates, and this only by using the utmost caution in approaching without giving them the wind of us, or making the slightest noise, even the cracking of a dry twig under our feet; so religiously did he believe in their superhuman sagacity in discovering and avoiding danger. Thus assured, I took my gun, more from the influence of the habit of some months of seldom stirring from camp without it, than from any expectation of seeing a beaver. I followed the water to the outlet, while others took the bank; here I stood watching the operations of those above, who had commenced removing the branches of cotton-wood which formed the covering of the domicile. I was startled suddenly by the splashing of the water at my feet, and, looking down, I saw the dusky back of a beaver a few inches under the surface, gliding out into the deep water of the river, and before I could prepare and bring my gun into position, he was out of sight. Nothing could have been easier, had I been prepared, than to have shot him as he thus passed within three feet of the spot on which I stood. Thus, from too much reliance on popular tradition of the unerring instinct of this animal, was I prevented from adding the skin, and description, and measurements of a fresh specimen of the beaver to the trophies of our expedition. As the beaver passed down the stream he was seen to rise for air, abreast of our boat, by some of the men on board. We then proceeded to unroof the house by removing the cotton-wood branches, which covered it for several feet in thickness; they extended for a considerable width on each side, and covered the passage from the house to the water; this passage was about fourteen inches square, as neatly excavated as a ditcher could have made it with a spade; it was from twenty-five to thirty feet long, following the scope of the bank, and ending some two or three feet under the water. The branches were laid with their butts uppermost, and formed a complete thatching to the house, nearly weather-proof. The house itself was a vertical excavation into the bank, cylindrical in form and about three and a half feet in diameter; the slope of the bank, where it was cut, gave it the figure of a section of a cylinder of about four feet high on the side of the bank, and the height of the passage to the river, on the other, about fourteen inches. The bottom and walls of this room were smooth and hard as though they had been pressed or beaten, but not plastered. The circle was apparently perfect in form. I should have said, it was rather more than half way up the bank. Prevost said that the house was unfinished, and that, before winter, the whole interior earth and brush of the sides and roof would have been neatly plastered with clay so as to render it entirely weather-proof. The quantity of cotton-wood branches and saplings used in this structure was enormous; I suspect the measurement would have been three cords, or as many wagon loads, and so closely impacted that it was only after considerable labor that a breach was made. On the bank above was the area of *stump-land* where they had felled their timber, taking what was suitable from the most convenient distance. The large block presented this evening was cut from the largest log felled; the branches only were taken, leaving the trunk where it fell. Small saplings were taken entire. The smaller piece, which is cut at both ends, was the butt of a bough or sapling, which, in their attempt to drag to the bank, had become wedged among a clump of bushes in such a manner that they could not back it out again, owing to the resistance of the branches on the ground and of other bushes, so, like the sailor who throws overboard a portion of his cargo to enable him to save the rest, they cut off this piece that they might steer clear of the difficulty with the remnant of their treasure. The chips are from the larger specimen; in cutting them out they must work horizontally around the trunk, and when they have cut two grooves at the proper distance apart, they take hold of the isolated portion with their teeth, and split off portions *vertically*, and so in succession split off chips until they have girdled the tree; a second course is then removed from the bottom of this, and so on diminishing the size of the chips until the tree is only supported by a portion of its heart connecting the apices of two cones—one on the stump upright, the other on the butt of the log inverted. In this manner, also, the Indians cut down trees with their hatchets, leaving the same form of a cone on the butt of the log and on the stump, as their beaver neighbors have done before them."

ART. XV.—*Note upon the Genus Graptolithus*, and description of some remarkable new forms from the shales of the Hudson River group, discovered in the investigations of the Geological Survey of Canada, under the direction of Sir W. E. Logan, F.R.S. By James Hall.

[Communicated to Sir W. E. Logan in April, 1855.]

[By the kind permission of Sir W. E. Logan, the Director of the Geological Survey, we publish the following description of new species of Graptolites, from his Report for 1857. He has placed at our disposal to accompany these descriptions, two plates which will shortly be published in the first decade of the fossils of Canada.—Editors.]

The discovery of some remarkable forms of this genus during the progress of the Canada Geological Survey, has given an opportunity of extending our knowledge of these interesting fossil remains. Hitherto our observations on the Graptolites have been directed to simple linear stipes, or to ramose forms, which except in branching, or rarely in having foliate forms, differ little from the linear stipes. In a few species, as *G. tenuis* (Hall), and one or two other American species, there is an indication of more complicated structure; but up to the present time this has remained of doubtful significance. The question whether these animals in their living state were free or attached, is one which has been discussed without result; and it would seem to be only in very recent times that naturalists have abandoned altogether the opinion that these bodies belonged to the Cephalopoda.

In the year 1847 I published a small paper on the Graptolites from the rocks of the Hudson River group in New York. To the number there given, two species have since been added from the shales of the Clinton group. Other species, yet unpublished, have been obtained from the Hudson River group; and since the period of my publication in 1847, large accessions have been made to our knowledge of this family of fossils, and to the number of species then known. The most important publications upon this

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* An accident prevents us from giving the second plate, but it will appear in the next number.—Eds.

subject are, *Les Graptolites de Bohême*, par J. Barrande, 1850; *Synopsis of the Classification of British Rocks, and Descriptions of British Palæozoic Fossils*, by Rev. A. Sedgwick and Frederick McCoy, 1851; *Grauwacken Formation in Sachsen, etc.*, H. B. Geinitz, 1852.

The radix-like appendages, known in some of our American as well as in some European species, has been regarded as evidence that the animal in its living state was fixed; while Mr. J. Barrande, admitting the force of these facts, asserts his belief that other species were free. It does not however appear probable that in a family of fossils so closely allied as all the proper *Graptolitideæ*, any such great diversity in mode of growth would exist.

It will appear evident from what follows, that heretofore we have been compelled to content ourselves for the most part, with describing fragments of a fossil body, without knowing the original form or condition of the animal when living. Under such circumstances, it is not surprising that various opinions have been entertained, depending in a great measure upon the state of preservation of the fossils examined. The diminution in the dimensions, or perhaps we should rather say in the development, of the cellules or serrations of the axis towards the base, has given rise to the opinion advanced by Barrande, that the extension of the axis by growth was in that direction, and that these smaller cells were really in a state of increase and development. In opposition to this argument, we could before have advanced the evidence furnished by *G. bicornis*, *G. ramosus*, *G. sextans*, *G. furcatus*, *G. tenuis*, and others, which show that the stipes could not have increased in that direction. It is true that none of the species figured by Barrande indicate insuperable objections to this view; though in the figures of *G. serra* (Brong.), as given by Geinitz, the improbability of such a mode of growth is clearly shown.

It is not a little remarkable that with such additions to the number of species as have been made by Barrande, McCoy, and Geinitz, so few ramose forms have been discovered; and none so far as the writer is aware, approaching in the perfection of this character to the American species.

Maintaining as we do the above view of the subject, which is borne out by well-preserved specimens of several species, we cannot admit the proposed separation of the Graptolites into the genera *Monograpsus*, *Diplograpsus*, and *Cladograpsus*, for the reason that one and the same species, as shown in single indiv duals, may be *monoprionidean* or *diprionidean*, or both; and we shall see still farther objections to this division, as we progress, in the utter impossibility of distinguishing these characteristics under certain circumstances. We do not yet perceive sufficient reason to separate the branching forms from those supposed to be not branched, for it is not always possible to decide which have or have not been ramose, among the fragments found. Moreover, there are such various modes of branching, that such forms as *G. ramosus* present but little analogy with such as *G. gracilis.*

Mr. Geinitz introduces among the *Graptolitideæ* the genus *Nereograpsus*, to include *Nereites*, *Myrianites*, *Nemertites*, and *Nemapodia.* Admitting these to be organic remains, which the writer has elsewhere expressed his reasons for doubting, they are not related in structure, substance, or mode of occurrence, to the Graptolites, at least so far as regards American species ; and the *Nemapodia* is not a fossil body, nor the imprint of one, but simply the *recent track of a slug* over the surface of the slates. The genus *Rastrites* of Barrande has not yet been recognized among American *Graptolitideæ.* These forms are by Geinitz united to his genus *Cladograpsus*, the propriety of which we are unable to decide.

The genus *Gladiolites* (*Retialites* of Barrande, 1850, *Graptophyllia* of Hall, 1849) occurs among American forms of the *Graptolitideæ*, in a single species in the Clinton group of New York. A form analagous, with the reticulated margins and straight midrib, has been obtained from the shales of the Hudson River group in Canada, suggesting an inquiry as to whether the separation of this genus on account of the reticulated structure alone, can be sustained. In the mean time we may add that the Canada collection sustains the opinion already expressed, that the *Dictyonema* will form a genus of the family *Graptolitideæ.* The same collection has brought to light other specimens of a character so unlike anything heretofore described, that another very distinct genus will thereby be added to this family. The Canadian specimens show that the Graptolites are far from always being simple or merely branching flattened stems.

The following diagnosis will express more accurately the character of the genus *Graptolithus*, as ascertained from an examination of perfect specimens in this collection.

Genus GRAPTOLITHUS (Linn.).

Description.—Corallum or bryozoum fixed, (free ?) compound or simple ? the parts bi-laterally arranged, consisting of few or many simple or variously bifurcating branches, radiating more or less regularly from a centre, and united towards their base in a continuous thin corneous membrane or disk, formed by an expansion of the substance of the branches, and which in the living state may have been in some degree gelatinous. Branches with a single or double series of cellules or serratures, communicating with a common longitudinal canal, affixed by a slender radix or pedicle from the centre of the exterior side.

The fragments, either simple or variously branched, hitherto described as species of *Graptolithus*, are for the most part to be regarded as detached portions from the entire frond.

In its living state we may suppose it to have been concavo-convex (the upper being the concave side), or to have had the power to assume this form at will. In many specimens there is no evidence of a radix or point of attachment, and they have very much the appearance of bodies which may have floated free in the ocean.

GRAPTOLITHUS LOGANI.

PLATE I. Fig. 1—6. PLATE II. Fig. 1, 2, 3, 4.

Description.—Frond composed of numerous branches nearly equally disposed on two sides of a central connecting stipe, and each again subdividing nearly equally, after which they bifurcate, always near the base, with greater or less regularity ; connecting membrane thin, composed of the same substance, and continuous with the branches, and extending from the centre to some distance beyond the bifurcations ; the branches after the third bifurcation become marked on the inner side by a row of cellules, and along the centre by an abruptly depressed line which follows the divarication of the branches ; cellules minute, not prominent towards the base of the branches, being compressed vertically, and appearing like a double series with a central depressed line, becoming developed as they recede from the base. The branches beyond the disk are turned on one side and laterally flattened, and present a single series of cellules or serrations, which are moderately deep, with the serratures acute at their extremities ; from twenty-four to twenty-eight in an inch. The substance of the branch upon the exterior surface near the centre, is marked by a depressed longitudinal line, which follows the ramifications, and gradually dies out as the branches become finally simple, when the surface on the same side is smooth or somewhat obliquely striated. The disk is smooth exteriorly, and from the centre is a small radicle from which the two sets of branches diverge.

This species, though in a general manner bi-lateral, and presenting four principal branches, is nevertheless, from the irregular division of these, usually unequal upon the two sides ; and we find on examination of those figured that they are as ten and ten, nine and eleven, eight and nine, ten and eleven, seven and ten, twelve and twelve, eight and eight, eight and ten, while the half which is figured on Plate II. has eleven rays.

Plate I. Fig. 1. An individual showing the exterior surface ; the central portions entire, with the impression of the connecting corneous membrane, some portions of which remain still attached to the arms. The extent and outline of the membrane are very distinctly preserved. Some of the arms are broken off at the termination of this membrane or disk, while others extend to some distance beyond its limits ; all however are imperfect.

The appearence of serratures is due to exfoliation, which shows. the impression of the inner side upon the stone.

Fig. 2. Exterior view of another individual, in which some portions of the membrane still remain, the branches being all broken off just beyond the last bifurcation.

Fig. 3. The inner side showing the commencement of the cells, which appear in some places to be in a double series. The connecting membrane of the branches is removed in this specimen.

Fig. 4. Enlarged view of the exterior surface of the central portion of an individual.

Fig. 5. Enlarged view of the inner surface, exhibiting the appearance of a double series of cells, separated by a depressed line in the substance of the branch. In some instances these appear to be absolutely separate, while in others they are connected, showing that there is but a single series, and the apparent separation is due to the depression along the centre.

Fig. 6. An enlarged view of a fragment of a branch, showing serratures on one side, with a corresponding row of obscure, elevated ridges, which may perhaps be due to the foldings of the branch.

Plate II. Fig. 1. An individual preserving the connecting membrane almost entire, showing the sinuous outline.

Fig. 2. A specimen exhibiting the half of an individual, in which the disk is unequally extended between the rays. The margins are apparently entire between all of these; and from whatever cause or injury this inequality may be due, it existed in the animal while living.

Fig. 3. A fragment of slate preserving portions of three individuals. The connecting membrane had been removed by maceration before they were imbedded in the stony matter; but the branches are preserved to the length of more than seven inches. It does not appear that the portions preserved present the entire animal; on the other hand, it is almost certain from the condition of the specimens, that the branches were originally much longer. It will be observed that the branches do not all show the serrated margin at equal distances from the centre, but this is due to the accidental position assumed by the branches as they were imbedded; some present the exterior surface for a considerable distance, and, gradually turning, become flattened laterally.

Fig. 4. The exterior of the base of a specimen, showing the small node or radicle which proceeds from the centre of the vinculum or connecting stipe.

The preceding illustrations are of a single species in different degrees of preservation. The manner of branching, although subject to slight modifications, is still always reliable for the purposes of distinguishing the species.

Locality and Formation.—These specimens were obtained at Point Lévy, opposite to Quebec, in a band of bituminous shale, separating beds of grey limestone. These strata belong to the Lower Silurian series, and are of that part of the Hudson River Group which is sometimes designated as Eaton's sparry limestone, being near the summit of the group; they form also the rocks of Quebec.

Collectors.—J. Richardson, Sir W. E. Logan, and James Hall.

GRAPTOLITHUS ABNORMIS.

Description.—This species, of which only imperfect specimens have been seen, presents four principal branches diverging from the centre, two from each extremity of the vinculum, and each one of these bifurcating and branching unequally, and at unequal distances from the centre.

The forms above described do not by any means exhaust the variety presented in this collection. With a single exception however, all the specimens which offer any new light in regard to the habit of the Graptolites, indicate that the mode of growth was in the manner described, in radiating branches from a centre, or in tufts joining in a central connecting substance.

The specimens from the Canadian locality afford further evidence in confirmation of what we have elsewhere observed, that, with few exceptions, the species have a limited geographical range. This locality has already, after very cursory examination, afforded eight new species of Graptolites, with one or two species which appear to be identical with those previously found in the State of New York. A comparison of specimens from more southern localities with those of New York, shows a large proportion of new species; and it now appears probable that the number of American species of *Graptolithus* previously known (about twenty) will soon be increased by an equal number of new ones.

Locality and Formation.—Point Lévy, Hudson River Group.

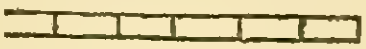
Collectors.—J. Richardson, Sir W. E. Logan, and James Hall.

Since the date of the above communication, great numbers of Graptolites have been added to the Canada collection; and with an increased number of species, our knowledge of the structure of these animals has been very much extended. Had we at that time possessed all the materials which we now have, the subject might perhaps have been treated in a more natural order by presenting in the first place the more simple forms; but since the first two plates of the species were then engraved, I follow this note with the descriptions of others of the same character, which have been prepared since that time.

GRAPTOLITHUS FLEXILIS.

Description. — Multibrachiate, bi-lateral; branches slender, flexile, bifurcating at irregular intervals; bifurcations of contiguous branches often opposite, repeated four times within one and a-half inches of the centre, having from thirty-two to forty or more branchlets at the extremities. Substance of branches thin, extremely compressed; non-celluliferous side smooth or faintly striated; celluliferous side with slight transverse indentations when compressed vertically, and with serratures when compressed laterally; serratures not deep, acute at the extremities, variable in prominence according to the position of the branch; about twenty-four in an inch. Branches often compressed in the direction of the cell to such a degree as to give an apparent double serrature, or serrature on each side of the axis. In this condition the edges of the cells are at right angles to the axis, very shallow, and not pointed.

When the celluliferous side, compressed in the direction of the cell, is uppermost on the surface of the shale, a line may be traced across the branch joining the edge of the serratures, thus showing that the two apparent serratures are but the single one, so compressed that its extremities project beyond the margin.

We have thus all gradations: the smooth surface of the branch with minute striations upon the outer side; the inner side when not compressed with serratures, showing as indented lines across the surface, ; the double serration, produced by more pressure in the same direction, ; and again, as the branch is turned around, these serratures disappearing from one side, and becoming more prominent upon the other ; finally showing their full breadth as the ray is compressed in its transverse or lateral direction.

This condition, which has not been understood with regard to many species, is the principal cause of the diminution and sometimes final disappearance of cells towards the base of a branch; even when both sides are serrated, a less degree of compression, which might very naturally result towards the base, would cause the serratures to be less prominent, as is seen in many of the figures in Barrande's *Graptolites dè Bohême;* in the New York Palæontology, etc.

The serratures of this species differ essentially from those of any other in the Canadian collection, and from any in the New York collections or others that have come under my observation.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—J. Richardson and E. Billings.

GRAPTOLITHUS RIGIDUS.

Description.—Multibrachiate, bi-lateral; branches slender, cylindroid exteriorly; rigid, maintaining their width to the third bifurcation, and beyond this very gradually diminishing; bifurcations five in the space of one and a half inches; internodes unequal shorter near the base, and increasing towards the extremities; serratures undetermined.

In some specimens the branches are broader and flattened near the base, and the connecting bar or vinculum is broad and strong, with a small central node, the base of the radicle. Some portions of the corneous membrane or disk are preserved in a single specimen.

The subdivisions of each branch are from fifteen to twenty, or perhaps more numerous when entire; giving from sixty to eighty or more branchlets at the extremities of the frond.

A distinguishing feature of the species is its rigid and divergent bifurcation, and the almost uniform size of the branchlets.

All the specimens of this species examined are in a coarse arenaceous shale, and present the exterior or non-celluliferous side only. A single specimen has the extremities of the branches partially turned on one side, and gives some obscure indication of serratures. Individuals are extremely numerous in certain layers, and are spread out in profusion upon the surfaces of the slate, the bifurcating and interlocking branchlets presenting a net-work in which it is extremely difficult to trace the ramifications of each individual.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—J. Richardson and E. Billings.

GRAPTOLITHUS OCTOBRACHIATUS.

Description.—Frond composed of eight simple undivided branchlets, arranged bi-laterally, and proceeding from the two extremities of a short strong vinculum, which is subdivided, and each part again divided near the base, giving origin to four equal rays or branchlets. Branchlets strong, linear, not sensibly diminishing in size as they recede from the centre; subangular, flattened upon the outer side, with a depressed line along the centre; obliquely striated; serratures short and strong, twenty in an inch, varying in depth according to the position of the branch, in one or two instances showing a deeper indentation.

This species presents the essential characteristic of eight simple arms or branchlets, which appear to have been subquadrangular in its living state, and when compressed laterally are scarcely broader, excepting the serratures, than when vertically compressed.

The branches are formed by the division of the vinculum at each extremity, first into two parts, making four; each of these is again subdivided almost immediately, and often so close as to present the appearance as if the four branchlets on each side originated from the same point. A careful examination however will show a little intervening space, and in one individual in its young state this feature is very characteristic.

The disk is a thick carbonaceous film, much stronger and coarser than in any of the preceding species, and corresponding in this respect to the stronger branches. It is moreover variable in form and extent in different specimens, and does not always appear to be in proportion to the size of the branches.

All the specimens yet examined present the exterior surface, so that the celluliferous face of the arms has not been seen. An impression of a short fragment of that surface of one of the branchlets shows strong, deep indentations. The vigorous aspect of this species contrasts with all others in this collection. In one specimen, where the frond is imperfect, one of the arms extends to a distance of more than eight and a-half inches from the centre, while two others are more than six inches each, and these are all broken at their extremities.

In its long linear branches, this species resembles the *G. sagittarius* (Hall, Pal. N. Y., Vol. I., pl. 74, fig. 1, perhaps not the European species of that name), but the branches are stronger and the serrations coarser; it is moreover associated with a group of species, all or nearly all of which are quite distinct from those of New York with which the *G. sagittarius* occurs.

Locality and formation.—Point Lévy, Hudson River Group.

Collectors.—J. Richardson and E. Billings.

GRAPTOLITHUS OCTONARIUS.

Description.—Frond composed of four principal branches, two diverging from each extremity of the short vinculum; each branch equally subdivided near the base, giving eight branchlets which continue simple to their extremities; branchlets gradually expanding from the base; serratures slightly inclined and truncated above almost rectangularly to the direction of the serratures and oblique to the rachis, giving a slightly obtuse extremity; about twenty-four in the space of an inch; substance of the branchlets thick; divisions between the cells marked by a strongly depressed line which extends from the base of the serrature downwards as far as the second serrature below, ending near the back or lower side of the branch.

The branchlets of this species resemble those of *G. bryonoides*, and the distance of the serratures is almost the same, while in some well-preserved specimens the obliquity of these parts is greater. There is also some difference in the form of the branchlets. In separate branches the characters are too nearly alike to offer the means of description, unless they are in a very perfect state of preservation.

From *G. octobrachiatus* it differs conspicuously in the form of its branchlets, and in the comparative number and form of the serratures.

Locality and Formation.—Point Lévy.

Collector.—J. Richardson.

GRAPTOLITHUS QUADRIBRACHIATUS.

Description.—Frond composed of four simple undivided branches, arranged bi-lateraly, or two from each extremity of the vinculum; branches slender, linear, obliquely striated, usually somewhat incurved, serrated upon the inner side; serratures a little recurved, and mucronate at the tip; about twenty-four in an inch; indented to about one-third the width of the branch when completely flattened. Disk thick, strong, often extending along the branches and giving them a somewhat alate appearance; point of attachment of radicle obscure.

Almost all the specimens of this species are obscure, and all are fragmentary; in a few specimens only the serratures are exhibited with some degree of perfection. The branches are preserved in some specimens to an extent of two inches.

GRAPTOLITHUS CRUCIFER.

Description.—Frond composed of four simple strong branches united by a small thickened disk; branches broad, connected by a short vinculum; serratures nearly vertical to the direction of the branch and sloping at an almost equal angle on each side, acute at the extremity, and apparently mucronate or setiferous; about twenty-four in an inch.

This species preserves the general character of G. *quadribrachiatus*, but the branches are much stronger, and about twice the width. The serratures are scarcely oblique to the rachis, and are very clearly mucronate at the tips, while some of them exhibit the appearance of long setæ. The imperfect preservation of the specimen examined renders it impossible to determine accurately the nature of these appendages.

In the specimen here described one of the branches is preserved to the extent of two and a half inches, with a width of three-sixteenths of an inch to the extremity of the points of the serratures, exclusive of the setæ; the branch to the base of the teeth being five-sixths of the whole width.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—J. Richardson, E. Billings.

GRAPTOLITHUS BRYONOIDES.

Description.—Frond composed of four short simple branches, united at the base by a vinculum, and terminating below in a minute radicle; branches short, comparatively broad, obliquely and strongly striated from the base of the serratures to the outer edge of branch; serratures moderately oblique, the outer and inner margins making very nearly a right angle; mucronate at the tip; about twenty-four to twenty-eight in an inch.

Of several specimens in the collection none of the branches exceed an inch in length, while they are almost one eighth of an inch in width from the tip of the solid part of the serratures to the outer edge. They are all strongly striated from the base of the serratures to the outer margin, the striæ sometimes a little curved. The serratures are usually slightly oblique, or with the longer sloping side directed towards the base of the branch, and the shorter side advanced a little beyond a right angle to the rachis. In one specimen, where the branches are less than five-eights of an inch in length, the serratures seem to be equally or nearly equally sloping on the two sides from the tip to the base.

The vinculum is obscure, and from the mode of imbedding in many specimens, this part might be inferred to be absent.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—J. Richardson, E. Billings, Sir W. E. Logan, James Hall.

(*To be continued in the next number*).

Miscellaneous.

UNUSUAL MIGRATION OF WILD PIGEONS.—A correspondent in Barrie, C.W., sends us the following interesting facts, worthy of record among the other exceptional features of the past winter. We shall at all times be glad to receive short communications of this kind from any of our subscribers.—EDS.

On the afternoon of Friday, the 19th of March, immense flights of wild pigeons passed along the shores of Kempenfeldt Bay (an arm of Lake Simcoe) flying generally in a westerly and north-westerly direction. One flock at a fair computation was at least three miles long, and in the distance looked like a very large cloud rising gradually from below the horizon.

The pigeons during this day flew high, but in the pine woods some large flocks pitched. On Sunday the flocks were smaller, and flew very much lower, the birds then were to be found in the beech woods.

No one here ever remembers so early an arrival of these birds; April 21st, I believe, is the earliest date at which they have been seen.

The winter has however been peculiar; generally from December or the end of November till the beginning of April no birds are to be seen here but a few crows and a blue jay at intervals.

This year woodpeckers, blue tomtits, tree-creepers, and a small red-headed bird,* blue jays, and a small finch were seen almost every day. With the thermometer at 8°, I have seen them flying about.

With regard to the number of pigeons seen, I have often heard and read of the large flights of passenger pigeons on this continent, but never until now could have believed them possible.

Annual Report of the Canadian Institute of Toronto.—This society, much younger than the Natural History Society, is now a vigorous rival, and has in some respects much outgrown its older sister. Its labours in the past year have been highly creditable, embracing the reading and publication of a large number of valuable papers, the publication of the Canadian Journal, the collection of many books and specimens, and preparations toward the erection of a building. The number of members is said to amount to 614, the papers read to 37, and the Journal is distributed to 42 of the leading societies and sicentific institutes in Europe and America, bringing large returns by way of exchange. The following paragraphs show the view taken by the council of a portion of the institute and its causes.

"The constant accession of new members, the numerous and valuable donations presented to the Library and Museum, the comparatively large and increasing attendance at the meetings of the session, the character of the papers communicated to these meetings and finally the continued success of the Journal of the Institute, are each and all, it is submitted, legitimate subjects of

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* Linaria minor ?

congratulation. Showing, as these facts most assuredly do, the honorable position accorded to the institute in the estimation of the Province.

"It is believed that the papers read will compare favorably with those of other years: more especially, as several have been deemed worthy of re-publication in some of the leading Scientific Journals of Europe. It is also gratifying to observe, with regard to those papers, that the appeals of preceding Councils for more active co-operation on the part of Members generally, has been to a great extent responded to. The present Council venture, therefore, to express a hope that a still more extended co-operation in this department, may be anticipated in the session now about to commence.

"Feeling strongly that the success of the Institute is dependent on, or at least largely influenced by, the success of its Journal, the Council have great satisfaction in alluding to the now fairly established and very marked success which has accompanied the issue of the new series of the "Canadian Journal," under the editorship of Dr. Wilson and a Committee appointed by the respective Councils of 1855 and 1856. The Council cannot allow this opportunity to pass without expressing an earnest desire that some special recognition on the part of the Members of the Institute, be devised to mark their sense of the zealous and valuable services of the chief editor."

Rejoicing as we do in the prosperity of the Canadian Institute, and recognising it as a worthy representative of Canadian Science, we are desirous of making its prosperity a reason why in the Natural History Society of Montreal similar vigour should be exhibited. We trace the rapid growth of the Institute, in the first place to the active exertions of a few leading scientific and literary men in Toronto, more especially of the Professors of University College. In the next place, to the regular publication of its Journal and the ability of the Society to give this publication to every member for a subscription, the whole amount of which is not more than the price of the Journal itself. Lastly, the large public aid received by the Institute, has given it the means thus liberally to repay its members their subscriptions and otherwise to extend its operations.

In the case of the Natural History Society of Montreal, we have now a body of active members fully able by their Scientific and Literary exertions to sustain the Society; and we have a

Journal, comparable in its peculiar field with that of the Canadian Insitute; but on the other hand not having any available means, except the annual subscriptions of members, this society is unable to give its Journal gratuitously to its members, or by means of exchanges to augment its library. The truth is, that Science in Toronto as represented by the Canadian Institute is liberally fostered by the Legislature, whereas Science in Montreal as represented by the Natural History Society receives only the pittance allotted to ordinary Mechanics' Institutes. We are very far from grudging the Institute the grant so well bestowed on it, and we admit in our own case that independence cultivates many rugged self-reliant virtues. Nor do we deny that, other things being equal, a Journal or publication unsupported by public aid will usually be better managed than one so supported. In the meantime however, as a stimulus to our membership, and for the wider circulation of the results of Canadian Science, we think it very desirable that the friends of Natural Science, in Lower Canada should endeavour to secure, for this its leading representative, some adequate share of legislative aid.

EFFECTS OF FOREIGN POLLEN ON FRUIT.—The following on this curious subject is from Silliman's Journal, No. 73 :—In the last number of this Journal, p. 443, some facts were referred to, which led to the supposition that pollen applied to the stigma may exert some specific action upon the ovary itself, independent of its action upon the ovules determining the formation of the embryo. This was mentioned as furnishing the most probable clue to the explanation of the reputed fact that squashes are spoiled (that is the quality and appearance of the fruit altered) by pumpkins growing in their vicinity, and *vice versa* ; and even that melons are spoiled by squashes ; and this notwithstanding the fact, ascertained by Naudin, that distinct species of *Cucurbitaceæ* refuse to hybridize, although the various races of the same species cross with the greatest facility. It is generally agreed that the alteration of the character of the fruit is immediate, i. e., that it affects the ovary itself which has been contaminated by strange pollen. It might then equally affect the fruit whether the seeds were any of them fertilized or not; and in Naudin's experiments the application of pollen apparently caused the fruit to set, even when no ovules were fertilized.

Now a similar case of direct action of alien pollen upon the fruit, or grain, occurs in Indian corn, and is familiar to every farmer in the country, in the form of grains of different varieties on the same ear. A decisive instance is before us in a small ear of sweet corn, grown in the vicinity of a patch of the common hard, yellow variety; in consequence from three to six grains in every row have become yellow corn, while the rest retain the characteristic appearance of the sweet variety. It is not rare, where several sorts of maize are cultivated together, to find nearly all of them separately represented upon one ear. This must be the result either of cross-fertilization of the previous year showing itself, not in a blending of the characters of the fruit of the progeny, but in a complete separation into the constituent sorts in the fruit resulting from one seed, which would be a wonderful anomaly, but no impossibility; or else, of an immediate action of the pollen the present year, as is reputed of squashes and melons. But the occurence of three sorts of corn upon one ear goes far towards excluding the first supposition, since there can have been but two immediate parents to one embryo. (Prof. Gray).

Agassiz's Contributions to the Natural History of the United States.—The first two volumes of this work have made their appearance and are worthy of the high reputation of their author. We shall in a future number review the work at length, and in the meantime give the following summary of its contents.

Vol. I., Part I. *Essay on Classification.*

Chapter I. The fundamental relations of animals to one another and to the world in which they live, as the basis of the natural system of animals: under which head the author treats of —the actual foundation in nature of the true zoological system or classification,—the unity of plan throughout the diversified types —the distribution of the same types over widely diverse geographical regions, and as widely diverse geological ages,—the permanency of types and the immutability of species,—the relations between plants and animals and the surrounding world,—embryology a basis for determining the rank of species—succession in geological time a basis for deciding approximately upon rank;— all of which topics, besides others not here enumerated, are so handled as to bear directly on the question of creation by physical agencies, giving it a decided negative reply.

Chapter II. Leading groups of the existing system of animals —a philosophical disquisition on the true significance of the grades of subdivisions in the kingdoms of life, the nature of species, genera, families, orders and classes.

Chapter III. Notice of the principal systems of zoology, including observations on the systems of Aristotle and Linnæus; the *anatomical* systems of Cuvier, Lamarck, Ehrenberg, Burmeister, Owen, von Siebold and others; the *physio-philosophical* systems of Oken and McLeay; and the *embryological* systems of Dollinger, von Baer, Bogt, etc.

Part II. *North American Testudinata.*

Chapter I. The order of Testudinata, its rank, classification, general characters, anatomical structure, geographical distribution, geological history, etc.

Chapter II. The Families of Testudinata.

Chapter III. North American genera and species of Testudinata—their characters, distributions, etc., for the several families.

Part III. *Embryology of the Turtle.*

Chapter I. Development of the egg from its first appearance to the formation of the embryo.

Chapter II. Development of the embryo from the time the egg leaves the ovary to that of the hatching of the young, including the laying of the eggs,—the deposition of the albumen and formation of the shell,—the absorption of albumen into the yolk sac,—the transformations of the yolk in the fecundated egg,—segmentation of the yolk,—the whole egg is the embryo,—foldings of the embryonic disc and successive stages of growth of the turtle,—formation and development of the organs,—histology,—chronology of the development of the embryo.

The young of various species and the several successive phases in embryological development are illustrated with details in the plates, all of which are crowded full of figures.

Ascent of Chimborazo.—The Edinburgh New Philosophical Journal quotes the following interesting account of an ascent of Chimborazo by a French traveller, M. Jules Remy, and an English traveller, Mr. Brenchley:—

"On the 23d of June, 1802, the illustrious Humboldt, accompanied by his friend Bonpland, made the first attempt to ascend Chimborazo. On account of a pointed rock, which presented an insurmountable barrier, they were unable to ascend above 5909 metres of the mountain, then regarded as the highest in the world, and which still occupies a principal place among the colossi of America.

"Thirty years later, on the 16th of December, 1831, M. Boussingault, after a long and skilful examination of the Cordillera of the equator, endeavoured to accomplish the ascent in which his predecessor had failed. He reached the enormous height of 6004 metres, that is to say, 95 metres higher than the others; but he was arrested by rocks as they had been, and could not get beyond this limit, which was then the most elevated point ever attained by man on mountains.

"The accounts of these famous travellers had deprived us of all hope of reaching a height so considerable; but, after having observed the snowy and rounded summit of Chimborazo from Guayaquil, we could not help thinking that it was accessible from some point or other. M. Brenchley and myself were thus led to form the design of attempting a third ascent.

"On the 21st of July, 1856, as we crossed the plateau of the Andes on our way to Quito, we halted at the foot of this stupendous mountain. We employed two days in studying its outlines from a distance, with the view of discovering any peculiar places on the surface of its gigantic dome which might afford us a passage.

"The route followed by MM. Humboldt and Boussingault, seemed to us at first to be greatly the most easy and desirable on account of its regular declivity; but the barrier of rocks, which we readily distinguished, presented no outlet to the eye. When we had made nearly the entire circuit of this mighty mountain, and without success, we resumed our journey towards Quito, reserving the execution of our plan till we should be better fortified against the rigorous climate of the higher Cordilleras.

"After visiting Pichincha, Cotopaxi, and other giants of the Andes, we again found ourselves, on the 2d of November, at the foot of Chimborazo. We pitched our camp at a height of 4700 metres, a little below the line of perpetual snow, in a valley between Arenal and the point where the Riobamba route separates from that of Quito. We intended to spend the following day in collecting plants and hunting deer and birds, endeavoring, at the same time, to determine beforehand the places which might afford us the most easy access to the summit.

"We took up our quarters under a huge inclined rock, which afforded us sufficient protection against the northwest wind, but gave us no shelter in the event of rain. Rain had fallen in the afternoon. The weather cleared at night-fall, the sky became sprinkled with myriads of stars, and Chimborazo was delineated, in all its splendour, on the azure and sparkling vault of the firmament.

"On the morning of the 3d of November, at five o'clock, when day had not yet dawned in the equinoctial regions, we left our camp in charge of our people, and departed on our exploring expedition, carrying with us a coffee pot, two thermometers, a compass, matches, and tobacco. A steep hill, sandy and rough with pebbles, which separated us from the perpetual snow, occasioned us so much fatigue at our outset, that two of the natives who accompanied us became discouraged and turned back.

"When we had surmounted this hill, we descended on some soft sand to the bottom of a valley, which we followed, and from the extremity of which we distinguished very clearly the summit of the mountain, entirely free from snow.

"After walking half an hour on the snow, vegetation suddenly ceased, and we saw no other living thing but two large partridges, and on the rocks a few lichens of the families Idiothalamus and Hymenothalamus. At this point of our ascent we collected some dry branches of chuquiragua, and made a bundle of them, which we tied to our backs. We had still to scale an immense rock of trachyte, from the top of which the summit of Chimbarazo appeared to us so near, that we thought we could reach it in half an hour.

"Our ascent was so rapid, that we were soon obliged, from fatigue, to make frequent stoppages to recover our breath. Thirst also began to be severely felt, and in order to moderate it we almost always kept snow in our mouths. But we felt no symptoms of illness or any morbid affection, such as is spoken of by the majority of travellers who have ascended high mountains.

"After halting a few seconds, without even seating ourselves, we again started not only with renewed ardour, but even a kind of furious determination inspired by so near a view of the summit. It appeared evident to us, by this new instance confirming so many previous ones, that at those heights the atmospheric column is still sufficient to prevent any impediment to respiration, and that the shortness of breath and organic affections which are so generally complained of at considerable elevations, must be ascribed to some other cause.

"Always rapidly ascending, we now began to overlook the peaks of the Cordilleras, and to discover a distance furnished with immense valleys, when some light vapors, which at first appeared only like spiders webs on the sides of the mountain, soon began to detach themselves in the form of white flakes, stretching nearer and nearer to each other, till they at last arranged themselves like a girdle along the horizon.

"All of a sudden, about eight o'clock, this curtain enlarged itself, and approached Chimborazo; then in a few minutes it mounted to us, thin at first, but becoming perceptibly more dense. We no longer could perceive the summit. We continued, however, to mount upwards, enticed by the hope of attaining our object much more easily than we had supposed on leaving our encampment.

"The fog continued to increase; we could not see twenty paces from us. At half-past nine, it had become so thick that it was almost as dark as night at the distance of a few metres. Confident of finding our footsteps again to guide our descent, we travelled on with additional stubborness; but we had every moment to examine the compass, in order to avoid a precipice which we had left on our right before reaching the terminal depression by which we resolved to gain the summit.

"It seemed to us that the declivity became less steep, we breathed more freely, and walked with less effort. Some dull detonations began at intervals to be heard in the distance. At first we ascribed them to the explosions of Cotopaxi; but soon reverberating peals, such as are heard only in the vicinity of the equator, convinced us that thunder was rolling in the lower regions. A terrible storm was in preparation.

"In the fear that the hail or snow would efface the marks of our feet, and thereby expose us to the risk of losing ourselves in the descent, we determined, with regret, to halt for a while. We hastened to kindle our chuquiragua wood, in order to melt the snow in our coffee-pot. At ten o'clock, the thermometer which, at five feet above the snow, indicated 1·7, was plunged in boiling water where the mercury stood at 77·5.

"At five minutes past ten, our observations terminated, and we began to descend with giant strides in order to regain our encampment as speedily as possible. We arrived there in the midst of the thick fog about an hour after noon. The thunder rolled almost without interruption, the flashes of lightning describing dazzling zigzags around us, never seen elsewhere so distinctly defined except in pictures.

"About three o'clock, a fearful tempest of rain, hail, and wind assailed us under our rock. It continued throughout a part of the night with a fury which seemed as if it could never be allayed. We were literally lying in water. On the morrow, at day break, our eyes rested everywhere on a vast field of hail.

"Certain indications of another tempest made us abandon the idea of trying again the ascent of Chimborazo, which we henceforth regarded as quite impracticable. We made all haste to break up our camp and make for Guaranda, where we arrived about three o'clock, travelling through a cold and dense fog, which prevented us for that day admiring one of the most beautiful views in the world.

"When we calculated our observations, we were not a little surprised to find that we had reached the summit of Chimborazo without being aware of it. According to personal researches, made at first in the Archipelago of Hawaii, and afterwards repeated among the Cordilleras of the equator, the co-efficient of a degree in the centigrade thermometer, reckoning between the point to which the mercury rises when the instrument is immersed in boiling water, and the boiling point of water at the level of the sea, is found to be 290·8; that is to say, each degree below 100 indicates a difference of level equal to 290·8 meters, or about 29 meters for the tenth of a degree, hence the formula

$$x=(100-B)\ (290{\cdot}8)$$

which gives us 6543 meters for the absolute vertical height we had reached on Chimborazo. This figure places us quite on the summit, the altitude of which, above the sea level, according to Humboldt's triangulations, is 6544 metres. But whatever degree of confidence may be conceded to our calculations, the unquestionable fact resulting from our ascent is, that the summit of Chimborazo is accessible."

Artesian Wells in Sahara, (Athen., No. 1562).—The *Moniteur Algérien* brings an interesting report on the newly-bored Artesian wells in the Sahara Desert, in the province of Constantine. The first well was bored in the Oasis of Oued-Rir, near Tamerna, by a detachment of the Foreign Legion, conducted by the engineer, M. Jus. The works were begun in May, 1856, and, on the 19th of June, a quantity of water of 4,010 litres per minute, and of a temperature of 21° Réaumur, rushed forth from the bowels of the earth. The joy of the natives was unbounded; the news of the event spread towards the South with unexampled rapidity. People came from long distances in order to see the miracle; the Marabouts, with great solemnity, consecrated the newly-created well, and gave in the name of "the well of peace." The second well, in Temakin, yielded 35 litres, of 21° temperature, per minute, and from a depth of 85 metres; this well was called "the well of bliss." A third experiment, not far from the scene of the second, in the Oasis of Tamelhat, was crowned with the result of 120 litres of water per minute. The Marabouts, after having thanked the soldiers in the presence of the whole population, gave them a banquet, and escorted them in solemn procession to the frontier of Oasis. In another Oasis, that of Sidi-Nached, which had been completely ruined by the drought, the digging of "the well of gratitude" was accompanied by touching scenes. As soon as the rejoicing outcries of the soldiers had announced the rushing forth of the water, the natives drew near in crowds, plunged themselves into the blessed waves, and the mothers bathed their children therein. The old Emir could not master his feelings; tears in his eyes, he fell down upon his knees, and lifted his trembling hands, in order to thank God and the French. This well yields not less than 4,300 litres per minute, from a depth of 54 metres. A fifth well has been dug at Oum Thior, yielding 108 litres per minute, Here a part of the tribes of the neighborhood commenced at once the establishment of a village, planting at the same time hundreds of date-palms, and thus giving up their former nomandic life. The last well is that of Shegga, where soon an important agricultural centre will spring up. There is no doubt but that these wells will work in these parts a great social revolution. The tribes which, after the primeval custom of their ancestors, kept wandering from one place to another, will gather round these fertilizing springs, will exchange the herdsman's staff for the plough of the farmer, and thus take the first steps towards a civilization, which, no doubt, will make rapid progress in Northern Africa.

Day of Month.
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another. The substance of the disk is strong and somewhat rugose, either from its original character or from the accidents ac-

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF FEBRUARY, 1858.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Snow in inches.	Amo'nt of Rain in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	30·185	29·972	30·005	— 9·2	10·1	3·0	·017	·045	·044	·57	·60	·85	N. E. by E.	N. E. by E	N. E. by E.	0·71	1·78	9·96	....	....	Clear.	Clear.	C. Str. 10.
2	29·504	315	29·363	2·7	20·5	17·7	·038	·096	·086	·73	·85	·84	N. E. by E.	N. E. by E.	N. E. by E.	27·09	20·07	2·65	....	9·80	Snow.	Snow.	" 10.
3	547	538	709	20·9	28·0	23·2	·075	·099	·100	72	·64	·74	W. S. W.	W. S. W.	N. W.	13·08	19·60	12·61	....	....	Cirr. Str. 4.	C. Str. 4.	" 10.
4	863	800	898	6·4	23·0	15·0	·043	·088	·061	·75	·62	·73	W. by S.	W. by S.	N. E. by E.	7·95	6·15	5·77	....	....	Clear.	Clear	" 10.
5	894	858	875	1·0	12·4	7·0	·030	·051	·048	69	69	·77	W. by N.	W. by N.	S. S. W.	1·30	4·81	8·57	....	....	"	C. Str. 4.	" 10.
6	996	956	969	— 1·8	18·2	7·2	·034	·075	·040	·84	·71	·79	W. S. W.	W. S. W.	S. S. E.	0·20	7·46	1·40	....	....	"	" 4.	Clear.
7	765	627	698	8·6	21·0	22·0	·042	·070	·101	·68	·80	·86	N. E. by E.	N. E. by E.	S. W.	5·43	4·37	1·81	....	0·75	C. Str. 10.	C. Str. 10.	C. Str. 10.
8	944	971	30·050	9·0	15·0	— 0·3	·051	·055	·034	·77	·68	·81	N. W.	S. by W.	S. by W.	19·71	10·50	1·31	....	....	" 6.	Clear.	Clear.
9	30·031	674	29·377	—14·1	4·2	9·1	·012	·038	·051	·50	·73	·77	N. E. by E.	N. E. by E.	N. E. by E.	1·47	5·85	15·30	....	3·10	C. C. Str. 4.	Snow.	Snow.
10	29·201	344	526	10·3	16·4	— 2·0	·054	·074	·030	·78	·83	·80	W. by S.	W. by S.	W.	14·85	14·05	23·05	....	0·97	C. Str. 4.	C. Str. 8.	C. Str. 4.
11	787	910	30·044	—15·7	1·0	—13·4	·010	·032	·012	·45	·70	·54	W.	W.	W.	23·35	1·22	18·50	....	....	Clear.	C. C. Str. 4.	Clear.
12	30·120	30·124	183	—26·3	9·8	—11·9	·002	·054	·063	·18	·78	·81	W.	W.	W. S. W.	4·21	11·14	0·18	....	....	C. Str. 2.	Clear.	"
13	330	310	236	—30·2	— 3·0	—15·5	·002	·025	·010	·20	·66	·46	W. S. W.	W.	W.	0·08	0·11	0·33	....	....	Clear.	"	"
14	010	29·952	29·876	—14·7	0·0	— 0·3	·011	034	·034	·48	·70	·80	N. E. by E.	N. E. by E.	W. by S.	3·12	4·60	3·50	....	Inapp.	C. C. Str. 8.	C. Str. 10.	"
15	29·973	920	30·032	— 9·8	14·0	2·8	·019	·067	·036	·60	·81	·72	W. S. W.	W. S. W.	W. S. W.	0·32	3·15	12·47	....	....	Cirr. 2.	Str. 4.	"
16	886	724	29·885	— 9·3	11·9	2·2	·018	·051	·028	·58	·70	·67	W. S. W.	W. by S.	W. by N.	7·27	2·22	25·40	....	....	Clear.	Clear.	C. Str. 10.
17	933	976	990	— 5·0	8·8	0·1	·022	·054	·036	·63	·78	·80	E. by N.	W. by N.	W. by S.	28·83	5·71	1·91	....	....	C. Str. 4.	"	Clear. Aurora Borealis.
18	983	948	30·079	— 5·4	5·0	— 4·0	·022	·037	·024	·63	·62	·65	W.	W.	W.	20·03	11·47	10·87	....	Inapp.	" 10.	"	" " "
19	30·227	30·137	182	—20·2	10·6	— 9·4	·006	·054	·022	·33	·78	·78	W. S. W.	S. E.	E. N. E.	1·13	0·11	0·13	....	....	Clear.	"	C. Str. 4.
20	29·958	29·748	29·701	—10·0	12·0	10·6	·021	·063	·050	·77	·81	·70	N. E. by E.	E. N. E.	W.	4·90	7·97	1·10	....	....	C. C. Str. 8.	C. C. Str. 10.	" 10.
21	606	896	868	9·5	24·5	20·8	·081	·111	·085	·77	·81	·78	S. W.	S. W.	W. by N.	8·08	7·22	3·86	....	0·46	C. Str. 10.	C. Str. 10.	" 8.
22	910	920	30·001	— 3·6	13·3	— 3·7	·025	·080	·025	·66	·79	·66	W. by N.	W. S. W.	W. by N.	9·46	1·64	4·72	....	....	Clear.	Clear.	Clear.
23	30·114	30·179	278	—16·9	16·4	3·5	·009	·065	·032	·43	·74	·60	S. W. by W.	S. S. W.	S. W. by S.	0·02	0·40	8·17	....	....	"	"	"
24	156	29·928	29·728	— 5·3	28·5	14·8	·022	·111	·061	·65	·81	·73	S. S. E.	N. E. by E.	N. N. E.	1·63	2·25	1·22	....	....	C. C. Str. 8.	C. Str. 10.	C. Str. 10.
25	29·683	540	720	13·1	30·0	21·0	·063	·130	·090	·80	·78	·78	E. by S.	S.	W. by N.	0·01	3·35	10·06	....	....	Nim. 10.	C. C. Str. 8.	" 4.
26	796	781	763	7·0	34·9	13·2	·045	·155	·054	·76	·79	·72	W. by S.	S. S. W.	S.	2·06	1·07	2·96	....	....	Clear.	Clear.	Clear.
27	604	470	650	13·6	39·4	32·0	·063	·192	·169	·81	·82	·89	S. by E.	S. by E.	S. by E.	9·72	7·00	0·93	Inapp.	....	C. Str. 8.	C. Str. 8.	C. Str. 4.
28	600	460	410	32·0	34·0	32·5	·162	·155	·156	89	·99	·85	S. S. E.	E. N. E.	W. by N.	0·73	3·57	5·90	....	2·90	" 10.	Sleet.	Snow.

REPORT FOR THE MONTH OF MARCH, 1858.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2. p. m.	10 p. m.
1	29·562	29·642	29·780	22·0	36·3	21·0	·112	·171	·101	·93	·82	·86	W. N. W.	E. S. E.	E.	0·00	0·31	0·01	....	0·30	C. C. Str. 4.	C. Str. 10.	Snow.
2	514	425	571	10·6	18·0	9·4	054	·087	·057	78	·84	·88	N. N. E.	W.	W. S. W.	18·11	7·50	12·40	....	1·00	C. Str. 10.	Snow.	C. Str. 10.
3	816	879	30·016	— 9·0	15·4	—15·3	·019	·035	·016	·60	·74	72	W. S. W.	S. W.	E. S. E.	7·17	3·31	1·48	....	....	Clear.	Clear.	Clear. Aurora Borealis.
4	30·112	30·052	125	—21·9	18·0	— 3·2	·011	·067	·025	·63	·68	·66	S. S. E.	S.	N. N. E.	0·01	0·30	0·48	....	....	"	"	" Aurora Borealis.
5	·110	29·797	29·714	—15·8	11·8	8·1	·016	·051	·048	·70	·69	·71	W.	W.	W. S. W.	2·30	10·55	15·55	....	Inapp.	C. C. Str. 4.	"	C. Str. 4.
6	29·762	743	700	3·0	9·0	0·2	·041	·051	·036	·74	·77	·84	W.	W. by N.	W. N. W.	14·03	4·10	9·43	....	1·00	Snow.	C. Str. 10.	Clear.
7	626	500	371	— 5·0	11·1	10·1	·022	·057	·054	·62	·76	·78	W. N. W.	W. N. W.	W. N. W.	14·30	1·55	6·07	....	....	Clear.	" 10.	C. C. Str. 8.
8	565	464	464	— 1·1	26·9	2·9	·023	·117	·036	·61	·82	·72	N. W.	S. W.	E. by S.	7·10	0·70	0·06	....	....	"	Clear.	Cir. Str. 10.
9	211	134	238	2·5	16·0	12·0	·034	·065	·060	·71	·74	·80	N. N. E.	N. W. by N.	W. by N.	0·87	5·77	11·63	....	Inapp.	C. Str. 10.	C. Str. 4.	" 4.
10	353	424	517	14·0	36·7	20·2	·051	·184	·070	·63	·85	·71	W.	W.	W.	5·17	6·22	28·16	....	Inapp.	" 8.	" 4.	Clear.
11	257	226	539	15·7	31·0	20·6	·065	·155	·075	·74	·89	·70	S. W.	W.	W. by N.	1·31	8·57	14·48	....	2·00	" 10.	Sleet.	Snow.
12	699	850	937	3·0	32·0	13·1	·036	·149	·048	·72	·84	·62.	W. S. W.	W. S. W.	E.	17·71	10·47	5·08	....	....	Clear.	C. Str. 4.	Str. 2.
13	30·361	30·270	30·223	2·0	19·0	14·1	·034	·071	·051	·71	·69	·63	E. by N.	S. W.	S. W.	6·01	1·51	3·92	....	....	"	Clear.	Clear. Aurora Borealis.
14	29·958	29·850	29·999	7·1	24·1	17·5	·045	·094	·072	·75	·73	·75	S. E.	N.	W. N. W.	1·60	5·41	0·02	....	0·90	Snow.	C. Str, 10.	" Aurora Borealis.
15	30·050	30·060	30·030	28·0	52·8	34·0	·135	·334	·175	·88	·86	·89	S. W.	S. W.	W.	1·06	0·01	0·21	....	....	C. Str. 10.	" 10.	C. Str. 10.
16	29·941	29·842	29·741	32·1	35·2	34·6	·162	·183	·175	·89	90	89	N. E.	S. E.	W. by S.	1·96	0·63	0·02	....	....	" 10.	Rain.	Rain.
17	847	471	334	38·0	52·4	40·3	·208	·334	·212	·91	·86	·83	S. W. by W.	W. by S.	S. W.	0·24	0·48	2·47	0·199	....	" 4.	C. Str. 4.	C. Str. 8.
18	246	382	682	38·0	43·0	36·7	·216	·254	·195	·91	·84	·82	S. W.	W. S. W.	W. by N.	10·97	10·60	15·47	0·041	....	" 10.	" 10.	" 6.
19	30·001	30·150	30·199	26·0	44·4	26·1	·117	·186	·105	·76	·67	·75	N. N. W.	S. W.	S. S. W.	12·63	1·71	0·26	....	....	Clear.	Clear.	Clear.
20	170	29·971	29·795	18·4	49·8	34·0	·075	·278	·155	·70	·71	·79	S. S. W.	S. W. by W.	W. by S.	0·01	0·01	0·28	....	....	"	"	"
21	29·180	021	110	32·1	44·2	34·1	·143	·241	·175	·79	·84	·89	S. by E.	W. S. W.	W. S. W.	8·20	13·85	9·41	0·045	....	Rain.	Rain.	C. Str. 8.
22	489	682	782	25·5	24·4	20·4	·111	·083	085	81	·74	·78	W. by N.	W. N. W.	N. W.	34·61	23·85	27·52	....	....	C. Str. 4.	Clear.	Clear.
23	882	882	918	11·1	34·8	25·0	·048	·149	·103	·69	·74	·80	N. W.	S. S. W.	N. by W.	4·80	2·26	1·00	....	....	Clear.	"	Cir. Cum. 4. Lunar Halo.
24	963	863	984	11·4	40·6	24·6	·037	·188	·094	·79	·77	·73	N. E.	S. S. W.	W. by N.	12·72	0·72	8·57	....	....	"	"	Clear.
25	759	534	626	15·1	36·2	35·0	·065	·156	·162	·74	·75	·80	W. by N.	S. S. W.	N. W. by W	1·46	1·70	7·11	....	....	C. C. Str. 6.	C. C. Str. 2.	"
26	675	584	770	32·1	36·2	26·1	·162	·156	·105	·89	·75	·75	N. W. by W	S. S. W.	W. N. W.	11·97	13·77	1·20	....	....	C. Str. 10.	Clear.	C. Str. 6.
27	703	661	675	19·9	42·6	30·6	·075	·199	·148	·71	·74	·89	W. N. W.	W. by N.	S. S. W.	16·55	9·00	2·73	....	....	" 8.	Cirr. Str. 4.	Clear.
28	632	595	694	18·9	48·9	36·2	·071	·245	·170	·70	80	·80	W. by S.	S. W. by S.	S. W. by W.	0·50	0·17	0·11	....	....	Clear.	Clear.	"
29	754	737	830	31·0	55·0	40·0	·130	·349	·203	74	·81	·82	W. S. W.	S. W. by W.	N. by W.	0·56	0·22	7·30	....	....	"	"	C. C. Str. 4.
30	950	937	995	32·4	53·2	38·7	·137	·269	·201	·74	·67	·86	E. N. E.	W. S. W.	S. S. W.	2·55	0·95	0·01	....	....	"	"	C. Str. 8.
31	30·002	964	959	30·0	61·6	40·6	·136	·383	·197	·83	·71	·78	E. N. E.	S. by W.	S. by W.	1·96	0·00	0·00	....	....	"	"	Clear. Aurora Borealis.

REMARKS FOR FEBRUARY, 1858.

Barometer.. .. { Highest, the 13th day, 30·330 inches.
Lowest, the 10th day, 29·201 "
Monthly Mean, 29·809 inches.
Monthly Range, 1·129 " }

Thermometer... { Highest, the 27th day, 39°4.
Lowest, the 13th day, —30°2.
Monthly Mean, 7°56.
Monthly Range, 69°6. }

Greatest intensity of the Sun's rays, 62°1.
Lowest point of terrestrial radiation, —31°2.
Mean of humidity, ·703.

Rain fell on 1 day; it was raining 15 minutes. Inappreciable.
Snow fell on 8 days; it was snowing 53 hours 45 minutes, and amounted to 17·58 inches.
Most prevalent wind, W. by S. Least prevalent wind, E.
Most windy day, the 10th day; mean miles per hour, 17·31.
Least windy day, the 13th day; miles per hour, 0·14.
Aurora Borealis visible on 1 night.
Moon Eclipse visible.
The Electrical state of the atmosphere has indicated high tension.
Ozone was in moderate quantity.

REMARKS FOR MARCH, 1858.

Barometer. ...... { Highest, the 13th day, 30·361 inches.
Lowest, the 21st day, 29·021 "
Monthly Mean, 29·804 inches.
Monthly Range, 1·340 " }

Thermometer. { Highest, the 31st day, 61°6.
Lowest, the 4th day, —21°9.
Monthly Mean, 23°52.
Monthly Range, 83°5. }

Lowest point of terrestrial radiation, —22°1.
Mean of humidity, ·789.
Rain fell on 3 days; it was raining 19 hours, and amounted to 0·285 inches.

Snow fell on 8 days; it was snowing 20 hours 45 minutes, and amounted to 4·20 inches.
Most prevalent wind, W. by N. Least prevalent wind, N.
Most windy day, the 22nd day; mean miles per hour, 28·65.
Least windy day, the 28th day; mean miles per hour, 0·26.
Greatest intensity of the Sun's rays, 89°0.
Aurora Borealis visible on 4 nights. Lunar Halo visible 1 night.
Eclipse of the Sun invisible, owing to cloudy weather.
The Song Sparrow first heard on the 20th day.
The Electrical state of the atmosphere has indicated feeble intensity.
Ozone was in moderate quantity.

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ARTICLE XVI.—*Note upon the Genus Graptolithus*, and description of some remarkable new forms from the shales of the Hudson River Group, discovered in the investigations of the Geological Survey of Canada, under the direction of Sir W. E. Logan, F.R.S. By James Hall.

(*Continued from our last.*)

GRAPTOLITHUS HEADI.

Description.—Frond robust, four-branched; disk large, subquadrangular, moderately extended along the branches; branches strong, much elongated, sub-angular exteriorly; serratures small, acute, from twenty-two to twenty-four in an inch; fine distinctly marked striæ extend from the base of the serratures nearly across the branch.

The specimen described presents the disk, which in its diameter across the centre between the branches is nearly one inch and an eighth, or nine-sixteenths of an inch on each side of the centre; while from the centre to its extent along the branches it varies from about three-fourths of an inch in one branch to an inch in another. The substance of the disk is strong and somewhat rugose, either from its original character or from the accidents accompanying its imbedding in the rock. The specimen exhibits the inner or serrated side, and the branches are turned so as to be compressed laterally at a distance of two inches or more from the centre; one of the branches presents a length of nearly seven inches from the centre. This species is named after its discover, Mr. John Head.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Mr. John Head, and Sir W. E. Logan.

GRAPTOLITHUS ALATUS.

Description.—Frond composed of four branches; disk much extended along the sides of the branches, giving them an extremely alate character; branches strong, angular on the lower side; upper or serrated side unknown. Some indentations on the exterior side of the branches, which may indicate the place of serratures on the opposite side are about one twenty-fourth of an inch distant.

The only specimen of this species yet recognized is a part of the disk with three of the branches, two of which present the corneous expansion apparently entire, extending about two inches from the centre along the branches, while its margin in the indentation between the branches is not more than three eighths of an inch from the centre. This species is much more robust than *G. quadribrachiatus* or *G. bryonoides*, and the form of the disk when preserved will always be a distinguishing feature.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Mr. John Head, and Sir W. E. Logan.

GRAPTOLITHUS FRUTICOSUS.

Description.—Branches bifurcating from a long slender filiform radicle, and each division again bifurcating at a short distance above the first; branches and branchlets short, narrow linear; serratures apparently commencing in the lower axil, where there are one or two between the first and second bifurcations. Serratures somewhat obtuse at the tip; lower side longer, upper margin nearly at right angles to the rachis; about sixteen serratures in the space of an inch. Substance of the branches thin, fragile.

In one specimen the position of the serratures is such as to present elongate acute apices in one of the branches.

This species has the general habit of *G. nitidus* and *G. bryonoides*, but is very distinct in its long slender radicle, narrow fragile branches, and distant, obtuse serrations. Two individuals only have been obtained, but the form and habit are so precisely alike, and so distinctive in both of these, as to mark it a very well characterised species.

Locality and Formation.—Island of Orleans; Hudson River Group.

Collectors.—J. Richardson, and E. Billings.

GRAPTOLITHUS INDENTUS.

Description.—Fronds consisting of two simple branches, diverging at the base from a slender radicle, and continuing above in a nearly parallel direction: branches narrow, slender; serratures very oblique, somewhat obtuse, truncated above almost rectangularly to the line of the rachis; about twenty-four in the space of an inch; a depressed line reaching from the serrature to near the base or outer margin of the branch where it terminates in a small node; surface of branches striate.

This species resembles the *G. nitidus* in form, except that it is less divergent, the divergence from the base being at an angle of about thirty-six degrees for half an inch or more, after which the two branches continue nearly parallel. Though it is probable that this character may vary in some degree, it seems nevertheless to mark the species, and in numerous individuals of *G. nitidus* I have seen none with parallel or converging branches. The serratures in the two species differ in some degree in form, and the proportional distances, thirty-two and twenty-four, form a very characteristic distinction. A single fragment of a branch measures six inches, but the full extent when perfect is not known.

Locality and Formation.—Point Lévy; Hudson River Group.

Collectors.—Sir W. E. Logan, and James Hall.

GRAPTOLITHUS NITIDUS.

Description.—Frond composed of two simple branches, diverging from a small radicle; branches narrower towards the base, gradually expanding towards the extremities, which in perfect specimens appear to be rounded, and the last serrations a little shortened; serratures small, shorter at the base, and becoming gradually developed as they recede from this point; acute at the extremities, almost vertical to the line of the rachis, and making an angle of about sixty degrees, the two sides being almost equal in length; about thirty-two in the space of an inch. A well-defined groove or depressed line extends from the base of the serrature obliquely towards the base of the branch, and at its termination the surface of the branch is marked by a minute but distinct round tubercle.

This beautiful little species differs very distinctly from any others of this genus, in the thickened substance of its branches, the closely arranged serratures, and the minute tubercles at the base of the grooves or striæ. The specimens usually preserve considerable substance, and are far less flattened than most of the other species, owing either to their original character or to the nature of the surrounding matrix. The impressions of the oblique lines or striæ are often well preserved in imprints of the fossil left in the slate.

The impressions of *G. bryonoides* resemble those of this species; but the branches are broader, and the striæ are less rigid and less distinctly impressed, while the absence of tubercles, and the coarser serratures, when visible, at once serve to distinguish the species.

In mode of growth and general aspect this species resembles the *G. serratulus* (Pal. N. Y., vol. 1, p. 274, pl. 74, fig. 5, a, b.) of the Hudson River shales; but in the latter the serratures are coarser and more oblique, the lower side being much the longer. The branches of that species are also more distinctly linear, while in this they become gradually wider from the base, and are very distinctly striate and tuberculate in well-preserved specimens.

The preceding description applies to the specimens of this species where the branches diverge abruptly, or nearly at a right angle, from the radicle.

Locality and Formation.—Point Lévy, Hudson River Group.

Collector.—J. Richardson.

GRAPTOLITHUS BIFIDUS.

Description.—Two-branched; branches very gradually and uniformly diverging from the base to the extremities; surfaces obliquely striated; serratures moderately oblique; extremities often nearly vertical to the rachis, and submucronate (?); from thirty-eight to forty in the space of an inch; radicle short.

This species resembles in general features the *G. nitidus*, and might be mistaken for that species with the branches approximated by pressure. In several individuals examined the serratures are much closer, being from six to eight more in the space of an inch, while the general form is constant. The outer margins of the branches are curved for a short distance from the radicle, and thence proceed in a uniform divergent line. The entire branch is very narrow at the base, but becomes gradually wider, the full width being attained at about half an inch from the bifurcation, while a few of the serratures towards the outer extremity, not having attained their full development, leave the branches narrower in that part. The same feature is observed in *G. nitidus* and others of this general character. and probably may be observed in all species where the extremities of the branches are entire.

Locality and Formation.—Point Lévy ; Hudson River Group.
Collectors.—J, Richardson, E. Billings.

GRAPTOLITHUS PATULUS.

Description.—Frond composed of two simple widely diverging branches from a small radicle ; branches long-linear, having a width from the base of the serratures to the back of the branch of from one-sixteenth to one-twelfth of an inch ; serratures oblique, with vertical mucronate points, which from base to apex are more than half as wide as the branch. A well-defined line or ridge extends downwards from the apex of the denticle two-thirds across the branch.

Fragments of this species are numerous upon some slabs of greenish or blackish-green slate where no other species occurs. The fragments are sometimes five or six inches in length, offering in different individuals little variation in width. Sometimes the branches are compressed vertically, and present the smooth, linear base or exterior, which is less in width than when compressed laterally.

The lateral faces of the branches exhibit considerable variety of surface, dependant on the degree of compression, or in some instances, the replacement or filling of the interior by iron pyrites. In such cases, or when the branch is not flattened, the surface is deeply striated, or wrinkled obliquely. In some of the extremely compressed individuals the surface has some appearance of vesicular structure ; but this is probably due to influences attending the mineralization of the fossil, or the filling up of the original canal, and not to the structure of the substance itself.

Locality and Formation.—Point Lévy, Hudson River Group.
Collectors.—J. Richardson, E. Billings.

GRAPTOLITHUS EXTENSUS.

Frond probably two-branched ; branches long-linear, varying in width in different individuals from one-twelfth to one-tenth of an inch exclusive of the serratures, and from one-tenth to one-eighth of an inch including the serratures. Serratures oblique, with the extremities slender and nearly erect, mucronate at the tip ; about twenty in the space of an inch ; base of branch scarcely narrowed, showing a few smaller serratures ; surface strongly striated, the striæ being preserved in those specimens which are extremely compressed.

The branches of this species bear a very close resemblance to those of *G. octobrachiatus*, but an individual in which the base is preserved shows in its peculiar curving and smaller serratures a feature which belongs only to the two-branched forms. The serratures also appear to be more slender, and are slightly closer in their arrangement ; branches of the same size in the two, presenting respectively eighteen and twenty serratures.

This species in separate branches of from three to six or eight inches in length, is abundant on some slabs of decomposing grayish-brown shale, associated with *G. bryonoides*, *G. nitidus*, and others.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J. Richardson, E. Billings, Sir W. E. Logan, James Hall.

GRAPTOLITHUS DENTICULATUS.

Description.—Frond apparently consisting of two broad branches (the base and junction of which are obscure in the specimen ;) margins defined by a rigid line, beyond which on the inner side are serratures which have the form and character of small denticulations inserted upon the margin of the branch and vertical to its direction, broad at base, abruptly tapering above, and ending in mucronate points ; about sixteen in the space of an inch.

This very peculiar species is readily recognised by the denticulations, which have the character of small sharp teeth fixed upon the margin of the branch. These denticles are more widely separated, as well as different in character, from those of any other species observed.

Locality and Formation.—Point Lévy, Hudson River Group.

Collectors.—Sir W. E. Logan, James Hall.

GRAPTOLITHUS PRISTINIFORMIS.

Description.—Stipe simple, with serratures on both sides ; serratures closely arranged, very oblique, acute, mucronate ; thirty-two in the space of an inch.

This species approaches to *G. pristis* (Pal. N.Y., vol I., p. 265, pl. 72, fig. 1), but the serratures are more ascending, and the extremities more distinctly mucronate. The specimens observed however, are imperfect fragments, which are very closely compressed, being barely a film upon the surface of the shale, and the determination is somewhat unsatisfactory.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collector.—J. Richardson.

GRAPTOLITHUS ENSIFORMIS.

(*Genus* RETIOLITES ? Barrande.)

Description.—Stipe simple, sub-ensiform or elongate-spatulate, usually broader in the middle and narrower towards the extremities ; a central rib, with strongly marked obliquely ascending striæ which reach the margins ; serratures obscure, apparently corresponding to the striæ ; margin usually well defined.

Several specimens of this form occur on a single slab of slate, associated with *G. tenaculatus* and *G. quardribrachiatus.* The oblique striæ apparently indicate the direction of the serratures, and in one specimen there is an appearance of obtuse indentations upon the margin ; but it is scarcely possible at the present time to define satisfactorily the character of these serratures. In form and general character this species differs from all the others sufficiently to be readily distinguished.

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J. Richardson, Sir W. E. Logan, James Hall.

GRAPTOLITHUS TENTACULATUS.

(*Gensus* RETIOLITES, Barrande.)

Description.—Stipe simple, linear, elongate-lanceolate or sometimes elongate-ellipticle when entire ; mid-rib double, extending much beyond the apex of the frond ; exterior margins when entire, reticulate and armed with mucronate points, (and with mucronate points alone, or smooth, when imperfect,) with an extended setiform tentacle-like process from each side of the basal extremity ; substance of the centre reticulate or cellular ?

This species presents much variety of appearance dependant upon the condition of preservation. In specimens most nearly entire, the double midrib often extends beyond the apex nearly as far as the length of the frond ; the margins present a series of oval or sub-hexagonal reticulations, every second one (and sometimes each one,) of which is armed by a minute mucronate spinule. When these outer cells or reticulations are broken away, the transverse walls between them often remain, and the specimens then present an undulating margin, with a short mucronate extension, which is the original wall between the marginal reticulations, and which is continuous with the striæ or fibres which traverse the frond from the midrib to the margins. On each side of the basal extremity the long setiform fibres extend obliquely forward to the distance of half an inch, and between these are two short terminal ones, like the processes on the sides of the frond.

In many specimens the whole exterior reticulate portion is removed, leaving the frond with straight or nearly straight parallel sides, the long extended midrib above, and the two setiform processes from the lower extremity ; while in some specimens these parts are also removed. The serratures cannot well be determined in any of the numerous individuals examined, but they doubtless correspond to the vein-like markings of the centre, and the reticulate marginal extension.

Some specimens indicate that the central portion may be finely reticulate, which character, with that of the exterior, would be regarded as sufficient to warrant us in referring it to the genus *Retiolites.*

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—J. Richardson, Sir W. E. Logan, James Hall.

PHYLLOGRAPTUS.

Among the various forms in this Canadian collection of *Graptolitideæ* there are several which approach in general form to *G. ovatus* of Barrande, and *G. folium* of Hisinger. They present however some differences of character, varying from broad-oval with the extremities nearly equal, to elongate oval or ovate, the apex usually the narrower, but in a few instances the base is narrower than the apex. These forms are sometimes extremely numerous in the shales, and present on a cursory examination a general similarity to the leaves of large species of *Neuropteris* in the shales of the coal measures.

Instead of the narrow filiform mid-rib represented in the figures and descriptions of the authors mentioned, these specimens present a broad linear mid-rib continued from the apex to the base, and extended beyond the base in a slender filiform radicle, usually of no great extent, but in some instances nearly half an inch in length. The mid-rib is rarely smooth, varying in width, with its margins not often strictly defined. In examining a great number of individuals of one species, I have discovered that this mid-rib is serrated ; and though for the most part the serratures are obscure, they nevertheless present all the characteristics which they exhibit in graptolites of other forms, in which the branches have been compressed vertically to the direction of the serratures.

In this view, the lateral leaf-like portions appear to be appendages to the central serrated portion ; but these are nevertheless denticulate on their margins, and the intermediate spaces are well-defined, as if admitting of no communication by serratures or cellular openings with the centre.

In another species the central axis or mid-rib is strong and broad, often prominent and distinctly serrate, the edges of the interspaces being all broken off as if the extremities had been left in the slate cleaved from the surface. At the same time the lateral portions are so well preserved as to show distinct cellules upon each side. We have therefore three ranges of cells visible, the central axis projecting at right angles to the two lateral parts• This remarkable feature leads to the interference that this graptolite was composed of four semi-elliptical parts joined at their straight sides, and projecting rectangularly to each other, presenting on each of the four margins a series of serratures, which penetrating towards the centre, were all united in a common canal, and all sustained upon a simple radicle.

In another more elongate form, the specimens examined are extremely compressed, and I have not been able to detect serratures in the axis, which however is sufficiently wide to admit of this feature.

For these remarkable forms, whether consisting of bilateral or quadrilateral foliate expansions, or with two or four series of cellules, I propose the name of PHYLLOGRAPTUS, from their leaf-like appearance when compressed in the slaty strata.

It is easy to perceive how bodies formed as these are may present different appearances, dependant upon the line of separation of the parts by the slaty luminœ. When separated longitudinally through the centre, the cells of the parts laterally compressed, would be seen with the mid-rib not strictly defined ; and the bases of the cells of that part vertically compressed, scarcely or not at all visible. When a small portion of the base of that part which is vertically compressed is preserved, the bases of the cells remain and mark the axis. When instead of being imbedded so that two parallel sides are compressed laterally and the other vertically, the whole frond lies in an oblique position, the two adjacent rectangular parts are spread open and flattened upon the surface of the slate, the specimen then appears as if the cells were conjoined at their bases, or as if separated by a filiform mid-rib. An individual compressed in this manner and then separated through the middle, will present the bases of the two adjacent divisions with the cells lying obliquely to the plane of the slaty laminæ. These and other varieties of appearance are due to the position in which the fossil was imbedded, and the direction of the cleavage or lamination of the slate.

PHYLLOGRAPTUS. (New Genus.)

Description.—Frond consisting of simple foliate expansions, celluliferous or serrated upon the two opposite sides ; margins with a mucronate extension from each cellule ; or of similar foliate forms united rectangularly by their longitudinal axes, and furnished on their outer margins with similar cellules or serratures, the whole supported on a slender radicle.

These bodies which usually appear upon the stone in the form of simple leaf-like expansions, may possibly have been attached in groups to some other support ; but the form of some of them, and the character of the projecting radicle at the base, indicates that we have the entire frond. These forms furnish perhaps the best illustration of all the *Graptolitideæ*, of the lesser development of the cells at the base, and their gradual expansion above, until they reach the middle or upper part of the frond. Many of them diminish from the centre upwards, and rarely the cells are more developed above the centre, reversing the usual form, and leaving the narrower part at the base.

PHYLLOGRAPTUS TYPUS.

Description.—Frond elliptical, elongate-ovate or lanceolate, broad-oval or obovate ; margins ornamented by mucronate points ; serratures closely arranged, about twenty-four, rarely twenty-two and sometimes twenty-six in an inch, usually obscure at the margins; axis or mid-rib broad, often crenulate or serrate; radicle usually short; frond robust.

This species assumes considerable variety of form; and from the examination of a few specimens of the extremes of the series one might be disposed to regard them as distinct species. After examining several hundred individuals however, I have not been able to find reliable characters in the form, or subordinate parts, to establish specific differences. The individuals figured represent the principal varieties noticed, though a greater number of forms might have been given. I have not thus far observed forms intermediate between the short broad ones and the more elongate oval ones; but it is not probable that larger collections will furnish such. The number of serratures in entire fronds varies in different individuals from twenty-five or twenty-eight to fifty on each side, depending on the size and form of the specimen. The smallest examined have about twenty-five on each side.

The specimens of this species examined are all so much compressed that the rectangular arrangement of the parts of the frond, as seen in *P. ilicifolius*, cannot be shown, the only evidence of this character being the serratures along the central axis, which are transverse to those of the two sides.

Locality and Formation.—Point Lévy; Hudson River Group

Collector.—J. Richardson.

PHYLLOGRAPTUS ILICIFOLIUS.

Description.—Frond apparently broadly oval or ovate, with the margin ornamented by mucronate points; mid-rib or axis broad, serrated; the extension of the serratures broken off in the separated laminæ of shale; radicle short. Serratures from thirty to thirty-two in the space of an inch, varying slightly with the proportionate length of the frond.

The form in reality however is that of two broadly oval or ovate leaves or fronds, joined rectangularly at their centres or by the longitudinal axis, and in a transverse section presenting a regular cruciform figure. The expansions of the two sides, which are laterally compressed, show distinct serratures or cells with projecting mucronate extensions. Those which are vertically compressed have their outer portions broken off in the separated laminæ of slate, and present the bases of the cells, which, having sometimes been filled and distended with mineral matter before imbedding, are very conspicuous. In a few instances the cells of the lateral portions are filled in the same manner, presenting the character of curving, conical tubes, with the broader extremity outwards.

The condition of preservation in several species examined is such as to render unavoidable any other conclusion as to their mode of growth than the one I have given above, however anomalous it may seem. This species differs from *P. typus* in its thicker substance, proportionally shorter and broader form, and more closely arranged serratures.

Locality and Formation.—Point Lêvy ; Hudson River Group.

Collector.—J. Richardson.

PHYLLOGRAPTUS ANGUSTIFOLIUS.

Description.—Frond elongate-elliptical or elongate-lanceolate, closely serrated ; serratures furnished with mucronate extensions, about twenty-four in the space of an inch ; mid-rib broad, smooth ; radicle scarcely preserved.

This species is readily distinguished from either of the preceding by its narrow and elongate form. The individuals examined are very numerous, but being for the most part upon slaty laminæ, which are extremely compressed, they preserve scarcely any substance ; a mere outline with a more brilliant surface being almost the only remaining character by which they are recognized.

The individuals of this species are, in several specimens, equally abundant with those of *Phyllograptus typus.* The mucronate extensions upon the margins of this species are not so abrupt as in *P. typus* and *P. ilicifolius*, the substance of the cell margin being more extended along the mucronation. The number of serratures upon each side of the frond varies according to the size of the individual, being ordinarily from eleven or twelve to twenty-four, while in a single individual of nearly two inches in length there are forty-three or forty-four on each side. The mid-rib in this species though broad, like those of the preceding species, is not conspicuously serrate in any of the specimens examined. This feature however may have been obliterated by pressure.

Locality and Formation.—Point Lèvy ; Hudson River Group.

Collector.—J. Richardson.

PHYLLOGRAPTUS SIMILIS.

Description.—Frond broad-oval; margins ornamented by slender, sub-mucronate serratures, which are closely arranged, being in the proportion of thirty-two to an inch, usually from thirteen to sixteen upon each side ; axis disjoined ; radicle unknown.

This species exhibits much variety of aspect. The more perfect forms are broadly oval, the diameters being about as six to seven. The central portion is open and free from any organic substance, as if there had originally been a cavity in the place of the longitudinal axis. In other specimens the parts are separated at one extremitv, and appear like three or four branches closely joined at the other extremity, giving it the aspect of a four-branched frond. On examining numerous specimens they appear to have been originally arranged like the species of this genus already described, with perhaps this difference, that the margins of the axial portion were not closely united, or were quite disjoined along the centre. From the equal extremities of the frond, and the almost rectangular serratures, conjoined wlth the very obscure condition of the specimens, it has not been possible to determine whether the separation of the parts at the extremities has taken place at the base or the summit.

This species occurs associated with *G. Logani* and *G. quadribrachiatus.*

Locality and Formation.—Point Lévy ; Hudson River Group.

Collectors.—Sir W. E. Logan and James Hall.

Besides the forms described in the preceding pages, there are several others belonging to the genus *Graptolithus*, of which I have not specimens in sufficient perfection to furnish a proper description ; and there are others which, possessing some abnormal characters, I hesitate to describe as distinct species, until I shall have an opportunity of seeing more specimens. One of these, having the general character of *G. octobrachatus*, has but seven branchlets, three from one extremity of the vinculum and four from the outer, bifurcating as in the species named above. The branches, however, are more slender than in *G. octobrachiatus*, and it may prove to be a distinct species.

Another form having the general habit of *G. Logani* has but nine branchlets, four from one and five from the other side of the vincolum. The exterior side only is visible, and the branches being broken off a short distance from the vinculum, no opportunity is offered of examining the serratures. It seems quite probable that this may prove a distinct species.

A single fragment of a ramose form, with two branches like *G. ramosus*, of New York, has been observed, but I have not thought it desirable to give its characters at present.

Among other forms of the *Graptolitideæ*, there are at least three species of *Dictyonema*, which are of common occurrence, associated with the Graptolites of Point Lévy.

The genus *Dictyonema* was described in the Palæontology of New York, vol. 2, p. 174, from an examination of the broad flabelliform or sub-circular expansions of corneous reticulated fronds common in the shales of the Niagara group. These forms were described as having " the appearance and texture of Graptolites, to which they were doubtless closely allied," Further examinations have demonstrated the truth of this remark in the discovery of serratures, like those of *Graptolithus*, on the inner side of the branchlets of both *D. retiformis* and *D. gracilis*. The celluliferons side adhering more closely to the stone than the opposite, as in *Ratepora* and *Fenestella*, is much more rarely seen than the other. The mode of growth, though probably flabelliform in some species, is clearly funnel shaped in *D. retiformis*, the serratures being upon the inner side as in *Fenestella*.

The generic characters heretofore given may therefore be extended as follows.

DICTYONEMA.

Generic characters.—Frond consisting of flabelliform or funnel-shaped expansions, (circular from compression) composed of slender radiating branches, which frequently bifurcate as they recede from the base ; branches and subdivisions united laterally by fine transverse dissepiments ; exterior of branches strongly striated and often deeply indented ; inner surface celluliferous or serrate, as in *Graptolithus*.*

The general aspect of the species of this genus is like that of *Fenestella*, both in the form of the fronds and the bifurcation of the

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* A paper by J. W. Salter, Esq., Palœontologist of the Geological Survey of Great Britain, read before the American Association, for the advancement of Science, at the Montreal Meeting, 1857, describes a new genus of the Graptolite family under the name of *Graptopora*. Although having had no opportunity of examining this paper, it appears to me that the forms described are true *Dictyonema*.

branches. Some of the species have heretofore been referred to that genus, and others to *Gorgonia.* They may be known from either of these genera by the striated and serrated corneous skeleton, and absence of round cellules, which latter character, with a calcareous frond, marks the *Fenestella.*

Since the essential characters of *Dictyonema*, with figures of two species, have been given long ago, and their similarity to Graptolites pointed out, I am disposed to retain the name, and to describe the Canadian species under that designation.

There are still two other types in this collection which seem to merit generic distinction. One of these consists of imperfect branching fronds, the smaller branchlets of which are often rigidly divergent from the main branch at an angle of about thirty-six degrees. In others the branchlets diverge in a similar manner, but are less rigid. Exterior of branches smooth, interior surface celluliferous. There are two or three forms of this type which I propose to designate as DENDOGRAPTUS.

Another form consists of fronds which are strong stipes near the base, and become numerously and irregularly branched, ending in a great number of filiform branchlets, one side of which is serraed. The general aspect is that of a shrub or tree in miniature. For these forms I would propose the generic name of THAMNOGRAPTUS.

There is also a single species approaching in character to that published in the Report of the Fourth Geological District of New York as *Filicites ?* The lateral branchlets are much longer, more lax and slender, being in this respect more nearly like *Filicites gracilis* of Shumard, (Geol. Report of Missouri, part 2, p. 208, pl. a. fig. 11) but the branchlets in the Canadian species are longer and more slender. They have all the same general plumose character, and from the well preserved corneous structure in the Canadian specimens, I regard them as belonging to the Graptolideæ, although the celluliferous or serrated margins have not been seen. For these forms of Canada, New York and Missouri, should they prove generically identical, I propose the name of PLUMALINA, making the *Filicites ?* cited above, the type of the genus with the name of *Plumalina plumaria*, while the western species will receive the name of *P. gracilis.*

The disk-like forms which are described in the Palaeontology of New York, vol. 1, p. 277, under the name of *Discophyllum*, are probably the disks of a species of *Graptolithus* with numerous branches. One specimen preserves a thick corneous substance, which is the exterior surface, while the other preserves the mould of the opposite side, the radiating impressions of which are crenulated. There are no evidences of branches extending beyond the margin of the disk.

We have now so many well-established forms in the family *Graptolitideæ*, that we have the means of comparison with other allied families among palæozoic fossils.

Although numerous species in this collection are shown to be of compound structure, or to consist of fronds composed of two or more branches, and many of them originating in, or proceeding from a disk of thickened corneous substance, yet it is not improbable that there are among true Graptolites simple stipes or stems, as all the species have been usually heretofore regarded. I am disposed to believe that those Graptolites where the stipe is serrated on the two sides (*Diplograpsus*) may have been simple from the base ; and that the branching forms having both sides, or one side only of the branches serrated, may possibly also have been simple, or bearing no more than a single stipe from the radicle. The bifurcate appearance at the base of *G. bicornis* however, offers some objections to this view, and these too may have been compound, like those which have only one side serrated.

The numerous compound forms shown in this collection, and the great variety of combination in the mode of branching, induces the belief that all those with a single series of serratures have been originally composed of two, four, or more branches, either diverging from a radicle or connected by a vinculum from which the radicle has extended.

The *Phyllograptus*, although apparently an anomalous form, is not more so with our present knowledge of the Graptolites than *G. Logani* or *G. octobrachiatus* would have been considered a few years since.

It is not among the least interesting facts, that we should find the *Graptolitideæ* simulating in their mode of growth so many of the Palæozotic *Bryozoa*. We have *Fenestetla* represented in *Dictyonema* ; the ramose forms of *Retepora* in *Dendrograptus ; Glauconome* and *Ichthyorachis* in *Plumalina ;* while the spirally ascending forms figured by Barrande appear to simulate in their mode of growth the spiral forms of *Fenestella* or *Archimedes.*

The forms of Graptolites now known are so numerous as to deserve especial consideration in their relations to other groups or families of fossil or living forms. They have been referred to the *Radiata* and to the *Bryozoa*. They were all originally composed of a thin corneous film which enclosed the bodies of the animals inhabiting the cells, and formed the general canal or source of communication along the axis. The substance of the Graptolites was then unlike that of the *Radiata* of the same geological age; the sub-divisions are in twos, or some multiple of two, except in a few instances which appear to be abnormal developments; and when the sub-divisions are irregular there is far less similarity with *Radiata*.

From all Palæozoic *Bryozoa* the Graptolites differ essentially in the form and arrangement of the cellules, and the nature of the substance and structure of the skeleton; and simulate only the general forms of Bryozoan genera.

ARTICLE XVII.—ENTOMOLOGY, NO. 2. *By Wm. Couper, Toronto.*

The 2nd of April was a beautiful day, such as a person would select to enjoy a ramble in the neighbouring woods of Toronto—indeed, it was a naturalist's day—birds sang sweetly, and butterflies appeared in their innocent gambols through forest paths and open spots whereon the sun's rays produced warmth. Three species of *Vanessa* made their appearance on Friday; I captured specimens of two species, but the third I did not secure on account of its scarcity. It has long been known that the imago of the American *Vanessa antiopa* passes the winter in some sheltered place, in a semi-torpid state, but now I am of opinion that two additional species *V. progne* and *V. Interrogationes* do so likewise; probably it is natural to the few northern types of the genus, while in the same species in more genial southern latitudes, such instinct is very rarely developed. As butterflies are supposed to subsist only on the nectar of flowers, the non-entomologist may naturally enquire how do they receive nourishment when there are no flowers? During this month trees are also awakening from torpidity, and should there happen to be recent wounds on the south side of a maple or birch, the sap while ascending may be seen to ooze; to these wounds our April butterflies repair to nourish themselves. Their activity after remaining the whole winter in a torpid state, is really astonishing. For the first ten days they were flitting before us in the woods and elsewhere, but where did they go during the cold days that followed? Back to the semi-torpid state there to remain until sufficient warmth returned to cause the sap to flow again—hence the sudden appearance and re-appearance of our April butterflies.

It is my intention to describe species of micro-lepidoptera, when they can be satisfactorily traced from the larvæ, and I am induced to call the attention of my Canadian brother entomologists to a pretty little species which appears to be rather common in the vicinity of Toronto. The larva is at present unknown to me; however, it may be discovered from the description of the imago, its cocoon and exuvia :—

Head and face white, the former crowned with a tuft of ferruginous cilia; eyes black, and concealed above by white cilia; antennæ long, threadlike, and silvery; anterior wings mottled black and silver, the latter predominent at the base, with greyish cilia on the posterior margin, longest towards the apex; posterior wings silvery, densely surrounded with grey cilia; body and legs silvery. Exp. al. 3¼ lin.

When in repose, the wings are closed around the body; on the base of anterior wings there is a little black tuft, and a large one near the centre, surrounded anteriorly with a white lunule.

The cocoon of this moth is white, oblong, and longitudinally but slightly lined. From observations already made, it appears the larva select various places for its construction, some are found under bark of trees, others are attached to stones, but the greater number were upon grass and stems of clover. The color of the exuvia or pupa case is deep chestnut, and the joints of abdominal rings are visible to the naked eye. This pretty microlep belongs to the genus *Nepticula*, and probably is a new species. My specimens appeared in April. Cocoons of this moth containing pupa were found in the middle of May.

If leaves of basswood are examined in July and August they will be found mined by small white larvæ. Not unfrequently as many as four may be noticed in a single leaf. They occupy distinct cells that are at first small, but as the age and appetite of the larva increases, so likewise the cells. When about to change to the pupa state, each constructs a perfectly circular brown-colored cell, by uniting the upper and lower sections of the leaf together, and there remains till it becomes a perfect insect. I have failed to secure the imago from this larva last summer, but I hope to be more fortunate in my second attempt. I am strongly of opinion that it is lepidopterous, probably belonging to the genus *Nepticula.*

I trust that ere long, some clever lepidopterist will enter this field of study, which, as Mr. Stainton the English micro-lepidopterist says :—"Of all the groups of lepidoptera, perhaps none are more interesting than the *Tineina*, and few, if any, so far from being understood. The peculiarity of their forms in numerous instances, the gorgeousness of their coloring, the wonderful beauty of the pencilled markings of their wings, the fanciful and grotesque position in which many of them delight to stand, the variety and singularity of their transformations, all of these and other characteristics render them uncommonly attractive; while on the other hand, their minuteness, the pains taken and the expertness manifested by both larvæ and perfect insects in concealing themselves, or escaping if discovered, as well as the difficulty of obtaining uninjured specimens, have thrown difficulties in the way of the scientific student, if not insuperable, at least extremely perplexing and tantalizing."

I procured an entomological curiosity from the woods, which serves to illustrate the parasitic family *Chalcididæ*; the specimen is worthy of notice as an interesting addition to my collection of insect architecture. It is a small branch of the common alder that had been last summer infested by a species of *Coccus*, which, while alive, were attacked by a micro-ichneumon-fly of the above family. The *Coccidæ* occupying the upper section of the branches, were of a whitish color, hence their detection with the naked eye. Knowing at the time that vegetable parasites are occasionally infested by other insects, led me to examine them with my pocket magnifier which soon revealed that some minute insect occupied the interior of each and every *Coccus*. The specimen is now in my possession about twelve days, and since, I have with pleasure, liberated an occasional issue of those eminently useful insects. For a little insight into their economy, as well as to point out the difference between the *Cynipidæ* and *Chalcididæ*, I quote the following from Harris, whose description will serve to determine them :—"Gall insects are often destroyed by little parasites belonging to the family *Chalcididæ*, and as these are liable to be mistaken for the former, especially when coming from the same gall, it may be well to point out the difference between them. The four winged gall-flies have rather long, straight threadlike and ascending antennæ; the fore-wings with a few veins, forming two triangular meshes, one of which is very small, and situated near the middle of the wing, the other mesh larger and near the the base; the hind body roundish but laterally compressed; and the piercer spiral or curved, and concealed. The *Chalcidians* have shorter, elbowed, and drooping antennæ, which are enlarged towards the end ; a single vein, running from the shoulder near the outer margin of the fore-wing, uniting with this margin near the middle, and emitting thence, towards the disc of the wing, a short oblique branch, which is enlarged or forked at the end; the hind body generally oval, pointed at the end in the females, and provided in this sex with a straight piercer, which is more or less visible beneath, and prominent at the extremity."

About a month ago, I picked up a specimen of *Helix albolabris*. Upon examining the shell, I discovered that the animal it contained had been consumed, and nothing remained but a number of larvæ attached to the interior. I took them to be coleopterous, as they appeared to the naked eye to resemble that of *Dermestidæ*—since then they have turned out to be *Diptera*. The form of antennæ classes it as a *Tachina*, but in general characters it resembles a minute species of parasitic *Sarcophaga*; it differs from *Tachina* in having its wing longitudinally folded when at rest. This is the first instance within my recollection of having found a dipterous parasite within a terrestrial mollusc.

I once had the pleasure of witnessing the stratagems of a little cuckoo fly; it was on the island opposite Toronto, where a large spider is found during summer, generally under stones, and in the sand. Nature has clothed this spider, as is invariably the case with insecta that conceal from their enemies, in colors resembling the sand it inhabits,—however, color does not protect this spider from all its enemies, particularly a sand wasp *Sphex Pennsylvanica*; indeed, these spiders constitute the principal food of the larvæ of these wasps. I observed one of the wasps running backwards, holding and dragging with its mandibles the body of a spider; it would occasionally drop it and reconnoitre, forming a series of circles, which were extended according to distance from centre, and although these round-about excursions were many times repeated, the wasp, with head down, like a dog on scent, arrived at the identical spot where its prey lay. Its manœuvres appeared strange to me; oft times it stood in an erect position with open mandibles, as if in defence, and well it might, for all this time it was followed by a small species of *Tachina* or cuckoo-fly, which despite the energy of the wasp to carry off its prey, managed to deposit its minute eggs in the body of the spider ; it effected this either in hovering in a direct line over the head of the wasp while it was dragging the spider, or keeping within range of its compound eyes, and no sooner did the wasp leave it for a short time, than the little fly would return and deposit its eggs. The wasp was instinctively aware of the presence of an enemy, which accounts for the strange erect position in which it sometimes placed itself. Whether this fly is a parasite on the larvæ of the wasp, making the spider the means of conveying its eggs to the nest, or on the spider, I am not in possession of facts to shew; but there is a probability it is the spider, and, that as soon as parasitic larvæ make their appearance, the wasp drags the spiders containing them, out of its burrow or nest, to the surface sand where they effect their propagation.

On the 28th of April, when examining the bark of trees for mining beetles, I came in possession of a cluster of insect's eggs that are new to me. The following description of the form, &c., under the microscope, together with the locality may lead to the discovery of the parent. The number is about fifty, closely arranged in quincunx order. Cup-like in form ; lower part attached to the bark, light brown ; a ring near the margin is dark brown, and the margin white, surrounded with short bristles, of the same color, which give it a star-like appearance. The lid is semi-spherical, whitish on the disk, and surrounded with a dark brown ring. The form of the egg is more oblong than round, and something less than a line in length. They are attached to the interior bark of the maple; probably they are *Coleopterous.* "The eggs of insects are very variable in shape ; most perhaps are oval or round ; in some instances they are lenticular, in others somewhat conical ; sometimes they are pediculated. Many when examined through the microscope closely resemble the shelly cases of echini, often called sea-eggs. All insects deposit their eggs upon or near the substances which are to furnish the future caterpillars, grubs, &c., with food. Consequently situations chosen, and the mode in which their safety is secured, are almost as diversified as the species are numerous."

It is generally the case that students in entomology overlook the small insects, even when they constitute material towards their particular order, under the idea that they are too minute either to do good or evil. This is a great mistake and one that arises from carelessness; he who rejects an insect because it is small, is no entomologist, and this he discovers when he happens to converse with the more advanced in the minutiæ of nature. In the Feb. number of the "Zoologist" (English) there is a communication from one of its correspondents, headed "*What there is beneath our Noses.*" He says:—"My wish is to draw the attention of all and sundry young men who have never bethought themselves about the subject, to the wonders which the road-sides, quiet lanes, woods, thickets, moors, or amongst whatsoever kind of scenery they may chance to be located, would yield them, if, instead of frittering away and spending their time without a single thought of seeing into nature, they would only lie in her lap for an odd half hour at a time, and recount to themselves a few of the many histories which even a couple of yard's square of a grassy bank furnishes. I feel convinced that one single experiment would astonish them at their ignorance. It startled me considerably, some few years ago, when I first heard of caterpillars taking up their quarters in leaves of grass, and that they were to be found everywhere for looking after; places where I had lain a thousand times, either resting after a days' hunting, or thrown myself down upon with a friend to enjoy our *otium cum dig.*, being tenanted by scores of larvæ mining and working out an existence in such narrow houses. Yet there they are sure enough, and abundant proofs have been shewn establishing the fact."

ARTICLE XVIII.—GEOLOGICAL GLEANINGS.

Geology of the Western States.—Western geology is making rapid progress, under the active exertions of many skilful explorers. In the Proceedings of the Academy of Natural Sciences, Philadelphia, we have a long report on the geology and fossils of Nebraska, so well known on account of the remarkably interesting mammaliferous tertiary-beds of the Mauvaises Terres. Messrs. Meek & Hayden, the authors, give the following summary of the structure of the region:—

General Section of the Geological Formations seen in and near the Black Hills (descending).

1*st.* Miocene beds consisting of whitish clays and sandstones of various thickness.

Cretaceous System.

No. 5. Of the Nebraska general section, with its usual characters and fossils—150 ft.

No. 4. Presenting its usual characters and containing its characteristic fossils,—150 ft.

No. 3. Usual fossils and composition,—150 to 200 feet.

No. 2. Usual lithological characters and fossils, with some new forms,—200 to 250 ft.

No. 1. Upper part yellowish and reddish sandstone, sometimes in heavy beds, passing down into alternations of yellowish, gray, bluish, and reddish laminated shale, with seams and layers of dark carbonaceous matter or impure lignite; beneath which there is a heavy bed of compact yellowish and reddish sandstone, with indistinct vegetable remains, and much fossil wood,—above beds variable at different places, —300 to 400 ft.

Then come alternations of light gray argillaceous grit, and rather soft sandstone, containing *Ammonites Henryi*, n. s. p., and a small oyster; also in bluish gray compact argillo-calcareous masses *Unio nucalis* n. s. p., and a small *Planorbis*, with other small univalves like *Paludina*.

Jurassic System.

A.—Layers of argillo-calcareous, somewhat gritty mass, containing *Belemnites densus*, n. s. p., *Ammonites cordiformis*, n. s. p., *Avicula (Monotis) tenuicostata*, n. s. p., *Arca (Cucullæa) inornata*, n. s. p.; passing down into a 6 or 8 foot bed light gray, or yellowish sandstone, with ripple marks and trails of marine worms,—50 to 80 ft.

B.—Light red argillo-calcareous gritty bed, with greenish seams, and nodules (sometimes wanting),—30 to 40 ft.

C.—Soft gray and dark brownish sandstone, passing down into about 8 feet of laminated shale of various colors, below which there is a 6 foot bed of sandstone similar to that above, containing *Avicula tenuicostata*, and trails of marine worms. Then comes 30 to 40 feet of bluish, or ash-colored argillaceous shale, with great numbers of *Lingula brevirostra*, n. s. p., and *Serpula*. Next we have a light-gray calcareous grit, containing columns of *Pentacrinus asteriscus*, n. s. p., *Avicula tenuicostata*, *Serpula*, &c., the more compact and calcareous portions often perforated by *Pholas?* The latter bed passes down into a light-yellowish gray sandstone, splitting into thin layers, and containing imperfect casts of *Mytilus (Modiola) Pecten*, *Trigonia*, and other bivalves, in considerable numbers. Whole 60 to 100 ft.

Carboniferous System.

D.—Brick-red, incoherent, argillo-calcareous, very fine slightly gritty material, containing great quantities of gypsum in the form of seams, layers, and irregular beds,—100 to 150 feet.

E.—Bluish and reddish gray, very hard gritty limestone, in which were found a smooth *spirifer* like *S. lineatus*, two or three species small *Pleurotomaria*, two species *Macrocheilus* and one or two species of *Bellerophon*. This bed is variable in thickness,—10 to 50 ft.

F.—Brick-red material, very similar to the bed D, excepting that it contains much less gypsum; passing down into a very hard compact concretionary sandstone,—250 to 300 ft.

G.—Hard, more or less gritty, yellowish and whitish limestone, containing *Productus*, *Spirifer*, *Euomphalus*, &c. &c., passing down into a light yellow calcareous grit; altogether 50 ft.

Carbon. System. H.—Very hard reddish-gray limestone, containing *Syringopora, Productus, Terebratula*, &c. In the middle of this bed there is an 8 foot layer of very hard compact bluish limestone containing many crinoid remains, whole 50 ft.

Oldest Silurian. I.—Potsdam sandstone, containing *Lingula, Obolus?* and fragments of *Trilobites*,—30 to 50 ft.

J.—Coarse feldspathic granite, forming mountain masses.
K.—Highly metamorphosed strata, standing vertical.

We have also received from the authors a paper by Messrs. Shumard & Swallow, describing a large number of new species of animal remains from the coal measures of Missouri and Kansas, and a paper by Prof. Swallow and Major Hawn on the Permian rocks referred to in our last number. It would appear from this paper that the Permian rocks of Kansas attain a thickness of 820 feet, and consist of Limestone, magnesian limestone, shales, and clays of various texture and colour, conglomerate, and gypsum. They are divisible into two subordinate groups, an upper and lower, and are wholly marine. Their distinct superposition on the coal measures, and the character of the fossils, would seem to leave little doubt that they are really of the age ascribed to them.

We learn that in Prof. Hall's Report on Iowa, soon to be published, evidence will be adduced of the existence of the latest member of the Palæozoic series in that state, and also in Illinois. Nothing affords a stronger evidence of the activity of geology in the West, than the nearly simultaneous discovery of this important fact by several observers.

In the same report, Prof. Hall notices the remarkable intercalation in the coal measures of the West of a bed of limestone higher than the true or underlying carboniferous limestone, and gradually thickening westward. He argues from this the prevalence of oceanic conditions throughout the far West, at a time when terrestrial conditions prevailed to the East:—

"The evidences of the existence of this ocean in the far west and south-west during the Coal period, amount to almost a proof that the conditions of that area which now constitutes a part of the continent, were never such as to admit of the production of coal plants, and the deposition of such materials as make up the Coal measures, at least during the latter part of the Coal period. In regard to the earlier part of that period, or the time in which the Lower Coal measures were formed, we have not, at present, as I conceive, the means of fully deciding what were the conditions in the central and south-western part of our continent."

"These facts, the result of so many observations, and coincident over so vast an area in the west, confirm conclusions drawn from other sources, that the dry land and land plants first appeared in the eastern part of the continent. Indeed we have good reason to believe that dry land existed in proximity to our present continent on the east from the earliest geological time, as shown in the vast accumulation of materials in the Laurentian and Huronian periods.

"The Potsdam sandstone, it is true, seems to be almost equally spread out over the entire breadth of the country, from the slopes of the Rocky Mountains, to the Atlantic; and judging from its augmenting thickness in many western localities, we may expect to find it, either in its normal condition or as a metamorphic rock, strongly developed in some parts of the Rocky Mountains. Subsequent to this period, however, every sedimentary formation indicates the proximity of land on the east. The great thickness of strata, coarse materials, and numerous fucoids of the Hudson River group in its eastern extension, indicate proximity to land, or the course of strong currents; while in the west the formation dies out in some inconspicuous fine shaly and calcareous beds, which, both in the nature and condition of the material and in the fossil contents, indicate great distance from land and a quiet ocean. The Clinton group, in like manner, in its coarse materials and abundant fucoids, points to a littoral condition of its area of deposition in the east; while it gradually diminishes in its western extension, and is finally altogether lost in that direction.

"In the sedimentary rocks of the Devonian period, including the Hamilton, Portage, Chemung and Catskill Mountain groups, we find in Canada and Eastern New York the first appearance of land plants, some of which closely resemble plants of the Coal period; and it was at that time that this peculiar vegetation began its existence on this continent, where we now find its remains in strata of these several groups.

"Notwithstanding this great accumulation of land-derived material with its marine shells, gradually decreasing westward as calcareous deposits increase—its numerous fucoids and land plants, the whole series has diminished to less than two hundred feet of marine sedimentary deposits in the Mississippi valley, and is there marked by marine fossils only.

"We cannot expect that the Coal formation, with its land-derived materials and its abundant land plants—far more abundant in the east than in the west—will prove an exception to this general rule; and when we find that these strata have a thickness of more than fourteen thousand feet in Nova Scotia, according to the measurements of Sir W. E. Logan; that the productive coal measures in Cape Breton are estimated by Mr. Brown to exceed ten thousand feet; and that in Pennsylvania, the coal measures, including the conglomerate, may be about eight thousand feet, and in the Mississippi valley one thousand feet,—we are forced to the conclusion already suggested of the ultimate disappearance of the coal measures in that direction.

"It would therefore appear, that from the earliest Silurian times, the Great West, or the region of the Rocky Mountains, has been an ocean, which successively received the finer sediments derived from eastern lands, or which produced within its own area the calcareous deposits, but ever an ocean, not only to the close of the Carboniferous period, but still later through the Permian, Jurassic and Cretaceous periods; showing apparently no evidences of dry land till about the beginning of the Cretaceous era, or perhaps a little earlier; while in later Tertiary periods, the continental fauna and flora have been remarkably developed over the same area.

"Thus while the older Palæozoic formations have been largely accumulated in the east, in successive beds, having altogether a thickness of several times the height of our highest mountains, they have greatly diminished in the west. At the same time, while the Post-palæozoic formations are very thin or often absent in the east, they have accumulated in vast amount along the line of the Rocky Mountains, from one end of the continent to the other."

These are hints of great general truths, of profound significance in geology: but a much larger induction of facts than we at present possess, is required to give them certainty; and they will be found to be liable to many local exceptions, even if fully established for the continent at large.

Canadian Geology.—Prof. Chapman introduces to us two new species of the genus *Asaphus*, found in the lower Silurian rocks of Upper Canada, and which he names *A. Canadensis* and *A. Halli.* (Canadian Journal, May.)

We are also indebted to Prof. Chapman for a very valuable paper on the Blow-pipe Assaying of Coals. The precise differences in the composition of coals have been too much neglected by geological observers; and a considerable amount of experience in assays and other examinations of this mineral, enables us to say that the methods recommended by Prof. Chapman will be found exceedingly valuable in circumstances in which trials on a larger scale cannot be made. We copy, for the benefit of students of this subject, Prof. Chapman's preliminary classification of the coals:—

"Without attending to minor distinctions or points of merely local value, we may arrange all varieties of coal, so far as regards practical purposes, under the following sub-divisions:

1. Anthracites.
2. Anthracitic or Dry Coals.
3. Caking or Fat Coals.
4. Cannel or Gas Coals.
5. Brown Coals or Lignites.

These varieties pass by almost insensible transitions into one another. Thus, the cannel coals are related to the lignites by the different kinds of jet, some of which are referable to the one, and some to the other sub-division. Between the caking and the cannel coals there are also various links; whilst the anthracite or dry coals, on the other hand—passing by excess of bitumen into the caking coals, and by a diminution of bituminous matter into the anthracites—serve to connect the first and third divisions. The typical or normal specimens of each of these five varieties, however, are sufficiently well marked.

1. *Anthracites.*—The true or normal anthracites possess a brilliant sub-metallic lustre, a degree of hardness varying from 3.0 to 3.25*, and a specific gravity of at least 1.33. A specimen from Pennsylvania gave 1.51; another specimen, 1.44; one from the department of the Isère in France, 1.56; and three from Wales yielded respectively 1.33, 1.37, 1.34. It should be stated, however, that many of the Welsh specimens belong strictly to the division of anthracitic coals, rather than to that of the true anthracites. The normal anthracites exhibit also a black or grayish-black streak; and all are good conductors of electricity. The

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* Hausmann in his *Handbuch der Mineralogie*, gives 2.5 as the extreme hardness of all coals; but this is evidently erroneous, as many specimens, not only of anthracite, but of common and cannel coals, scratch calcareous spar.

latter character may be conveniently shewn by the method first pointed out by Von Kobell. A fragment placed in a solution of sulphate of copper (blue vitriol) in contact with a strip of zinc, will become quickly coated with a deposit of metallic copper: a phenomenon not exhibited in the case of common coal. Deducting ash and moisture, true anthracites present, as a mean, the following composition:—Carbon 92½, Hydrogen 3½, Oxygen (with trace of Nitrogen) 4. All yield an amount of coke equal to or exceeding 89 per cent. The coke is frequently pulverulent, never agglutinated.

The comportment of anthracite before the blowpipe has not hitherto been given in detail. It is as follows: *Per se*, the assay quickly loses its metallic brilliancy. After continued ignition, small white specks of ash appear on its edges. In borax it dissolves very slowly, with constant escape of bubbles. It is not attacked by salt of phosphorus; the assay works to the top of the bead and slowly burns away. In carbonate of soda, it effervesces, scintillates, and turns rapidly in the bead; and the soda is gradually absorbed. In the bulb tube a little water is always given off, but without any trace of bituminous matter.

As regards their geological position, the true anthracites belong chiefly to the middle portion of the Palæozoic series, below the Carboniferous formation; or otherwise, they constitute the under portion of the coal measures. Frequently also, anthracites occur in the vicinity of erupted rocks, and amongst metamorphic strata, as manifest alterations of ordinary coal.

2.—*Anthracitic Coals.*—These are often confounded with the true anthracites, into which indeed, as already stated, they gradually merge. Normally, they differ from the true anthracites in being non-conductors of electricity, in burning more easily and with a very evident yellow flame, in yielding a small quantity of bituminous matter when heated in a tube closed at one end, and in furnishing an amount of coke below 80 per cent. The coke is also in general more or less agglutinated, although it never presents the fused, mamillated appearance of that obtained from caking coal. The mean composition, ash and moisture deducted, may be represented as follows:—Carbon 89½, Hydrogen 5, Oxygen (with trace of Nitrogen) 5½; or Carbon 89, Hydrogen 5, Oxygen (with trace of Nitrogen) 6.

3.—*Caking Coals.*—These are often termed, technically, "Fat Coals." They constitute the type-series of the coals, properly so called. All yield a fused and mamillated coke, varying in amount from 65 to 70 per cent. Sp. gr. = 1.27–1.32. Commonly mixed with thin layers of strongly soiling "mineral charcoal" or fibrous anthracite. Mean composition (ash and moisture excluded): Carbon 87.9, Hydrogen 5.1, Oxygen (with Nitrogen) 7.0.

4. *Cannel Coals.*—These coals, at least in normal specimens, do not fuse or "cake" in the fire. They give off a large amount of volatile matter, frequently more than half their weight; hence their popular name of "gas coals." They soil very slightly, or not at all. The coke obtained from them is sometimes fritted, and partially agglutinated, but never fused into globular, mamillated masses, like that obtained from the caking coals. It varies in amount from 30 to 60, or, in typical specimens, from 55 to 58 per cent. Mean composition (normal cannel): Carbon 80–85, Hydrogen 5.5, Oxygen (with Nitrogen) 9–12.3.

5. *Lignites or Brown Coals.*—These coals of Tertiary age, differ greatly from one another in external aspect. Some of the so-called jets—passing into the cannel coals—are black, lustrous, and non-soiling; whilst other varieties are brown, and of a ligniform or stratified structure; or, otherwise, earthy and loosely coherent. All, however, are partially soluble in caustic potash, communicating to it a dark brown colour. The coke—usually of a dull charcoal-like aspect, or in sharp-edged fragments retaining their original form—varies from 25 to 50 per cent. Its separate fragments are rarely agglutinated, except in the case of certain varieties (as the lignites of Cuba, and those from the fresh-water deposits of the Basse Alpes in France) which contain asphaltum. All the typical varieties of lignite, as pointed out by Cordier, continue to burn for some time, in the manner of "braise" or ignited wood, after the cessation of the flame occasioned by the combustion of their more volatile constituents; whereas with ordinary coal, ignition ceases on the flame going out. The mean composition of lignite may be represented by—Carbon 65–75; Hydrogen 5, Oxygen (with Nitrogen) 20–30.

All the different kinds of coal, enumerated above, contain a variable amount of moisture, and of inorganic matter or "ash." The moisture rarely exceeds 3 or 4 per cent., although in some samples of coal it is as high as 6 or 7, and even reaches 15 or 20 per cent. in certain lignites. The amount of ash is also necessarily a variable element. In good coals it is under 5, frequently indeed, under 2 per cent. On the other hand, it sometimes exceeds 8 or 10, and in bad samples even 15 or 20 per cent. The ash may be argillaceous, argillo-ferruginous, calcareous, or calcareo-ferruginous. The ferruginous ashes are always more or less red or tawny in color from the presence of sesqui-oxide of iron, derived from the iron pyrites (Fe S^2) originally present in the coal. If much pyrites be present, the coal is not available for furnace operations, gas making, engine use, &c., owing to the injurious effects of the disengaged sulphur. Calcareous ashes are more common in Secondary and Tertiary coals than in those of the Palæozoic Age.

Lower Carboniferous Coal-measures of British America.—A paper by Principal Dawson, giving an account of the present state of knowledge respecting these interesting beds and their fossils, was read before the Geological Society of London, at its meeting of April 28th. The following is from the Abstracts of Proceedings of the Society :

" Deposits indicating the existence of the Coal flora and its associated freshwater fauna at the beginning of the Carboniferous period, are well developed in Nova Scotia and New Brunswick, with a clearness and fulness of detail capable of throwing much light on the dawn of the terrestrial conditions of the Coal-period, and on the relations of these lower beds to the true coal-measures. This lower series comprises shales and sandstones (destitute of marine remains, but containing fossil plants, fishes, entomostraca, worm-tracks, ripple, and rain marks, sun-cracks, reptilian footprints, and erect trees) and great overlying marine limestones and gypsums. These are distinct from the true coal-measures by their position, mineral character, and fossil remains. In the western part of Nova Scotia (Horton, Windsor, &c.) the true (or Upper and Middle) Coal-measures are not developed; and here the Lower Carboniferous marine deposits attain their greatest thickness. The lower coal-measures (or Lower Carboniferous freshwater or estuarine deposits) have here a thickness of about 600 feet. These beds are traceable as far as the Shubenacadie and Stewiacke Rivers. They outcrop also on the south side of the Cobequid Mountains, where the marine portion is very thin, owing perhaps to the fact of these mountains having been land in the coal-period.

Along the northern side of the Cobequid Range the upper and middle coal-measures and the marine portion of the Lower Carboniferous series are of great thickness. The freshwater beds are absent here, though brought up on the northern side of the coal-trough of Cumberland, where, as well as in New Brunswick (Peticodiac River, &c.), they are remarkable for their highly bituminous composition, their well-preserved fish-remains, and the almost entire absence of plants. To the north, at the Bay of Chaleurs, the great calcareous conglomerate, with sandstone and shale, 2766 feet thick, described by Logan, and containing a few plant-remains, probably represent the Lower Coal-measures of Nova Scotia. In eastern Nova Scotia and Cape Breton the Middle Coal-measures are found at Caribou Cove and elsewhere; the marine limestones and gypsums, and the underlying sandstones and shales, are seen at Plaister Cove; also at Right's River, and St. Mary's River.

In Nova Scotia these older Coal-measures, as compared with the true coal-measures, are more calcareous, more rich in remains of fishes, and have fewer vegetable remains, and indications of terrestrial surfaces. They occur generally along the margins of the coal-areas, near their old shores; and, as might be expected under such circumstances, they are associated with or replaced by beds of conglomerate derived from the neighboring highlands of Devonian or Silurian rocks. When the conglomerates are absent, alternations of sandstones with sandy and calcareous shales occur, with frequent changes in character of the organic remains; the general aspect being that of muddy estuarine deposits, accumulated very slowly, and discoloured by decaying organic substances. The supply of sediment, and the growth and preservation of vegetable matter, appear to have been generally on a smaller scale in this early carboniferous period than subsequently. In those districts where the true coal-measures are least developed the lower series is most important; showing that the physical and vital conditions of the Coal-measures originated as early as those of the Mountain-limestone; and that locally these conditions may have been contemporaneous throughout the whole period; but that in some localities the estuary and swamp deposits first formed were completely submerged and covered by oceanic deposits, whilst in others early marine beds were elevated and subjected to the conditions of gradual subsidence and vegetable growths indicated in the great coal-measures of the South Joggins, Pictou and Sydney.

In Nova Scotia the Lower Coal-measures are characterized by a great preponderance of *Lepidodendra* (especially *L. elegans*) and *Poacites*, with few Ferns or Sigillariæ. The middle Coal-measures are rich in sigillariæ and Ferns, as well as *Lepidodendra.* The Upper Coal-measures especially abound in Conifers Calamites and Ferns. *Palæoniscus*, *Gyrolepis* or *Acrolepis*, *Centrodus*, *Rhizodus*, and *Ctenacanthus* are the chief fossil fishes of this Lower Carboniferous series. Unio-like shells are nearly the only remains of Molluscs.

ART. XIX.—*On the Existence of a Cave in the Trenton Limstone at the Côte St. Michel, on the Island of Montreal.* By GEORGE D. GIBB, M.D., M.A., F.G.S., Member of the Canadian Institute; corresponding Member of the Natural History Societies of Montreal, and of Boston, and of the Literary and Historical Society of Quebec.

A peculiar interest is at all times attached to the discovery of caverns, more especially to the paleontologist if they have contained an abundant harvest of organic remains; a large number of extinct fossil mammalia, at the present moment, would be unknown, but for the accidental opening into these caves. North America is prëeminently celebrated for its remarkable caverns, among which the Mammoth cave in Kentucky and Weger's Cave in Virginia are well known. So far as I can learn, Canada possesses but few indeed. The neighbouring Provinces of New Brunswick, Nova Scotia and Newfoundland, have not as yet afforded any published evidence of their presence.

When a lad I made several ineffectual attempts to discover a cave said to exist in the Montreal mountain, and although foiled in my efforts, the impression remained on my mind that there was a cave somewhere on the Island or Montreal. That impression has recently become confirmed, by an interview with a friend in London, who, many years ago was actually inside of it.

Now, although it is by no means of such wonderful magnitude and proportions as those I have just mentioned, it still deserves to be placed upon record, so that it may be examined by some competent geologist, and a more accurate description of it published than this pretends to be.

The cave exists on the borders of a limestone ridge, running in a N. E. and S. W. direction which skirts a number of farms back of the main road at Côte St. Michel. Its dimensions are not very great, being some twenty-five yards or more in depth, with a width of two or more yards. The latter varies a good deal and is somewhat irregular, but the roof is considerably wider than the floor, which is covered with water to the depth of some feet. A part of the floor will permit of a footing, and when in the cave a person can stand upright with plenty of room to spare. The roof of the Cave is of limestone, lined with a coating of stalactitical carbonate of lime, but from which there do not project any stalactites; some portions of the floor however contain stalagmites, as my friend collected a few specimens. No bones of animals were found, possibly owing to the presence of the water. I would surmise their presence at the bottom, and possibly consolidated into a sort of breccia from the lime held in solution becoming deposited around them during super-saturation. This could be ascertained by pumping the water out of the cave.

It would seem from the description of the cave, as if its origin was due to upheavel from below, producing a dislocation of the stratum of limestone and the formation of a wide fissure. This can be determined by a careful examination.

The name of the farmer upon whose property is the cave, is forgotten; the cave is situated some six or eight acres back of his house in the limestone ridge, which here takes somewhat of the character of a hill, at the base of which is an opening leading into its interior. It was accidentally discovered some thirty years ago, on the occasion of a party of *habitans* going out hunting. The dog belonging to the party commenced to scratch at the spot which forms the entrance of the cave, and suddenly disappeared; he had fallen into it, and his cries brought the hunters to the hole in the ground, the opening was enlarged and the party entered the cave by crawling on their hands and feet. I can do no more in this short paper than to communicate the fact of the existence of the cave, and leave it to others residing in Montreal to make out its formation and precise locality.

The *route* which must be followed to reach the site of it, is along the Victoria and Papineau Roads, continuing till the Road of the Côte de la Visitation is arrived at; this must be followed till the chemin de ligne is reached, which partly traverses the Island. Half way up the Chemin de ligne is the Côte St. Michel, and on turning into the Road St. Michel in a N. E. direction for about half a mile more or less, is the farm in question containing this cave.

Although of small dimensions the discovery of the cave was at the time looked upon as someting very wonderful; it adds another to the many objects of interest which already abound in the vicinity of Montreal.

14 Queen Square, London, April, 1858.

ART. XXI.—*On the Theory of Igneous Rocks and Volcanos.* By T. Sterry Hunt, of the Geological Survey of Canada.

(Read before the Canadian Institute, 13th March, 1858.)

In a note in the American Journal of Science for January, 1858, I have ventured to put forward some speculations upon the chemistry of a cooling globe, such as the igneous theory supposes our earth to have been at an early period. Considering only the crust with which geology makes us acquainted, and the liquid and gaseous elements which now surround it, I have endeavored to show that we may attain to some idea of the chemical conditions of the cooling mass by conceiving these materials to again re-act upon each other under the influence of an intense heat. The quartz, which is present in such a great proportion in many rocks, would decompose the carbonates and sulphates, and aided by the presence of water, the chlorids both of the rocky strata and the sea, while the organic matters and the fossil carbon would be burned by the atmospheric oxygen. From these reactions would result a fused mass of silicates of alumina, alkalies, lime, magnesia, iron, etc., while all the carbon, sulphur and chlorine, in the form of acid gases, mixed with watery vapour, azote, and a probable excess of oxygen, would form an exceedingly dense atmosphere. When the cooling permitted condensation, an acid rain would fall upon the heated crust of the earth, decomposing the silicates, and giving rise to chlorids and sulphates of the various bases, while the separated silica would probably take the form of crystalline quartz.

In the next stage, the portions of the primitive crust not covered by the ocean, undergo a decomposition under the influence of the hot moist atmosphere charged with carbonic acid, and the feldspathic silicates are converted into clays with separation of an alkaline silicate, which, decomposed by the carbonic acid, finds its way to the sea in the form of alkaline bicarbonate, where, having first precipitated any dissolved sesquioxyds, it changes the dissolved lime-salts into bicarbonate, which precipitated chemically or separated by organic agencies, gives rise to limestones, the chlorid of calcium being at the same time replaced by common salt. The separation from the water of the ocean, of gypsum and sea-salt, and of the salts of potash, by the agency of marine plants, and by the formation of glauconite, are considerations foreign to our present study.

In this way we obtain a notion of the processes by which, from a primitive fused mass, may be generated the silicious, calcareous and argilaceous rocks which make up the greater part of the earth's crust, and we also understand the source of the salts of the ocean. But the question here arises whether this primitive crystalline rock, which probably approached to dolerite in its composition, is now anywhere visible upon the earth's surface. It is certain that the oldest known rocks are stratified deposits of limestone, clay and sands, generally in a highly altered condition, but these, as well as more recent strata, are penetrated by various injected rocks, such as granites, trachytes, syenites, porphyries, dolerites, phonolites, etc. These offer, in their mode of occurence, not less than their composition, so many analogies with the lavas of modern volcanos, that they are also universally supposed to be of igneous origin, and to owe their peculiarities to slow cooling under pressure. This conclusion being admitted, we proceed to inquire into the sources of these liquid masses, which, from the earliest known geological period up to the present day, have been from time to time ejected from below. They are generally regarded as evidences both of the igneous fusion of the interior of our planet, and of a direct communication between the surface and the fluid nucleus, which is supposed to be the source of the various ejected rocks.

These intrusive masses, however, offer very great diversities in their composition, from the highly silicious and feldspathic granites, eurites, and trachytes, in which lime, magnesia and iron are present in very small quantities, and in which potash is the predominant alkali, to those denser basic rocks, dolerite, diorite, hyperite, melaphyre, euphotide, trap and basalt; in these, lime, magnesia and iron-oxyd are abundant, and soda prevails over the potash. To account for these differences in the composition of the injected rocks, Phillips, and after him Durocher, suppose the interior fluid mass to have separated into a denser stratum of the basic silicates, upon which a lighter and more silicious portion floats like oil upon water, and that these two liquids, occasionally more or less modified by a partial crystalization and eliquation, or by a refusion, give rise to the principal varieties of silicious and basic rocks, while from the mingling of the two zones of liquid matter, intermediate rocks are formed. (Phillip's *Manual of Geology*, p. 556, and Durocher, *Annales des Mines*, 1857, vol. 1, p. 217.

An analogous view was suggested by Bunsen in his researches on the volcanic rocks of Iceland, and extended by Streng to similar rocks in Hungary and Armenia. These investigators suppose a trachytic and a pyroxenic magma of constant composition, representing respectively the two great divisions of rocks which we have just distinguished; and have endeavored to calculate from the amount of silica in any intermediate variety, the proportions in which these compounds must have been mingled to produce it, and consequently the proportions of alumina, lime, magnesia, iron-oxyd and alkalies which such a rock may be expected to contain. But the amounts thus calculated, as may be seen from Dr. Streng's results, do not always correspond with the results of analysis. (Streng, *Annales de Chimie et de Physique*, 3rd series, vol. 39, p. 52.) Besides there are varieties of intrusive rocks, such as the phonolites, which are highly basic, and yet contain but very small quantities of lime, magnesia and iron-oxyd, being essentially silicates of alumina and alkalies in part hydrated.

We may here remark that many of the so-called igneous rocks are often of undoubted sedimentary origin. It will scarcely be questioned that this is true of many granites, and it is certain that all the feldspathic rocks coming under the categories of hyperite, labradorite, euphotide, diorite, amphibolite, which make such so large a part of the Laurentian system in North America, are of sedimentary origin. They are here interstratified with limestones, dolomites, serpentines, crystalline schists and quartzites, which are often conglomerate. The same thing is true of similar feldspathic rocks in the altered Silurian strata of the Green Mountains. These metamorphic strata have been exposed to conditions which have rendered some of them quasi-fluid or plastic. Thus for example, crystalline limestone may be seen in positions which have led many observers to regard it as intrusive rock, although its general mode of occurrence leaves no doubt as to its sedimentary origin. We find in the Laurentian system that the limestones sometimes envelope the broken and contorted fragments of the beds of quartzite, with which they are often interstratified, and penetrate like a veritable trap into fissures in the quartzite and gneiss. A rock of sedimentary origin may then assume the conditions of a so-called igneous rock, and who shall say that any of the intrusive granites, dolerites, euphotides, and serpentines, have an origin distinct from the metamorphic strata of the same kind, which make up such vast portions of the older stratified formation? To suppose that each of these sedimentary rocks has also its representative among the ejected products of the central fire, seems a hypothesis not only unnecessary, but when we consider their varying composition, untenable.

We are next led to consider the nature of the agencies which have produced this plastic condition in various crystalline rocks. Certain facts, such as the presence of graphite in contact with carbonate of lime, and oxyd of iron, not less than the presence of alkaliferous silicates, like the feldspars in crystalline limestones, forbid us to admit the ordinary notion of the intervention of an intense heat such as would produce an igneous fusion, and lead us to consider the view first put forward by Poulett Scrope, * and since ably advocated by Scheerer and by Elie de Beaumont, of the intervention of water aided by fire, which they suppose may communicate a plasticity to rocks at a temperature far below that required for their igneous fusion. The presence of water in the lavas of modern volcanos led Mr. Scrope to speculate upon the effect which a small portion of this element might exert at an elevated temperature and under pressure, in giving a liquidity to masses of rock, and he extended this idea from proper volcanic rocks to granites.

Scheerer in his inquiry into the origin of granite has appealed to the evidence afforded us by the structure of this rock, that the the more fusible feldspars and mica crystallized before the almost infusible quartz. He also points to the existence in granite of what he has called pyrognomic minerals, such as allanite and gadolinite, which, when heated to low redness, undergo a peculiar and permanent molecular change, accompanied by an augmentation in density, and a change in chemical properties, a phenomenon completetly analogous to that offored by titanic acid and chromic oxyd in their change by ignition from a soluble to an insoluble condition. These facts seem to exclude the idea of igneous fusion, and point to some other cause of liquidity. The presence of natrolite as an integral part of the zircon-syenites of Norway, and of talc and chlorite and other hydrous minerals in many granites show that water was not excluded from the original granitic paste.

Scheerer appeals to the influence of small portions of carbon and sulphur in greatly reducing the fusing point of iron. He alludes to the experiments of Schafhautl and Whöler, which show

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* See Journal of Geol. Society of London, vol. xii. p. 326.

that quartz and apophylite may be dissolved by heated water under pressure and recrystallized on cooling. He recalls the aqueous fusion of many hydrated salts, and finally suggests that the presence of a small amount of water, perhaps five or ten per cent., may suffice at a temperature which may approach that of redness, to give to a granitic mass a liquidity, partaking at once of the characters of an igneous and an aqueous fusion.

This ingenious hypothesis, sustained by Scheerer in his discussion with Durocher, * is strongly confirmed by the late experiments of Daubrée. He found that common glass, a silicate of lime and alkali, when exposed to a temperature of 400° C., in presence of its own volume of water, swelled up and was transformed into an aggregate of crystals of wollastonite, the alkali with the excess of silica separating, and a great part of the latter crystallizing in the form of quartz. When the glass contained oxyd of iron, the wollastonite was replaced by crystals of diopside. Obsidian in the same manner yielded crystals of feldspar, and was converted into a mass like trachyte. In the experiments upon vitreous alkaliferous matters, the process of nature in the metamorphosis of sediments is reversed, but Daubrée found still farther that kaolin, when exposed to a heat of 400° C. in the presence of a soluble alkaline silicate, is converted into crystalline feldspar, while the excess of silica separates in the form of quartz. He found natural feldspar and diopside to be extremely stable in the presence of alkaline solutions. These beautiful results were communicated to the French Academy of Sciences on the 16th of November last, and as the author well remarked, enable us to understand the part which water may play in giving origin to crystalline minerals in lavas and intrusive rocks. The swelling-up of the glass also shows that water gives a mobility to the particles of the glass at a temperature far below that of its igneous fusion.

I had already shown in the Report of the Geological Survey of Canada for 1856, p. 479, that the reaction between alkaline silicates and the carbonates of lime, magnesia and iron at a temperature of 100° C. gives rise to silicates of these bases, and enables us to explain their production from a mixture of carbonates and quartz,

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* NOTE.—See for the arguments on the two sides, Bulletin of the Geo Soc. of France, Second series, vol. iv., p.p. 468, 1018 ; vi. 644 ; vii., 276 viii., 500 ; also, Elie de Beaumont, Ibid, vol, iv., p. 1312. See also the recent microscopical observations of Mr. Sorby, confirming the theory of the aqueous-igneous origin of granitie.—*L. E. & D. Phil.Mag.*, Feb.1858.

in the presence of a solution of alkaline carbonate. I there also suggested that the silicates of alumina in sedimentary rocks may combine with alkaline silicates to form feldspars and mica, and that it would be possible to crystallize these minerals from hot alkaline solutions in sealed tubes. In this way I explained the occurrence of these silicates in altered fossiliferous strata. My conjectures are now confirmed by the experiments of Daubrée, which serve to complete the demonstration of my theory of the normal metamorphism of sedimentary rocks by the interposition of heated alkaline solutions.

But to return to the question of intrusive rocks: Calculations based on the increasing temperature of the earth's crust as we descend, lead to the belief that at depth of about twenty-five miles the heat must be sufficient for the igneous fusion of basalt. The recent observations of Hopkins, however, show that the melting points of various bodies, such as wax, sulphur and resin are greatly and progressively raised by pressure, so that from analogy we may conclude that the interior portions of the earth are, although ignited, solid from great pressure. This conclusion accords with the mathematical deductions of Mr. Hopkins, who, from the precession of the equinoxes, calculates the solid crust of the earth to have a thickness of 800 or 1,000 miles. Similar investigations by Mr. Hennessey however assign 600 miles as the maximum thickness of the crust. The region of liquid fire being thus removed so far from the earth's surface, Mr. Hopkins, suggests the existence of lakes or limited basins of molten matter which serve to feed the volcanos.

Now the mode of formation of the primitive molten crust of the earth would naturally exclude all combined or intermingled water, while all the sedimentary rocks are necessarily permeated by this liquid, and consequently in a condition to be rendered semi-fluid by the application of heat as supposed in the theory of Scrope and Scheerer. If now we admit that all igneous rocks, ancient plutonic masses, as well as modern lavas, have their origin in the liquefaction of sedimentary strata, we at once explain the diversities in their composition. We can also understand why the products of volcanos in different regions are so unlike, and why the lavas at the same volcano vary at different periods. We find an explanation of the water and carbonic acid which are such constant accompaniments of volcanic action, as well as the hydrochloric acid, sulphuretted hydrogen and sulphuric acid, which are so abundantly evolved by certain volcanos. The reaction between silica and carbonates must give rise to carbonic acid, and the decomposition of sea-salt in saliferous strata by silica in the presence of water, will generate hydrochloric acid, while gypsum in the same way will evolve its sulphur in the form of sulphurous acid mixed with oxygen. The presence of fossil plants in the melting strata would generate carburretted hydrogen gases, whose reducing action would convert the sulphurous acid into sulphuretted hydrogen; or the reducing agency of the carbonaceous matters might give rise to sulphuret of calcium which would be in its turn decomposed by carbonic acid or otherwise. The intervention of carbonaceous matters in volcanic phenomenon is indicated by the recent investigations of Deville, who has found carburetted hydrogen in the gaseous emanations of Etna and the lagoons of Tuscany. The ammonia and the nitrogen of the volcanos are also in many cases probably derived from organic matters in the strata decomposed by subterranean heat. The carburetted hydrogen and bitumen evolved from mud volcanos, like those of the Crimea and of Bakou, and the carbonized remains of plants in the *moya* of Quito, and in the volcanic matters of the Island of Ascension, not less than the infusiorial remains fround by Ehrenberg in the ejected matters of most volcanos, all go to show that fossiliferous sediments are very generally implicated in volcanic phenomena; It is to Sir John F. W. Herschel that we owe, so far as I am aware, the first suggestions of the theory of volcanic action which I have here brought forward. In a letter to Sir Charles Lyell, dated February 20, 1836, (Proceedings Geol. Soc. London, vol. 11, p. 448), he maintains that with the accumulation of sediment the isothermal lines in the earth's crust must rise, so that strata buried deep enough will be crystallized and metamorphosed, and eventually be raised, with their included water, to the melting point. This will give rise to evolutions of gases and vapours, earthquakes, volcanic explosions, etc. all of which results must, according to known laws, follow from the fact of a high central temperature; while from the mechanical subversion of the equilibrium of pressure, following upon the transfer of sediments, while the yielding surface reposes upon a mass of matter partly liquid and partly solid, we may explain the phenomena of elevation and subsidence. Such is a summary of the views put forward more than twenty years since by this eminent philosopher, which, although they have passed almost unnoticed by geologists, seem to me to furnish a simple and comprehensive explanation of several of the most difficult problems of chemical and dynamical geology.

To sum up in a few words the views here advanced, We conceive that the earth's solid crust of anhydrous and primitive igneous rock is everywhere deeply concealed beneath its own ruins, which form a great mass of sedimentary strata permeated by water As heat from beneath invades these sediments, it produces in them that change which constitutes normal metamorphism. These rocks at a sufficient depth are necessarily in a state of igneo-aqueous fusion, and then in the event of fracture of the overlying strata, may rise among them, taking the form of eruptive rocks. Where the nature of the sediments is such as to generate great amounts of elastic fluids by their fusion, earthquakes and volcanic eruptions may result, and these, other things being equal, will be most likely to occur under the more recent formations.

ART. XXII.—*Agassiz' Contributions to the Natural History of the United States.* (Vols. 1 & 2. Boston.)

Anything from so great an authority as Professor Agassiz, commands the attention of naturalists; and especially an elaborate work like the present, giving matured views on leading subjects in Zoology. For this reason we propose to devote some pages to a sketch of the contents of these volumes. The work, it is true, has had a circulation unexampled in the case of such a book, and we are glad to see several Canadian names on the subscription list; but many of our young Naturalists may not have had access to it, and it is too elaborate and scientific to reach the mass of readers.

The first volume is in great part occupied with investigations of general principles; and chiefly with those concerned in classification, considered in its widest sense as the attempt of the human mind to explore the plans of construction adopted in nature and to represent them systematically.

The first topic under this head is the unity of plan in nature, and its origin from an all pervading Intelligence. Unity, design, and creative power, as evidenced in nature, are no new ideas. From the time of the Hebrew lawgiver downward, they have been articles of faith with all true philosophers, and in more modern times have been popularly expounded in a multitude of works, from Paley down to Hugh Miller and McCosh. It might indeed, in this period of the world's history, seem superfluous to devote a large portion of a scientific work to such a subject, had not some late writers, with that same eccentricity which occasionally brings up a strong and wordy opponent of the Coperincan system in astronomy, attempted to maintain the introduction of organic forms in a way different from the "Miracle of Creation." In this part of the subject, therefore, we find little that is new in itself, but a sort of cumulative argument, gathering into one a vast number of considerations illustrated by facts familiar to the writer, and all bearing on the doctrine that nature is not God; but that in studying what we call nature we have before us the works of a Supreme intelligent creator. Coming from a man so thoroughly versed in his subject, and supported as it is by a vast mass of illustrative facts, the conclusion tells with irresistible force. Most strenuously and boldly does Agassiz assert this great result, in which science, rising above her favourite ideas of recurring cycles and unchanging law, finds herself in direct relation with the great First Cause.

The argument on this subject is spread over a great number of heads, but they may in effect be reduced to the following:—

1. The idea of type or pattern in nature, as distinguished from that of mere individual adaptation, the construction of creatures intended for similar uses on different types, and the persistence of the same type through many subordinate varieties of structure, the simultaneous existence of the most diversified types in identical circumstances and the converse of this, the persistence of all the leading types through the whole sequence of geological ages, the wide geographical distribution of some types and the narrow range of others, the special resemblances in details of structure that occur in animals otherwise quite different, the order of succession of types in geological time. These and many other considerations founded on types in nature, prove a thinking Agent, just as similar considerations in reference to the various styles of architecture, would effectually answer any one who should attribute these, like the columns of basalt, or the stalactites of a cavern, to merely physical agencies.

2. The relations of animals to each other and to the world around them. Among these are the relative sizes of animals, and the relations of size to the media in which animals exist; the adaptation of animals in their structure and habits to the world in which they live and its various conditions; the relations of animals with each other as mutually dependent; the mutual

dependence of the animal and the plant; the relations of parasites to animals. Under all these and other heads, we have the old argument of Paley against the accidental origin of the watch or its production by physical agencies, vastly augmented by the great additional stores of fact since collected by naturalists.

3. The permanency of species in nature and the changes through which the individuals of the species pass. Here we have immutability of structure associated with continued succession of individuals, and that succession often complicated by a series of changes, as in the egg, the caterpillar, the chrysalis, and the butterfly, and some even more marvellous than this. Further, we have these changes in the individual, presenting a singular parallelism with the gradations of rank which our minds invariably recognise in distinct species, and on the other hand with the grand succession of species in geological time; so that in the great march of creation, in the ephemeral life of the individual animal, and in the ideas of order in nature which arise within our minds, we have a resemblance indicating at once the planning Creator and the fact that our own minds are created in his image.

4. The union of the whole animal kingdom in one great system, dividing in a regular manner into subordinate groups, and the persistence of this, whether we regard widely separated geographical areas, or the lapse of geological time, indicate thought; and, when we consider the vastness and intricacy of the subject, thought which the most gifted naturalists are ready to admit transcends the powers of man.

We have preferred thus to group, however imperfectly, some of the leading considerations adduced by our author, to avoid confusing the reader with too numerous heads; but we shall give as a specimen of the treatment of the subject, the details of the argument on one of the points least familiar to the general reader, the doctrine of "*prophetic types.*"

PROPHETIC TYPES AMONG ANIMALS.

"We have seen in the preceding paragraph, how the embryonic conditions of higher representatives of certain types, called into existence at a later time, are typified, as it were, in representatives of the same types, which have existed at an earlier period. These relations, now they are satisfactorily known, may also be considered as exemplifying, as it were, in the diversity of animals of an earlier period, the pattern upon which the phases of the developement of other animals of a later period were to be established. They appear now, like a prophecy in those earlier times, of an order of things not possible with the earlier combinations then prevailing in the animal kingdom, but exhibiting in a later period, in a striking manner, the antecedent consideration of every step in the gradation of animals.

This is, however, by no means the only, nor even the most remarkable case, of such prophetic connections between facts of different dates.

Recent investigations in Palæontology have led to the discovery of relations between animals of past ages and those now living, which were not even suspected by the founders of that science. It has, for instance, been noticed, that certain types which are frequently prominent among the representatives of past ages, combine in their structure, peculiarities which at later periods are only observed separately in different, distinct types. Sauriod Fishes before Reptiles, Pterodactyles before Birds, Ichthyosauri before Dolphins, etc.

There are entire families, among the representatives of older periods, of nearly every class of animals, which, in the state of their perfect development exemplify such prophetic relations, and afford, within the limits of the animal kingdom, at least, the most unexpected evidence, that the plan of the whole creation had been maturely considered long before it was executed. Such types, I have for some time past, been in the habit of calling *prophetic types.* The Sauroid Fishes of the past geological ages, are an example of this kind. These Fishes, which have preceded the appearance of Reptiles, present a combination of ichthyic and reptilian characters, not to be found in the true members of this class, which form its bulk at present. The Pterodactyles which have preceded the class of Birds, and the Ichthyosauri which have preceded the appearance of the Cetacea,* are other examples of such prophetic types. These cases suffice for the present, to show that there is a real difference between *embryonic* types and *prophetic* types. Embryonic types are in a measure also prophetic types, but they exemplify only the pecularities of development of the higher representatives of their own types;

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* In the text the author is made to say *Crustacea* instead of *Cetacea*; and we observe other typographical errors, which the publisher should endeavour to avoid in succeeding volumes.

while prophetic types exemplify structural combinations observed at a later period, in two or several distinct types, and are, moreover, not necessarily embryonic in their character, as for example, the Monkeys in comparison to Man; while they may be so, as in the case of the Pinnate, Plantigrade, and Digitigrade Carnivora, or still more so in the case of the pedunculated Crinoids.

Another combination is also frequently observed among animals, when a series exhibits such a succession as exemplifies a natural gradation, without immediate or necessary reference to either embryonic development or succession in time, as the Chambered Cephalopods. Such types I call *progressive types.*

Again a distinction ought to be made between prophetic types proper and what I would call *synthetic types*, though both are more or less blended in nature. Prophetic types proper, are those which in their structural complications lean towards other combinations fully realized in a later period, while synthetic types, are those which combine, in a well balanced measure, features of several types occurring as distinct, only at a later time. Sauroid Fishes and Ichthyosauri are more distinctly synthetic than prophetic types, while Pterodactyles have more the character of prophetic types; so are also Echinocrinus with reference to Echini, Pentremites with reference to Asterioids, and Pentacrinus with reference to Comatula. Full illustrations of these different cases will yet be needed to render obvious the importance of such comparisons, and I shall not fail, in the course of this work, to present ample details upon this subject. Enough, however, has already been said to show, that the character of these relations among animals of past ages, compared with those of later periods or of the present day, exhibits more strikingly than any other feature of the animal kingdom, the thoughtful connection which unites all living beings, through all ages, into one great system, intimately linked together from beginning to end."

Another example may be taken from a section giving the views of Agassiz, on the much debated question of the date of succession of fossil animals in its relations to their grade in nature.

PARALLELISM BETWEEN THE GEOLOGICAL SUCCESSION OF ANIMALS AND PLANTS AND THEIR PRESENT RELATIVE STANDING.

"The total absence of the highest representatives of the animal kingdom in the oldest deposits forming part of the crust of our globe, has naturally led to the very general belief, that the animals which have existed during the earliest period of the history of our earth were inferior to those now living, nay, that there is a natural gradation from the oldest and lowest animals to the highest now in existence. To some extent this is true; but it is certainly not true that all animals form one simple series from the earliest times, during which only the lowest types of animals would have been represented, to the last period, when Man appeared at the head of the animal creation. It has already been shown (Sect. VII.) that representatives of all the great types of the animal kingdom have existed from the beginning of the creation of organized beings. It is therefore not in the successive appearance of the great branches of the animal kingdom, that we may expect to trace a parallelism between their succession in geological times and their relative standing at present. Nor can any such correspondence be observed between the appearance of classes, at least not among Radiata, Mollusks, and Articulata, as their respective classes seem to have been introduced simultaneously upon our earth, with perhaps the sole exception of the Insects, which are not known to have existed before the Carboniferous period. Among Vertebrata, however, there appears already a certain coincidence, even within the limits of the classes, between the time of their introduction, and the rank their representatives hold, in comparison to one another. But upon this point more hereafter.

It is only within the limits of the different orders of each class, that the parallelism between the succession of their representatives in past ages and their respective rank, in the present period, is decidedly characteristic. But if this is true, it must be at the same time obvious to what extent the recognition of this correspondence may be influenced by the state of our knowledge of the true affinities and natural gradation of living animals, and that until our classifications have become the correct expression of these natural relations, even the most striking coincidence with the succession of their representatives in past ages may be entirely overlooked. On that account it would be presumptuous on my part to pretend, that I could illustrate this proposition, through the whole animal kingdom, as such an attempt would involve the assertion that I know all these relations, or that where there exists a discrepancy between the classification and the succession of animals, the classification must be incorrect, or the relationship of the fossils incorrectly appreciated, I shall therefore limit myself here to a general comparison, which may, however, be sufficient to show, that the improvements which have been introduced in our systems, upon purely zoological grounds, have nevertheless tended to render more apparent the coincidence between the relative standing among living animals and the order of succession of their representatives in past ages. I have lately attempted to show, that the order of Halcyonoids, among Polyps, is superior to that of Actinoids; that, in this class, compound communities constitute a higher degree of development, when contrasted with the characters and mode of existence of single Polyps, as exhibited by the Actinia; that top-budding is superior to lateral budding; and that the type of Madrepores, with their top-animal, or at least with a definite and limited number of tentacles, is superior to all other Actinoids. If this be so, the prevalence of Actinoids in older geological formations, to the exclusion of Halcyonoids, the prevalence of *Rugosa* and *Tabulata* in the oldests deposits, the later prevalence of Astræoids, and the very late introduction of Madrepores, would already exhibit a correspondence between the rank of the living Polyps and the representatives of that class in past ages, though we may hardly expect a very close coincidence in this respect between animals the structure of which is so simple.

The gradation among the orders of Echinoderms is perfectly plain. Lowest stand the Crinoids, next the Asterioids, next the Echinoids, and highest the Holothurioids. Ever since this class has been circumscribed within its natural limits, this succession has been considered as expressing their natural relative standing, and modern investigations respecting their anatomy and embryology, however extensive, have not led to any important change in their classification, as far as the estimation of their rank is concerned. This is also precisely the order in which the representatives of this class have successively been introduced upon earth in past geological ages. Among the oldest formations we find pedunculated Crinoids only, and this order remains prominent for a long series of successive periods; next come free Crinoids and Asterioids; next Echinoids, the successive appearance of which since the triasic period to the present day, coincides also with the gradation of their subdivisons, as determined by their structure; and it was not until the present period, that the highest Echinoderms, the Holothurioids, have assumed a prominent position in their class.

Among Acephala there is not any more uncertainty respecting the relative rank of their living representatives, than among Echinoderms. Every zoologist acknowledges the inferiority of the Bryozoa and the Brachiopods when compared with the Lamellibranchiata, and among these the inferiority of the Monomyaria in comparison with the Dimyaria would hardly be denied. Now if any fact is well established in Palæontology, it is the earlier appearance and prevalence of Bryozoa and Brachiopods in the oldest geological formations, and their extraordinary development for a long succession of ages, until Lamellibranchiata assume the ascendency which they maintain to the fullest extent at present. A closer comparison of the different families of these orders might further show how close this correspondence is through all ages.

Of Gasteropoda I have nothing special to say, as every palæontologist is aware how imperfectly their remains have been investigated in comparison with what has been done for the fossils of other classes. Yet the Pulmonata are known to be of more recent origin than the Branchifera, and among these the Siphonostomata to have appeared later than the Holostomata, and this exhibits already a general coincidence between their succession in time and their respective rank.

Our present knowledge of the anatomy of the Nautilus, for which science is indebted to the skill of Owen, may satisfy everybody that among Cephalopods the Tetrabranchiata are inferior to the Dibranchiata; and it is not too much to say, that one of the first points a collector of fossils may ascertain for himself, is the exclusive prevalence of the representatives of the first of these types in the oldest formations, and the later appearance, about the middle geological ages, of representatives of the other type which at present is the most widely distributed.

Of Worms, nothing can be said of importance with reference to our inquiry; but the Crustacea exhibit, again, the most striking coincidence. Without entering into details, it appears from the classification of Milne-Edwards that Decapods, Stomapods, Amphipods, and Isopods constitute the higher orders, while Branchiopods, Entomostraca, Trilobites, and the parasitic types, constitute, with Limulus, the lower orders of this class. In the classification of Dana, his first type embraces Decapods and Stomapods, the second Amphipods and Isopods, the third Entomostraca, including Branchiopods, the fourth Cirripedia, and the fifth Rotatoria. Both acknowledge in the main the same gradation; though they differ greatly in the combination of the leading groups, and also the exclusion by Milne-Edwards of some types, as the Rotifera, which Burmeister first, then Dana and Leydig, unite justly, as I believe, with the Crustacea. This gradation now presents the most perfect coincidence with the order of succession of Crustacea in past geological ages, even down to their subdivisions into minor groups. Trilobites and Entomostraca are the only representatives of the class in palæozoic rocks; in the middle geological ages appear a variety of Shrimps, among which the Macrouran Decapods are prominent, and later only the Brachyoura, which are the most numerous in our days.

The fragmentary knowledge we possess of the fossil Insects, does not justify us, yet, in expecting to ascertain with any degree of precision, the character of their succession through all geological formations, though much valuable information has already been obtained respecting the entomological faunæ of several geological periods.

The order of succession of Vertebrata in past ages, exhibits features in many respects differing greatly from the Articulata, Mollusks, and Radiata. Among these we find their respective classes appearing simultaneously in the oldest periods of the history of our earth. Not so with the Vertebrata, for though Fishes may be as old as any of the lower classes, Reptiles, Birds, and Mammalia are introduced successively in the order of their relative rank in their type. Again, the earliest representatives of these classes do not always seem to be the lowest; on the contrary, they are to a certain extent, and in a certain sense, the highest, in as far as they embody characters, which, in later periods, appear separately in higher classes, (See Sect. 26,) to the exclusion of what henceforth constitutes the special character of the lower class. For instance, the oldest Fishes known, partake of the characters, which, at a later time, are exclusively found in Reptiles, and no longer belong to the Fishes of the present day. It may be said, that the earliest Fishes are rather the oldest representatives of the type of Vertebrata than of the class of Fishes, and that this class assumes only its proper characters after the introduction of the class of Reptiles upon earth. Similar relations may be traced betweens the Reptiles and the classes of Birds and Mammalia, which they precede. I need only allude here to the resemblance of the Pterodactyli and the Birds, and to that of Ichthyosauri and certain Cetacea. Yet, through all these intricate relations, there runs an evident tendency towards the production of higher and higher types, until at last, Man crowns the whole series. Seen as it were at a distance, so that the mind can take a general survey of the whole, and perceive the connection of the successive steps, without being bewildered by the details, such a series appears like the development of a great conception, expressed in such harmonious proportions, that every link appears necessary to the full comprehension of its meaning, and yet, so independent and perfect in itself, that it might be mistaken for a complete whole, and again, so intimately connected with the preceding and following members of the series, that one might be viewed as flowing out of the other. What is universally acknowledged as characteristic of the highest conceptions as genius, is here displayed in a fulness, a richness, a magnificence, an amplitude, a perfection of details, a complication of relations, which baffle our skill and our most persevering efforts to appreciate all its beauties. Who can look upon such series, coinciding to such an extent, and not read in them the successive manifestations of a thought, expressed at different times, in ever new forms, and yet tending to the same end, onwards to the coming of Man, whose advent is already prophesied in the first appearance of the earliest Fishes!

The relative standing of plants presents a somewhat different character from that of animals. Their great types are not built upon so strictly different plans of structure; they exhibit, therefore, a more uniform gradation from their lowest to their highest types, which are not personified in one highest plant, as the highest animals are in Man.

Again, Zoology is more advanced respecting the limitation of the most comprehensive general divisions, than Botany, while Botany is in advance respecting the limitation and characteristics of families and genera. There is, on that account, more diversity of opinion among botanists respecting the number, and the relative rank of the primary divisions of the vegetable kingdom, than among zoologists respecting the great branches of the animal kingdom. While most writers agree in admitting among plants, such primary groups as Acotyledones, Monocotyledones, and Dicotyledones, under these or other names, others would separate the Gymnosperms from the Dicotyledones.

It appears to me, that this point in the classification of the living plants cannot be fully understood without a thorough acquaintance with the fossils and their distribution in the successive geological formations, and that this case exhibits one of the most striking examples of the influence classification may have upon our appreciation of the gradation of organized beings in the course of time. As long as Gymnosperms stand among Dicotyledones, no relation can be traced between the relative standing of living plants and the order of succession of their representatives in past ages. On the contrary, let the true affinity of Gymnosperms with Ferns, Equisetaceæ, and especially with Lycopodiaceæ be fully appreciated, and at once we see how the vegetable kingdom has been successively introduced upon earth, in an order which coincides with the relative position its primary divisions bear to one another, in respect to their rank, as determined by the complication of their structure. Truly, the Gymnosperms, with their imperfect flower, their open carpels, supporting their polyembryonic seeds in their axis, are more nearly allied to the anathic Acrophytes, with their innumerable spores, than to either the Monocotyledones or Dicotyledones; and, if the vegetable kingdom constitutes a graduated series beginning with Cryptogams, followed by Gymnosperms, and ending with Monocotyledones and Dicotyledones, have we not in that series the most striking coincidence with the order of succession of Cryptogams, in the oldest geological formations, especially with the Ferns- Equisetaceæ, and Lycopodiaceæ of the Carboniferous period, followed by the Gymnosperms of the Trias and Jura and the Monocotyledones of the same formation and the late development of Dicotyledones? Here, as everywhere, there is but one order, one plan in nature."

The discussions to which we have referred, are all regarded by our author as introductions to the classification of animals; a most just and noble view, since when classification sinks to be a mere matter of arbitrary naming or even a convenient arrangement of structures, it foregoes its highest aims. We now know that there is in nature plan and system, depending upon the arrangements of the Creator, and appreciable to our minds. This plan, in so far as we have yet attained to its comprehension, marks the true relations of animals and plants as products of a thinking mind, and relates not only to structures but to embryonic development, habits, geographical and geological distributions. Classification in nature thus rises from its minute facts and structures, to a great philosophical system of the universe.

"It may appear strange that I should have included the preceding disquisition in that part of my work which is headed Classification. Yet, it has been done deliberately. In the beginning of this chapter, I have already stated that Classification seems to me to rest upon too narrow a foundation when it is chiefly based upon structure.* Animals are linked together as closely by their mode of development, by their relative standing in their respective classes, by the order in which they have made their appearance upon earth, by their geographical distribution, and generally by their connection with the world in which they live, as by their anatomy. All these relations should, therefore, be fully expressed in a natural classification; and though structure furnishes the most direct indication of some of these relations, always appreciable under every circumstance, other considerations should not be neglected, which may complete our insight into the general plan of creation.

In characterizing the great branches of the animal kingdom, it is not enough to indicate the plan of their structure, in all its peculiarities; there are possibilities of execution which are at once suggested to the exclusion of others, and which should also be considered, and so fully analyzed, that the various modes in which such a plan may be carried out shall at once be made apparent. The range and character of the general homologies of each type should also be illustrated, as well as the general conditions of existence of its representatives. In characterizing classes, it ought to be shown why such gronps constitute a class and not merely an order, or a family; and to do this satisfactorily, it is indispensable to trace the special homologies of all the systems of organs which are developed in them. It is not less important to ascertain the foundation of all the subordinate divisions of each class; to know how they differ, what constitutes orders, what families, what genera, and upon what characteristics species are based in every natural division."

To be concluded in our next Number.

ART. XXIII.—*Coal in Canada. The Bowmanville Discovery.*

The thing that we cannot have, is always that which we most desire, and the more richly we are endowed otherwise, the more earnestly do we long for the one object that may have been withheld. So it would seem to be with the Canadian public in the matter of coal. All the riches of the earth and of the hills and of the deep beneath, have been thrown into its lap, except this; and like the child whose toys are all valueless because mamma cannot give it the moon to play with in its own hand, it turns its eyes away from all its other treasures, and cries for coal. Then when any clever pretender, or simple practical man misled by indications which he does not understand, for a time deludes it with the fancy that it possesses the much coveted combustible, it rails at the stupid Geological Survey which has failed to make the discovery, and snaps its fingers at the geologists, whose spectral "theories" have—like the ghosts that guard hidden treasure—hitherto scared it from the prize.

We are far from desiring to insinuate that in Canada the public mind is in such matters behind that of other countries; and it is cheering to know that many intelligent men are fully aware of the real position of this country in its geological resources. It is however very disheartening to scientific men, to find on the periodical recurrence of delusive mining schemes or unexpected practical facts, how very little even the more literary portion of the people are leavened with scientific truth. We write and lecture, and finally suppose that men have at least some general appreciation of that which we teach; but on a sudden we find ourselves quite mistaken, and the public ready to give ear to any statement, no matter how much at variance with the facts established by long and patient enquiry. The best use to be made of such unpleasant discoveries of popular ignorance, is to take advantage of the excitement which they occasion, in order to diffuse better ideas.

The latest of these professed discoveries is that of coal at Bowmanville, C. W., a town of about 4000 inhabitants, 43 miles distant from Toronto. A practical miner acquainted with the digging of coal, and therefore supposed to know more of its whereabout than the geologists and such unpractical persons, has made his way to this place. He assures a proprietor there that there is coal on his property, though situated on Lower Silurian rocks, and these rocks overlaid by no one knew how much tertiary clay and sand. A glance at the geological reports scattered broadcast over the country, would have shown that the occurrence of coal there is in the last degree improbable. But miners are supposed to have a wonderful penetration in such matters. Without taking any competent advice, a bore is made, and, wonderful to relate, at the depth of 150 feet, coal or something like it is found. Specimens are now sent to a learned professor in Toronto, who damps the ardour of the enthusiastic by assuring them, that it is only compact bitumen, like that often found in small quantities in the "Utica shale" which is believed to be the rock of the locality, and by giving a great many geological reasons why the occurrence of coal there should be considered not absolutely impossible, but contrary to all known facts.

But the enterprise is not to be quashed in this summary manner. The bore-hole is again appealed to, and now produces actual veritable coal, not only like coal and burning like coal, but having all the characteristics of true coal-measure coal, and showing its vegetable structures. The mineral is further stated to be found under clay and sand having the aspect of the ordinary tertiary clays and sands of Upper Canada, and showing none of the characteristics of coal measures either in mineral character or fossils. These and other further statements render the reality of the discovery still more improbable; but gentlemen who cannot distinguish ordinary calcareous clay from fire clay, who suppose that fire clay often or ever forms the roof of coal seams, and who believe that fetid exhalations and inflammable gases escaping from wells are infallible indications of the presence of coal, are not likely to be easily staggered by geological evidence.

Accordingly their faith only becomes established by the growing improbability, and we find them at the date of our latest information sending a deputation to Toronto to solicit aid from the Government toward prosecuting the discovery, and their friends in the newspaper press chuckling over the "nuts" which they have given the geologists to crack. The one wise proposal which the believers in this discovery make, is that the Director of the Geological Survey should be requested to examine the locality. This however should have been done at the first. Sir W. E. Logan is always ready to give any information in his power; and is not disposed, as his reports show, to treat with scepticism or contempt any statement of a valuable discovery however improbable. In the present state of the matter, it is hardly likely that anything he will be able to state, on the evidence of surface indications, will satisfy the public; and a shaft may have to be sunk, at an expense of several hundreds of pounds, to find out that there has been a mistake or a fraud at the bottom of the matter instead of a seam of coal. We do not say that this will be the certain result; there are, as we shall show in the sequel, certain geological possibilities of the occurrence of coal at Bowmanville, but no indications of these appear in the statements which have been made, and all the facts before us at present point to the conclusion that the very common trick of secretly supplying the bore-hole with the materials afterwards obtained from it, has been practised by some interested or mischievous person. We give this opinion on the facts which have reached us up to the 1st of June, and we are glad to observe that the Government have very properly thrown the onus of opening the deposit on the proprietors and people of the locality.

Having pursued the narrative thus far, we proceed to give a few plain statements as to the actual condition of the question. Does Canada contain workable coal? Many persons are of opinion that geologists, and more particularly those of the Survey, have arrived at the conclusion that coal cannot possibly be found in this country. This is entirely a mistake. To maintain such a sweeping negative would be mere presumption, such as no really scientific man could be guilty of. All that we assert is embodied in the expression of Prof. Chapman, that "all known facts are opposed to the idea" that coal occurs here, and therefore that any reported discovery should be regarded with distrust and carefully scrutinized. Let us look for a moment at a general statement of the evidence on which this view rests.

It has been ascertained that nearly all the valuable coal seams known, exist in the coal-measures of a particular geological system—the carboniferous—readily distinguishable by its relations to other systems of rocks and by its characteristic fossils. In some of the formations overlying or newer than this coal series *par excellence*, beds of coal have been found, as for instance in the Triassic series at Richmond, Virginia, in the tertiary of Western America; but these are exceptional cases, and the mineral is for the most part different from the coal of the carboniferous system or differs in its accompanying fossils. In the formations older than the carboniferous system no workable coal has been found, and these formations have now been so extensively explored as to render it probable that they are quite destitute of the mineral; though still, geologists do not assert this as a positive conclusion, but merely as the negative result likely to be reached when all the facts are known, and in the meantime as a useful warning against imprudent speculation.

Now in relation to Canada, the whole province so far as known—

except a small district in Gaspé—rests on rocks older than the carboniferous system. This great general fact is a most important one practically, and has already saved much ruinous expenditure. It is a fact to be insisted on with this view; and has been so insisted on by the head of the Survey; but he has not overstepped the bounds of certainty in the matter, and has in each case of supposed coal discovery, stated merely the facts and principles bearing on that case, without indulging in rash general statements. We may take for example, and as a further illustration of the subject, the following from the report of 1849-50. It refers to the supposed discovery of coal at Bay St. Paul and Murray Bay.

"Wherever workable seams of coal have yet been found on the face of the globe, the evidences connected with them prove beyond a doubt, that their origin is due to great accumulations of vegetable matter, which has been converted into a mineral condition. The vegetable structure is detected in the mineral by microscopic examination, and as might be expected, the strata associated with coal beds are profusely stored with fossil plants; even where the seams are too thin to be workable, or so thin as to be readily passed over without great attention, the vegetable remains disseminated in the masses of rock dividing the seams, are still in vast abundance. In the section of the Nova Scotia coal rocks, at the Joggins, for example, as detailed in the report transmitted to the Government in 1844, it will be found that in a thickness approaching 15,000 feet, seventy-six coal seams occur with a total thickness of no more than forty-four feet, and that for thousands of feet in some parts, no coal seam is met with over three inches; there are yet comparatively few layers of the rock that are wholly free from vegetable remains, and the substance of these remains, however thin the leaf or small the fragment, being generally converted into coal, the mineral—from the multitude of grains of it disseminated through great thicknesses of the strata—frequently gives a peculiar character to the stone as one of its constituents. The same thing is observable in other carboniferous localities, both in America and Europe, and it appears quite reasonable to suppose, that if coal seams were discovered of an older date than those which constitute the present known great magazines of fossil fuel, the vegetable growth that would be required to give them an approach to a workable thickness, would afford the means of an extensive distribution of remains in the strata with which they were associated. The formations of Bay St. Paul and Murray Bay however show no carbonized vegetable remains whatever, and the only plants they presented at all, were a very few obscure fucoids, the forms of which were replaced by peroxyd of iron. The bitumen of the limestone may possibly be derived from the soft tissues and gelatine of the marine animal remains which have been buried in the deposit, and supporting this opinion, indurated bitumen has been found in the interior of some of the fossil testacea, of the same limestone at Beauport; but the calcareous material of the harder part of such remains, so predominates over the carbon of the softer, that coal seams could not be expected as the result of the mixture.

"There being not the remotest doubt whatever of the geological age of the limestone of Bay St. Paul, supposing the specimens were really derived from the strata, and that the species of plants should at the same time be ascertained to be identical with some of those of the carboniferous period, it would prove that all evidence up to the present time has been imperfect, and that the flora of this period is of hitherto unsuspected antiquity. But even in such a case, or supposing the plants were different in species from those of the true coal era, the paucity of vegetable remains being such that scarcely a trace of them is found in so great and so clear a development of the strata as occurs at Cap au Rets, the probability, amounting almost to certainty, would be, that the specimens were derived from some local patch so thin and circumscribed, as to be altogether worthless in an economic point of view."

All Sir William's early reputation as a geologist was gained in the coal-fields, no more competent mining surveyor for coal could be found, and no one would be more rejoiced at the opportunity of reporting on a coal-field in Canada. But for this very reason, he is too cautious to hazard any conjecture as to the probability of the occurrence of fossil fuel in a country where facts palpable to the geologist, have inscribed everywhere a negation of its presence.

Not having this public responsibility weighing upon us, we may venture to mention certain possibilities as to the occurrence of coal in Canada, which would furnish the only means of accounting for the Bowmanville discovery should it prove a reality. The fundamental rocks of Canada are as we have said below the carboniferous, and therefore unlikely to contain workable coal. But Canada may in this respect prove an exception to other countries.

There may have been a land flora and the accumulation of coal at an earlier period than we have elsewhere ascertained these phenomena to exist. Unfortunately however no indication of this exists except the discovery, by Sir W. E. Logan, of a bed of coal one inch thick, in the Devonian rocks of Gaspé, associated with a few vegetable fossils. This is in itself a rare and interesting geological fact, and the beds in which it occurs are those which are next below the true carboniferous series.

Secondly, the coal measures approach Canada somewhat closely both on the East and West. In the peninsulas of Canada West, and of Gaspé, we have the Devonian series, the next below the carboniferous. To these succeed respectively the coal-fields of Michigan and New Brunswick, which on the West and East occur just beyond the limits of Canada. In those parts of the province which thus approach nearest to the carboniferous system, it is barely possible that outliers of these carboniferous districts, as yet unobserved, may extend within our limits. The Bowmanville locality is however too far distant from the Western coal-fields to give any likelihood to such a view in this case.

Again it sometimes occurs that locally certain members of the geological series are wanting, and the coal-measures may thus rest directly on beds far older than themselves. For instance at Bowmanville a small and hitherto unobserved independent coal-field, may rest unconformably on the Utica slates. But then in such cases the coal never occurs alone, but in company with shales and sandstones containing fossil plants, and usually also with limestones containing fossils quite distinct from those of the underlying Silurian and Devonian rocks. Coal sometimes even occurs on unstratified or altered rocks, as granite or gneiss ; but in those cases it still has its characteristic accompaniments, and it must be observed that such rocks are of all geological ages, many granites being even newer than the true coal formation. A curious misapplication of this fact has we observe been made by one of our contemporaries; but we have determined not to attempt any exposure of the multitudinous errors that are showered upon the public on every side from the press, as these would already in the Bowmanville case, require nearly a whole volume of the *Naturalist* for their full illustration and explanation. If in the Bowmanville case any evidence of the characteristic accompaniments of coal had been adduced, all geologists would at once have admitted the credibility of the statement, without any cavil as to its resting on very old rocks. They cannot do this merely on the assertion of an unknown person, against whose statements all the facts, even those said to be ascertained by his own borings, militate.

Farther, in the transference of materials over the surface, in the so called drift period, fragments of coal derived from distant coal-fields may have been mixed with the superficial tertiary deposits. In coal districts it is not uncommon thus to find loose coal in places where it does not occur in situ. Various circumstances make such an occurrence unlikely in the drift of Canada; and as it must be very limited and exceptional, and could not *a priori* be anticipated, the discovery of such drift-coal in a deep bore-hole is in the highest degree improbable.

Lastly, it is not uncommon to find in the tertiary superficial beds themselves, consolidated peat and imperfect coal (*brown coal*), a substance which exists largely in such deposits in the West and North of America. Such material though not likely to occur in workable quantity, might be of some economic importance. The Bowmanville mineral is however evidently not of this kind.

These exceptional cases taken together, give scarcely a shadow of a hope of coal in Canada, and none of them applies to the Bowmanville case, as it stands at present. We must therefore in the meantime regard this case as beyond the pale of ordinary geological facts, and as either a fraud, a mistake, or a singularly exceptional occurrence only to be explained by further explorations of the locality.

With respect to the mineral itself, it would seem that specimens sent to Prof. Chapman had the aspect of compact bitumen, but other specimens sent to the same geologist and to this city, are true coal, having the aspect, properties and structure of rich bituminous coal of the true coal formation. The writer has submitted small fragments—prepared in a manner which he has applied to numerous specimens of coal from other localities—to microscopic examination, and finds that they afford three distinct kinds of vegetable structure, all found in ordinary coal, and one of them the scalariform tissue characteristic of sigillariæ and ferns. The substance is therefore true coal, formed from the remains of land plants, and not distinguishable from that of the carboniferous system.*

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* To prevent farther mistake, it is necessary to add that, since this article went to press, the writer has seen some additional specimens said to be from Bowmanville, some of which are not coal, but appear to be charred wood saturated with some bituminous substance.

With regard to the geological position assigned to the coal of Bowmanville, it appears from the latest statements to be, not the Silurian rocks of the country, but the tertiary clays and sands. This we need hardly say excludes a number of the ways of accounting for it above stated, and almost shuts us up to the conclusion that if a real discovery at all, the coal is a boulder or layer of boulders of coal transported from a distance, no doubt a very unlikely mode of occurrence, when we take into account the usual direction of Canadian tertiary drift from the N. E., and the absence of any known coal within a reasonable distance in that direction. The following is given in a Hamilton newspaper as an authoritative statement of the beds passed through, and it corresponds very nearly with a manuscript boring journal which we have seen, and which was furnished by one of the persons employed.

" A shaft of 60 or 65 feet was sunk last November, then boring for about 90 feet deeper before reaching the coal. The materials were, beginning at the surface.

" 1. Fine clay, about 25 feet.

" 2. Large boulders, 7 or 8 feet.

" 3. Fine clay, 30 feet.

" 4. Clean washed lake sand, 20 feet.

" 5. Fire-clay, 30 or 40 feet.

" 6. The remainder of the distance—nearly 50 feet, a kind of hard pan fire-clay, gravel, stones, and a mixture of clay and sand.

" 7. One foot or foot and a-half of a hard substance—rock of some kind, I could not say what on account of sand and clay falling in from the sides, but I drew up small pieces of coarse red sandstone.

" 8. Six feet or six feet and a-half of coal."

This section is followed by the very *naïve* remark that it shows " no material which ought according to existing theories to be found above coal." This is quite true, inasmuch as the tertiary sands and clays may, like the green sod, cover anything; but it would be quite a different thing to say that they are the materials usually or ever found immediately above a coal seam. On the contrary the occurrence of coal like that sent from Bowmanville, in situ, immediately under or in the bottom of such a mass, without any of the usual shales, under-clays, ironstones, or sandstones accompanying the mineral, or any of the fossils of the formation, would if possible be more extraordinary than its occurrence in the

Silurian rocks themselves. Prof. Chapman further informs us, in a letter published in a Toronto paper, that the clays are not coal measure fire-clays, but the ordinary tertiary clays, and that the red sandstone of the boring section is merely a boulder of syenite, and the ironstones, said to be found, iron pyrites. Were it not that we are aware of the many uncertainties of such explorations, and of the probability that the parties concerned may misrepresent their own case, we should thus, on the evidence adduced by themselves, be disposed to regard the whole affair as an absurd practical joke. Prof. Chapman we observe has boldly taken this ground, but as in such cases all possibilities should be fully allowed for, and as we cannot perceive in the published accounts any indication on the part of the persons reporting the discovery, of that familiarity with the structure of coal-measures and the operation of boring for that mineral, which could alone give value to their testimony, we are willing to take the most charitable view possible, and even to suppose that, contrary to all probability, they may have, by a rare and marvellous accident, discovered coal in circumstances hitherto unheard of, and therefore beyond all rational anticipation.

In concluding this article it may be useful to group together a few general statements which may serve to prevent misapprehension on the subject.

First. Geologists do not assert that no coal can exist in Canada. They only maintain that all the facts hitherto known to them afford no indication that it does occur.

Secondly. The occurrence of coal in any locality or geological formation not known to contain the mineral, would not effect theoretical geology. It would only extend the amount of facts available for the construction of the theory of the science.

Thirdly. Geologists thus hold no "theory" depending on the non-occurrence of coal in Canada or in the Lower Silurian rocks; and in respect to the latter they would be very glad to obtain so interesting a fact as the evidence of terrestrial vegetation in that period.

Fourthly. Should coal be found in any part of the Silurian district of Canada, the fact would be one of those comparatively rare cases to be accounted for in some of the ways stated above; but geologists will be slow to credit it unless accompanied by evidence of the presence of some of the usual accompaniments of coal, either in its ordinary relations, or in some other of the more rare circumstances above stated.*

Fifthly. Boring operations are so very liable to fraud error, or that they cannot be considered as establishing any fact otherwise improbable, without the further evidence of such inspection as can be made by actually opening up the deposit, or of corroborative facts obtained from surface indications. It is principally the entire want of such facts, and the substitution of irrelevent statements, in the reports now before the public, that causes us at present to doubt, what otherwise would be a most welcome discovery whether in a scientific or practical point of view.

J. W. D.

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* As the ordinary accompaniments of coal have been several times referred to in this article, we give below a characteristic example, being the beds accompanying the main coal of the S. Joggins in Nova Scotia.

	ft.	in.
Shale, gray, passing into black. Modiola in lower part,	0	6
Shale, calcareo-bituminous. Modiola, Cypris, Fish-scales,	0	10
Coal and bituminous shale. Poacites, Sigillaria, Spirorbis, Fish-scales, Cypris,	0	8
Underclay. Rootlets of Stigmaria,	3	9
Sandstone, gray. Rootlets,	4	6
Shale and sandstone,	8	0
*Underclay, hard and sandy below. Roots and rootlets of Stigmaria,	1	6
Coal impure. Full of Poacites,	0	1
Shale and argillaceous sandstone. Plants with Spirorbis, rain-marks?	7	0
Sandstone and arenaceous shale. Erect Calemites in five feet of upper part; an erect coaly tree passes through these beds and the sandstone below,	8	0
Sandstone, gray. Erect coaly tree as above,	7	0
*Shale, gray. Roots of coaly tree spread in this bed,	4	0
Sandstone, gray,	4	0
Shale, gray. Prostrate and erect Sigillaria and Lepidodendron, Poacites, Asterophyllites, Ferns, Modiola, Spirorbis on surface of fossil plants, Stigmaria and rootlets,	0	6
COAL, *main seam*, worked by the General Mining Association,	3	6
Shale or underclay. Thins out in working to N.E.,	1	6
COAL, worked with main seam,	I	6
*Underclay and shale with bands of sandstone,	20	0
*Sandstone and clay. Stigmaria stools; on the surface of this bed a thin film of coaly matter [*Coal Mine Pier here.*]	2	6
Sendstone and shale. Irregular beds,	5	0
Shale, gray, with bands of sandstone and ironstone,	4	0

	ft.	in.
Sandstone, gray. Two erect stumps. one of them a Sigillaria with Stigmaria roots, erect Calamites......................	2	0
*Shale, gray and Ironstone. Roots and rootlets of erect stumps,	6	6
Coal, impure. Much Poacites,..................................	0	0½
Shale, gray,..	0	11½
Coal and bituminous shale. Prostrate trunks and mineral charcoal, ...	0	0½
*Sandstone with clay parting. Stigmaria rootlets and prostrate Sigillaria above the clay parting,.....................	3	6
Sandstone and shales with ironstone,......................	12	0
Ironstone-band. Sigillaria, Favularia, Poacites, Ferns, &c.; Spirorbis attached to many of these plants,.................	0	3
*Underclays. Rootlets of Stigmaria and carbonized plants,...	2	0
Coal, impure,..	0	1
*Sandstone, Argillaceous. Stools and rootlets of Stigmaria, ..	2	6
*Sandstone alternating with shales. In one bed, Stigmaria stools and an erect tree. In another Ulodendron and other trees, prostrate, with Spirorbis attached,..................	10	0
*Shale, gray, passing downwards into underclay. Poacites, Lepidophylla, &c.; an erect tree, Stigmaria rootlets in lower part, ...	3	10
Coal,..	0	3
*Underclay. Rootlets,.....................................	0	5
COAL and bituminous shale, in several alternations. Lepidodendron, Ulodendron, Poacites, Lepidophylla. (This is called the Queen's Vein.)..	1	9
*Shale, gray. Poacites in upper part. In lower part an underclay with remains of erect stumps,........................	4	4
Coal,..	1	0
*Underclay, black, bituminous, slickensided, resting on hard arenaceous understone. Stools and rootlets of Stigmaria,...	3	0

The remainder of this section, one of the most distinct in the world, may be found in Sir W. E. Logan's first report; and with full illustrations of its fossils, in "Acadian Geology," and in the Journal of the Geological Society of London, 1853.

OBITUARY.

JAMES BARNSTON, M. D.

Since the last number of the *Naturalist* was issued, the most active member of its Editing Committee, and one of the principal and most valued contributors to its columns, has passed to his rest. On Thursday the 20th May last, Prof. James Barnston, M.D., after a long and severe illness, breathed his last, at his residence in Little St. James Street, in this city. The deceased was the eldest son of George Barnston, Esquire, Chief Factor of the Hon. Hudson's Bay Company. He was born at Norway House, in the Territories of that Company, on the 3rd July, 1831 ; and, consequently, at the time of his death, had not completed his twenty-seventh year. He began his studies at Red River Settlement in 1840, and remained there for a period of five years. He was then removed to Canada, where his education was principally of a private nature; but he early distinguished himself by his thirst for knowledge, and especially pursued with assiduity those preparatory studies suited for the learned and honorable profession it was his intention to enter; and of which, had his life been spared, he would have become a distinguished ornament. In 1847 he went to Edinburgh, and entered upon the study of Medicine at the University there. He went through the usual course, and in 1851 passed the final examination for his degree with the greatest credit. Being then under age, he did not receive his diploma till the following year. During the third year of his course he filled the post of House-Surgeon to the Royal Maternity Hospital; an office which he resigned on passing his examination. He subsequently became assistant to a Physician in extensive practice in the town of Selkirk and adjacent country; but on receiving his diploma in the Spring of 1852, he went to the continent, with the view of "walking" the Hospitals there, acquiring additional knowledge of his profession, and completing his medical studies. He remained there over a year, principally in Paris and Vienna, and received the highest certificates from the Medical Directors of the

Hospitals where he attended. In October, 1853, he returned to Canada, and commenced practice in Montreal; and, consequently, at the time of his death he had been upwards of four years a Physician in our city.—We have said that he graduated at Edinburgh, before his twenty-first year, with the highest honors. During his stay at the University he carried of several prizes, two of which were for Botany, one of his favorite studies. In Medical Science, Midwifery was the particular branch to which he devoted himself. He made it indeed, to some extent, a special duty. In the year 1857 he was appointed to the newly-established chair of Botany in McGill College; and had nearly completed his first course of lectures when prostrated by illness. His class-lectures were distinguished by an intimate knowledge of his subject, clearness of illustration, and appreciation of the difficulties of learners, which gave earnest of the highest success as a teacher of this delightful branch of natural science. During his studies in Scotland, he made a large collection of Botanical Specimens; and it was his delight, when time and opportunity offered, to add to and increase this from the great variety to be found on the Mountain, and in the vicinity of Montreal. He had commenced a detailed catalogue of Canadian plants, which it is hoped may be sufficiently advanced to be in part, at least, published; and which would have given him a high place in American Botany.—Dr. Barnston held until the time of his death the office of Curator and Librarian to the Natural History Society. He was one of its most valued members, and foremost and most active friends. He read many interesting papers, and delivered many delightful, and instructive lectures, before its members; and among those of his own age, whom he has left behind, we fear the Society will find few upon whom his mantle will fall.—In private life, the Doctor was quiet, unassuming and gentle. There was something about him which provoked to love; and to those with whom he was intimate, he was a friend indeed. For a young man, who had so lately entered upon the practice of a profession numbering so many old and honor-ed members, he enjoyed a large share of the public patronage; and his devoted attention at the bed-sides of his patients, and the uniform kindness and gentleness which characterized his treatment of them, would in time have assuredly gained him an extensive practice. A constitution naturally delicate, and ardent devotion to his scientific and professional pursuits, conspired to invite and hasten the inroads of disease; but, unwilling to abandon his cherished fields of usefulness and study, he held out to the last, and worked until the night had come. He then resigned himself meekly to the will of God. His sufferings at times were very severe; but he bore them with resignation; and his end was peace. He was a member of the Church of England; and was cheered by the prayers of its Priests, and received at their hands the Holy Communion shortly before his last hour came. He leaves behind him a young wife, to whom he had been married scarcely a year, and an infant daughter. It were vain in us to attempt to console them under their sad bereavement. But God tempers the wind to the shorn lamb. The husband and the father is not lost, but gone before. He cannot return to us; but if we strive, and watch and pray, we shall assuredly go to him:—

> " 'Tis sweet, as year by year we lose
> Friends out of sight, in faith to muse
> How grows in Paradise our store.
>
> " Then pass ye mourners cheerly on,
> Through prayer unto the tomb,
> Still, as ye watch life's falling leaf,
> Gathering from every loss and grief
> Hope of new spring and endless home."

Dr. Barnston's remains were interred on the Monday following his decease. The Principal, many of the Professors and Students of McGill College, the Dean and a large number of the Medical Faculty, and a great concourse of friends, followed him to the grave. He sleeps in a quiet nook in our new Cemetery—on the side of that Mountain he has so often traversed, in order to gather fresh specimens of plants and flowers, to illustrate and adorn the science he loved so well.

A. N. R.

ANNUAL MEETING OF THE NATURAL HISTORY SOCIETY.

At the Annual General Meeting of the Natural History Society of Montreal, held on Tuesday evening, May 15th, 1858,—

Present:—Principal Dawson, President, in the chair; Doctors Wright, Fenwick, Jones, Fraser, Craik, Hingston, and Kolmeyer; and W. H. A. Davies, H. Rose, T. M. Taylor, E. Murphy, Jno. Leeming, Jos. T. Dutton, Hen. Bouker, A. N. Rennie, D. Robertson, Esqrs.

The Report of last Annual Meeting of the Society was read over and confirmed.

The Reports of the Council, Curator and Librarian, and Treasurer, were presented,—(they will be found below.)

On motion of Mr. Davies, seconded by Mr. Leeming, it was ordered, That the Report of the Council, with those of the Curator and Treasurer, be received and printed under the direction of the Council.

The meeting then proceeded to the election of officers for the ensuing year, and

Messrs. Rose and Murphy were appointed Secretaries.

The election of Officers by ballot resulted as follows:

Principal Dawson, *President*, elected unanimously.
Rev. A. de Sola, LL.D.,................ 1*st. Vice-President.*
The Anglican Lord Bishop of Montreal,.. 2*d.* "
E. Billings, Esq.,......................3*d.* "
Dr. Hingston, ...*Corresponding Secretary.*
Jno. Leeming, Esq.,.....*Recording Secretary.*
Jas. Ferrier, Jun., Esq., *Treasurer.*
Dr. Fenwick, ...*Curator and Librarian.*
W. S. M. D'Urbain,.....*Sub-Curator.*

COUNCIL:

Dr. Jones. Dr. Fraser. A. N. Rennie, Esq.
W. H. A. Davies, Esq. W. Chapman, Esq.

It was then moved by Mr. Murphy, seconded by Mr. Rose,

That the Secretaries be added to the Publishing Committee, which was carried unanimously.

Mr. Taylor, moved, seconded by Mr. Robertson,

That the thanks of the Society are hereby given to the retiring Office-bearers and Council for their valuable and efficient services during the past year. Carried unanimously.

After some conversation on the subject, it was moved by Mr Taylor, seconded by Mr. Rose,

That the Council be authorised to sell the building in the possession of the Society, for such sum as they can obtain not less than two thousand pounds, clear of brokerage and seignorial dues, and that the details of the arrangement be left with them,—which was carried.

The meeting then broke up.

Annual Report of the Council of the Natural History Society of Montreal, for the year ending May 18th, 1858.

The Council of the Natural History Society have the honor to lay before the members, the following Report of the condition and proceedings of the Society during the past year, along with some suggestions for the consideration of their successors in office.

The Council have much pleasure in noting that the past year has been one of marked interest to the students of natural history in this city. In the month of August last, we had the honor and pleasure of giving a hearty welcome to "The American Association for the Advancement of Science," which met for the first time in this city and province. This meeting has been the most noteworthy event which has ever happened in the history of the Society. Mainly through the efforts of the Society was this meeting brought about. In conjunction with influential citizens of Montreal, you invited the Association to meet here in the year 1857. This invitation having been cordially accepted, your Council, co-operating with the Local Committee of the "Association," made every effort to provide suitable accommodation for its several meetings, and for the hospitable entertainment of its members. These efforts, the Council are happy to report, were eminently successful. In the most prompt and cordial manner the Court House, with its halls and rooms, so admirably adapted for the purposes of the "Association," was put at the disposal of the Local Committee. The City Council also freely granted the use of the City Hall to your Society, for the public entertainment of our guests.

In accordance with the resolution of the Society, a portion of the funds granted by the Legislature for the reception of the "Association," was appropriated for a public Conversazione in the City Hall. This meeting was held on Thursday, Aug. 13, 1857, and was attended by about 800 of our fellow-citizens, who welcomed with much satisfaction the officers and members of the "Association." Considering our inexperience in the management of such large assemblies, it was yet most gratifying to witness the general excellency of the arrangements, and the complete success of the entertainment. For the interest of the meeting your Council were successful in obtaining for exhibition the celebrated Indian curiosities and pictures, the property of Paul Kane, Esq., who, with a liberality worthy of all praise, placed these valuable objects freely at our disposal.

The Council feel that they not only express their own sentiments, but also those of every member of this Society, when they state that the opportunity which this scientific convention afforded them of meeting with so many gentlemen of scientific celebrity, was in the highest degree gratifying, and an honor which they highly appreciate. We had then amongst us the distinguished representatives of the Geological and Linnean Societies of Britain, together with the savans of the United States and Canada, vying with each other in the exposition of their scientific discoveries. Many valuable papers were read, and facts of interest and value elicited in discussion, in the various sections into which the Association was distributed. In the more popular departments of geology and ethnology the citizens generally took a deep and appreciating interest. In the various sections it was also gratifying to note the cordial reception and honorable position accorded to the representatives of Canadian science. May we not indulge the hope that a Canadian Scientific Associaion may soon be organized, and take an honorable place alongside of similar institutions in Europe and America?

Your Council have good reason to believe that this most successful meeting of the "American Association" has awakened an interest in scientific pursuits, both in this city and in the province at large, which will yet prove most beneficial in its results. Your Society has, undoubtedly, reaped much advantage from this event. Its zealous members have been greatly cheered, its numbers considerably increased, and hopes have been awakened, that it will yet occupy a higher position of scientific eminence than that to which it has yet attained.

The Council report with regret that their sanguine expectations of being able to proceed with the erection of a new and more commodious building than that which the Society now occupies have been frustrated. In the report of last year it was announced that a site had been obtained, on very liberal terms, from the Governors of McGill College, that plans had been prepared for the building, that contributions to a considerable amount had been subscribed, and that we only waited a favorable offer for the purchase of the present building to commence operations. This last and indispensible step to further progress has, contrary to their expectations, not yet been carrièd into effect. In these circumstances the Society must wait a more favorable season for the prosecution of this good project. Your Council are equally of opinion with their predecessors, that the premises now occupied are most unsuitable in many important particulars, either for a museum, library, or lecture room, and that no great improvement can be expected in any of these departments until a building erected for their special use has been obtained. The Council would earnestly commend this matter to the immediate consideration of their successors.

Your Council have also to report that petitions have again this year been presented to His Excellency the Governor General, and to both Houses of the Legislature, urging them, from public and national considerations, to grant a more liberal sum of money to the Society for scientific purposes, than we have hitherto received. It may be confidently said that there is no scientific institution in the country so comprehensive in its aims as ours is, possessing a larger collection of scientific objects than our museum contains, or publishing transactions on natural history of greater scientific value than are to be found in our Journal—these facts, we therefore think, entitle us to some more marked consideration at the hands of the Legislature than we have yet obtained. We deem it at least but justice that this, the oldest and not the least honorble of the incorporated institutions of the country, should be placed upon an equal footing as regards public support with the Canadian Institute of Toronto. Hitherto we have been left mainly to our own efforts and resources in arranging and furnishing our museum and library; and the building we now occupy, together with our valuable collections in zoology, geology, and ethnology, testify to the liberality of our members and friends. But it is now felt that if the Society is to take that place which the rapid progress of modern science demands, large additions *must* be made to its museum and library, and some method adopted to keep alive a public interest in its proceedings. This last desirable object the Council think would be best attained by the publication and gratituous distribution of our transactions among the members. Preceding Councils have advised and attempted this, but as yet without success. With our limited income such a step has hitherto been quite impossible. It is therefore to be hoped that the prayer of our just and reasonable petition to His Excellency the Governor and to the Legislature will meet with a favorable response.

LECTURES.

Your Council have much pleasure in reporting that the series of Lectures, in accordance with the Somerville bequest, have been of much interest this season, and been generally well attended. The gentlemen who have lectured with so much acceptance are all members of your Society, and are entitled to your thanks for their zeal on its behalf. The Council deem that it would be an improvement, did your funds permit, to invite some of the distinguished naturalists of Britain, the United States, or Canada West, to take part in these lectures. They would commend this matter to the consideration of their successors, hoping that means may be found to carry it into effect.

The subjects of the lectures are as follows:—

Things to be observed in Canada and especially in Montreal and its vicinity, by PRINCIPAL DAWSON, the President, 25th February.

Scripture Botany, by the REV. A. DESOLA, LL.D., 4th March.

On the Alkalies, by T. S. HUNT, Esq., 8th March.

Marine Algæ, by the REV. A. F. KEMP, 18th March.

The Boracic Acid Springs of Italy, by MR. DUTTON, 25th March.

MUSEUM.

The Council have much pleasure in reporting that the Museum has undergone a thorough review and re-arrangement, under the able superintendence of Mr. W. S. M. D'Urban, for some time our sub-curator. The departments of Ornithology and Mammalia have been carefully classified, and many new specimens added. Upon each object the specific name has been placed; and the divisions of genera, family and class, have been noted and labelled. The Ethnological collection has also been judiciously arranged and described. The valuable collection of Minerals and Fossils, The "Canadian Naturalist" is now a good vehicle for the publication of investigations and discoveries in the Natural History of Canada. It has a wide circulation in Canada, the United States and Europe. The Committee are therefore in a position to invite communications from those engaged in scientific pursuits, Short statements of interesting facts will be equally acceptable to the Editors as more elaborate papers.

The Committee beg to draw the Society's particular attention to the fact, that this Journal of admitted value to science, although edited by its members, is not published at the cost or risk of the Society; but is entirely supported by its own subscribers, and issued at the risk of the publisher. The members of the Society have therefore no special privilege in regard to it, and can only obtain it on payment of the full subscription price, over and above their annual subscription to the Society. This is a state of things which your Committee cannot regard as satisfactory. The Committee are decidedly of opinion that it would be most beneficial to the Society, were each member to receive a copy of the Journal gratuitously, on the payment of his annual subscription. Nothing they conceive would more materially promote the interests of the Society or the advancement of that department of science with which it is identified than this. They therefore deeply regret that the Society's funds will not admit of such a desirable object being immediately carried into effect. They cannot help comparing their condition, in this respect, with that of the Canadian Institute of Toronto. That Society has been able, by a liberal annual parliamentary grant, to give its Journal gratuitously to its members and to circulate it widely among the scientific institutions of America and Europe; whereas our Society, older, and equally devoted to the advancement of Canadian science, has hitherto been all but left to its own resources. It is therefore to be hoped that the Legislative aid for which we have again applied, will this year be granted, so that we may be able to assume our just position as a Canadian Scientific Institution. The publication of our Journal for circulation among our members, and for distribution as a vehicle of scientific research among learned societies, is one of the chief objects, on account of which we have again urged our petition upon the Legislature. Your Council are of opinion that this is a step of the utmost importance to the future welfare of the Society, and would recommend that it be prosecuted with perseverance and energy by their successors.

The Council would further notice, that, during the past year the monthly meetings of the Society have been regularly held, and sustained with some spirit. At each meeting one hour has been devoted to business, and the remainder of the evening to the reading of scientific papers and to discussions on topics of natural history.

As most of these papers have been or will be published in the Journal, it is unnecessary further to refer to them here. The Council trust that the next year will be one of even greater activity and zeal than the past. A wide field of investigation is open in this province to the students of natural science. Some departments have not yet been touched, and many are but partially treated. This Society offers to the lovers of nature a happy stimulant to exertion, together with the fellowship of kindred minds, and a medium through which discoveries may be communicated to the world.

Report of the Curator and Librarian.

The Curator has reason to congratulate the Society upon the marked improvements in the general appearance and actual value of the Collections in its Museum and Library. This will be adjudged from the following report of Mr. W. S. D'Urban, Sub-Curator, whose services to the Society can now be fully appreciated :—

REPORT OF THE SUB-CURATOR.

Prof. James Barnston, M.D., Curator :

Sir,—In compliance with your request, that I would draw up a short statement of the arrangements effected by me in the Museum of the Society during the time I had the care of the collections, I beg to submit the following brief summary of them.

In the first room to the left, on the second floor, I have assembled all the Vertebrate Animals, with the exception of the Birds. The Canadian Mammalia are cased separately, and are classified and named. A few foreign specimens, belonging to such orders as are not represented in Canada, are also cased and stand next to those of this country. Such specimens as are of too great size for the cases occupy the middle of the floor. This room also contains two large cabinets of specimens illustrating Comparative Anatomy, two cabinets of Reptiles (Canadian and Foreign), and one case of Foreign Fish. The walls are hung with Deer's Heads and Antlers, and various parts of Vertebrated Animals are disposed in the remaining vacant portions of the room.

The room adjoining the last has the side on the right entirely devoted to the Invertebrata. There are here displayed twelve cases of Insects systematically arranged, one large case of Crustacea, one of Echinodermata, and one of Polypi, whilst various fine specimens of Corals are exhibited on the walls and underneath the cases. Two other sides and the centre are occupied by ten flat cases on tressels, respectively devoted to Miscellaneous Objects, Pottery, Objects of Historical Interest, Articles of Clothing of various nations, Objects of Interest from Battle-fields, North American Antiquities, Roman Antiquities from Pompeii, Vegetable Substances, Coins, Medals and Medallions. The walls above are hung with the weapons of different races of men, and various other Ethnological specimens. On the remaining side of the room stands the large cabinet containing the fine Botanical Collection, and round it are hung various Vegetable substances.

The long room on the other side of the passage, opposite the Mammalian Room, contains the collection of Mounted Birds, three sides being devoted to North American species, the whole of which are grouped under their respective families and orders, and to each specimen is attached a printed label indicating its scientific and English name; to which I have added, whenever practicable, its sex, locality, &c. The fourth side is allotted to Birds from various parts of the world, of which there is a large collection, as yet only partially arranged. There is also a case containing a small collection of Foreign Nests and Eggs. In the centre of the room are two long table-cases; one contains a considerable collection of Foreign Shells, arranged under their proper families; and the other, when the specimens are numerous enough, will be filled with Canadian and American species.

In the Curator's room, adjoining the Bird Room, is placed a large chest for Bird-skins, collections of Insects, &c., for which there is no available space in other parts of the Museum.

The room on the ground floor opposite the Library contains the whole of the extensive collection of Minerals, as well as those of Fossils and Geological specimens, all of which have been cleaned and neatly arranged.

It will thus be seen that every branch of Natural History is more or less fully represented in the Museum. My aim has been to exhibit as prominently as possible everything which might tend to illustrate Canadian Natural History, and to arrange the specimens in such a manner as would give a clear idea of their scientific classification. The shortness of the time allotted me, the number of subjects to be attended to, and the small means at my disposal, will I trust be taken into consideration and admitted as some excuse that these objects have not been carried out as successfully as could have been wished; and I am glad that I can report the collections in, at least, tolerable order and good preservation.

I have the honor to be, Sir,
Your obedient servant,
WILLIAM STEWART M. D'URBAN,
Sub-Curator.

Montreal, May 10th, 1858.

The Curator may observe here, that a considerable number of Birds, some of our smaller Mammalia, as well as numerous Reptiles, Insects, Mollusks, &c., have been added to the Museum during the past year, besides the articles contained in the subjoined list of donations; a portion of which were presented by the Sub-Curator, and the remainder acquired by purchase.

The following list of Donations to the Museum and to the Library, is respectfully submitted.

JAMES BARNSTON, M.D.,
Librarian and Curator.

Montreal, 18th May, 1858.

* * *

DONATIONS TO THE LIBRARY, 1857-58.

Statutes of Canada, 1857; in French and English; 8vo., half-calf; two copies.

Journal of the Legislative Assembly, with Appendices; 10 vols., 8vo., half-calf.

Maps appended to Report of the Commissioner of Crown Lands, 4to., half-calf.

Table des Statuts Provinciaux en force dans le Bas Canada, 1857; 8vo., half-calf; 2 copies.

Report of the Canada Geological Survey for the years 1853-54-55-56; 8vo., cloth; 2 copies.

Journal and Transactions of the Board of Agriculture of U. C.; No. 4, Vol. 1.

Report of the Commissioners of Crown Lands of Canada for 1856, 8vo.

Bombay Magnetical and Meteorological Observations, 1854-55, 4to., bd., ... H. E. I C.

Report of the Superintendant of the U. S. Coast Survey for 1855; 4to., cloth, } Geo. F. Houghton, Vermont.

Smithsonian Institution Reports for 1855 and 1856; 2 vols., 8vo., cloth. Smithsonian Contributions to Knowledge, Vol. IX.; 4to., cloth.	Smithsonian Institution.
Annual Report of the Board of Regents of the Smithsonian Institution, Washington, U. S., 1855-56, 1 vol.	
Patent Office Reports for 1853-54-55; 8vo., cloth; 6 vols.	U. States Patent Office.
Fourth Annual Report of the Sec'y. of the Massachusetts Board of Agriculture; 8vo, cloth. Report of Commissioners on the Artificial Propagation of Fish; pamphlet. 14th Annual Report relating to the Registry and Returns of Births, Marriages, Deaths, &c., in Massachusetts for 1855.	C. L. Flint, Secretary to the Massachusetts Board of Agriculture, Boston.
Catalogue of the N. Y. State Library 1856, Maps, Manuscripts, &c.; 8vo., half-calf, Annual Reports of the Trustees of the N. Y. State Library for 1855-56-57, 17th Annual Report of the Regents of the University of the State of N. Y., 1857; 8vo., cloth. Eighth, Ninth and Tenth Annual Reports of the Regents of the University of N. Y. on the condition of the State Cabinet of Nat. Hist., &c. A Report of the Navy Department of the U. States on American Coals, 1844. Various Pamphlets.	The Regents of the University of the State of New York.
Report of the Sanitary Commissioners on the Epidemic Yellow Fever of 1853, 8vo. Proceedings of the New Orleans Academy of Sciences. Vol. 1, No. 1. Constitution and By-laws " " " Annual Address read before the " " by Prof. J. L. Riddell, 1856. Report of the Special Committee of " " on the importance of a Geological Scientific Survey of the State of Louisiana. Papers relating to the Coal-field on the Upper Machita River. A Sketch of General Jackson, by himself.	New Orleans Academy of Sciences.
Bulletin of the Geographical and Statistical Society of New York, 2 vols.	
Address to Natural History Society of New York, pamphlet.	
Reports I. and II. Geological Survey of Missouri, U. S., by Prof. J. C. Swallow, State Geologist, 1 vol.	
Catalogue of the Human Crania in the Collection of the Academy of Natural Sciences of Philadelphia, by A. Meigs, M. D., Librarian, 1 vol.	
Proceedings of the Academy of Natural Sciences of Philadelphia from pages 17 to 72.	
The Canadian Journal of Industry, Science, and Art, conducted by the Editing Committee of the Canadian Institute, Toronto.	
The Journal of Education for U. C. Vols. 2, 3, 4, 5; 4to. Correspondence on the Subject of the School Law for Upper Canada. Annual Reports of the Model and Common Schools in U. C. for 1848 and '49.	Rev. E. Ryerson, D.D.
Lower Canada Journal of Education, French and English, 2 vols.; presented by the Hon. J. O. Chauveau.	

Agassiz's Contributions to the Natural History of the United States of America; 2 vols., 4to. cloth.	
Binney's Terrestrial Mollusks and Shells of the United States; 3 vols., 8vo. half-calf.	Dr. Gould, in accordance with will of author.
Blodget's Climatology of the U. S., imp., 8vo.	B. Dawson.
The Canada Educational Directory and Calendar for 1857-8.	
Catalogue de la Collection Envoyee du Canada a l'Exposition de Paris, 1855; 12mo.	L. A. H. Latour.
Letter of Chief Engineer in reply to Resol. of Council for information respecting Water Works.	
Report of the City Surveyor of Montreal, 1853.	
Les Servantes de Dieu en Canada.	
Hind's Essay on the Insects and Diseases injurious to the Wheat Crops, 8vo. cloth; 3 copies.	
Annals of the Lyceum of Nat. Hist. of N. Y. Vol. 5, and part of Vol. 6.	Lyceum of Nat. Hist., N. Y.
Transactions of the Academy of Sciences, St. Louis. No. 1.	Acad. Sciences, St. Louis.
Report on Strychnia, by Lewis H. Steiner, M.D.; pamph.	The Author.
Address delivered before the Am. Assoc'n for the advancement of Learning at Montreal, 1857, by Hon Charles Mondelet.	The Author.
Natural History in its Educational Aspects, by J. W. Dawson	The Author.
On the occurrence of Natro-boro-calcite with Glauber Salts in the Gypsum of Nova Scotia, by Prof. Henry How.	The Author.
Report on the Artificial Propagation of Fish	H. Wheatland.
Address at the Opening of the 103rd Session of the Society for the encouragement of Arts, Manufactures and Commerce, by Col. W. H. Sykes, 1856.	
Notes sur les Registres de Notre Dame de Quebec.	
Annual Announcement of Jefferson Med. College, Philadelphia, 1857-8.	
Proceedings upon the Dedication of Plummer Hall at Salem, Oct. 6, 1857.	
A Geological Map of Wisconsin, by J. A. Lapham.	The Author.
Illustrated Map of British Guiana, mounted with roller.	W. S. M. D'Urban.
Remains of Domestic Animals discovered among the Post-Pliocene fossils, by Prof. F. S. Holmes, Charleston, S. C.	

DONATIONS TO THE MUSEUM.

A Box containing a large quantity of Tertiary Fossils, Talcohuano Bay, Chili, S. A.	
A Box containing Fossils from supposed Coal measures. Aranco Bay, Chili; and a specimen of the Coal.	
Two Fossil Trilobites; Belleville, C. W.	J. H. Merchell, Esq.
Collection of Interesting Relics, numbering 29 specimens, from Sebastopol and other localities in the Crimea.	Dr. Gibb.
Snake (in Spirits) from heights of Inkerman	J. T. Dutton, Esq.
Skeleton of Common Rat	Dr. Fenwick.
2 Specimens of Cancer Sayii, Sable Island	Prof. Dawson.
3 Specimens of Clypeaster, Nova Scotia,	" "
Collection of British Birds' Eggs	Philip Holland, Esq.
Egg of Rhea Americana	
Gar-fish of the Atlantic, in spirits	
Chinese Lady's Shoes	Capt. Brown, of Bark *Emily*.
2 Bamboo Jars inscribed with Chinese Characters	

7 Cases British Lepidoptera, containing upwards of 400 species, named and arranged. "Pepper-pot" Bowl used by Natives of Demerara.	W. S. M. D'Urban.
A valuable collection of Rocks and Minerals from the volcanic regions of Italy	Geo. Platt, Esq.

REPORT OF THE FINANCE COMMITTEE.

The Special Committee appointed to report on the Finance operations of the Society for the year ending 18th May, 1858; beg to state that they have examined the Treasurer's Book and vouchers, (a recapitulation of which will be found annexed), and find that the general statement is much larger than usual, owing to the government grant and disbursements on account of the meeting of the American Association in this city in August of last year.

The amount received from subscribers during the past year is somewhat larger than the previous one, but not near so much as your Committee think ought to be obtained from our citizens, if a right appreciation of the great benefits the Society does and will confer was more generally felt, and they recommend renewed exertions on the part of the Society to bring its claims before the public, and especially do they desire to express their hope that this Society will be placed on the same footing as regards Parliamentary aid as its respected "younger sister" in Toronto, which is enabled to place its periodical in the hands of every one of its members in return for their subscription to the Society. If your Society could obtain similar favor from the Government, and be thus enabled to place its "bi-monthly Canadian Naturalist" in the hands of each of its members, it is not too much to expect that their number might readily be trebled, its efficiency very largely increased, and the Society placed on a footing which its antecedents and present prospects, justify your Committee in predicting would be alike honorable to the city, and greatly conducive to the promotion of the objects for which it was instituted.

Your Committee would draw attention to the very large amount paid for advertising and printing, and recommend rigid retrenchment in those items.

Your Committee believe that with an increased revenue for the coming year, arising from additional membership, as well as an additional grant from Government, with greater economy in advertising, &c., the fiscal affairs of your Society will continue to improve, and cease to be a source of anxiety to your officers, and permit them to avail themselves of purchases for its legitimate objects, which they regret to learn have, in some cases, been impracticable for want of necessary funds.

The whole nevertheless respectfully submitted.

Wm. Edmonstone,
James Ferrier, Jr.,
John Leeming.

DR. Montreal Natural History Society in account current with James Ferrier, Jr., Acting Treasurer. CR.

1858.	RECAPITULATION.	£	s.	d.
May 1.—To Cash for Salaries,		107	0	0
	Commissions,	7	14	3
	Repairs,	43	5	0
	Fuel,	41	19	0
	Gas,	9	6	6
	Water,	3	0	0
	Furniture,	5	13	5
	Birds, per Mrs. Broome and Hunter,	9	6	3
	Postages, &c., per Dr. Hingston's act.,	4	3	9
	Express Charges,	1	4	5
	Advertising and Printing,	77	10	2
	Insurance,	12	10	0
	Interest,	36	6	3
	Incidentals,	13	12	1
	H. H. Whitney, Treas. Amer. Assoc'n,	150	0	0
	A. N. Rennie, account of Services,	25	0	0
	C. Alexander, Refreshment account,	82	19	5
	Mr. Sprake, Band Services,	10	0	0
	J. C. Spence, Decorating Hall,	7	10	0
	Sundry persons, service at Soiree,	5	2	6
"	Balance to New Account,	43	4	4
		£696	7	4

1857.	RECAPITULATION.			
May 1.—By Balance in Treasurer's hands,		10	0	5
1858.				
May 1.—By Cash from Subscriptions and Diplomas,		128	5	0
	By " " Government Annual Grant,	50	0	0
	By " " " Special "	500	0	0
	By " " J. Hearle, 2 mos. rent of Lecture Room,	5	0	0
	By Interest from Montreal Savings Bank,	3	1	11
		£696	7	4

E. & O. E.

JAMES FERRIER, Jr., *Treasurer.*

Montreal, 1st May, 1858.

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF APRIL, 1858.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	30·060	29·950	29·961	28·4	51·9	40·0	117	·302	·188	·76	·82	·77	E. N. E.	N. E. by E.	E. N. E.	1·75	0·57	2·65	....	....	Clear.	Clear.	Clear.
2	29·916	811	761	37·0	60·2	46·2	199	283	·238	90	·54	·77	S. E.	S. W.	S. S. W.	0·00	0·00	0·00	....	....	C. Str. 10.	"	"
3	770	771	724	41·6	60·1	37·0	212	·310	·178	82	·60	·81	S. W. by S.	E. by N.	E. by N.	0·00	0·00	0·00	....	....	" 10.	"	Clear. Aurora Borealis.
4	828	718	651	32·0	48·9	46·7	143	242	262	79	74	84	N. E. by E.	S. E. by E.	S. E.	0·00	0·00	0·00	....	....	Clear.	C. C. Str. 10.	Str. 4.
5	714	657	579	43·6	55·5	46·7	231	315	286	83	71	92	S. S. E.	S. E.	S. by E.	0·00	0·00	0·00	Inapp.	....	Ni. 10.	" 6.	C. Str. 10.
6	710	726	932	33·4	42·6	25·5	175	134	100	94	50	74	W. S. W.	W. by N.	W. N. W.	0·00	20·10	21·50	....	....	Clear.	C. Str. 4.	Clear.
7	30·073	929	30·061	16·0	34·8	30·2	059	138	150	65	71	78	W. N. W.	W. S. W.	W. N. W.	21·30	14·90	16·25	....	....	"	Clear.	"
8	120	30·155	29·925	21·1	48·0	34·0	080	236	162	71	70	83	N. E.	S. E.	N. E. by E.	1·47	0·85	0·45	....	....	"	Str. 4.	C. Str. 9. Aurora Borealis.
9	29·650	26·549	510	28·4	31·5	30·6	117	168	161	76	95	95	N. E. by E.	N. E. by E.	N. by E.	8·82	15·21	9·62	0·573	....	Ni. 10.	Ni. 10.	C. Str. 10.
10	674	868	950	28·4	37·9	34·3	135	171	155	88	76	79	N. E. by E.	N. W.	N. W.	0·86	2·73	0·52	Inapp.	....	C. Str. 10.	C. Str. 1.	Clear. Aurora Borealis.
11	29·997	961	970	24·4	42·3	35·0	083	177	162	66	66	80	N. by W.	N. N. W.	N. N. E.	8·77	8·23	6·27	....	....	Clear.	Clear.	" Aurora Borealis.
12	874	850	729	23·6	47·9	39·0	105	212	188	66	62	77	N. E.	E. S. E.	N. E. by E.	4·00	3·31	2·14	....	....	"	C. C. Str. 6.	C. Str. 9. " "
13	698	464	467	37·2	13·0	40·3	178	261	241	81	96	98	N. E. by E.	N. E. by E.	N. E. by E.	10·37	6·85	6·52	0·600	....	C. Str. 10.	Ni. 10.	Ni. 10.
14	332	256	360	38·1	43·5	41·5	229	271	251	99	96	93	N. E. by E.	N.	W. by N.	2·90	5·52	0·00	Iaapp.	....	" 10.	C. Str. 10.	C. Str. 10.
15	327	378	476	36·9	47·0	44·3	207	249	282	98	77	97	S. S. E.	W. S. W.	S. W. by S.	0·20	10·41	5·61	....	....	" 10.	C. C. Str. 6.	Ni. 10.
16	370	614	635	38·1	56·1	37·0	208	308	184	92	69	85	S. W.	S. S. W.	W. S. W.	4·86	11·22	7·42	0·040	....	Str. 2.	C. Str. 4.	Clear. Aurora Borealis.
17	720	714	830	[illegible]·4	12·2	33·0	162	134	150	84	50	80	W. S. W.	W.	W. by N.	7·80	15·90	8·97	....	....	Clear.	" 8	Clear.
18	909	929	070	29·0	18·7	37·0	093	120	116	59	36	53	W. N. W.	N. W.	W. N. W.	0·02	7·02	9·43	....	....	"	Clear.	"
19	263	175	164	29·5	53·0	37·7	129	136	171	80	35	76	N. N. E.	N. by E.	S. by E.	0·88	1·01	1·33	....	....	"	"	Light Cirri. Lunar Halo.
20	045	793	655	33·5	50·6	36·2	175	186	170	94	51	80	E.	S. E. by E.	S. E.	0·48	7·97	7·52	0·253	....	C. Str. 8.	C. Str. 10.	Rain.
21	29·283	423	615	33·5	42·6	36·1	162	177	170	84	66	80	E. by S.	E. by N.	S. W. by S.	6·45	0·80	0·02	0·310	2·80	Snow.	" 10.	C. Str. 10.
22	730	686	548	34·0	51·5	45·0	182	289	251	95	76	84	S. E. by S.	S. E. by S.	S. by W.	6·02	1·98	3·27	....	....	C. Str. 2.	" 10.	Clear.
23	601	498	581	45·0	50·6	44·1	182	258	218	61	71	76	S. W.	W.	W. N. W.	10·96	13·13	8·93	0·263	....	C. C. Str. 8.	Ni. 10.	C. Str. 10.
24	603	592	760	34·5	35·5	32·0	155	177	088	79	85	49	W.	S. W.	S. W. by W.	8·20	8·63	19·36	....	....	C. Str. 6.	C. C. Str. 6.	Clear.
25	875	900	30·000	30·0	36·1	31·0	154	149	142	94	71	84	N. N. W.	W.	S. by W.	3·62	4·00	3·75	....	....	" 10.	C. Str. 6.	"
26	006	29·934	30·031	29·6	41·9	35·3	105	169	177	66	65	85	N. E. by E.	S. W.	S. S. W.	0·51	1·92	0·32	....	....	Clear.	" 10.	C. Str. 8.
27	29·912	847	862	30·0	55·0	39·1	180	157	131	73	38	55	W.	S. E. by S.	N. by E.	0·31	0·42	0·57	....	....	"	C. C. Str. 8.	Cirr. Cum. 6.
28	624	510	648	34·5	49·0	34·5	138	086	142	71	24	70	N. W.	W. N. W.	W.	10·82	8·10	16·23	....	....	C. Str. 10.	C. Str. 10.	Clear.
29	630	562	541	36·0	57·3	47·5	170	142	249	80	30	77	W.	W. by N.	S. by W.	9·48	32·02	6·16	....	....	Clear.	Clear.	C. Str. 6.
30	329	286	556	39·9	43·5	43·8	188	271	269	77	93	90	N. E. by E.	N. by E.	S. S. E.	7·08	8·05	1·90	0·803	....	C. Str. 10.	Ni. 10.	" 10.

REPORT FOR THE MONTH OF MAY, 1858.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2. p. m.	10 p. m.
1	29·762	29·877	30·065	41·0	54·2	41·1	·190	·206	·169	·74	·69	·65	N. W. by N.	W. by N.	N. W. by W	5·37	4·22	6·70	....	....	Clear.	Cirri. 2.	Str. 2.
2	30·316	30·265	306	34·1	49·6	59·0	·162	·175	·131	·80	·50	·55	N. W. by N.	N. W.	N. by W.	5·20	0·51	1·47	....	....	"	" 1.	Clear.
3	404	212	194	29·0	57·3	42·5	136	242	215	83	52	79	W. by N.	S.	S. by E.	0·64	0·70	1·15	....	....	"	Clear.	"
4	150	29·985	29·980	36·5	71·6	50·6	191	572	300	90	76	85	E.	S. E. by E.	E. S. E.	0·00	0·20	0·00	....	....	"	"	"
5	29·831	718	647	46·0	68·1	53·6	262	380	375	83	56	93	E. by N.	S. E. by E.	S. by E.	0·00	1·38	0·21	Inapp	....	C. Str. 10.	Rain.	C. Str. 10.
6	697	617	699	54·1	56·5	50·0	396	449	309	99	99	85	S. E. by S.	N. E. by N.	N. E. by N.	0·25	5·80	9·81	0·300	....	" 10	C. Str. 10.	Clear.
7	759	748	782	43.1	69·6	53·6	254	600	375	92	68	93	N. E. by N.	E. by S.	S. E. by S.	4·90	1·80	0·15	....	....	Clear.	Clear.	Cirr. Str. 4. Aurora Bor's.
8	895	662	684	42·3	78·2	58·1	222	550	537	83	58	70	E.	S. E. by S.	S. E. by S.	0·20	0·00	0·01	....	....	"	Cir. Str. 4.	C. Str. 10.
9	625	583	537	58·5	72·9	67·2	476	559	626	97	72	95	S. E. by S.	S. S. E.	S.	1·43	3·60	6·60	0·253	....	C. C. Str. 10.	C. Str. 6.	Cirr. Str. 2. Aur. Borealis.
10	737	739	866	41·0	54·5	45·2	190	231	218	74	55	76	W. by N.	W.	E. N. E.	16·06	10·40	2·70	....	....	C. Str. C.	" 4.	C. Str. 6.
11	914	814	701	36·2	50·1	46·8	170	283	305	80	78	99	N. E.	N. E. by E.	N. E. by E.	0·20	0·93	11·86	0·100	....	Cirr. 4.	" 8.	Rain.
12	395	411	505	45·4	55·0	44·7	293	382	241	98	96	84	N. E. by E.	N. E. by E.	S. W. by W.	5·25	6·19	3·58	1·266	....	Rain.	Rain.	C. Str. 10.
13	616	842	30·020	43·3	52·0	42·2	222	232	177	83	60	61	W. N. W.	W.	N. W.	17·40	14·17	8·00	....	....	C. Str. 4.	C. Str. 2.	Clear.
14	990	911	29·848	40·1	58·4	47·0	182	282	273	73	58	85	N. E. by E.	S. S. E.	S. E.	1·46	0·66	1·60	....	....	Clear.	Clear.	"
15	677	588	641	44·5	65·2	47·4	251	490	292	84	81	92	E. N. E.	E.	N. W.	3·56	2·31	8·08	Inapp.	....	C. Str, 10.	C. Str. 10.	C. Str. 6.
16	860	873	971	39·0	49·7	42·1	158	182	140	68	53	53	N. by W.	S. E. by E.	E.	9·60	13·77	15·07	....	....	" 10.	Cirr. 2.	Clear. Aurora Borealis.
17	894	816	798	46·0	68·1	45·0	269	282	251	88	58	84	W.	W.	S. by W.	1·20	1·48	4·70	....	....	Str. 4.	C. C. Str. 6.	C. Str. 6.
18	762	723	856	43·5	47·5	48·0	254	320	282	92	96	96	S. E.	S. by W.	W. S. W.	11·09	0·00	0·71	0·486	....	Ni. 10.	Rain.	Rain.
19	855	797	850	44·1	67·2	53·0	265	487	328	92	69	83	W.	S. by W.	S.	1·71	1·11	1·19	0·616	....	C. Str. 8.	C. Cuml. 4.	Cirr. Cum. 6. Lunar Halo.
20	655	600	643	49·1	52·4	47·2	345	334	320	99	86	98	S.	W. S. W.	N. by W.	4·31	6·81	4·20	0·112	....	Rain.	C. Str. 10.	C. Str. 10.
21	593	708	751	45·3	50·0	46·0	275	315	298	92	89	96	N. E.	S. W. by W.	N. E.	5·51	6·46	0·20	0·203	....	C. Str. 8.	Rain.	" 9.
22	884	909	30·003	44·0	60·4	48·0	279	330	219	99	76	89	E. N. E.	W. N. W.	W. N. W.	7·15	1·22	4·05	0·103	....	" 8.	C. Str. 1.	C. C. Str. 7. Lunar Halo.
23	959	702	29·569	47·2	67·6	52·5	256	407	361	81	63	93	W. N. W.	W. by S.	S. S. W.	3·00	3·72	9·45	0·203	....	Cumulus. 4.	C. C. Str. 10.	Rain.
24	365	410	590	52·4	61·6	55·7	361	338	515	94	65	77	N. E. by E.	S. S. W.	N. E. by E.	7·40	12·17	3·62	1·606	....	Rain.	C. Str. 8.	C. Str. 10.
25	724	849	824	47·4	61·1	50·5	276	310	309	86	60	85	N. E. by E.	N. E.	E. S. E.	1·46	8·11	3·51	....	....	C. C. Str. 6.	Cir. Cum. 4.	C. C. Str. 6.
26	823	825	892	51·7	73·0	56·3	296	416	336	79	52	75	N. E. by E.	S. E. by S.	S. E. by. S.	2·05	6·65	1·90	....	....	" 6.	" 4.	Str. 10.
27	849	845	947	54·6	75·1	57·8	308	409	268	74	50	56	E. by N.	N. E. by E.	N. E. by E.	0·20	1·43	1·41	....	....	Str. 4.	C. Str. 6.	Clear.
28	30·060	995	946	51·9	74·2	60·1	221	467	462	59	53	90	W. N. W.	E. by N.	S. E.	5·13	0·42	0·16	....	....	Clear.	Clear.	"
29	047	907	811	52·1	77·6	59·0	282	475	358	73	49	73	E.	S. E.	S. E. by S.	0·12	0·92	2·15	....	....	Cirri. 2.	"	"
30	29·918	805	876	58·1	76·3	61·0	323	348	456	74	39	88	S. E.	S. E.	S. E.	0·62	3·90	1·43	....	....	Clear.	"	"
31	910	675	608	50·0	79·9	70·1	283	772	436	78	78	57	S. E.	S. S. E.	S. S. E.	0·12	8·00	10·42	Inapp	....	Cirri. 4.	C. Str. 6.	C. Str. 6.

REMARKS FOR APRIL, 1858.

Barometer. ...... {Highest, the 19th day, 30·203 inches.
Lowest, the 14th day, 29·256 "
Monthly Mean, 29·757 inches.
Monthly Range, 0·947 "

Thermometer. {Highest, the 2nd day, 61°1.
Lowest, the 7th day, 16°0.
Monthly Mean, 39°06.
Monthly Range, 45°1.

Mean of humidity, ·717.

Greatest intensity of the Sun's rays, 94°1.

Lowest point of terrestrial radiation, —14°7.

Amount of Evaporation in inches, 2·310.

Rain fell on 11 days, amounting to 2·832 inches; it was raining 7 hours, and accompanied by thunder on 1 day.

Snow fell on 1 day, amounting to 2·80 inches; it was snowing 5 hours and 40 minutes.

Most prevalent wind, W. N. W. Least prevalent wind, N.

Most windy day, the 7th day; mean miles per hour, 17·45.

Least windy day, the 2nd day; mean miles per hour, 0·00.

Aurora Borealis visible on 6 nights. Lunar Halo visible 1 night.

The Electrical state of the atmosphere has indicated high tension.

Ozone was in rather large quantity.

Frogs first heard on the 15th day.

Swallows first seen on the 15th day.

Errata.—In Reports for February and March, 1858, instead of "Amount of *Snow* in Inches," read Amount of *Rain* in Inches; and instead of "Amount of *Rain*," read Amount of *Snow*.

REMARKS FOR MAY, 1858.

Barometer . ..... {Highest, the 3rd day, 30·104 inches.
Lowest, the 24th day, 29·365 "
Monthly Mean, 29·751 inches.
Monthly Range, 1·039 "

Thermometer ... {Highest, the 31st day, 80°5.
Lowest, the 14th day, 30°6.
Monthly Mean, 53°02.
Monthly Range, 49°9.

Greatest intensity of the Sun's rays, 99°9.

Lowest point of terrestrial radiation, 30°1.

Mean of humidity, ·784.

Amount of Evaporation in inches, 2·89.

Rain fell on 14 days, amounting to 5·387 inches; it was raining 97 hours 25 minutes, and was accompanied by thunder on 1 day.

Most prevalent wind, N. E. by E. Least prevalent wind, W.

Most windy day, the 13th day; mean miles per hour, 13·19.

Least windy day, the 4th day; mean miles per hour, 0·06.

Aurora Borealis visible on 3 nights.

Lunar Haloes visible on 2 nights.

Ozone was present in large quantity.

The Electrical state of the atmosphere has indicated high tension.

Shad first caught on the 29th day.

Frost occurred on the morning of the 14th day.

MONTHLY METEOROLOGICAL REGISTER, AT MONTREAL, (LATITUDE 45° 30′ N., LONGITUDE 73° 36′ W.,) FOR THE MONTH OF FEBRUARY, 1858.

HEIGHT ABOVE THE LEVEL OF THE SEA, 57·07 FEET.

BY A. HALL, M. D.

Day of Month.	Barometer, Corrected and reduced to Fah., 32°.			Temperature of the Air.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction and Force of the Wind, from 0, Calm, to 10, Violent Hurricane.			Amo'nt of Snow in Inches.	Amo'nt of Rain in Inches.	Clouds and their Proportion, in Numbers, from 0, Cloudless, to 10, perfectly Overcast.			OBSERVATIONS.
	7 a. m.	2 p. m.	9 p. m.	7 a m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.	
1	30·299	30·272	30·159	-1·0	+10·0	+6·0	·028	039	·028	·68	·57	51	W 1	N 1	N 4	....	....	Cu. St. 10	Cu. St. 1	Cu. St.	Slight Fog early A. M. Snow during the night.
2	29·754	29·421	29·540	+13·5	22·0	20·0	·057	·112	·091	72	93	·85	N N E 1	N 2	N 2	....	11·5	Nim. 10	Nim. 10	Nim.	Snow.
3	654	764	909	25·0	27·0	28·0	·117	·111	·417	87	75	76	W 3	W S W 2	W S W 2	....	5·0	Nim. 10	Cu. St. 4	Cu. St.	
4	30·005	961	30·002	18·0	23·0	19·8	·082	·073	·081	84	59	77	W S W 1	W S W 2	W S W 2	....	....	Strat. 2	Strat. 6	Cu. St.	
5	016	952	29·978	13·0	17·0	11·8	048	078	045	62	83	60	N W 2	N W 2	N W 1	....	....	Cu. St. 10	Cu. St. 10	Cu. St.	Lunar Corôna.
6	069	30·091	30·093	9·7	18·8	10·2	045	077	039	68	76	57	W N W 1	W 2	W 1	....	....	Strat. 10	Cir. St. 3	0	Bright Zodiacal Light.
7	29·837	29·741	29·350	17·0	22·2	24·6	078	101	117	83	86	87	W S W 1	N N W 1	N N W 1	....	0·75	Nim. 10	Nim. 10	Nim.	Snow.
8	991	30·122	30·154	17·0	12·0	7·0	078	045	017	83	60	29	N N W 1	N N W 1	N N W 2	....	1·25	Cu. St. 10	0 0	0	Bright Zodiacal Light.
9	30·109	29·866	29·471	-3·0	5·9	17·0	041	029	078	96	51	83	N N W 2	N 2	N 3	....	....	Fog.	Nim. 10	Nim.	Snow.
10	29·293	302	579	±13·0	20·0	5·0	048	108	027	62	100	49	S W 1	W S W 6	W S W 2	....	9·75	Strat. 1·5	Nim 10	Strat.	Snow. Faint Zodiacal Light.
11	898	988	30·146	-12·0	-3·0	-5·0	013	071	022	51	74	63	N 3	W 3	W 3	....	0·25	Cum. 0·5	0 0	0	Bright Zodiacal Light.
12	30·225	30·217	281	-17·0	+0·3	-2·4	002	017	022	9	39	63	W 1	W 1	W 1	....	....	Pog.	Strat. 3	0	" " "
13	400	302	316	-11·4	-2·0	-5·5	007	014	015	29	34	43	N 1	N 1	N 1	....	....	0 0	0 0	0	" " "
14	185	018	29·962	-7·2	+2·1	+4·5	014	020	027	34	43	49	N E 3	N N E 2	N E 2	....	....	Strat. 2	Cu. St. 10	Nim.	Solar Halo. Rad. 22°.5.
15	006	030	30·110	-2·0	9·8	6·0	014	039	029	34	57	51	N W 2	W 3	W 2	....	Inap.	Strat. 2	Cu. St. 4	0	Imperfect Solar Halo. Bright Zodiacal Light. Auroral Bank.
16	29·996	29 837	29 917	+1·0	11·0	6 2	014	042	029	34	59	51	W N W 1	W 2	N W 2	....	....	Strat. 0·5	Cu. St. 8	0	Faint Zodiacal Light.
17	30·005	30·006	30·129	-1·8	8·5	1·9	014	022	020	34	35	43	W 3	W 3	W 2	....	....	Strat. 1	Strat. 4	0	
18	057	069	200	-2·3	5·0	2·9	014	027	023	34	49	45	W N W 2	W 2	W 2	....	....	Cu. St. 10	Cir. 6	0	Faint Auroral Light.
19	349	298	234	-9·4	1·8	-1·0	015	025	028	43	43	68	N W 1	N 1	N 1	....	....	0 0	0 0	Cir. Str.	
20	079	29·819	29 777	-9·9	0·0	+12·7	023	045	048	76	68	62	N 1	N 1	N 1	....	....	Strat. 2	Cu. St. 10	Cu. St.	
21	29 737	588	638	+13·0	24·0	24·5	048	094	117	62	73	87	S W 1	S W 1	W S W 2	....	....	Cu. St. 10	Nim. 10	Nim.	Snow.
22	30·031	30·054	30·111	6·0	12·0	6·0	029	045	029	51	60	51	W 1	W 1	W 1	....	Inap.	0 0	0 0	0	Lunar Corona. Faint Auroral Light.
23	270	330	342	-4·4	11·2	6·8	022	036	017	63	49	29	N N W 2	W S W 2	W S W 2	....	....	0 0	0 0	0	Hazy, A. M. Lunar Corona.
24	285	29·964	29·805	-1·8	21·0	21 0	014	074	074	34	83	83	S S W 1	S 2	S W 2	....	....	Cir. St. 2	Cu. St. 9	Cu. St.	Hazy, A. M. Solar Halo. Rad. 22°.5.
25	29·716	655	757	+22·5	32·8	28·0	119	182	123	93	95	82	S S W 1	W 2	W N W 1	....	0·50	Nim. 10	Nim. 10	Cu. St.	Slight snow during day.
26	893	901	877	19·6	26·0	17·3	081	111	078	77	81	83	N N W 1	W N W 1	W S W 1	....	0·50	Cu. St. 7	0 0	0	
27	671	565	650	22·8	39·0	32·0	106	195	143	86	82	79	S S W 1	S S W 1	S S W 1	....	....	Cu. St. 10	Cir. St. 10	Cu. St.	Lunar Eclipse, seen from Dr. Smallwood's house, St. Martins.
28	709	555	496	32·9	34·0	33·0	176	196	188	94	100	100	W S W 1	N N E 1	N N E 5	0·08	....	Nim. 10	Nim. 10	Nim.	Rain, sleet, snow.

REPORT FOR THE MONTH OF MARCH, 1858.

	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.			7 a. m.	2 p. m.	9 p. m.	
1	29·689	29·735	29·785	28·0	30·0	24·0	·117	·148	·094	·76	·89	·73	N 1	N 1	N 1	0·38	1·5	Cir. 10	Cu. 9	Cu. St.	
2	629	518	671	10·0	20·0	10·0	·057	·108	·057	·79	·100	·79	N 3	W N W 3	W N W 1	....	0·25	Nim. 10	Nim. 10	Cu. St.	Snow.
3	895	30·032	30·144	2·0	8·0	1·0	·034	·034	·019	·71	·54	·42	W N W 2	W S W 2	W S W 2	....	2·00	Strat. 1	0 0	0	Dense Fog at 2.30 A. M. Lunar Corôna.
4	30·210	186	190	-8·0	10·5	3·0	025	033	009	80	48	18	N 0·5	N 0·5	N 0·5	....	....	0 0	0 0	0	Faint Zodiacal and Auroral Lights. Lunar Corôna.
5	140	29·917	29·821	-5·5	10·5	8·0	015	045	040	43	69	64	W N W 1	W N W 3	W N W 3	....	....	Cu. St. 10	Cu. St. 6	Nim.	Snow.
6	29·851	782	761	+6·0	14·4	8·9	029	061	051	51	73	77	W 2	W 2	W 2	....	1·40	Cu. St. 10	Cu. St. 10	Cu. St.	
7	701	609	611	7·5	18·0	15·2	012	167	055	19	68	64	W 2	W 2	W 1	....	....	0 0	Cir. St. 9	0	Lunar Corona.
8	673	604	511	6·0	14·0	10·0	029	051	039	51	63	57	N W 2	N W 2	S 2	....	....	Strat. 2	0 0	Cu. St.	
9	324	235	312	11·5	22·0	15·0	051	084	070	70	71	82	N N W 3	W 2	W 2	....	Inap.	Cu. St. 10	Cu. St. 9	Cu. St.	Slight Snow, A. M.
10	459	522	633	12·0	25·0	21·0	078	117	096	83	87	85	W N W 3	W 2	W 2	....	Inap.	Cu. St. 10	Cir. St. 6	0	" " " Faint Auroral Light.
11	453	296	738	22·0	38·0	24·0	101	229	094	86	100	73	S 1	S W 2	W N W 2	....	0·75	Nim. 9	Nim. 10	Cu.	Snow, Rain, Sleet. " " "
12	30·024	979	30·049	9·8	28·0	22·0	031	135	101	46	88	86	S W 2	S W 2	W S W 2	Inap.	Inap.	0 0	Cu. St. 10	0	Snow. Brilliant Aurora, with streamers.
13	412	30·442	357	9·0	21·0	13·0	022	096	063	35	85	81	N 2	W 2	W 2	....	Inap.	0 0	0 0	Strat.	Bright Aurora.
14	114	29·991	096	14·2	23·3	22·2	067	119	101	81	93	86	N N W 2	N 2	N 1	....	1·50	Cu. St. 10	Nim. 10	Cu. St.	Snow. Bright Aurora.
15	165	30·175	118	35·0	44·3	37·0	149	189	199	74	64	90	W 1	W N W 1	W S W 1	....	2·50	Cu. St. 10	Cu. St. 10	Nim.	Solar Eclipse invisible in consequence of clouds.
16	066	29·939	29·779	36·5	44·6	41·0	212	282	257	100	96	100	E 0·5	E S E 0·5	S W 1	....	....	Fog.	Cu. St. 10	Nim.	Rain.
17	29 645	523	410	42·2	53·0	43·0	267	369	254	100	90	92	S W 0·5	S W 0·5	S W 0·5	0·71	....	Cu. St. 10	Cu. St. 10	Cu. St.	Rain. Faint Auroral Light early A. M. of 18th.
18	323	476	861	43·0	44·7	30·0	231	228	131	83	76	55	W S W 4	W 3	W 2	Inap.	....	Cu. St. 4	Cu. St. 10	Cu. St.	Snow during night.
19	30·179	30 314	30·461	29·8	33·3	26·5	111	150	105	67	80	75	N 2	N N E 2	N N E 4	0·18	Inap.	Strat. 3	0 0	0	Rain during day. [Melodia first heard.
20	360	124	29·861	24·0	42·3	35·0	077	134	191	60	50	·90	W S W 1	W S W 1	S W 1	....	....	0 0	0 0	0	Faint Auroral Light. Rain beginning about midnight. Fringilla
21	29·402	29·117	170	38·0	40·2	39·0	229	248	238	100	100	100	S 2	S W 2	W 6	0·15	....	Nim. 10	Cu. St. 10	Cu. St.	Rain.
22	534	702	956	29·0	32·5	25·0	160	181	117	100	100	87	N W 5	N W 2	N W 2	0·28	Inap.	Cu. St. 10	0 0	0	Auroral Light. Lunar Corôna. High wind during night.
23	30 106	30·035	30·038	18·5	28·0	26·2	087	117	076	84	76	52	N N W 3	W 1	S S W 0·5	....	....	0 0	0 0	0	Lunar Halo. Rad. 30°. Auroral Light.
24	078	29·904	29·987	19·4	33·0	25·0	055	131	105	53	70	75	N N E 1	S W 2	N N W 2	....	....	Strat. 3	0 0	0	Double Lunar Corôna.
25	29 884	661	628	30·0	35·5	30·0	130	142	130	78	70	78	N N W 1	S W 1	N W 3	....	....	Cir. St. 7	Cu. St. 5	Cu. St.	" " "
26	803	786	851	27·0	32·0	28·0	111	143	117	75	79	76	N 1	W N W 2	N 4	....	....	Cu. St. 10	Cu. St. 4	Cu. St.	Lunar Corôna.
27	879	761	741	23·0	35·0	32·0	089	142	143	72	70	79	W 2	W S W 2	W S W 1	....	....	Cu. St. 8	Cu. St. 5	Cu. St.	Lunar Halo. Rad. 42°5.
28	720	724	763	29·5	43·0	38·6	117	142	124	72	51	51	N 2	N 1	W S W 0·5	....	....	Strat. 1	0 0	0	Lunar Corôna. Saw a Butterfly.
29	857	884	962	30·6	46·0	41·0	136	286	147	78	92	57	Calm.	N 1	N N W 2	....	....	0 0	Cu. St. 3	Cu. St.	
30	30·025	30·081	30·104	40·0	47·0	40·0	139	156	182	56	48	73	N N E 2	N E 1	E 1	....	....	0 0	Cu. St. 0·5	Cir.	
31	178	138	174	38·0	48·0	41·0	136	189	169	62	56	65	N N W 1	N 1	N 1	....	....	0 0	0 0	0	Faint Auroral Light.

REMARKS FOR FEBRUARY, 1858.

Barometer ...... Highest, the 13th day: 30·400 inches
Lowest, " 10th " 29·293 "
Monthly mean, 29·9513 inches.
Monthly range, 1·107 "

Thermometer. . Highest, 27th day: +44° 0.
Lowest, 12th " —20° 0.
Monthly mean, +10° 95.
Monthly range, 64° 0.

Warmest day was the 28th, its mean temperature being 35° 30.
Coldest " " 11th, " " " —6° 56.
Greatest intensity of the sun's rays, 78° 2, on the 27th day.
Mean of humidity, ·637.

It rained on 1 day during 13 hours. There fell 0·08 inches. It snowed on 9 days during 74 hours 5 minutes. There fell 29·50 inches, which melted yielded an equivalent to rain of 2·51 inches. Conjoined melted snow and rain equivalent to 2·59 inch's.

The most prevalent wind was the W.

The least prevalent wind was the S.

The mean monthly Dew Point is —1°5.

The most windy day was the 11th.

There was no calm day.

There is no record of wind from the E.N.E., E., E.S.E., S.E., and S.S.E.

Cloudless days occurred on the 13th, 22nd, and 23rd.

The Aurora was seen on 3 nights, but faintly. It was not visible on 10 nights.

The Zodiacal Light was seen on 8 nights. On one night particularly fine and bright.

An eclipse of the moon took place on the 27th.

Ozone was in moderate proportion.

N. B. The rain and snow guages are noticed each morning at 10 a. m.

REMARKS FOR MARCH, 1858.

Barometer ...... Highest, the 19th day, 30·461 inches.
Lowest, " 9th " 29·235 "
Monthly mean, 29·8430 inches.
Monthly range, 1·226 "

Thermometer. . Highest on the 31st day, 53° 0.
Lowest " 5th " —9° 0.
Monthly mean, 26° 03.
Monthly range, 62° 00.

Greatest intensity of the sun's rays, 111° 8, on the 29th day.
Warmest day was 17th; its mean temperature being 46° 06.
Coldest day was 4th; " " 1·83.

It rained on 6 days during 29 hours; there fell *in toto* 1·70 inch; It snowed on 10 days during 37 hours 15 minutes. There fell 9·9 inches, which, melted, yielded an equivalent to rain of 0·941 in's. Conjoined melted snow and rain equivalent to 2·641 inches.

The most prevalent wind was the N.

The least " " were the E.S.E. and S.S.W.

No record of wind from the N.E., E.N.E., S.E., and S.S.E.

The most windy day was the 18th.

The most windy hour between 11 and 12 p. m. of 21st.

There was no calm day.

Cloudless days occurred on 4th, 20th, and 31st.

Ozone was in rather large proportion.

The Aurora was seen on 10 nights, with streamers brilliantly on 1. On 7 nights it was not present.

The Zodiacal Light was seen on one night.

The Solar Eclipse of the 15th was invisible here in consequence of the clouded condition of the atmosphere.

The Fringilla Melodia (Song Sparrow,) was first heard on 20th, and a butterfly "sporting in the sunbeam" was noticed on 28th.

N. B. The rain and snow guages are noted each morning at 10 a. m,

MONTHLY METEOROLOGICAL REGISTER, AT MONTREAL, (LATITUDE 45° 30′ N., LONGITUDE 73° 36′ W.,) FOR THE MONTH OF APRIL, 1858.

HEIGHT ABOVE THE LEVEL OF THE SEA, 57·07 FEET.

BY A. HALL, M. D.

Day of Month.	Barometer, Corrected and reduced to Fah., 32°.			Temperature of the Air.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction and Force of the Wind, from 0, Calm, to 10, Violent Hurricane.						Amo'nt of Rain in Inches.	Amo'nt of Snow in Inches.	Clouds and their Proportion, in Numbers, from 0, Cloudless, to 10, perfectly Overcast.						OBSERVATIONS.
	7 a. m.	2 p. m.	9 p. m.	7 a m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.		2 p. m.		9 p. m.				7 a. m.		2 p. m.		9 p. m.		
1	30·201	30·078	30·013	31·8	50·5	41·0	·149	·186	·169	·84	·51	·65	N W	2	N W	1	N W	1	....	....	Cir.	3	Strat.	3	0	0	
2	050	29·942	29·866	41·8	56 7	44 2	·184	·194	·196	·70	·42	·68	S W	1	S W	1	S W	1	....	....	Cu. St.	10	0	0	0	0	Lunar Halo early A. M. of 3d.
3	29·862	866	937	46·0	52·6	41·0	·192	·146	·155	·62	·36	·58	N W	3	N E	1	N N E	1	....	....	Cu. St.	10	0	0	0	0	
4	998	790	743	33 0	50·0	40·0	149	234	215	71	65	69	N	1	N	1	N N W	1	....	....	Cu. St.	10	Cu. St.	10	0	0	Solar Halo, A. M.
5	807	672	668	44·5	54·0	49·0	204	194	258	68	48	71	S	1	S	3	S W	1	0·06	....	Nim.	10	Cu. St.	10	Nim	10	Rain.
6	811	851	30·037	36 0	43·0	27·0	149	142	093	71	51	63	W	2	W N W	1	W N W	1	0·04	....	Cu. St.	10	Cu. St.	7	Strat.	2	High wind.
7	30·189	30·109	181	19·5	34·5	29 6	065	136	111	62	65	67	N W	3	W N W	3	W N W	2	....	....	Cir. St.	5	0	0	0	0	Faint Auroral Light.
8	257	138	021	30 6	39·5	36·0	118	167	129	68	68	61	N	1	N	1	N W	1	....	....	0	0	Cir. St.	7	Cu. St.	9	
9	29·733	29·579	29 606	34 5	33 0	30·0	183	188	174	90	100	100	N E	1	N N E	1	N N E	1	0·12	....	Nim.	10	Nim.	10	Nim.	10	Rain. Slight Snow during night.
10	724	945	30·062	31·0	33·0	35·0	149	178	191	84	81	90	N	3	N	2	N W	1	0·37	Inap.	Cu. St.	10	Cu. St.	10	Cu.	4	Aurora, with streamers.
11	30·156	987	022	31 6	41·5	37·0	112	235	221	63	91	100	N W	1	N W	1	N	2	....	....	0	0	Cirr.	2	0	0	Bright Aurora, with streamers.
12	043	914	29·861	35·0	44 5	41·2	127	251	244	62	84	91	N E	1	N E	1	Calm.		....	....	0	0	Cir. Str.	4	Cu. St.	10	
13	29·729	584	527	36·5	43·0	40·8	199	248	235	90	88	91	E	1	E S E	1	S E	1	0·05	....	Nim.	10	Cu. St.	10	Cu. St.	10	Rain.
14	420	381	405	38·0	45·0	41·3	201	228	244	86	76	91	N E	1	N N E	1	N N E	1	0·55	....	Cu. St.	10	Cu. St.	10	Cu. St.	10	Hazy early A. M. Rain.
15	410	429	550	43·0	48·0	41·8	254	260	244	92	78	91	N N W	1	N N W	1	N N W	1	0·01	....	Cu. St.	10	Cu. St.	10	Nim.	10	Rain.
16	624	674	706	43·0	52·0	41·8	193	173	177	71	46	66	W	4	W	2	W	1	0·08	....	Strat.	2	Cu. St.	6	0	0	
17	815	821	444	44·0	46 4	37·0	173	146	103	60	47	45	N N W	3	N N W	3	N W	2	....	....	0	0	Cu.	5	0	0	
18	30·070	30·124	30·198	41·8	49·0	41·0	173	099	177	73	29	66	N W	1	N N W	1	N W	1	....	....	0	0	Cu.	0·5	0	0	Lunar Corôna. Faint Auroral Light.
19	367	254	220	36·5	47 0	39·5	118	125	139	68	40	56	N N E	2	N N E	1	S	1	....	....	Cirr.	1	0	0	Cir. St.	3	
20	189	29·909	29·717	37·0	52 3	37·0	136	166	199	62	43	90	E	1	E S E	1	S E	1	....	....	Cum.	7	Cu. St.	10	Nim.	10	Rain, changing to snow during night.
21	29·438	492	716	34·5	40·6	37·0	190	167	178	95	68	81	E S E	1	E	1	N N E	1	0·70	Inap.	Nim.	10	Nim.	10	Cu. St.	10	*Hirundo Bicolor*, Common Swallow, seen this day, Lun. Halo. Rad. 25°.
22	831	815	634	42 2	54·0	50·5	222	263	283	83	64	78	W	1	S S E	1	S E	1	0·05	....	Strat.	4	Cu. St.	10	Strat.	3	
23	475	585	605	55·3	48·0	45·0	335	285	198	80	85	65	S	2	S W	4	S W	3	....	....	Cu.	3	Cu. St.	10	Cu. St.	10	Slight Snow. Lunar Corôna.
24	720	723	830	34·5,	38·4	34·0	155	165	120	79	72	61	W N W	3	W	4	W -	2	0·06	Inap.	Cu. St.	10	Cu. St.	10	Cir. St.	8	Hard Frost. Lunar Corona.
25	992	30·101	30·165	32·0	38·8	32·0	100	131	113	54	55	60	W N W	2	W	3	W	2	....	Inap.	Cu. St.	10	Cu. St.	9	0	0	
26	30·136	100	119	36 4	43·0	36·6	127	177	136	62	66	62	N E	2	N N E	2	W	1	....	....	Cir. Cum.	9	Cu. St.	10	Cu.	5	
27	120	020	29·885	44 8	47·0	41·2	160	112	134	53	34	50	N E	2	N E	1	N E	1	....	....	0	0	Cu. St.	10	Cu. St.	10	
28	29·704	29·615	668	39·0	51·4	43·0	104	104	108	43	28	37	N N E	1	N	3	W	1	....	....	Cu. St.	10	Cu. St.	10	0	0	Lunar Corôna.
29	761	659	621	47·4	57·0	49·0	176	094	175	57	20	50	W	4	W N W	4	W N W	3	....	....	0	0	0	0	0	0	Wind squally.
30	419	593	636	47·0	48·0	46·5	202	213	251	62	63	84	S	1	N N E	3	N N E	3	Inap.	....	Cu. St.	10	Nim.	10	Nim.	10	Rain. First arrival from sea.

REPORT FOR THE MONTH OF MAY, 1858.

	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.		2 p. m.		9 p. m.				7 a. m.		2 p. m.		9 p. m.		
1	29·917	29·936	30·165	47·5	55·0	44·5	·125	·194	·173	·39	·48	·60	N	3	N N W	2	N W	2	0·34	....	0	0	Cu. St.	7	Cu. St.	6	
2	30·400	30 410	430	42·0	48·0	41·5	·147	·156	·113	·57	·48	·42	N,	1	N N W	2	N E	1	....	....	0	0	Cu.	2	0	0	
3	551	421	370	48 3	50·8	41·0	·120	·139	·155	·36	·39	·58	N	0·5	S W	1	S W	0·5	....	....	0	0	0	0	0	0	
4	275	120	037	45 8	62·0	50·5	202	216	245	71	40	65	Calm.		S	0·5	Calm.		....	....	0	0	0	0	0	0	*Cypselus Pelasgius* (Chimney Swallow) first seen this day. *Grystes* [*Nigricans* (Black Bass) first caught at Lachine.
5	29·960	29·853	29·811	52·0	61·6	55·0	245	297	276	65	55	87	S	0·5	S	2	S	0·5	....	....	Cu. St.	10	Cu. St.	10	Cu. St.	10	Slight rain.
6	743	721	806	56·0	54·0	50·0	433	390	270	100	93	72	S S W	0·5	N N E	3	W	4	0·27	....	Nim.	10	Nim.	10	Cu. St.	5	Rain.
7	930	944	982	52·5	60·0	52·0	289	310	308	76	60	79	N E	3	N E	0·5	E	0·5	0·05	....	0	0	Cu.	2	0	0	Brilliant Aurora, with streamers.
8	30·032	916	858	60·5	69·0	59·0	309	306	283	64	43	54	Calm.		S S E	1	Calm.		....	....	Cirr.	5	Cir. St.	8	0	0	
9	29·761	645	629	59·0	69·0	58·0	358	411	439	73	60	88	S	3	S S W	2	W	2	Inap.	....	Cu. St.	10	Cu. St.	10	Nim.	10	Rain, thunder, and lightning.
10	916	952	30 007	47·0	52·3	44·5	208	208	160	66	53	53	W	2	N W	1	Calm.		0·13	....	Cu. St.	9	Cu.	5	Cu. St.	8	Rain.
11	30·070	880	29·596	40·0	55·0	45·0	132	181	251	52	43	84	N E	2	N E	2	E N E	2	....	....	Cu. St.	8	Nim.	10	Nim.	10	Rain.
12	29·511	475	505	46·0	52·0	42·2	280	361	204	88	93	68	E	1	W S W	2	W	4	0·44	....	Nim.	10	Nim.	10	Cu.	10	Faint Auroral Light seen through northern clouds.
13	820	30·020	30·172	40·0	51·0	42·0	258	149	142	71	40	51	W N W	3	W N W	3	W	1	0·43	....	Cir. St.	5	Strat.	3	0	0	Distant Thunder.
14	30·188	090	29·900	47·0	51·0	47·0	241	210	212	84	58	63	N N E	2	N E	0·5	Calm.		....	....	0	0	0	0	0	0	
15	29 821	29·673	777	46·0	63·7	48·2	238	373	247	77	62	71	Calm.		Calm.		N W	2	Inap.	....	Cu. St.	10	Cu. St.	8	Cu. St.	4	Rain. Wind squally.
16	30·014	30·054	30·144	46·4	51·2	42·0	238	142	121	77	37	43	N W	4	N W	2	Calm.		0·06	....	0	0	Cu.	3	0	0	Solar Halo. Rad. 23°.5. Faint Auroral Light.
17	086	009	29·930	44·8	58·0	46·0	173	160	215	60	34	69	W	3	W N W	1	W	4	....	....	Cu. St.	8	Cu. St.	10	Cu. St.	10	Rain.
18	29·871	29·873	942	44·7	47·0	46·2	251	273	273	84	85	45	E S E	3	S E	3	S	2	0·05	....	Cu. St.	10	Nim.	10	Nim.	10	Rain.
19	30·024	990	924	45·5	59·0	51·0	286	289	136	92	54	35	W	3	S S E	0·5	Calm.		0·17	....	Cu.	7	Cu.	9	Cu. St.	10	Rain.
20	29·799	734	957	48·8	52·0	49·0	303	341	322	80	89	92	S S E	1	Calm.		Calm.		0·03	....	Cu. St.	10	Cu. St.	10	Nim.	10	Rain.
21	761	811	893	46·0	50 0	46·0	262	234	286	84	65	92	N	1	N E	1	Calm.		0 28	....	Cu. St.	10	Nim.	10	Nim.	10	Rain.
22	982	30·092	30·105	44·3	57·0	49·0	251	295	258	84	63	71	N N E	4	N	1	W	0·5	0·09	....	Nim.	10	Cu.	7	0	0	Rain. *Hirundo Purpurea* first seen.
23	30·108	29·966	29·733	55·0	64·0	55·0	269	327	295	62	57	68	S W	2	S	2	S	3	Inap.	....	Cir.	5	Cu. St.	10	Cu. St.	10	Rain.
24	29·368	569	686	51·0	59·0	55·0	368	323	186	96	65	51	N	2	N N W	3	N N W	3	1·05	....	Nim.	10	Cu. St.	10	Cu. St.	10	Rain.
25	29·856	929	924	56·5	68·8	53·0	342	260	269	78	54	57	N	3	N	3	N E	3	0·01	....	Strat.	2	C. St. & Cu.	5	0	0	Swallows building.
26	928	891	900	54·0	69·0	56·0	321	329	308	80	46	69	N E	2	S	4	Calm.		....	....	Cir. St.	8	Cir. St.	5	Cu. St.	8	
27	981	978	30·080	51·6	70·0	59·0	315	353	255	83	48	49	S E	0·5	N E	0·5	N E	1	....	....	Cir. St.	9	Cum.	6	0	0	Shad-flies first noticed (*Ephemera vulgata*).
28	30·206	30·154	154	60·5	69·0	58·0	283	398	352	54	56	70	E	3	N E	3	Calm.		....	....	0	0	Strat.	3	0	0	Shad-fish (*Alosa Præstabilis*) in market.
29	204	101	051	60·2	72·8	59·0	338	339	323	65	41	65	N E	1	S	0·5	Calm.		....	....	0	0	0	0	0	0	
30	092	29·954	29·953	61·5	72·0	61·0	235	237	299	43	30	52	Calm.		S S E	3	Calm.	4	....	....	0	0	0	0	0	0	
31	29·973	973	758	67·4	77·0	68·0	450	469	373	48	67	54	S	4	S	6	S S W	5	....	....	Strat.	3	Cir. Cu.	5	Cir. Cu.	7	High wind, continuing most of day.

REMARKS FOR APRIL, 1858.

Barometer ...... Highest on the 19th day: 30·367 inches.
Lowest " 14th " 29·381 "
Monthly mean, 29·8371 inches.
Monthly range, 0 986 "

Thermometer. . Highest on the 23d day: 60°4.
Lowest " 7th " 17°5.
Monthly mean, 41°41.
Monthly range, 42°9.

Greatest intensity of the sun's rays, 117·6 on the 6th day.
Warmest day was the 29th, its mean temperature being 51°13.
Coldest " " 7th, " " " 27°80.
Mean of humidity for the month, ·664.

Rain fell on 10 days during 64 hours 10 minutes, amounting to 2·09 inches.

Snow fell on 4 days during 11 hours 50 minutes, the amount inappreciable, and estimated as rain.

The most prevalent wind was the N. W.

The least prevalent wind was the S. S. E.

No record of wind from the E.N.E., S.S.W., or W.S.W.

The most windy day was the 29th.

The most windy hour between 3 and 4 A. M. of same.

There was no calm day.

A cloudless day occurred on the 29th.

Ozone was in rather small ratio.

N. B. The rain and snow guages are noted each morning at 10 a. m.

REMARKS FOR MAY, 1858.

Barometer ...... Highest on the 3rd day: 30·551 inches.
Lowest " 24th " 29·[illegible]68 "
Monthly mean, 29·9472 inches.
Monthly range, 1·183 "

Thermometer. . Highest on the 31st day, 79°0.
Lowest " 2d " 33°0.
Monthly mean, 53°70.
Monthly range, 46°00.

Greatest intensity of the sun's rays, 119°5, on the 29th day.
Warmest day was the 31st, its mean temperature being 70°80.
Coldest day was the 2nd, " " 43°83.
Mean of humidity for the month, ·634.

Rain fell on 14 days during 87 hours 28 minutes, amounting to 3·40 inches. No snow fell.

The most prevalent wind was the N. E.

The least " " were the E.N.E., E.S.E., and W.S.W.

A record of wind from each of the sixteen quarters, the division employed.

The most windy day was the 31st.

The most windy hour between 12 and 1 p. m. of 31st.

A calm day occurred on the 15th.

Cloudless days occurred on the 3d, 4th, 14th, 29th, and 30th.

Ozone was in rather large ratio, its mean average being 2·93.

N. B. The rain and snow-guages are noted each morning at 10 a. m.

THE

CANADIAN

NATURALIST AND GEOLOGIST.

VOLUME III. AUGUST, 1858. NUMBER 4.

ARTICLE XXIV.—*Agassiz' Contributions to the Natural History of the United States.* (Vols. 1 & 2. Boston.)

(*Concluded from our last.*)

The second chapter is one of the most important in the work. It treats of the actual basis in nature of the various ranks of groups in which animals are arranged,—the *Branch* or *Province*, the *Class*, the *Order*, the *Family*, the *Genus*, the *Species*. Is there any reason in nature why this particular gradation should be adopted, or is it merely an artificial convenience. Agassiz thinks that it is natural, and that naturalists, like many other workers, have reached to a truly scientific system without knowing it. He believes that the successive subdivisions of the animal kingdom are based on the following considerations:—

"Branches or types are characterised by the *plan* of their structure.

Classes by the *manner* in which the plan is executed, as far as ways and means are concerned.

Orders by the *degrees of complication* of structure.

Families by their *form*, as far as determined by structure.

Genera by the *details* of the execution in special parts.

Species by the relations of individuals to one another and to the world in which they live, as well as by the proportions of their parts, their ornamentation, &c."

The very attempt thus to attach a scientific value to these divisions is a great step in advance; for, though such distinctions have almost instinctively fixed themselves more or less strongly on the minds of naturalists, no one has given them full and formal expression as Agassiz now does. The attempt, however, is full of difficulty; and, as might have been anticipated,—and as the author himself fully and modestly admits,—must be regarded as very imperfectly successful; though the whole doctrine of type and homology in nature implies that there must be a definite gradation of groups. Let us examine it in detail; and, in doing so, we would wish to direct the attention of students in natural history to a careful consideration of the subject as set forth in the work itself.

1. Following Cuvier in this, our author justly regards the animal kingdom as separating itself into four great types of structure known as Sub-Kingdoms, Provinces, or, as Cuvier originally called them, "*Branches*." This first distinction is based wholly on the idea of pattern or type. But here the question arises,—type or pattern in what? In art, when we speak of type, pattern or style, we may refer to a spoon, a piece of calico, or a cathedral. In nature, in like manner, each great kingdom has its own sets of types, corresponding to the materials employed and the uses they are to serve. If we speak of animals, then, as one portion of the Creator's works, that we may think correctly of their plan, it is necessary that we first clearly comprehend the material and place in nature of the animal, and its truly essential qualities. This question—what is the animal?—our author scarcely touches, perhaps because it is so constantly and clearly present to his own mind. We may answer it in its most important bearing by the words used by Linnæus to indicate the distinction between the animal and the plant, "Sententia, sponteque moventia," adding the related fact, enforced by modern physiology and chemistry, that, in reference to its sustenance and material, the animal life is based upon the vegetable. The animal is an organised being endowed with sensation and volition, and, as the agents of these powers, with nervous matter and muscular fibre; while to supply the material of these, and maintain their vital powers, it consumes and oxidizes previously organised matter. In other words, the processes necessarily performed by the animal are the assimilation and oxidation of vegetable or animal matter. These processes go on to supply the essential structures of the animal, tele-

graphic nerve and contractile muscle; and these are produced and maintained to subserve its psychical endowments of sensation and voluntary motion.

This being the general and essential nature of the animal, type or pattern may be discovered in any one of these three leading peculiarities: in the psychical nature of the animal; in the arrangement of its nerve and muscle, or, subordinate to them, in the arrangement of the hard parts which protect the former or serve for the attachment of the latter; or lastly, in that of the apparatus employed for nutrition, respiration and circulation. It must happen, that, to a certain extent, these will agree as grounds of arrangement. Thus if the nerve matter be arranged on a given plan, this must indicate something corresponding in the psychical endowments, and may probably require something corresponding in the apparatus for motion, protection, and nutrition. Still, some of these points may be more important than others. For instance, psychical characters, not being material, cannot be accurately measured; apparatus for nutrition has a broad similarity amounting almost to general identity of plan, over the whole animal kingdom, while again it is subject to modification in nearly related species, intended to consume different articles of food. For such reasons, when we study the types of animals, we prefer to take as our chief guide that part of the physical structure which is most independent of the accidents of outward relations, and which is most nearly connected with the intelligence, which is the essence of the animal. Hence Agassiz very justly traces the old division of Aristotle into *enaima* and *anaima*, and that of Lamarck into *vertebrata* and *invertebrata*; not so much to the perceived difference in blood or skeleton, as to the perception, perhaps unconsciously, that there is an essential difference between the plans of structure in those animals that have the nervous matter protected in separate cavities of skull and spinal column, and those that have it confounded, as it were, with the organs of vegetative life. Hence also Cuvier, examining more minutely the nature and value of these differences, proposed the four branches of the Vertebrata, Mollusca, Articulata and Radiata, based on the arrangement of the structures protective of the nervous matter or subserving voluntary motion. Hence also Owen, penetrating more deeply into the real philosophy of the subject, names these branches from the arrangement of the nerve matter itself, Myelencephala, Heterogangliata, Homogangliata, and Nematoneura;

including in this last the Acrita, or those in which a nervous system, existent no doubt, has not yet been distinctly traced.

Agassiz, as we have seen, prefers to take a more general view of the plan of structure as a whole, though accepting the four branches of Cuvier. We confess that we entertain doubts whether this is not, as compared with the position of Owen, a backward step. We might point, for example, to undoubted Radiata even among the Echinodermata and Acalephae, in which the general radiated structure does not exist, while the type of nervous system does. On the other hand, the separation of the Bryozoa, the Rotifera and the Entozoa from the Radiates, now so generally accepted, appears to us very likely to be condemned in the future progress of Zoology, as an error caused by want of attention to dominant structures, as compared with those which pertain to merely vegetative life and accidents of existence.*

Before leaving this subject of the division of Animals into four great branches, we would pause to insist on the fact, that while, as our author very properly insists, this division does not depend on gradation of rank or complexity of structure, it is still inseparably connected with these, just as in art, certain styles are connected with higher and others with lower works. The Vertebrate in no form sinks so low as the Invertebrate; and though the Articulates and Molluscs may be regarded as parallel series, both are higher on the whole than the Radiates and lower than the Vertebrates. These differences are not arbitrary, but apparently based on the inherent capabilities of the types themselves.

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* As an illustration of the reasons for doubt on this subject, we may point to the fact that in Allman's recent able monograph, he admits the difficulty of establishing the homology of the nervous systems in Bryozoa and Tunicates. In short, he finds affinities in the accessories, but fails to find them, or finds them only obscurely, in the essential structures pertaining to sensation and voluntary motion. Huxley, who differs materially from Allman in his explanation of these supposed homologies, finds the same difficulty. On the other hand, some marine worms affect the general aspect of Bryozoa; and we know from personal observation as well as from the statements in the work now before us, that the Vorticellidæ, with no good claim to be regarded as Molluscs, are little else than minute Bryozoa. In our view the radiates should be regarded as not strictly a distinct branch, but as a sort of root-stock of the animal kingdom, approaching in many points in its plans of structure to the plant, and in other points uniting itself closely with the basis of the Molluscous and Articulate branches.

2. *Classes*, we are told, refer to the "ways and means employed" in the structure of animals, or to the "combinations of their different systems of organs",—somewhat vague grounds, which we may perhaps illustrate by an example, all the more clear because very familiar. Let us suppose the animal kingdom, not the living clay from the hand of the Great Potter, but a collection of earthenware vessels appertaining to table uses; and that we have to effect an orderly arrangement of the mass. First we might observe that among this collection of vessels of all shapes and sizes, there were only a few different patterns,—some all white, some white and gold, some with a landscape, some with a flower; and each having in connection with this its peculiar style of form. We might then adopt, as our first basis of arrangement, pattern or type, both for simplicity and as indicating in the highest respect the mind of the artist. Having formed four great heaps on this ground, we should find that we had in each, vessels differing in material, in shape, in use, in complexity of parts; and we might carry out our farther division on any of these grounds. According to our author, we take the material, whether common earthenware or china, for instance, as our ground, this corresponding to ways and means of construction. Just, however, as we found that type could not be dissociated from rank, so neither can ways and means; and these moreover have a direct relation to use, and until we had read the views of Prof. Agassiz, we had supposed that this, or perhaps more generally, position in the economy of nature, was the predominant idea in the class. Let us place before our minds the classes of Invertebrates as proposed by Agassiz:—

Radiata.	*Mollusca.*	*Articulata.*
1. Polypi.	1. Acephala.	1. Worms.
2. Acalephae.	2. Gasteropoda.	2. Crustacea.
3. Echinodermata.	3. Cephalopoda.	3. Insects.

Now, it is quite evident that in these several classes the ground insisted on by our author, the manner of combination of the structures, is highly distinctive, and affords a good ground for discrimination in practical Zoology; but it appears to us that there is a higher reason in the distinction of these groups, which refers to the idea of modification of the type with reference to uses or place in nature. First, then, we would observe that there is a manifest gradation in elevation of rank. The Echinoderm, Cephalopod, and Insect, are respectively at the head of their branches, representing therefore their highest perfection; the Polypi, Acephala and Worms are respectively at the lowest or simplest portion of each branch. Secondly, it is manifest that the three highest classes have each a special reference to the highest development of the psychical powers of the branch, and of its organs of sense and nervous system. The three middle classes represent the highest adaptation of the type to variety of locomotion and habitat. The three lowest classes represent the modification of the type with especial reference to the highest development of the mere vegetative life. Class, then, represents the expression of the general intention of the Creator in the construction of the members of a branch. Ways and means, or combinations of organs, are the indications of that intention which we most readily perceive. In this limited sense we are quite willing to accept the definition of our author.

In the ordinary division of the vertebrates, even the popular mind, we think, has all along recognised this principle. The Mammal, the Bird, the Reptile and the Fish, differ not merely in structure; but the first is the expression of the Vertebrate type in relation to its highest psychical powers, the second in relation to extent of locomotive powers, the third and fourth in relation to mere vegetative life in air and in water respectively.

3. *Orders* have been fruitful causes of difference among naturalists. The ground on which they should stand is thus stated:

"To find out the natural characters of orders from that which really exists in nature, I have considered attentively the different systems of Zoology in which orders are admitted and apparently considered with more care than elsewhere, and in particular the *Systema Naturæ* of Linnæus, who first introduced in Zoology that kind of groups, and the works of Cuvier, in which orders are frequently characterised with unusual precision, and it has appeared to me that the leading idea prevailing everywhere respecting orders, where these groups are not admitted at random, is that of a definite rank among them, the desire to determine the relative standing of these divisions, to ascertain their relative superiority or inferiority, as the same order, adopted to designate them, already implies. The first order in the first class of the animal kingdom, according to the classification of Linnæus, is called by him *Primates*, expressing, no doubt, his conviction that these beings, among which Man is included, rank uppermost in their class. Blainville uses here and there the expression of "degrees of organization," to designate orders. It is true Lamarck uses the same expression to designate classes. We find, therefore, here as everywhere, the same vagueness in the definition of the different kinds of groups adopted in our systems. But if we would give up any arbitrary use of these terms, and assign to them a definite scientific meaning, it seems to me most natural, and in accordance with the practice of the most successful investigators of the animal kingdom, to call orders such divisions as are characterised by different degrees of complication of their structure, within the limits of the classes. As such, I would consider, for instance, the Actinoids and Halcyonoids in the class of Polypi, as circumscribed by Dana; the Hydroids, the Discophoræ, and the Ctenoids among Acalephs; the Crinoids, Asterioids, Echinoids, and Holothuriæ among Echinoderms; the Bryozoa, Brachiopods, Tunicata, Lamellibranchiata among Acephala; the Branchifera and Pulmonata among Gasterpods; the Ophidians, the Saurians, and the Chelonians among Reptiles; the Ichthyoids and the Auoura among Amphibians, etc."

It would be injustice to the author not to state that in the succeeding paragraph he carefully guards the reader against supposing that he denies or ignores distinction of rank in other groups, as in classes, for instance; but he holds that here it is predominant. We could have wished that the view had been followed farther into detail; for, taking orders as we now have them, there are some evident exceptions. In the birds, for instance, the orders differ far more markedly in adaptation to conditions of life and structures depending on these, than in grade. In the orders of insects there is the same idea, along with that of type or pattern in a subordinate form; for we must bear in mind that type, and the homologies which express type, descend in different degrees through all our sub-divisions from the great leading types to the genera. It is expressed as distinctly in the elytra of beetles and the scales of butterflies as in the skeletons of vertebrata or articuculata; it is curious, too, that naturalists have differed so very much as to the rank of the orders of insects. In other groups again, as the reptiles, the idea of rank is quite patent in the orders, but is much obscured when we add the fossil forms to those now living. In the orders of Mammals, as lately proposed by Owen, it is clearly exhibited. Dana has well shewn its existence in the Crustacea. It is pretty evident also in the orders of the several classes of Molluscs, and is very manifest in the Echinoderms. On the whole, we are willing to accept this view as at least one leading idea to be expressed by orders in the animal kingdom.

4. *Families* are characterised by general external form; and here we see no reason to differ from our author. The family is in short one of the most obvious and easily recognised relationships among animals, is almost instinctively perceived by us, and on this very account should have much more attention given to it in systematic Zoology than it has yet received, as one of the most useful aids in the determination of species.

"Unless, then, form be too vague an element to characterise any kind of natural groups in the animal kingdom, it must constitute a prominent feature of families. I have already remarked, that orders and families are the groups upon which zoologists are least agreed, and to the study and characterising of which they have paid least attention. Does this not arise simply from the fact, that, on the one hand, the difference between ordinal and class characters has not been understood, and only assumed to be a difference of degree; and, on the other hand, that the importance of the form, as the prominent character of families, has been entirely overlooked? For, though so few natural families of animals are well characterised, or characterised at all, we cannot open a modern treatise upon any class of animals without finding the genera more or less naturally grouped together, under the heading of a generic name with a termination in *idæ* or *inæ* indicating family and sub-family distinctions; and most of these groups, however unequal in absolute value, are really natural groups, though far from designating always natural families, being as often orders or sub-orders, as families or sub-families. Yet they indicate the facility there is, almost without study, to point out the intermediate natural groups between the classes and the genera. This arises, in my opinion, from the fact, that family resemblance in the animal kingdom is most strikingly expressed in the general form, and that form is an element which falls most easily under our perception, even when the observation is made superficially. But, at the same time, form is most difficult to describe accurately, and hence the imperfection of most of our family characteristics, and the constant substitution for such characters of features which are not essential to the family. To prove the correctness of this view, I would only appeal to the experience of every naturalist. When we see new animals, does not the first glance, that is, the first impression made upon us by their form, give us at once a very correct idea of their nearest relationship? We perceive, before examining any structural character, whether a Beetle is a Carabicine, a Longicorn, an Elaterid, a Curculionid, a Chrysomeline; whether a Moth is a Noctuelite, a Geometrid, a Pyralid, etc.; whether a bird is a Dove, a Swallow, a Humming-bird, a Woodpecker, a Snipe, a Heron, etc., etc. But before we can ascertain its genus, we have to study the structure of some characteristic parts; before we can combine families into natural groups, we have to make a thorough investigation of their whole structure, and compare it with that of other families. So form is characteristic of families; and I can add, from a careful investigation of the subject for several years past, during which I have reviewed the whole animal kingdom with reference to this and other topics connected with classification, that form is the essential characteristic of families. I do not mean the mere outline, but form as determined by structure; that is to say, that families cannot be well defined, nor circumscribed within their natural limits, without a thorough investigation of all those features of the internal structure which combine to determine the form."

5. *Genera*, also, are well and ably characterised:

"I have stated before, that in order to ascertain upon what the different groups adopted in our systems are founded, I consulted the works of such writers as are celebrated in the annals of science for having characterised with particular felicity any one kind of these groups, and I have mentioned Latreille as prominent among zoologists for the precision with which he has defined the genera of Crustacea and Insects, upon which he has written the most extensive work extant. An anecdote which I have often heard repeated by entomologists who knew Latreille well, is very characteristic as to the meaning he connected with the idea of genera. At the time he was preparing the work just mentioned, he lost no opportunity of obtaining specimens, the better to ascertain from nature the generic peculiarities of these animals, and he used to apply to the entomologists for contributions to his collection. It was not show specimens he cared to obtain, any would do, for he used to say he wanted them only "to examine their parts." Have we not here a hint, from a master, to teach us what genera are and how they should be characterised? Is it not the special structure of some part or other, which characterises genera? Is it not the finish of the organization of the body, as worked out in the ultimate details of structure, which distinguishes one genus from another? Latreille, in expressing the want he felt with reference to the study of genera, has given us the key-note of their harmonious relations to one another. Genera are most closely allied groups of animals, differing neither in form, nor in complication of structure, but simply in the ultimate structural peculiarities of some of their parts; and this is, I believe, the best definition which can be given of genera. They are not characterised by modifications of the features of the families, for we have seen that the prominent trait of family difference is to be found in a typical form; and genera of the same family may not differ at all in form. Nor are genera merely a more comprehensive mould than the species, embracing a wide range of characteristics; for species in a natural genus should not present any structural differences, but only such as express the most special relations of their representatives to the surrounding world and to each other. Genera, in one word, are natural groups of a peculiar kind, and their special distinction rests upon the ultimate details of their structure."

We could have wished in this place some remarks on the tendency at present prevalent to sub-divide the old genera into a multitude of new ones, characterised by the most trivial and evanescent differences, a process which threatens to reduce some departments of Zoology to a mere chaos; and which, from the differences of view that arise, as a matter of course, when a natural genus is thus broken up, loads science with an odious and vexatious synonymy. There appears to be a prevalent idea that a genus should necessarily contain few species; but this is obviously an error, since the number of species generically related to each other varies between large limits in different groups of animals. Nor is a genus to be created merely to include species related to each other in a very near degree; but for those portions of a natural family in which the details of execution in the more important parts correspond, however many the species so agreeing, may be. In such a genus there may be many minor sub-divisions established for convenient reference, or to express minor distinctions; but these should not be characterised as distinct genera. Attention to this is all the more important, because the generic name is attached to the species and should tell something of its affinities. In order to appreciate natural genera, some breadth of mind is required, as well as familiarity with details of structure. Unfortunately many naturalists are deficient in this. Hence they regard a good natural genus such as a mind like that of Linnæus could found, not as one, but as several; their mental vision not enabling them to see the whole of it at once, though they can see little trifling distinctions. They break it up, attach names to the fragments, and believe themselves discriminating interpreters of nature, until the discovery of a few more species or the glance of some higher intellect throws the whole again into one, and nothing remains except a shoal of obsolete synonymes, against which young students may wreck themselves. We could fill our pages with instances, but it is better not to enter into particulars. The subject is, however, so important to the progress, and especially to the diffusion of science, that it demands at least an energetic protest against the genus-makers as a body. We are glad to see in some good modern text books, as in Woodnaid's Mollusca, many useless genera restored to their proper places.

6. *Species.*—In this most important department of the subject a large number of naturalists will at once join issue with Agassiz; and we think that the interests of truth demand a careful sifting of the views put forth, not only in the short section under this head, but also in the introductory chapters. The general definition, which we have already quoted, is so vague in its terms that it hardly serves to give the author's view. The "relations of individuals to each other" may, for instance, mean much or very little; and on the interpretation of this expression hangs the whole question here in dispute between Agassiz and other naturalists. The precise view intended to be conveyed may perhaps be best gathered from the following passages:—

"The species is an ideal entity, as much as the genus, the family, the order, the class, or the type; it continues to exist, while its representatives die, generation after generation. But these representatives do not simply represent what is specific in the individual, they exhibit and reproduce in the same manner, generation after generation, all that is generic in them, all that characterises the family, the order, the class, the branch, with the same fullness, the same constancy, the same precision. Species then exist in nature in the same manner as any other groups, they are quite as ideal in their mode of existence as genera, families, etc., or quite as real. But individuals truly exist in a different way; no one of them exhibits at one time all the characteristics of the species, even though it be hermaphrodite, neither do any two represent it, even though the species be not polymorphous, for individuals have a growth, a youth, a mature age, an old age, and are bound to some limited home during their lifetime. It is true species are also limited in their existence; but for our purpose, we can consider these limits as boundless, inasmuch as we have no means of fixing their duration, either for the past geological ages, or for the present period, whilst the short cycles of the life of individuals are easily measurable quantities. Now as truly as individuals, while they exist, represent their species for the time being, and do not constitute them, so truly do these same individuals represent at the same time their genus, their family, their order, their class, and their type, the characters of which they bear as indelibly as those of the species."

In this general statement, with the explanations elsewhere given of it, in relation to the capacity of species for intermixture. and the supposed original creation of numbers of representatives of the same species in different places, we see much that is objectionable, and a want of that accuracy of thought which is essential in treating of such a subject.

First, we cannot admit the high standing here given to the individual animal. The individual is here confounded with an entirely different thing, namely, the *unit* of the science. As has been well stated above, the individual rarely represents the species as a whole. To give this we have to employ a series of individuals, including the differences of age and sex, and the limits of variation under external circumstances. The individuals representing these varieties are therefore only fractional parts of a unit, which is the species. Let it be observed, also, that the relation here is different from that which subsists between the species and the genus. Each species should have all the generic characters with those that are specific; but each individual, as a fraction of the species, need not necessarily possess all the mature characters of the species; and this is one reason of the indistinct notion in many minds that the limits of species are more uncertain than those of genera. On the other hand, the idea of specific unity is expressed by our attaching the specific name to any individual that we may happen to have; and even popular speech expresses it when it says the grisly bear, the Arctic fox.

Secondly, the species is not merely an ideal unit: it is a unit in the work of creation. No one better indicates than our author the doctrine of the creation of animals; but to what is it that creation refers?—not to genera and higher groups, they express only the relations of things created,—not to individuals as now existing, they are the results of the laws of invariability and increase of the species,—but to certain original individuals, protoplasts, formed after their kinds or species, and representing the powers and limits of variation inherent in the species—the potentialities of their existence, as Dana well expresses it. The species, therefore, with all its powers and capacities for reproduction, is that which the Creator has made, his unit in the work, as well as ours in the study. The individuals are merely so many masses of organised matter, in which, for the time, the powers of the species are embodied; and the only animal having a true individuality is man, who enjoys this by virtue of mental endowments, over-ruling the instincts which in other animals narrowly limit the action of the individual. To this great difference between the limitations imposed on animals by a narrow range of specific powers, and the capacity for individual action which in man forces even his physical organisation, in itself more plastic than that of most other animals, to bend to his dominant will, we trace not only the varieties of the human species, but the changes which man effects upon those lower animals which in instincts and constitution are sufficiently ductile for domestication.

Thirdly, the species is different, not in degree, but in kind, from the genus, the order, and the class. We may recognise a generic resemblance in a series of line engravings representing different subjects, but we recognise a specific unity only in those struck from the same plate; and no one can convince us that the resemblance of a series of coins, medals, or prints, from different dies or plates, is at all of the same kind with that which subsists between those produced from the same die or plate. In like manner, the relation between the members of the brood of the song sparrow of this spring, is of a different kind as well as different degree from that between the song sparrow and any other species of sparrow. So of the brood of last year to which the parent sparrows may have belonged; so by parity of reasoning of all former broods, and all song sparrows everywhere. The species differs from all other groups in not being an ideal entity, but consisting of individuals struck from the same die, produced by continuous reproduction from the same creative source. Nor need we suppose with our author—for as yet it is merely an hypothesis—that species may have sprung from two or several origins. We cannot be required to assume a cause greater than that which the effect demands; and if one pair of the American crow or Canada goose would now be sufficient, in a calculable number of years, to supply all America with these species, we need not suppose any more. Even in those cases where one centre of creation appears to be insufficient, this may only be a defect in our information, as to the precise range of the species, its capabilities for accommodating itself to external differences of habitat, and the geological changes which may have occurred since its creation. Take the example given at p. 40 of the "Contributions." The American Widgeon and British Widgeon, and the American and British red-headed Ducks are distinct species. The Mallard and Scaup Duck are common to both sides of the Atlantic. The inference is that since the distinct species of widgeons and red ducks were probably created on the opposite sides of the Atlantic, so were the Mallards, though specifically identical. To prove this is obviously altogether impossible; but even to establish some degree of probability in its favor, it would be necessary to show that the Widgeons and Red Ducks equal the Mallard and Scaup Duck in hardiness, in adaptability to different conditions of climate and food, in migratory instinct and physical powers of migration, and farther, that these species are equally old in geological time. We do not happen to know, in reference to this last particular, which species is the oldest, if there is any difference; but remains of ducks have been found in the later deposits, and if it should prove that the species now more widely distributed existed at a time when the distribution of land and water was different from that which now prevails, we should have a case quite parallel to many known to geologists, and utterly subversive of the view before us. The Mallard is also an unfortunate instance, from its well-known adaptation for domesticity, and consequently proved capability of sustaining very different conditions of existence. The Scaup Duck, hardy and carnivorous, a sea-duck and a good diver, and Asiatic as well as European, is probably far better fitted for extensive migration than the Widgeon. It is on such grounds, incapable of positive proof, and with palpable flaws in even the negative evidence, that we are required to multiply the miracle of creation, rather than submit patiently to investigate the psychical, physiological and physical agencies involved in one of the most interesting problems of Zoology, the geographical distribution of animals.

One farther remark is rendered necessary by the illustration above referred to. No one knows better than Agassiz that to compare, in reference to their geographical distribution, animals nearly related, may often lead to errors greater than those likely to result from the comparison of creatures widely different in structure but adapted for somewhat similar external conditions of existence. It is a fact very curious in itself, independently of this application, that we find closely related species differing remarkably in this respect; and that, on the other hand, animals of very different grades and structures are equally remarkable for wide geographical ranges. The causes of these differences are often easily found in structural, physiological, or psychical peculiarities, but in many cases they depend on minute differences not easily appreciable, or on the effects of geological changes.

Fourthly.—Our author commences his dissertation on species by taunting those who maintain the natural limits set to hybridity with a petitio principii. The accusation might be turned against himself. The facts shewing that species in their natural state do not intermix, and that hybrids are only in exceptional cases fertile, so enormously preponderate over the few cases of fertile hybridity, that the latter may be regarded as the sort of exception which proves the rule. The practical value of this character in ascertaining the distinctions of species in difficult cases is quite another question, as is the precise nature of the resemblances in distinct species which most favour hybridity, and the greater or less fixity of the barrier in the case of species inhabiting widely separated geographical areas, when these are artificially brought together. Nor is the specific unity to be broken down by arguments derived from the difficulty of discriminating or of identifying species. The limits of variability differ for every species, and must be ascertained by patient investigation of large numbers of specimens, before we can confidently assert the boundaries in some widely distributed and variable species; but in the greater number this is not difficult, and in all may be ascertained by patient inquiry.

Fifthly,—The above considerations, in connection with the doctrines of created protoplasts, and the immutability of species, as so ably argued by Agassiz himself, we hold irresistibly compel us to the conclusion of Cuvier, that a species consists of the "beings descended the one from the other or from common parents"; or at least to that of De Candolle, that the individuals of a species must "bear to each other so close a resemblance as to allow of our supposing that they may have proceeded originally from a single being or a single pair." This being admitted, it must be only on the most cogent grounds, to be established in every individual case, that we can admit a difference of origin either in geological time or in space, for animals that on comparison appear to be specifically identical.

It may be objected that this is a merely hypothetical definition; but we contend that it is as practical as the opposite view, that it is indeed essential to any trustworthy determination of species. If we have given to us a number of individuals absolutely similar, we do not doubt their specific unity, or, as we even sometimes venture to call it, identity; but if there are differences which we suppose may be specific, we inquire whether these differences exceed those known to occur in individuals of common parentage. If we are informed that these same diversities occur in individuals of the same brood or litter, in individuals that have been transferred to different conditions of life, or in individuals of different age or sex, we discard them as specific distinctions. If we cannot obtain these facts as to the species in question, we compare large numbers of specimens to ascertain the gradations that occur, or we refer to the known facts in allied species, or in those which may be supposed similar in tendency to variation. We always suspect determinations which, on the one hand, require us to believe specific diversity in forms no farther apart than those known to be connected by parentage; or, on the other, unity where the differences are greater than this. Other considerations, of course, enter into such questions; but the identity of the protoplast, or mould, is one essential element in our complete mental conception of the species.

We could, on the other hand, state practical evils injurious to the mere technical accuracy of Zoology, likely to arise from the opposite view. One of these may suffice. It is their tendency to take it for granted that forms must be new specifically, merely because they are found in new places—a mischievous laxity, likely to prevail where so loose views as to species are held by a great leading naturalist; too wise himself to be so misled, but unable to communicate his own largeness of mind to followers who eagerly adopt a view tending to increase their chance of becoming species-founders, or at all events their freedom to commit errors in this matter, without being liable to the charge of separating individuals connected by actual descent from common ancestors.

It only remains on this subject to remark that the practical difficulty of the discrimination of species occurs only in exceptional cases. When we endeavour by external characters, such as proportions of parts, external ornamentation, &c., accurately to distinguish forms of the same origin, we may, it is true, be deceived in some rare cases by the similarity of really distinct species, or the variations of the individuals of the same species. But, when we consider the well-defined limits of form, ornament, &c., in the greater number of animals, we cannot doubt that accurate attention to all the facts bearing on these will enable us eventually to solve the most intricate cases, without having recourse to any hypothesis destructive of the true unity of the species.

We have aimed in the above remarks only to show that grave difficulties beset the view of species advocated by Agassiz, and that such views, if carried to their legitimate results, would destroy all certainty in Zoology, quite as effectually as that opposite view which would so enlarge the limit of specific unity as to admit that any number of species may have descended from a common parentage.

As might have been expected, a mind so familiar with nature as that of Agassiz clings to the truth on this practical view of the subject, however far from it in the mere theory of species. Hence the able reasoning in this work on the immutability of species, their range of distribution in time and space, and the care necessary in their discrimination and description. On these last subjects the following paragraphs are well worthy of attention, though some of the considerations referred to are vastly more important than others :—

"If we would not exclude from the characteristics of species any feature which is essential to it, nor force into it any one which is not so, we must first acknowledge that it is one of the characters of species to belong to a given period in the history of our globe, and to hold definite relations to the physical conditions then prevailing, and to animals and plants then existing. These relations are manifold, and are exhibited: 1st. in the geographical range natural to any species, as well as in its capability of being acclimated in countries where it is not primitively found; 2d. in the connection in which they stand to the elements around them, when they inhabit either the water, or the land, deep seas, brooks, rivers and lakes, shoals, flat, sandy, muddy, or rocky coasts, limestone banks, coral reefs, swamps, meadows, fields, dry lands, salt deserts, sandy deserts, moist land, forests, shady groves, sunny hills, low regions, plains, prairies, high table-lands, mountain peaks, or the frozen barrens of the Arctics, etc.; 3d. in their dependence upon this or that kind of food for their sustenance; 4th. in the duration of their life; 5th. in the mode of their association with one another, whether living in flocks, small companies, or isolated; 6th. in the period of their reproduction; 7th, in the changes they undergo during their growth, and the periodicity of these changes in their metamorphosis; 8th, in their association with other beings, which is more or less close, as it may only lead to a constant association in some, whilst in others it amounts to parasitism; 9th, specific characteristics are further exhibited in the size animals attain, in the proportions of their parts to one another, in their ornamentation, etc. and all the variations to which they are liable.

"As soon as all the facts bearing upon these different points have been fully ascertained, there can remain no doubt respecting the natural limitation of species; and it is only the insatiable desire of describing new species from insufficient data which has led to the introduction in our systems of so many doubtful species, which add nothing to our real knowledge, and only go to swell the nomenclature of animals and plants already so intricate.

"Assuming, then, that species cannot always be identified at first sight, that it may require a long time and patient investigations to ascertain their natural limits; assuming further, that the features alluded to above are among the most prominent characteristics of species, we may say, that species are based upon well determined relations of individuals to the world around them, to their kindred, and upon the proportions and relations of their parts to one another, as well as upon their ornamentation. Well digested descriptions of species ought, therefore, to be comparative; they ought to assume the character of biographies, and attempt to trace the origin and follow the development of a species during its whole existence. Moreover, all the changes which species may undergo in course of time especially under the fostering care of man, in the state of domesticity and cultivation, belong to the history of the species; even the anomalies and diseases to which they are subject belong to their cycle, as well as their natural variations. Among some species, variation of color is frequent, others never change, some change periodically, others accidentally; some throw off certain ornamental appendages at regular times, the Deers their horns, some Birds the ornamental plumage they wear in the breeding season, etc. All this should be ascertained for each, and no species can be considered as well defined and satisfactorily characterised, the whole history of which is not completed to the extent alluded to above. The practice prevailing since Linnæus of limiting the characteristics of species to mere diagnoses, had led to the present confusion of our nomenclature, and made it often impossible to ascertain what were the species the authors of such condensed descriptions had before them. But for the tradition which has transmitted, geneation after generation, the knowledge of these species among the cultivators of science in Europe, this confusion would be still greater; but for the preservation of most original collections it would be inextricable. In countries, which, like America, do not enjoy these advantages, it is often hopeless to attempt critical investigations upon doubtful cases of this kind. One of our ablest and most critical investigators, the lamented Dr. Harris, has very forcibly set forth the difficulties under which American naturalists labor in this respect, in the Preface to his Report upon the Insects Injurious to Vegetation."

We have been led by the great interest of the subject into so long a discussion of the points already referred to, that it will be impossible to notice many others equally important, as for instance the application of the general views above discussed; or to say anything of the more special subject of the volume, the Embryology of the American Tortoises, so ably described and beautifully illustrated. Nor will it be possible to enter on the views given of the relation of embryonic development to classification and geological sequence,—a most tempting subject, though at present encompassed with a crowd of difficulties and apparent exceptions that await for their solution and explanation such investigations as those which now occupy Agassiz.

In conclusion, every true naturalist will endeavour not only to read but carefully to study this work, the high merits of which we do not wish to depreciate, however we may be constrained to differ from some of its more general doctrines. Agassiz himself will be the last to require an implicit assent to his views, merely because he holds them; and we know that he values truth too much, and is too deeply imbued with reference for nature and its

Maker, wilfully to misrepresent the smallest fact, or arrogantly to oppose the most full discussions of his results.

J. W. D.

GEOLOGICAL GLEANINGS.

1. *Sir Edmund Head on the temple of Serapis at Pozzuoli.* The Geologist is only a sort of pre-adamite antiquarian; but it is not often that the researches of the historical antiquary and scholar throw light on his pursuits. The paper named above, and published by the Society of Antiquaries is an exception. The building to which it relates is of exceeding geological interest, as showing in its erect columns perforated by lithodomous mullusks, that the ground on which it stands has been dry land, then submerged and again elevated since the erection of the temple. It is a curious instance of the peculiarities of the civilization and science of classical antiquity and the middle ages, that no distinct record remains of the nature and date of these remarkable changes of level. The little mussels that bored their burrows in the marble, were the only geologists of those days. Sir Edmund endeavours to supply this lack of testimony by pointing out a number of references more or less direct to the edifice and its fortunes, which have occurred to him in his reading. The following extract shows the mode of treating the subject, and contains one of the most curious results of the inquiry, namely, the possibility that part of the deposits covering the floor of the old temple may be artificial.

"At Pozzuoli a building of some sort occupied the centre of the area. Whether, as in Egypt, the image of the god was placed there, or behind the four columns to which the ruin owes its modern celebrity, may be uncertain. The lowness of situation must have deprived our temple of subterranean passages, and the underground arrangements so elaborately provided in the Egyptian model. The possession, however, of a natural hot spring just behind the temple must have made up for many disadvantages. No appendage could be more appropriate for the temple of a god who among his many attributes usurped those of Æsculapius.

"This warm spring, however, suggests another curious question with reference to a passage in Pausanias. After mentioning several cases of fresh springs in the sea, and the hot springs in the channel of the Mæander, Pausanias proceeds as follows:—

'Before Dicæarchia of the Tyrseni (Pozzuoli) there is water boiling up in the sea, and for the sake of it an island made with hands, so that not even this water is wasted, but serves people for warm baths.'

"May not this spring be the very one now existing behind the Temple of Serapis?

"Had the hot spring of Pausanias originally discharged itself into the sea, it does not seem likely that it would have been used at all; but if its virtues had been long known to the inhabitants of Pozzuoli, and a gradual encroachment of the sea, or rather a depression of the land, deprived them of the benefit of the baths to which they had become accustomed, what could be more natural than that a small mound or island should be made by hand in the shallow water, in order that the baths might be again available?

"Pausanias does not indeed say that these baths were connected with a temple of Serapis, but this is immaterial.

"On this theory a number of curious questions present themselves.

"Which is the pavement of the building existing at the time of Pausanias? What, relatively to the floor as now seen, was the level of the original building submerged in the sea? Is it represented by the mosaic pavement found five feet below the floor of the temple? If so, it would be important to examine the soil between the two pavements, and to ascertain whether it appears to warrant the supposition that it was a part of a mound constructed artificially.

"The intervention of the hand of man in filling up or raising this spot of ground, may complicate most materially the solution of the several changes of level.

"It should be stated that, according to the general notion, mosaic pavements were not in common use at Rome before the time of Sylla—that is, about eighty years before Christ; but it does not follow that a mosaic pavement may not have been added after that date to a building existing before it: so that the mosaic pavement in question may have been part of the Temple of Serapis mentioned in the "Lex Parieti faciundo." Pausanias lived in the time of Hadrain, as has been already stated, and, according to this view, the submergence of the first baths or temple must have taken place between the time of Sylla and that date. We cannot, I presume, suppose that a mosaic pavement would be originally laid under water.

"The level below the water of the Mediterranean of the old mosaic pavement must correspond pretty accurately with that of the base of the columns of the submerged "Temple of the Nymphs'' in the neighbouring bay. Did this submergence take place at the time of the great eruption of Vesuvius which overwhelmed Pompeii and Herculaneum, A.D. 79?

"Statius was born A.D. 61, and was therefore about nineteen at the time of the eruption of 79. As a native of Naples he may be presumed to have been conversant with all the phenomena which then took place. His lines on the subject of the destruction of the cities are very striking.

> "Hæc ego Chalcidicis ad te, Marcelle, sonabam
> Littoribus, fractas ubi Vesvius egerit iras,
> Æmula Trinacriis volvens incendia flammis.
> Mira fides! credetne virûm ventura propago,
> Cum segetes iterum, et jam hæc deserta virebunt,
> Infra urbes, populosque premi? proavitaque toto
> Rura abiisse mari? necdum letale minari
> Cessat apex——"

"The latter part of this passage seems to me to mean "lands tilled by our ancestors (proavita) have disappeared in the body of of the sea" (toto mari). The commentator in the Variorum edition (Lugd. Bat. 1671) appears to understand the word "proavita" as referring to the restoration of these districts hereafter "proavita dicit respectu futuræ posteritatis"—which seems to me absurd. How were posterity to get the lands out of the sea again? Such is not the use of the word when applied to Hector:—

> "Pugnantem pro se, proavitaque regna tuentem."
> *Ovid. Metamorph.* xiii. 416.

"I infer from the expressions of Statius that considerable tracts of land had been sunk in the sea by some sudden depression of the ground.

"May not this have been the time when the Temple of the Nymphs, and the first baths or temple of Serapis, were covered with shallow water? Is it not possible that between this convulsion and the time when Pausanias wrote the inhabitants of Pozzuoli may have made the island in the sea (*cheiropoieton*), and have erected on it a second temple—the one of which the ruins still puzzle the geologist?

"It may be worth while adding, that there exist three fragments of Latin verse, by a certain Regianus (or Regilianus), whose age does not appear to be known. One of these is entitled "de Baiis," another is "de Thermis." The latter contains this line—

> "In regnis, Neptune, tuis Vulcanus anhelat."

"Considering the proximity of Baiæ to Puteoli, it is not improbable that this last verse may refer to the baths described by Pausanias."

2. *Professor Ramsay, on the geological causes that have influenced the Scenery of Canada and the North Eastern States.* This lecture read at the Royal Institution in London, is one of the results of Professor Ramsay's visit last year. We take the following sketch from the published abstract of the lecture.

"The island of Belleisle and the Laurentine chain of mountains between the shores of Labrador and Lake Superior consist of gneissic rocks older than the Huronian formation of Sir Wm. Logan. This gneiss is probably the equivalent of the oldest gneiss of the Scandinavian chain, and of the north-west of Scotland, underlying that conglomerate, which, according to Sir Roderick Murchison, in Scotland represents the Cambrian strata of the Longmynd and of Wales. The mountains of the Laurentine chain present those rounded contours that evince great glacial abrasion; and among the forests north of the Ottawa the mammillated surfaces were observed by the speaker to be often grooved and striated, the striations running from north to south. The whole country has been moulded by ice. Above the metamorphic rocks, in the plains of Canada and the United States south of the St. Lawrence, and around Lake Ontario and Lake Erie, the Silurian and Devonian strata lie nearly horizontally, but slightly inclined to the South. Consisting of alternations of limestone and softer strata, the rocks have been worn by denudation into a succession of terraces, the chief of these forming a great escarpment, part of which, by the river Niagara, overlooks Queenston and Lewiston, and capped by the Niagara limestone, extends from the neighbourhood of the Hudson to Lake Huron. Divided by this escarpment the plains of Canada bordering the lakes, and part of the United States, thus consist of two great plateaux, in the lower of which lies Lake Ontario, Lake Erie lying in a slight depression in the upper plain or table land, 329 feet above Lake Ontario. The lower plain consists mostly of Lower Silurian rocks, bounded on the north by the metamorphic hills of the Laurentine chain. The upper plain is chiefly formed of Upper Silurian and Devonian strata. East of the Hudson, the Lower Silurian rocks that form the lower plain of Canada become gradually much disturbed and metamorphosed, and at length rising into bold hills trending north and south, form in the Green Mountains part of the chain that stretches from the southern extremity of the Appalatchian Mountains to Gaspé, on the Gulf of St. Lawrence. Between the plains of the lakes and this range, the steep terraced mass of the Catskills, formed of old red sandstone, lies above the Devonian rocks facing east and north in a grand escarpment.

"The whole of America south of the lakes, as far as latitude 40°, is covered with glacial drift, consisting of sand, gravel, and clay, with boulders, many of which, during the submergence of the country have been transported by ice several hundred miles from the Laurentine chain. Many of these are striated and scratched in a manner familiar to those conversant with glacial phenomena. When stripped of drift all the underlying rocks are evidently ice-smoothed and striated,the striations generally running more or less from north to south, indicating the direction of the ice-drift during the submergence of the country at the glacial period. The banks of the St. Lawrence, near Brockville, and all the Thousand Islands, have been rounded and *moutonnée* by glacial abrasion during the drift period.

"The submergence of the country was gradual, and the depth it attained is partly indicated in the east flank of the Catskill mountains. This range, near Catskill, runs north and south, about 10 or 12 miles from the right bank of the Hudson. The undulating ground between the river and the mountains is seen to be covered with striations wherever the drift has been removed. These have a north and south direction; and ascending the mountains to Mountain House, the speaker observed that their flanks are marked by frequent grooves and glacial scratches, running not down hill, as they would do if they had been produced by glaciers, but north and south horizontally along the slopes, in a manner that might have been produced by bergs grating along the coast during submergence. These striations were observed to reach the height of 2850 feet above the sea. In the gorge, where the hotel stands at that height, they turn sharply round, trending nearly east and west; as if at a certain period of submergence, the floating ice had been at liberty to pass across its ordinary course in a strait between two islands. During the greatest amount of submergence of the country, the glacial sea in the valley of the Hudson must have been between 3000 and 4000 feet deep, and it is probable that even the highest tops of the Catskills lay below the water.

"In Wales, it has been shown that during the emergence of the country in the glacial epoch, the drift in some cases was ploughed out of the valleys by glaciers; but though the Catskill mountains are equally high, in the valleys beyond the great eastern escarpment the drift still exists, which would not have been the case had glaciers filled these valleys during emergence in the way that took place in the Passes of Llanberis and Nant-Francon, and in parts of the Highlands of Scotland.

"It has been stated above that the upper plain around Lake Erie, and the lower plain of Lake Ontario, are alike covered with drift. Part of this was formed, and much of it modified during the emergence of the country. In the valley of the St. Lawrence, near Montreal, about 100 feet above the river, there are beds of clay, containing Leda Portlandica, and called by Dr. Dawson of Montreal, the *Leda clay*. Dr. Dawson is of opinion that when this clay was formed, the sea in which it was deposited washed the base of the old coast line that now makes the great escarpment at Queenston and Lewiston, overlooking the plains round Lake Ontario. It has long been an accepted belief that the Falls of Niagara commenced at the edge of this escarpment, and that the gorge has gradually been produced by the river wearing its way back for seven miles to the place of the present Falls.* In this case, the author conceives that *the Falls commenced during the deposition of the Leda clay, or near the close of the drift period*, when during the emergence of the country the escarpment had already risen partly above water. If it should ever prove possible to determine the actual rate of recession of the Falls, we shall thus have data by which to determine approximately the time that has elasped since the close of the drift period; and an important step may thus be gained towards the actual estimate of a portion of geological time."

3. *Sir Charles Lyell on the formation of Continuous Tabular Masses of stony Lava on steep slopes.*—The question as to whether volcanic cones have originated from the deposition of successive sheets of the ejectamenta of their vents, or from the bulging up-

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* The details on which this belief is founded, may be found in the writings of Professor Hall, of Albany, and Sir Charles Lyell.

ward of the crust by subterranean force has long been agitated, and Sir Charles Lyell has long upheld the former view. In the present paper Sir Charles removes an objection derived from the steep slopes of the beds of lava and scoriæ in some volcanic cones. In connection with this subject, the remains of a more ancient vent than the present crater of Etna and the probable antiquity of the mountain, are noticed.

"The question whether lava can consolidate on a steep slope, so as to form strata of stony and compact rock, inclined at angles of from 10° to more than 30°, has of late years acquired considerable importance, because geologists of high authority have affirmed that lavas which congeal on a declivity exceeding 5° or 6° are never continuous and solid, but are entirely composed of scoriaceous and fragmentary materials. From the law thus supposed to govern the consolidation of melted matter of volcanic origin, it has been logically inferred that all great volcanic mountains owe their conical form principally to upheaval or to a force acting from below and exerting an upward and outward pressure on beds originally horizontal or nearly horizontal. For in all such mountains there are found to exist some stony layers dipping at 10°, 15°, 25°, or even higher angles; and according to the assumed law, such an inclined position of the beds must have been acquired subsequently to their origin.

"After giving a brief sketch of the controversy respecting "Craterrs of Elevation," the author describes the results of his recent visit (October, 1857) to Mount Etna, in company with Signor Gaetano G. Gemmellaro, and his discovery there of modern lavas, some of known date, which have formed continuous beds of compact stone on slopes of 15°, 36°, 38°, and, in the case of the lava of 1852, more than 40°. The thickness of these tabular layers varies from 1½ foot to 26 feet; and their planes of stratification are parallel to those of the overlying and underlying scoriæ which form part of the same currents. The most striking examples of this phenomenon were met with—1st, at Aci Reale; 2ndly, in the ravine called the Cava Grande near Milo, where a section of the lava of 1689 is obtained; 3rdly, in the precipice at the head of the Val di Calanna, in the lava of 1852-53; and 4thly, at a great height above the sea near the base of the Montagnuola.

"Sir C. Lyell then alludes to the extraordinary changes which had taken place in the scenery of the Valley of Calanna and the Val del Bove since his former visit to Mount Etna in 1828—

changes effected by the eruption of 1852–53, one of the greatest recorded in history. A brief account is given, extracted from contemporary narratives and illustrated by a map, compiled with the assistance of Dr. Giuseppe Gemmellaro, of the course taken in 1852–53 by various streams of lava, some of them six miles in length, flowing during nine successive months from the head of the Val del Bove to the suburbs of Zafarana and Milo. The present aspect of this lava-field, parts of it still hot and emitting vapour, and the numerous longitudinal ridges and furrows on its surface are described. As to the origin of these superficial inequalities, the author inquires whether they may be due to the flowing of lava in subterranean tunnels, or whether they be anticlinal and synclinal folds caused by fresh streams pouring over preceding and half-consolidated ones, so that these last may be bent and crumpled by the newly superimposed weight, like soft yielding ground on which a railway embankment has been made. The cascade of the lava of 1852, descending a precipitous declivity 500 feet high, called the Salto della Giumenta, and the stony character of the layers which encrust the steep slope at angles of more than 35° and even 45°, are commented upon. This lava has overflowed that of 1819, which congealed on the same precipice; and it is shown that in such cases the junction-lines separating two successive currents must be obliterated, the bottom scoriæ of the newer dovetailing into the upper scoriæ of the older current.

"The structure of the nucleus of Etna, as exhibited in sections in the Val del Bove, is next treated of, and the doctrine of a double axis is deduced from the varying dip of the beds. The strata of trachyte and trachytic agglomerate in the Serra Giannicola seen at the base of the lofty precipice at the head of the Val del Bove are inclined at angles of 20° to 30° N. W *i. e.* towards the present central axis of eruption. Other strata to the eastwards (as in the hill of Zoccolaro) dip in an opposite direction, or S.E., while, in a great part of the north and south escarpments of the Val del Bove, the beds dip N.E. or N., and S.E. or S. respectively. There is, therefore, a quâquâversal dip away from some point situated in the centre of the area called the Piano di Trifoglietto. Here a permanent axis of eruption may have existed for ages in the earlier history of Etna, for which the name of the axis of Trifoglietto is proposed, while the modern centre of eruption, that now in activity, may be called the axis of Mongibello. The two axes, which are three miles distant the one from the other, are illustrated by an ideal section through the whole of Etna, passing from west to east through the Val del Bove, or from Bronte to Zafarana. Touching the relative age of the two cones, it is suggested that a portion only of that of Mongibello may be newer than the cone of Trifoglietto. The latter when it became dormant, was entirely overwhelmed and buried under the upper and more modern lavas of the greater cone. This doctrine of two centres, originally hinted at by the late Mario Gemmellaro, had been worked out (unknown to Sir C. Lyell at the time of his visit) by Baron Sartorius v. Waltershausen, and has been since supported in the fifth and sixth parts of his great work called "The Atlas of Etna" both by arguments founded on the quâquâversal dip of the beds as above explained, and by the convergence of a certain class of greenstone dikes towards the axis of Trifoglietto. Von Waltershausen has also shown that the superior lavas and volcanic formations crowning the precipices at the head of the Val del Bove, from the Serra Giannicola to the Rocca del Corvo, inclusive, are unconformable to the highly inclined beds in the lower half of the same precipice, the superior beds being horizontal, or, when inclined, dipping in such directions as would imply that they slope away from the higher parts of Mongibello."

"According to Sir C. Lyell, the alleged discontinuity between the older and modern products of Etna is, in truth, only partial, and almost confined to that flank of the mountain, where its physical geography has been altered by three causes: 1st, the interference of the two foci of eruption (Trifoglietto and Mongibello); 2ndly, the truncation of the cone of Mongibello; and 3rdly, the formation of the Val del Bove. The truncation of the mountain here alluded to is proved by the remains of the upper portion of a cone, traceable at intervals around the borders of an elevated platform between 9000 and 10,000 feet high. These remains bear the same relation to the highest and active cone, nearly in the centre of the platform, which Somma bears to Vesuvius. The manner in which the north and south escarpments of the Val del Bove diminish in altitude as they trend eastward from the high platform, is appealed to as showing that the great lateral valley had no existence till after the time when Mongibello had attained its fullest development and height.

"The double axis of Etna is then compared to the twofold axis of the island of Madeira, as inferred from observations made in 1854 by M. Hartung and the author. In that island the principal chain of volcanic vents, running east and west, and 30 miles long, attains at one point a height of 6000 feet. Parallel to it, at the distance of two miles, a shorter and lower secondary chain once existed, but was afterwards overflowed and buried to a great depth by lavas issuing from the higher and dominant chain. The space between the two axes, like the space which separated the two cones of Etna, has been filled up with lavas in part horizontal. On the north side of Madeira, as probably on the west side of Etna, where no secondary centre of eruption interfered with the slope of the volcanic formations, and where the order of their succession and superposition is uninterrupted, there occur, both in Madeira and Etna, deep crateriform valleys (the Curral and the Val del Bove) intersecting the products of the two axes of eruption.

"In concluding this part of his memoir, Sir C. Lyell observes, that the admission of a double axis, as explained by him, is irreconcileable with the hypothesis of "craters of elevation;" for it implies that, in the cone-making process, the force of upheaval merely plays a subordinate part. One cone of eruption, he says, may envelope and bury an adjoining cone of eruption; but it is obviously impossible that one cone of upheaval should mantle round and overwhelm another cone of upheaval.

"An attempt is then made to estimate the proportional amount of inclination which may be due to upheaval in those parts of the central nucleus of Etna where the dip is too great to be ascribed exclusively to the original steepness of the flanks of the cone. The highest dip seen by the author was on the rock of Musarra, where some of the strata, consisting of scoriæ with a few intercalated lavas, are inclined as 47°. Some masses of agglomerate and beds of lava in the Serra del Solfizio were also seen inclined at angles exceeding 40°. Some of these instances are believed to be exceptional and due to local disturbance; others may have an intimate connexion with the abundance of fissures, often of great width, filled with lava, for such *dikes* are much more frequent near the original centres of eruption than at points remote from them. The injection of so much liquid matter into countless rents may imply the gradual tumefaction and distension of the volcanic mass, and may have been attended by the tilting of the beds, causing them to slope away at steeper angles than before, from the axis of eruption. But instead of ascribing to this mechanical force, as many have done, nearly all, or about four-fifths of the whole class, one-fifth may, with more probability, be assigned as the effects of such movements.

"The alleged parallelism and uniformity of thickness in the volcanic beds of the Val del Bove, when traced over wide areas, is next considered, and the author remarks that neither in the northern nor southern escarpments of the great valley, could he and his companion verify the existence of such parallelism. Example of a marked deviation from it are given, both in cliffs seen from a distance, and in others which were closely inspected, even in cases where these last, when viewed from far off, appeared to contain regular and parallel strata.

"The direction and position of the dikes in the Val del Bove is then spoken of, both in reference to the two ancient centres of eruption, and to the question of the altered inclination of the intersected beds. In regard to the arrangement also of the lateral cones of eruption, the question is entertained, whether they are disposed in linear zones, or are in some degree independent of the great centre of Mongibello.

"The origin of the Val del Bove has been variously ascribed to engulfment, explosion, and aqueous erosion. Admitting the probable influence of the two first causes, the author calls attention to the positive evidence in favour of aqueous denudation afforded by the accumulation of alluvium in the low country at the eastern base of Etna between the Val del Bove and the sea. This rudely stratified deposit, 150 feet thick and several miles in length and breadth, contains at Giarre, Mangano, Riposto and other places, fragments, both rounded and angular, of all the rocks, ancient and modern occurring in the escarpments of the Val del Bove, and it implies the continuance there for ages of powerful aqueous erosion. The alluvium of Giarre is therefore supposed to bear the same relation to the Val del Bove that the conglomerate of the Barranco de las Angustias bears to the Caldera of Palma in the Canaries; and those two craterlike valleys, as well as the Curral of Madeira, are believed to have been shaped out in great part by running water. But to render this possible, the suspension, for a long period, of the outpouring of lava on the eastern flank of Etna must be assumed."

"The author fully coincides in the generally received opinion that the accessible parts of Etna are of subaërial origin, and refers to some fossil leaves presented to him by MM. Gravina and Tornabene of Catania, as well as to others collected by himself *in situ*, from the volcanic tuffs of Fasano and Licatia, which have been determined by Prof. Heer to belong to terrestrial plants, of the genera Myrtle, Laurel, and Pistachio, now living in Sicily. These tuffs, together with the general mass of Etna, repose on marine strata of the newer Pliocene period in which 150 species of shells, nearly nine-tenths of them identical with species now existing in the Mediterranean, have been found. A very modern marine breccia, with shells of living species extending to the height of thirty feet on the coast along the eastern base of Etna, was pointed out to the author by Signor G.G. Gemmellaro near Trezza, and in the Island of the Cyclops. The same formation has been traced together with lithodomous perforations by Dr. Carlo Gemmellaro and Baron v. Waltershausen along the sea-shore as far north as Taormina, beyond the volcanic region of Etna. From these and other data enlarged upon in the memoir, Sir C. Lyell concludes, first, that a very high antiquity must be assigned to the successive eruptions of Etna, each phase of its volcanic energy, as well as the excavation of the Val del Bove, having occupied a lapse of ages compared to which the historical period is brief and insignificant; and secondly, that the growth of the whole mountain must nevertheless be referred, geologically, to the more modern part of the latest Tertiary epoch."

4. *Arctic Geology.*—We are indebted to Silliman's Journal for the following Summary of Prof. Haughton's classification of the geological formations of Arctic America as observed in McClintock's voyage.

"(1.) *Granitic or crystalline rocks:* over eastern North Devon, long. 80°—82½°, lat. 74½—75¾°; western North Somerset, near long. 95°; in scattered boulders over many other parts of the islands.

"(2.) *Upper Silurian and Devonian:* over the northern part of Cockburn Island, 73°—73¾° N., and 75°—90° W.; the larger part of North Somerset; Cornwallis Island; all but the eastern part of North Devon.

"(3.) *Carboniferous limestone:* over the islands or parts of islands lying *north* of lat. 76°, from Grinnell Land on the east (93° W.) to Prince Patrick Land on the west. This limestone is stated to *overlie* the coal-bearing standstones.

"(4.) The *Coal-bearing sandstones* (referred to Subcarboniferous): over the same islands as the limestone, but *south* of 76°: including Bathurst Land, 75°—76° N., 99½°—104° W.; Melville Island, from its southern shore to 75° 50′ N.; Byam Martin Island between Bathurst and Melville; part of Eglinton Id., west of Melville, south of 75° 50′; Baring (or Banks) Land, 72½°—74½° N., 115°—125° W.

"(5.) *Jurassic rocks:* over a small peninsula on the eastern side of Prince Patrick Land; also at islets Exmouth and Talbe, north of Grinnell Land; in long. 95° W., lat. 77° 10′ N.

"Viewing the range or direction of the whole, the line between the "*Carboniferous* limestone" and the "coal-bearing sandstones," according to the map, is nearly straight between E. 5° N. and W. 5° S. In the coal-bearing sandstone region, two parallel outcrops of coal are marked as existing on Bathurst Land and southeastern Melville Island, and on the intervening island of Byam Martin, the distance between the two lines eight or ten miles; also a third outcrop in Melville Island, and along the same line in Baring Land to the southwest. The strike is represented as uniform between E.N.E. and W.S.W., and is deduced from the observed occurrence of coal at Cape Hamilton on Baring Island, Cape Dundas on Melville Island, also Bridport Inlet and Skene Bay on Melville Island; on Byam Martin Id.; and at Schomberg Point and Graham Moore Bay on Bathurst Island."

In addition to this series there are interesting tertiary deposits containing lignite, described in the following extract from Dr. Armstrong's voyage of the Investigator. The wood is probably like that of the present arctic sea, drift trunks.

"On ascending one of these hills, about a quarter of a mile from the beach on its side, about 300 feet high from the sea-level, we discovered the wood of which we were in search. The ends of trunks and branches of trees were seen protruding through the rich loamy soil in which they were embedded. On excavating to some extent, we found the entire hill a ligneous formation, being composed of the trunks and branches of trees; some of them dark and softened, in a state of semi-carbonization. Others were quite fresh, the woody structure perfect, but hard and dense. In a few situations, the wood, from its flatness and the pressure to which it had for ages been exposed, presented a laminated structure, with traces of coal. The trunk of one tree, the end of which protruded, was 26 inches in diameter by 16 inches; that of another, a portion of which was brought on board, was 7 feet in length, and 3 feet in circumference: and dense in structure,although pronounced then to be pine.* Other pieces, although still preserving the woody struc-

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* "A section of this piece of wood is to be seen in the Museum of the Royal Dublin Society, Dublin. To the obliging kindness of its able

ture, had a specific gravity exceeding that of water, in which they readily sunk, from their having undergone an incipient stage of impregnation with some of the earthy products of the soil. Numerous pine cones and a few acorns were also found in the same state of silicification. The trunks apparently extended a considerable distance into the interior of the hill, and were bituminous and friable. Many of those which were embedded crumbled away on being struck with a pickaxe, which readily found its way into any part of them, rendering their removal impossible; some of them were in such a state of carbonization as to approach lignite in character. The whole conveyed the idea of the hill being entirely composed of wood. As far as our excavations were carried, nothing else was met with, except the loamy soil in which they were embedded; but the decay of the wood in some places appeared to form its own soil. The petrifactions, with numerous pieces of wood, were found strewn everywhere over the surface of this and many of the contiguous hills. Many specimens of these were obtained, varying from one to fourteen inches in length, the longest not exceeding five or six in circumference; they consisted of portions of the branches of trees. Some of them were impregnated with iron (brown hæmatite), had a distinct metallic tinkle when struck, and were heavier than other pieces, without the metallic impregnation or sound; they were simply silicified, the sand entering into the composition of the soil being silicious or quartzose. Several smaller pieces of fresh wood were also found strewn about, which had not been, perhaps, subject to the petrifying influence of the water. The numerous small rills which issued from the interior, similar to those I had seen in the morning, flowed over the surface, and the constituents of the water, largely impregnated as it was with iron and sulphur, indicated from whence the metallic agency in the petrifaction was derived; this also possessed a dull yellowish-brown discoloration of the sulphur, (? oxide of iron,) and the stones everywhere over which the water flowed were coated with the same.

Director (Dr. Carte) I am indebted for a knowledge of this fact; who has also kindly informed me, that he submitted it to the examination of Drs. Steele and Joseph Hooker, both of whom pronounced it to be coniferous wood. The latter thought it of the white pine species; and one of the semifossilized cones has been pronounced by Dr. Harvey, Professor of Botany, Trinity College, Dublin, to be similar to the present Spruce of North America."

"On several of the neighbouring hills I observed distinct stratifications of wood running horizontally in a circular course, formed by the protrusion of the ends of the trunks of trees, to some of which the bark still adhered; and large pieces of this, cropping out and hanging loosely, frequently led in other situations to our detection of the wood to which the bark adhered in the soil. Any attempt to remove these with the hand or other slight means failed; and excavation ever established the fact that the hills were entirely composed of wood—the appearances met with being identical with those first mentioned. On subsequent occasions, when exploring the land several miles in the interior, observation led me to infer that a precisely similar state of things there existed. The situation in which our first excavation was made was in lat. 74° 27′ N., long. 122° 32′ 15″ W., and about a quarter of a mile from the beach. The distance, inland, whence similar appearances were observed, embraced a circuit from eight to ten miles in diameter."

5. *Age of remains found in Deltas.*—All geologists are aware how much uncertainty attends any reasoning as to the age of remains found in alluvial deposits, based on the depth at which they are imbedded; but very incautious inferences are sometimes drawn from such facts. The following from the *Athenæum* shows the extent of error possible in such reasoning.

"*Pottery in the Bowels of the Earth.*—In a late number of the *Athenæum* it was, I think, stated that a traveller in Egypt, having lately found a piece of pottery at some 30 feet below the present surface of the soil on the banks of the Nile, came to the conclusion that, because the annual deposit of earth by the stream would have required so many centuries to lay down so many feet of earth,—therefore, the bit of pottery found must have been manufactured some 13,000 years before the beginning of the Christian era. Does the following statement of facts bear at all on such a theory? Having lived for many years of my life on the banks of the river Ganges, I have seen the stream encroach on a village, undermining the bank where it stood, and deposit as a natural result bricks, pottery, &c. in the bottom of the stream. On one occasion, I am certain that the depth of the stream where the bank was breaking was above 40 feet; yet in three years the current of the river shifted so much that a fresh deposit of soil took place over the *débris* of the village, and the earth was raised to a level with the old bank. Now, had our traveller then obtained a bit of pottery from where it had lain for only three years, could he reasonably draw the inference that it had been made 13,000 years before?"

6. *New View of the Zoological relations of certain ancient corals by Prof. Agassiz.* The following appears in Silliman. If confirmed by farther investigation it will place nearly all our Silurian corals in a different class of the Radiata, from that to which they have hitherto been supposed to belong.

"I have seen in the Tortugas something very unexpected. Millepora is not an Actinoid polyp, but a genuine Hydroid, closely allied to Hydractinia. This seems to carry the whole group of Favositidæ over to the Acalephs, and displays a beautiful array of this class from the Silurian to this day."

"The drawings of Professor Agassiz which have been sent to us for examination, are so obviously Hydractiniæ in most of their characters that no one can question the relation. With regard to the reference of *all* the Favositidæ (a group including Favosites, Favistella, Pocillopora etc., as well as the minuter Millepora, Chætetes, etc.) to the Acaleph class, direct evidence is not yet complete, as the animal of the Pocillopora has not been figured by any author on zoophytes.* On this point Professor Agassiz observes in a subsequent letter, after observing that the Sideroporæ obviously are polyps:

"There are two types of radiating lamellæ, which are not homologous. In true Polyps (excluding Favositidæ as Hydroids), the lamellæ extend from the outer body wall inward, along the whole height of that wall, and the transverse partitions reach only from one lamella to the other, so that there is no continuity between them, while the radiating lamellæ are continuous from top to bottom in each cell. In Milleporidæ the partitions are transverse and continuous across the cells and so are they in Pocillopora and in all Tabulata and Rugosa, while the radiating lamellæ, where they exist, as in Pocillopora and many other Favositidæ, rise from these horizontal floors and do not extend through

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"* From the specimens of the species of this genus which I procured in the Pacific I never obtained a clear view of the polyps, and hence made no figure. The brief description on page 523 of my Report, may be reasonably doubted until confirmed by new researches. The much larger size of the cells in Pocillopora, Favosites and Favistella than in Millepora, and the frequently distinct rays in these cells, are the characters I had mentioned to Prof. Agassiz as suggesting a doubt as to their being Acalephs, and to this what follows above relates.—J. D. D."

the transverse partitions; indeed they are limited within the spaces of two successive floors, or to the upper surface of the last. A careful comparison of the corallum of Millepora and Pollicopora with that of Hydractinia has satisfied me that these radiating partitions of the Favositidæ far from being productions of the body-wall are foot secretions, to be compared to the axis of the Gorgonia, Corallium, etc., and their seeming radiating lamellæ to the vertical grooves or keels upon the surface of the latter, which reduced to a horizontal projection, would also make impression of radiating lamellæ in the foot of the Polyp. If this be so, you see at once that the apparent radiating lamellæ of the Favositidæ do no longer indicate an affinity with the true Polyps, but simply a peculiar mode of growth of the corallum; and of these we have already several types, that of Actinoids, that of Halcyonoids, that of Bryozoa, that of Millepora and other Corallines, to which we now add that of the Hydroids. Considering the subject in this light, is there any further objection to uniting all the Favositidæ with the Hydroids,—Sideropora and Alveopora being of course removed from the Favositidæ. It is a point of great importance in a geological point of view, and for years I have been anticipating some such result, as you may see by comparing my remarks in the Amer. Journal, May, 1854, p. 315. If all the Tabulata and Rugosa, are Hydroids, as I believe them to be, the class of Acalephs is no longer an exception to the simultaneous appearance of all the types of Radiata in the lowest fossiliferous formations and the peculiar characters which these old Hydroid corals present appears in a new and very instructive aspect."

The Bowmanville Coal Case.—The newspapers inform us that this bubble has at last burst, and has proved to have been a gross and deliberate fraud. As we did not give credence to the pretended discovery, we do not need to join in the outcry which now pursues the authors of the imposture. Such men usually begin by being themselves misled by appearances which they do not understand, and having gone a certain length under this influence, and finding themselves elevated into popular lions and a ready belief given to their statements, they are easily induced by the desire to maintain their credit and by the prospect of profit to go any length in deception. We trust that this lesson willnot soon be forgotten; and that those of our contemporaries who eulogised the self-taught practical man, ignorant of the "jargon" of geology, who made this great discovery, will confess themselves little less in fault than the poor sinner who, out of pocket and of work in a strange land, lends himself to deceive a too-credulous public and to afford scoffers at the hardly-earned results of scientific investigation a short-lived triumph.

SCIENTIFIC MEETING IN GERMANY.

Communicated by A. Gordon Esq.

The thirty-third annual meeting of German naturalists and physicists was held last September in Bonn; and having had an opportunity of witnessing a portion of the proceedings, it has occurred to me that a short account of what came under my notice may possess some interest for the readers of the Canadian Naturalist. Many of them are no doubt aware that it is to these meetings that the plan of the British Association owes its origin. The late Professor Oken is the man to whom the Germans are indebted for their first organization, and he himself received his idea from Switzerland. In noticing the proceedings of the Swiss naturalists in his Isis, Oken frequently took occasion to represent the advantages which Germany might derive from similar reunions, where the members, becoming personally acquainted, could interchange their opinions, communicate and endeavour to resolve each others' doubts, and afford each other mutual encouragement in the path of scientific inquiry. The first meeting took place at Leipzig in 1822, but it was several years before the number of participators rose so high as thirty. The stream, however, if not broad, was deep from the outset. Gradually it became wider. The recent meeting in Bonn though by no means so numerously attended as that held in 1856 at Vienna, mustered to the number of nine hundred and sixty, and included many of the most eminent names of Europe in the various departments of science. In the geological section, of which I formed an unworthy member, I observed Merian, Rose, Von Carnall, Blum, Noeggerath, Murchison, Elie de Beaumont.

The proceedings of the first general meeting were opened on 18th September by Professor Noeggerath, who greeted the assembly with genunine German *bonhommie.* His appearance reminded me of a weather-beaten column of basalt, which seemed to bid eternal defiance alike to time and to tempest. Dr. Kilian then read various letters of compliment or apology, the most interesting of which was a note from Alexander von Humboldt, who had been specially invited to assist at the proceedings, but excused himself on the ground of the necessity he felt himself to be under at his advanced period of life, to employ every available moment of his time in the completion of the works which he had now in progress. On Professor Noeggerath's motion, the whole assembly rose up, with acclamation, to testify their respect for the illustrious veteran; and a telegraphic message was despatched to him in the instant informing him of this grateful tribute of homage.

After the proceedings had been duly opened, Professor Schulzenstein delivered an address on the value of the natural sciences as a means of educating the human mind. Professor Mädler of Dorpat then read a contribution on the subject of the fixed stars. The motions, he said, of certain fixed stars were not compatible with the assumption of a central sun; nor did the assumption of partial systems appear admissible, inasmuch as, for the explanation of the size of the measured motions of individual fixed stars, the central masses—if such existed—must possess a mass incredibly great. The centre of gravity of the fixed siderial system, which may possibly lie in empty space, was to be regarded as the centre of motion. If the system possessed a globular form, with a nearly uniform distribution of the masses in the interior of the globe, the period of revolution of the various masses would be of nearly similar length, so that the whole viewed from one of the stars in conjunct motion, must appear nearly immoveable. A more definite decision was to be expected only from later centuries enriched with the spoils of long series of observations. The speaker considered it probable that the central point lay in the region of Taurus, perhaps in the group of the Pleiades, the apparent motions of which seemed best to harmonise with that assumption.

Dr. Hamel, of St. Petersburgh, then delivered a discourse, in which he endeavoured to trace the history of the invention of the Electric Telegraph. The first telegraphic apparatus worked by galvanism was that exhibited by Soemmering on the 29th August 1809, before the Academy of Sciences at Munich, in which the mode of signalling consisted in the development of gas bubbles from water placed in a series of glass tubes, each of which denoted a letter of the alphabet. Baron Schilling, attached to the Russian Embassy at Munich, was a particular friend of Soemmering's, and a frequent visitor at his laboratory in 1807 and 1808, when he was occupied with his galvanic telegraph. When Oersted in 1820 published his important discovery, it occurred to Schilling that the instant declination of the magnetic needle on the application of a stream of galvanism through a surrounding wire might be applied to telegraphic purposes; and although Ampére, no doubt, so early as the autumn of 1820, had announced an application of Oersted's discovery to telegraphy as something that was perhaps possible, Schilling was the first to realise the idea by *actually producing* an electro-magnetic telegraph, simpler in construction than that which Ampère had *imagined.* By degrees he succeeded in producing an apparatus with which, by means of a wire several (German) miles long, he was able successfully to transmit electro-magnetic signals, previously sounding an alarm when required. His journey to Mongolia (commenced in May 1830) interupted for a time his telegraphic labours, but he speedily resumed them upon his return home in 1832. The services of Professor Weber of Gôttingen in the same cause in 1833 Dr. Hamel passed over as already known to his auditory. In May 1835 Baron Schilling left St. Petersburgh on a tour through Germany, France, and Holland, and he attended the meeting of German naturalists which took place that year in Bonn. At the sitting of the Physical Section on the 23d September, of which the President for the day was Professor Muncke of Heidelberg, Schilling exhibited and explained his telegraphic apparatus, with which Muncke was greatly taken. He frequently spoke of it after his return to Heidelberg, and on the 6th March following (1836) he explained the whole thing to William Fothergill Cooke, who was then occupied at the Anatomical Museum with Professor Tiedemann's sanction, in the preparation of wax models for his father, then recently appointed Professor of Anatomy in the University of Durham. Cooke, although he had never previously studied physics or electricity, was so struck with what Muncke told him, that he instantly resolved on abandoning the work he was engaged on, and on endeavouring to introduce electro-magnetic telegraphs upon the English railways. With this object in view he reached London on the 22d April. On the 27th of February 1837, he became acquainted with Professor Wheatstone of King's College; and early in May the two gentlemen resolved to labour in common for the introduction of the Telegraph into

England—an object which they successfully accomplished. On the 12th of June they obtained their patent, and on the 25th July the first trial was made at the London terminus of the North-Western Railway with a wire a mile and a quarter long. About a fortnight previously, Steinheil of Munich had placed the buildings of the Academy of Sciences in electric communication with the Observatory at Bogenhausen; and his discovery, the following year, of the possibility of bringing the galvanic current in telegraphing through the earth, back to the battery, deserves greater recognition than it has yet received.

Schilling, on his return to St. Petersburgh, had renewed his efforts to turn his telegraph to useful account with more energy than ever. After a series of experiments, he believed he had succeeded in effecting a sufficient isolation of the conducting wire to admit of the transmission of signals through water, and he proposed to unite Cronstadt with St. Petersburgh by means of a submarine cable. He had got a rope prepared with several copper wires isolated agreeably to his instructions, when death put a stop to his labours on the 7th August 1837.

In the course of the summer of that year intelligence reached America of what had been done in Germany and England in the way of electric telegraphy. This news stimulated Samuel F. B. Morse to construct, with the assistance of Dr. Gale, Professor of Chemistry, an apparatus with which he hoped to be able to telegraph. The subject was not at that time quite new to Morse. He had been twice over in Europe to improve himself in his profession as a painter, and in the course of his second homeward voyage in 1832, he had had his attention awakened to the possibility of electro-magnetic telegraphy by Dr. Jackson, his fellow-passenger on board the Sully. On the 4th September—a month after Schilling's death—he made what he termed a "successful attempt." The speaker was in possession of a sketch prepared by Morse himself of the apparatus with which this successful attempt was effected. By means of a set of flat-toothed types there was impressed upon a sheet of paper moved horizontally over a cylinder a set of zigzag marks like the teeth of a saw, which were meant to denote figures. In this manner a set of numbers, was presented to the eye, each denoting a certain word or number for the ascertainment of which the receiver of the despatch required to consult a voluminous dictionary. The strip of paper operated upon on the 4th September 1837, represented, in teeth shaped somewhat like the letter V, the following numbers, viz.:—215, 36, 258, 112, 04, 01837, which, according to the dictionary, denoted "Successful experiment with telegraph September 4, 1837." This cumbrous process, of course, never came into actual use; but notwithstanding this, Morse boldly terms himself the inventor of electric telegraphy, and dates his invention from the year 1832. Nay more, the Supreme Court of the United States pronounced a judgment in 1854, finding that in this respect he had the priority of all Europe. It may possibly be worth while to observe that Morse is not, as seems to be commonly supposed, a Professor of Physics. In 1835 he was appointed "Professor of the Literature of the Arts of Design" in the educational institution termed the University of New York; but he never delivered a single lecture. The instrument now known by the name of Morse's Telegraph was brought to perfection by degrees, long subsequently to 1837, and after Morse had made two more voyages to Europe.

In November 1839, Cooke and Wheatstone executed in London a contract of copartnery, and on the 12th December they gave in their specification. Their process was founded essentially on the same principle as Schilling's, only giving the needle a vertical instead of a horizontal position. In August 1839 there were completed thirteen miles—namely, from Paddington to Drayton—of a telegraphic line along the Great Western Railway, then in progress. Other extensions followed, and in 1845 Cooke suddenly received commissions for a number of lines in various directions throughout the country. The telegraph had received a sudden accession of popularity from the aid it had afforded in the discovery and apprehension of John Tawell the murderer. In 1846 Cooke succeeded in forming the Electric Telegraph Company, which afterwards amalgamated with the International. Their head station is at Lothbury, and down to the present day most of the apparatus employed by them are constructed on the principle originally applied by Schilling, though now greatly improved by Wheatstone. From these apparatus proceed 150 different wires at the least, which run below the pavement to various localities.

Thus it was Baron Schilling of Cannstadt who was the first man by whom electro-magnetic telegraphy was really applied; and it was the telegraphic seed from St. Petersburgh which, after finding its way *viâ* Bonn and Heidelberg to England, struck its roots in London—roots from which a tree has sprung up whose gigantic branches, laden with golden fruit, now stretch and ramify over land and sea.

After the delivery of Dr. Hamel's address, and a few words upon the subject of it from Colonel von Siebold and Dr. Drescher, the meeting separated into the various sections, where the only business performed was the election of their respective presidents. The afternoon was pleasantly and profitably consumed in eating and drinking.

On Saturday (September the 19th), the proceedings of the Geological Section commenced with some observations by Dr. Jäger of Stuttgart, on the origin of regular forms in rocks, which he referred to processes of crystallisation in the sedimentary masses. Dr. Otto Volger, of Frankfort exhibited a series of specimens with the view of demonstrating the results of his inquiries (some of which had been already published) on the history of the development of mineral bodies, and the mode in which the various rocks originate.

Dr. Volger maintained that these specimens afforded direct and irrefragable proof that Feldspath and Quartz were formed in nature under circumstances which utterly excluded the notion of a high temperature having been one of the concurrent causes of their formation. The specimens had been taken from the crystalline rocks of the Alps formerly regarded as "primitive rocks" (Urgebirge) but afterwards claimed partly as plutonic lava rocks, partly as masses belonging to the first period of refrigeration of the globe from its original state of igneous fusion. According to the speaker's investigations, these were nothing else than metamorphic rocks that had arisen from the regular development depending upon chemical processes, of various mineral bodies particularly Feldspath and Quartz, which had come in the place of limestone masses contemporary with the jurassic formation. The speaker, in reference to this and to another more general and important result of his inquiries, namely, that the *silicates* so far from being primary formations, or even in the general case possessing a high degree of antiquity, as Geology had hitherto supposed, were always *younger than the carbonates*, and that the history of the development of the former constantly pre-supposed the earlier existence of the latter; he shewed by means of the specimens in question, on the largest and on the smallest scale, that Feldspath and Quartz had grown upon and between Carbonates of lime (Kalkspathen), which last were still to be found in a portion of specimens, well preserved, and without exhibiting the slightest trace of the operation of heat, partly surrounded by Feldspath and

Quartz crystals, and partly, where effaced through subsequent dissolution and lixiviation, leaving their impression on these crystals in the distinctest manner possible.

Dr. Pichler, of Innsbruck, exhibited a geognostic map of the northern limestone Alps of the Tyrol, from the borders of the Voralberg to the borders of Saltzburg, and spoke at some length upon the different formations. Dr. Von Dechen gave information with respect to the geognostical map of Rhenish Westphalia, of which eleven sections had already appeared and nine others were in course of preparation. Professor Plieninger spoke upon the difference in the formation of the teeth between the *microlestes antiquus*, from the upper breccia (betwixt the keuper and the lias) of Wurtemberg, and the *Plagiaulax* of the Purbeck oolite. Herr Von dem Borne discoursed on the geology of Pomerania, referring to the alluvium, the diluvium, the tertiary strata, and the Jura formations. The alluvium is found chiefly on the sandy coasts, greatly changed by currents. It is washed away from the Pomeranian and deposited on the Prussian coast. In the diluvium he distinguished a disturbed recent formation and a regularly deposited older one.

On Monday 21st September, Professor Gustav Rose made some observations on the gneiss which forms the north-western limit of the granitite of the Riesengebirge, and of the granite which occurs in it; he also spoke of the relation of granite to gneiss in general. The boundaries betwixt the two could, he said, be very distinctly drawn in the Riesengebirge. In 1856 at Vienna the learned Professor gave an account of some recent investigations which he had made in the Riesengebirge and Isergebirge, with a a view to determine the exact limits betwixt granitite and granite, and assigned the reasons which had induced him to regard the former as a separate species of rock from the latter. These reasons were—first, the distinct mineral composition—the white mica of the granite being entirely wanting; secondly, the accurate limits which can be drawn betwixt it and the granite of the Isergebirge: and, thirdly, the circumstance that mixtures of a similar composition to the granite of the Riesengebirge and Isergebirge occurred in the most diverse localities. From the relations of the granitite to the granite the Professor considered that the former must have penetrated to the surface more recently than the latter. [See also a contribution by Rose "Ueber die zur Granitgruppe gehörigen Gebirgsarten" in the first volume of the "Zeitschrift der deutsch-geologischen Gesellschaft."]

Sir Roderick Murchison laid before the meeting the most recent publications of the Geological Survey, consisting of maps, sections, &c., as illustrative of the Silurian or older palæozoic rocks, the coal measures, and the secondary and tertiary deposits; and he also referred to the records of the School of Mines and the Decades of Organic Remains, which exhibited the labours of various distinguished English geologists. M. E. de Verneuil observed that, whilst Sir R. Murchison had borne such willing testimony to the distinguished merits of his colleagues, he had entirely overlooked his own services; and pointed out that, in regard especially to the School of Mines, Sir Roderick had had the greatest share in its extension and results, both through the great works which he had himself accomplished, and through what others had accomplished under his guidance and superintendence.

Herr Von Carnall exhibited a copy of the new edition of his geognostical map of Upper Silesia, and explained in what respects it differed from the first edition. He took occasion to remark that of the ironstone rocks of Upper Silesia it was only a portion that could be regarded as middle-Jurassic; the portions of this formatian lying to the north and west of Oppel, and the great Rybnik and Rattibor portions, must be regarded as tertiary-miocene. Under these strata lay the Upper Silesian gypsum and marl rocks (tegel) with traces of salt, which are now in the course of being investigated.

Professor Von Zepharovich of Cracow, spoke of the progress that had recently been made in the knowledge of Austrian minerals, and pointed out the necessity of collecting and arranging the results of inquiries made during long periods of time in order to obtain a synoptical view of what had really been accomplished. He next exhibited a few printed sheets of a large work of this description applicable to the Austrian empire, and mentioned that the work itself would probably be published in the course of next year. He then handed the President a piece of fossil iron from Chotzen in Bohemia. Thereupon Dr. O. Volger, with reference to the aqueous origin of iron, mentioned the fact that Herr Von Baer had found in a fossil tree imbedded in the turf of a floating island on the coast of Sweden, which only occasionally emerged from the water, that the mass by which the cells had been replaced consisted of native iron.

The proceedings of the day were concluded by a few short but exceedingly interesting remarks from Professor Blum (Heidelberg), on the causes of the formation of different combinations of crystals in the same species of mineral. On this subject, he observed, our knowledge was exceedingly scanty. We had scarcely a single observation or inquiry to which we were able to refer. Experiment alone presented us with facts by the aid of which we might possibly make some progress. It was a familar fact that when an easily soluble salt (alum) crystallised from a pure solution, the forms exhibited differed from those which were obtained from impure solutions. This fact was sufficient of itself to show beyond a doubt that *the medium* in which substances crystallise exerts an influence upon the form of the crystal. Taking this for our principle, and applying it to nature, we find it to be a fact that certain minerals, when they occur in certain rocks, appear under one and the same form of crystal—when magnetic iron ore, for example, occurred in chlorite-schist, it was found in the general case to occur in the form of an octohedron. The subject was worthy of careful investigation, and might turn out to be of very great importance in a geognostic point of view.

At the sitting of Tuesday (September the 22nd), Professor Daubrée, of Strasburg, spoke on the formation of sulphuret of copper and apophyllite from the thermal springs of Plombières. In the course of certain excavations, undertaken with the purpose of fencing in these springs, the speaker had found two recent substances, which were of geological interest from the resemblance they bore to certain minerals. On a bronze cock, of Roman workmanship, which had been lying amidst the rubbish of ancient buildings for more than fifteen centuries, sulphuret of copper had been formed in the shape of beautiful crystals. They belonged to the hexagonal system, and could not be distinguished from natural crystals. From a similar composition, artificial crystals belonging to the regular system had already been obtained. The circumstances under which they had been formed seemed to differ from those under which the formation of similar crystals occurred in veins. The ancient mortar into which the warm water percolates includes in its cavities colourless crystals identical in form and composition with apophyllite. They owe their formation to the operation of the silicate of potash from the hot springs on the lime of the mortar. The formation both of the apophyllite and of the hexagonal sulphuret of copper had here taken place in water of which the temperature did not exceed 70 deg. C.

Dr. Volger gave an account of the result of his observations on the phenomena of earthquakes in Switzerland, and especially the earthquake of 25th July 1855 in the Visp-Thal, Canton of Valais. An investigation of the manner in which this earthquake operated showed the opinion which refers these phenomena to the development of subterranean gases, or to fluctuations of the earth's (hypothetical) fiery-fluid interior, to be mechanically inadmissible. On the other hand, there existed, in the structure of the Valais mountains, conditions which necessarily led to the movement of portions of the mountain masses. These were strata of gypsum underlying slate and jurassic masses of immense thickness, and thermal springs containing large quantities of this gypsum in solution. This was withdrawn from the earth; the underlying stratum was eroded; and the sinking of the overlying strata became inevitable.

Of the twenty springs of Leuk, a single one conveyed away from the soil of Valais no less than 60,000 cubic feet of gypsum annually. With the efforts of the subsidence of an undermined mass, and of the propagation in the strata of the earth of the impetus thereby conveyed to the solid substratum, the phenomena exhibited in the Valais earthquake entirely corresponded. The results of the speaker's inquiries were given in detail in a work of which two volumes had already appeared, and the third was now in the press.

The map belonging to this third volume, exhibiting the diffusion, intensity, and directions of movement of the Valais earthquake, together with the tables belonging to the two first volumes, with graphic representations of the relative frequency of earthquakes in different years and at different periods of the year in the various districts of Switzerland, were laid before the meeting.

Dr. Abich spoke on the subject of mud volcanoes, and their importance for geology. He founded this importance on an analysis of the history of the development of these formations as they occur in the environs of the Caucasus, particularly in the two Caucasian peninsulas Taman and Apsoheron and endeavoured to establish the following propositions:—1. The stratographic facts of the before named localities afford a proof that the structure of these formations, notwithstanding the Neptunian origin of the masses of which they are composed, is determined by precisely the same laws which regulate the various forms of mountains composed of strictly Vulcanic masses that have arisen in the mode of igneous fluidity. 2. The distribution of those small independent systems of mountains is most distinctly subordinate to the grand lines which determine the direction of mountain ranges, and therewith the fundamental features of our continents. 3. The linear grouping and serial arrangement of these mountains in accordance with these lines of elevation, was regulated by the same laws which regulated the foundation and successive completion of the mountain systems and ranges of every portion of the earth's surface. In conformity with these principles, Dr. Abich maintained that every view was to be rejected which might incline to refer the eruptive phenomena which still retain their permanent seat in the bosom of these formations to so-called secondary causes, that is, in the present case, to any other causes than such as depend upon Vulcanism.

Herr Ignatius Beissel spoke on the marl of Aix-la-Chapelle, and laid before the section a geological collection from the Friedrichsberg and the Willkommsberg, in the neighbourhood of that city. The distinction hitherto assumed between the Aix and Bohemian chalk on the one hand, and the Westphalian on the other, grounded on the occurrence of polythalami and cirrhipoda in the former, must now be done away with. Ehrenberg's discovery that marl consists of organic bodies is confirmed. The green sand has arisen from a marly rock by the loss of its carbonate of lime. Down to the present time the marl is passing into sandbeds under the influence of fresh water. The proofs which he adduced were :—1. Those fossils which characterise the green sand are found in banks of sandstone which have lost every particle of lime, in banks of sandstone containing lime, in the banks of Dumont's psammite glauconifère. 2. The speaker had himself found the characteristic fossils of the upper beds of the Aachen chalk in dry deposits of green sand. 3. The glauconite granule is in most cases the result of the formation of a stone nucleus in the shells of polythalamiæ. 4. On dissolving the marl in muriatic acid we obtain a residuum of green sand. That the lower portions of the chalk are precisely those which have lost their lime is explained by the circumstance that, being the last to be elevated above the sea, they were the longest exposed to the influence of the sea-water; moreover the meteoric waters flow over the clay strata of the Aachen sand, and thus fill the lower division while they merely filter through the upper. The speaker then discussed the residuum of the marl and green sand :—1. The double refracting siliceous splinter; 2. The single-refracting spongiolites. The siliceous splinters originate :—1. From spongiolites which become crystalline on the change of the amorphous silica; 2. From the disintegration of the white stone granules of polythalamiæ; 3. From glauconite granules which have burst and lost their colouring matter, and of which the amorphous silica had been changed into crystalline. The speaker's collections, and especially his microscopic preparations of the finest organisms, excited in the section the utmost admiration.

At the sitting of Wednesday (September 23) General von Panhuys explained a small geological map of the southern portion of the Duchy of Limburg, which he had prepared in 1850, by instructions of the Dutch War Office. The object had been to ascertain whether the coal measures extended to the Dutch territory. The speaker endeavoured to show that the Bardenberg district, north of Aix-la-Chapelle, is connected with the Liege coal trough, and forms a portion of it. Were this the case—a fact that can be perfectly ascertained only by borings—Limburg would be in possession of two square miles of coal measures, of which one-half is covered merely by green sand and the other half by green sand and by chalk.

Herr von der Marck spoke on the subject of some petrifactions of the Westphalian chalk, and exhibited a number of well-preserved fossils—amongst others, the remains of huge Saurians from the Schöppinger Berg, near Münster.

Herr Heymann spoke of the changes of certain constituents that had occurred in trachytic and basaltic rocks in the Siebengebirge. He exhibited specimens of oligoklas transmuted into kaolin and red Ehrenbergit; of hornblende transmuted into steatite; of transmuted augite and olivine in the basalt of the Menzenberg, near Honnef; radiated mesotype from the basalt of the Minderberg was also partly changed into a steatitic mass.

Professor Noeggerath denied that the black mica in the trachytes was altered hornblende.

Herr Max Braun observed that the occurrence of blende at the Wetternsee in Sweden, was something very different from what it is in our known veins and beds in the district of the Rhine. In Sweden the blende formed beds which were imbedded in the gneiss, following the gneiss strata, with similar strike and dip, for a considerable extent, and with a thickness of 15 to 20 feet or more. The blende is for most part finely granular, and always intimately mixed with more or less feldspath. In these beds of blende are found concretions of green feldspath and of quartz, including crystalline particles of blend. The gneiss in immediate contact with the blende contains a bed of granular lime, containing garnet and pistazite and thin layers of Wollastonite. Parallel to the blende strata is a bed of brown garnet, containing mica and dichroite, and in like manner subordinate to the gneiss. There were similar layers of white cobalt and copper pyrites imbedded in quartzose mica-slate. This occurrence of zinc blende is peculiar, and does not seem to harmonise well with our common views regarding mineral veins.

Sir Roderick Murchison exhibited the plates of a new edition of his Siluria, and explained the most important additions that had been made to our knowledge of the Silurian rocks during the last three years. He maintained that it was now proved, both by physical and zoological facts, that the Bala beds of Wales were identical with the Caradoc beds, resting similarly upon the Llandeilo formation, in the lower division of which a number of new fossil species had been discovered. He then referred to the group of the Llandovery rocks in South Wales (containing the *Pentamerns Oblongus*) lying between the lower and upper Silurian, and closely connected with each. Finally, he exhibited figures of gigantic crustaceans (pterygotus) found in the upper Silurian beds, which had been published by Mr. Salter in the Decades of the Geological Survey.

M. Ch. St. Claire Deville exhibited his topographical map of the island of Guadaloupe. In the centre rises the cone of the Sonfriere, surrounded by a crater of elevation. The latter consists of dolerite; the central one of a trachyte, the feldspath of which approaches in chemical composition to Labrador. The Sonfriere is an extinct volcano. At the request of Sir Roderick Murchison and Mr. Merian, the speaker then communicated his views with regard to the volcanoes of Italy and their mode of action. He held Von Buch's theory of elevation, but laid considerable stress upon *étoilement.* Vesuvius and Etna, as central volcanoes, he regarded as the points of intersection of radiating fissures, in which volcanic action burst forth. The Phlegrean fields, the Rocca Monfina, the Lago d'Amsanto, Ischia, and other points he considered as lying upon these fissures.

Herr von Carnall exhibited maps of the coal formation in Russian Poland on a scale of 1-20,000, and of Lower Silesia, at which Beyrich, Rose, and Roth had been working for years, on a scale of 1-100,000.

Director Nauck, with reference to the question agitated on Monday by Professor Blum, reported the result of a series of experiments undertaken with a view to the arbitrary production of secondary surfaces on artificial crystals. He described the method employed by him, by means of which he found that the number of surfaces became greater in proportion to the slowness with which crystallisation proceeded, a fact of which he cited several examples. He stated, in conclusion, that his experiments should be continued.

Professor Römer communicated the result of a survey of the Jurassic Wesergebirge between Hameln and Osnabrück. He referred especially to the striking alterations which the members of the Jura formation composing the range undergo in the course of their extent. In consequence of such a change, for example, the Oxford appears in the western spurs of the chain as compact quartz, whilst in a section of the Porta Guestphalica it is developed in layers of loose sandy marl schist, which crumbles to pieces in the atmosphere. As something altogether peculiar to the Wesergebirge, and differing from anything to be found either in other parts of North Germany or in any other district, he denoted the occurrence of thick beds of brown sandstone in the uppermost member of the series, which is distinguished chiefly by *exogyra virgula*, the member which in North Germany has hitherto been denoted as Portland, but would more properly be termed Kimmeridge. Such sandstone strata may be observed in the neighbourhood of Lübbecke and of Preussisch Oldendorff.

At the last sectional meeting (24th September), Berghauptman von Dechen gave an account of the progress that had been made in preparing the geognostical map of Germany, and received the thanks of the meeting for his own trouble in that work. In Dr. Ewich's absence, he also made some observations regarding the mineral spring in the Brohlthal and its future importance. He concluded with a short report on the thermal springs of Neuenahr near Beuel in the Ahrthal, recently discovered by Professor Bischof.

Dr. Volger pointed out the error that was committed when recent geological tendencies were characterised as "a revival of Neptunism." The new tendency had nothing in common with Neptunism except this, that it was the opposite of Plutonism. In a positive sense it partook no more of Neptunism than Plutonism had retained of the Neptunistic doctrine; nay, in essential points it deviated from these still more widely than Plutonism itself did. Neptunism assumed the crystalline rocks,—the Basalts, the Gneisses, the Granites—to be immediate sedimentary deposits in water, just as it assumed that mode of deposit for sandstone, clay, and limestone. The new geology entertained no doubts regarding the affinity of basalts with the lavas of active volcanoes; but it supposed these basalts, after their eruption in the form of lava, to have undergone chemical alterations in their masses, by virtue of which they now appear as basalts and not as lavas. The new geology, whilst, no doubt, absolutely denying the Vulcanic, or, if the term be more agreeable, the "Plutonic" origin of Gneiss, Granite and other crystalline rocks, was yet very far from regarding these as being therefore immediate sediments. On the contrary, it supposed these rocks to have proceeded, by means of complete chemical changes, from sediments which were originally of a totally different constitution;—to have proceeded, e. g. from limestone strata by processes capable of exact demonstration by means of the pseudomorphoses, the relative antiquity of the various minerals composing the rocks, and other aids to investigation. Again, no Plutonist had ever called in question that sandstone, clay, and stratified limestone were immediate deposits from water, just as their formation was conceived in Werner's Neptunism. The new Geology was not so neptunistic, but here too pointed out a number of chemical processes caused by the sediments partly in the act of their deposit and partly immediately afterwards. Whilst Plutonism, e. g. had never scrupled to assume that limestone strata had been formed and were still in process of formation, partly from the evaporation of water holding lime in solution, partly from the liberation of the carbonic acid by means of which the water held the lime in solution, the new Geology showed that this process so little occurs in nature that by no possibility could sedimentary limestone ever have arisen in such a manner. Sea water contained so much free carbonic acid that it could dissolve ten times the quantity of lime that it contains; and, far from being able to deposit lime for want of carbonic acid, it must operate as a solvent upon all masses of lime with which it comes in immediate contact. According to the results attained by the new geology, the mode in which sedimentary lime was formed was as follows: Its materials were furnished not only by the (Carbonate of) lime contained in the water, but also by the gypsum (sulphate of lime) which is such a singularly universal constituent of all the waters of the Earth and in sea-water especially is contained in great abundance. The business of separating the lime from the water was performed partly by plants, partly by animals. The former secreted the (carbonate of) lime by absorbing the carbonic acid by means of which it was held in solution in the water, and decomposing it in their change of matter, whilst by their organic materials themselves they protected the secreted lime from immediate contact with the water and thereby from being re-dissolved. The latter took up the gypsum, employed its sulphuric acid in the formation of such of their organic materials as require sulphur (flesh, blood, &c:) and combined the calcareous earth thus robbed of its acid with the carbonic acid constantly produced in their bodies by respiration. The carbonate of lime thus formed they deposited in their organs, especially in their skin, in the form of shell. It was of accumulations of these shells (interpenetrated with organic tissues and materials) and of the masses of lime secreted by plants, that all limestone strata originally consisted. The lowest classes of plants and animals, especially the microscopic (the one-celled Algæ—Diatomace or Bacillariæ—and the Foramenifera), are in this respect of by far the greatest importance in nature. Hence, in the apparently compact limestone masses, their origin from the incrustations of plants and the shells of animals generally escaped the naked eye and required the aid of the microscope for its demonstration. After the deposition of these calcareous sediments they were continually undergoing transpositions in consequence of the decomposition of organic materials which was going on within them. In this manner the traces of their origin became more and more obliterated; but even in limestones of the oldest formations, we could occasionally observe those traces to such an extent that it was impossible to mistake them. The speaker elucidated his observations by laying before the meeting a series of specimens from the miocene formation of the basin of Mainz taken from the locality of Frankfort.

The agreeable, though for me somewhat presumptuous, task which I undertook I have now performed to the best of my ability. I do not profess to have furnished anything like a complete outline of the proceedings; but I trust that I may have been the humble means of conveying to such readers of the *Naturalist* as take an interest in the proceedings of foreign geologists a slight idea of the contents of some of the more important communications, which will be found reported *in extenso* when the transactions of the meeting shall have been published.

ART. XXV.—*Geological Survey in Great Britain and her Dependencies.*

Extracted from the *Saturday Review* of 3rd July.

In 1769 there was born to a yeoman of Oxfordshire, named John Smith, a son, who in due course was christened William. William Smith, as he grew into boy's estate, delighted to wander in the fields collecting "poundstones (*Echintes*,) "pundibs" (*Terebratulæ*), and other stoney curiosities; and, receiving little education beyond what he taught himself, he learned nothing of classics but the name. Grown to be a man, he became a land surveyor and civil engineer, and by-and-by in the western parts of England was much engaged in constructing canals. While thus occupied, he observed that all the rocky masses forming the substrata of the country were gently inclined to the east and south-east—that the red sandstones and marls above the *coal-measures* passed below the beds provincially termed lias clay, and limestone—that these again passed underneath the sands, yellow limestones, and clays that form the table land of the Cotteswold-Hills—while they in turn plunged beneath the great escarpment of chalk that runs from the coast of Dorsetshire northward to the Yorkshire shores of the German Ocean. Gifted with remarkable powers of observation, he further observed that each formation of clay, sand, or limestone held to a very great extent its own peculiar suite of fossils. The "snakestones" (*Ammonites*) of the lias were different in form and ornament from those of the inferior oolite; and the shells of the latter, again, differed from those of the Oxford clay, cornbrash, and Kimmeridge clay. Pondering much on these things, he came to the then unheard-of conclusion that each formation had been in its turn a sea-bottom, in the sediments of which lived and died marine animals now extinct, many of them specially distinctive of their own epochs in time.

Here indeed was a discovery—made, too, by a man utterly unknown to the scientific world, and having no pretension to scientific lore. He spoke of it constantly to his friends, and at breakfast used to illustrate the subject with layers of bread-and-butter, placed with out-cropping edges to represent the escarpments that mark the superposition of the strata. He talked of it wherever he went—at canal boards, county meetings, agricultural associations, and Woburn sheep-shearings—and once much astonished a scientific friend and clergyman of Bath by deranging the zoological classification of his cabinet of fossils, and rapidly re-arranging them all in stratigraphical order:—"These came from the blue lias, these from the overlying sand and freestone, these from the fuller's earth, and these from the Bath building-stones." A new and unexpected light was thrown upon the whole subject, and thenceforth the Rev. Samuel Richardson became his disciple and warmest advocate. But "Strata Smith" was too obscure and unscientific to be at once received as an apostle by the more distinguished geologists of the day. Could a country land surveyor pretend to teach them something more than was known to Werner and Hutton? He might preach about strata and their fossils through the length and breadth of England, but the structure of the Earth was not to be unravelled in this unlearned manner. Established geologists therefore pooh-poohed him, and it took many a long year before his principles, working their way, took effect on the geological mind. This long-delayed result was chiefly due to the discrimination of the now venerable Doctor Fitton; and the first geologists of the day learned from a busy land surveyor that superposition of strata is inseparably connected with the succession of life in time. The grand vision indulged in by the old physicist Hook was at length realized, and it was indeed possible to "build up a terrestrial chronology from rotten shells" embedded in the rocks. Now there could be no mistake that the time had arrrived to do him honour, and through Sedgwick, the President of the Geological Society, William Smith was presented with the Wollaston medal, and hailed as "the Father of English Geology;" and his reputation still further ripening, he was ultimately created LL.D. by the University of Oxford.

But during all this time he did not confine himself to the promulgation of his doctrines by words alone. By incessent journeys to and fro, on foot and on horseback, in gigs, chaises, and on the tops of stage coaches, he traversed the length and breadth of the land, and, maturing his knowledge of its rocks, constructed the first geological map of England. It was a work so masterly in conception, and so correct in general outline, that in principal it served as a basis not only for the production of later maps of the British Islands, but for geological maps of all other parts of the world, wherever they have been undertaken; and thus the faintly expressed hope of Lister (1683) was accomplished, that if such and such soils and the underlying rocks were mapped, "something more might be comprehended from the whole, and from every part, than I can possibly foresee." In the apartments of the Geological Society Smith's map may yet be seen—a great historical document, old and worn, calling for renewal of its faded tints. Let any one conversant with the subject compare it with later works on a similar scale, and he will find that in all essential features it will not suffer by the comparison—the intricate anatomy of the Silurian rocks of Wales and the north of England by Murchison and Sedgwick being the chief additions made to his great generalizations. In 1840 he died, having, in his simple earnest way, gained for himself a name as lasting as the science he loved so well. Till the manner as well as the fact of the first appearance of successive forms of life shall be solved, it is not easy to surmise how any discovery can be made in geology equal in value to that which we owe to the genius of William Smith.

Since the publication of Smith's map, many others have appeared—the noble compilation for England by Greenough, the great original map of Scotland by Macculloch, and the yet finer map of Ireland by Sir Richard Griffith. The last is a work only less remarkable than Smith's in this—that, when commenced, the principles of geology were established, and he followed instead of leading the way. To these, of various dates, may be added the maps by Professor Phillips, Sir Roderick Murchison, and Knipe, and many others of districts in detail—an example first set by Smith in his geological maps of counties. But the most remarkable result of this appreciation of the growing value of the subject was the establishment of the Government Geological Survey of Great Britain, under the late Sir Henry De la Beche, to whom the whole honour is due of having commenced, and for many years successfully carried on, this great undertaking. From small beginnings in Cornwall he gradually extended his operations, and, aided by Government, he gradually trained or selected a corps of skilled geologists, who, ere his death in 1855, had already mapped and published nearly a half of England and Wales and part of the South of Ireland. The maps employed in this survey are the one-inch Ordnance sheets for the southern half of England, and the six-inch maps for Ireland, the north of England and Scotland. Each fault, each crop of coal, and every geological boundary is traced so minutely, that on some of the roughest and loftiest hills in Wales, twenty geological lines may be counted in the space of an inch, corresponding to one mile of horizontal measurement; and all the country is traversed by numerous measured sections on which the structure and disposition of the rocky masses is laid down in still more precise detail. On the death of Sir Henry De la Beche the office of Director General was conferred on Sir Roderick Murchison, himself a geological workman whose field of operations has extended from the Atlantic to the Caspian Sea.

The Government School of Mines and Geological Museum in Jermyn-street is an offshoot of the Survey. There, in addition to the published maps, other substantial proofs of the progress of the Survey are preserved and exhibited. Ores, metals, rocks, and whole suites of fossils are stratigraphically arranged in such a manner, that, with an observant eye for form, all may easily understand the more obvious scientific meanings of the succession of life in time and its bearing on geological economics. It is perhaps scarcely an exaggeration to say that the greater number of so-called educated persons are still ignorant of the meaning of this great doctrine. They would be ashamed not to know that there are many suns and material worlds besides our own; but the science, equally grand and comprehensible, that aims at the discovery of the laws that regulated the creation, extension, decadence, and utter extinction of many successive species of genera and whole orders of life is ignored, or if intruded on the attention, is looked on as an uncertain and dangerous dream—and this in a country which was almost the nursery of geology, and which, for fifty-one years, has boasted the first Geological Society in the world. Several other governments have followed the example of that of Great Britain. Similar Surveys have long been established in France, Belgium, Austria, and the United States; and others will certainly be founded as knowledge progresses, and as those branches of material prosperity advance on which the subject immediately bears. A direct result, perhaps not at first foreseen by the founder of the British Survey, was the establishment of kindred undertakings in our possessions abroad. In 1843, a systematic geological survey was commenced in Canada, in 1846 in India, and at later dates in Australia, the Cape of Good Hope, and Trinidad; and all of these sprang from the parent institution in which the chief Colonial geologists were trained in the field, while both the Survey and the School of Mines supplied many of the younger officers. We have before us a pile of Blue-books, Reports, and a large Atlas of the Geological Survey of Canada, published by order of the Legislative Assembly, and probably almost unknown in England except to a few scientific geologists. From them it appears that Sir William Logan, the Director of the Survey, and his assistants, have traversed and examined for 1500 miles, every part of Canada, from Gaspé to the head of Lake Superior, following the Lakes and the great and small rivers, and penetrating the forest-clad interior, often in districts utterly unvisited by settlers. The result is, that all the great geological features of Canada are laid down on the map, and in many districts, the most interesting new topographical and geological details have been inserted with unrivalled skill.

But those who merely look at the result have little idea of the difficulties that attend such an undertaking in a country the greater part of which is yet unreclaimed. From the want of accurate maps to serve as a foundation for geological work, Sir William and his assistants have actually been obliged in almost all cases to construct topographical plans—truly very different operations from those of an Ordnance Survey in fertile England, where houses and steeples, hill-tops and beacons, afford innumerable points for accurate triangulation, while all the minor field operations are carried on almost mechanically by well-trained Sappers and Miners. Though like in result also, their labour is yet very different in kind from English field-work in geology, where the explorer has road sections and railway cuttings, open rivers, quarries and coal-pits, all waiting to afford him data. If the lowlands of England were partly, and the highlands of Scotland and Wales entirely, covered with lofty and almost impenetrable forests, and if the most experienced English geologists were turned loose upon these countries, and required to unravel all the intricacies of their stratifications, they would have some idea of a kind of geological labour not to be met with in any part of Europe out of Russia. On a gigantic scale, the great Laurentine chain, extending from Labrador to Lake Superior, might represent the highlands of Scotland—Gaspé the mountains of Wales—and the flat Silurian strata bordering the St. Lawrence, the Ottawa, and Lakes Ontario, Erie, and Huron, might be compared, in their broad terraced arrangement, to the escarpments of the oolitic rocks and chalk in the centre of England. Geology is a delightful science, but it may be questioned if gentleman who live at home at ease would in all cases be enthusiastic enough to devote themselves to it were they obliged, for half of every year, for half a lifetime, to rough it in dreary pine forests—to navigate newly-discovered rivers in birch-bark canoes made by Indian assistants on the spot—to sleep in birch-bark tents with their feet to nightly fires at the entrance—to be thankful when they fell in with a few wild onions to flavour their daily salt pork—to have their paths disputed by occasional bears in quarries, on the river banks, or the shores of the desolate Anticosti—and, worst of all, to have but little of that direct sympathy and clear appreciation of the scientific value of their labours of which men of science who work amid their peers daily experience the value. The Government of Canada may well be proud of Sir William Logan and his well-selected staff, and the mother country has equal cause of gratulation that the great Imperial colony has emulated her example in founding, on a scale so large and efficient, a national work which no civilized country should be without.

ART. XXVI.—*Figures and Descriptions of Canadian Organic Remains.* Decade III. 8vo. Pp. 102, with 12 plates, price $1. Montreal: B. Dawson & Son.

In a scientific point of view, this is the first instalment of work of the Canadian Survey. The reasons for the early appearance, of this the third part, and other matters connected with it, are thus explained by Sir W. E. Logan in the preface:—

"One of the subjects comprehended in the recommendation of the Select Committee appointed by the House of Assembly, on the Geological Survey, in 1854, was the publication of figures and descriptions illustrative of such new organic forms as might be obtained in the progress of the investigation. In compliance with this recommendation, it was determined that the publication should be made in parts or decades, after the mode adopted by the Geological Survey of the United Kingdom, each part to consist of about ten plates, with appropriate descriptive text, and to comprehend one or more genera or groups of allied fossils, or the description of several species, for the illustration of some special point in geology.

"The first part or decade was confided for description, in 1855, to Mr. J. W. Salter, one of the Palæontologists of the Geological Survey of the United Kingdom. This comprehends different genera and species from one locality. Of these several are new, while others are more perfect forms of species already partially described; and the general object is to exhibit a commingling of forms heretofore supposed to belong to distinct epochs. The plates of this decade are the work of Mr. W. Sowerby, from drawings by Mr. R. C. Bone. The engravings are on steel; nine of the plates are finished, and it is expected the tenth will be completed in a short time.

"The second decade was undertaken also in 1855, by Mr. Jas. Hall of Albany, so justly celebrated for his works on the Palæontology of New York. It will comprehend the description of a large number of remarkable new forms of *Graptolithus* and allied genera from the Hudson River group. The drawings are by Mr. F. B. Meek. Six plates have been engraved on steel by Mr. J. E. Gavit, and ten more plates are in the engraver's hands. The number of species will probably be twenty-four, of which Mr. Hall has already given a description in the Report of Progress for the year 1857.

"On the appointment of Mr. E. Billings as Palæontologist of the Survey, in 1856, his first duty was to effect an arrangement of the Museum. This being accomplished, he devoted his attention to a third decade. This comprehends all the Cystideæ and Star-fishes, as well as all the Entomostraca, of the collection. With the view of obtaining the plates necessary for the illustration of these, Mr. Billings in the month of February last, carried his fossils to London. Finding that considerable delay was likely to attend the publication of the decade should he illustrate it by engravings on steel, he determined to have recourse to lithography. Although minute detail cannot be so finely given by this mode, nor so large an edition be obtained, it is yet perfectly suitable for all practical purposes. It is occasionally used for the fossils of the British Survey, and very generally for the illustration of the best palæontological works on the continent of Europe. The twelve plates which illustrate the third decade are the work of several well-known artists, who have all their respective merits. One of the plates is by Mr. R. C. Bone, two of them by Mr. J. Dinkle, four by Mr. Tuffen West, three by Mr. H. S. Smith, one by Mr. W. Sowerby, and one by Mr. G. West. Of the descriptive part, the Cystideæ and Star-fishes are by Mr. E. Billings; the genus Cyclocystoides by Mr. Salter and Mr. Billings; and the Entomostraca by Mr. T. R. Jones, assistant-secretary of the Geological Society of London, who is considered the best authority on this particular family of animals, and had previously described a large number of the Canadian species.

"While Mr. Billings was attending to the progress of his decade in London, it appeared doubtful which of the three that were in hand would be first ready for publication. He, in consequence, caused to be registered on the plates, as the number of the decade, the figure which indicates the order in which it was commenced. It therefore appears as the third decade, but being the first ready, and the subject quite distinct from those of the other two, no hesitation is experienced in placing it first before the public.

"Mr. H. S. Smith, who, as already stated, supplied three of the plates, has been induced to come out to Canada with the design of devoting his attention to the representation of the fossils of the Provincial collection; and it will therefore in future be unnecessary to go out of the country for the illustration of them, unless it be to procure the aid of the best authority on some special subject.

"Of the third decade an edition of 2000 copies is issued. Of these 500 copies are reserved for the members of the Legislature; and it is intended to fix upon the remainder a moderate price, and dispose of them to the public through some respectable bookseller. By this means it is hoped that they will fall into the hands of those who will really appreciate them. The same course will be pursued in respect to the first and second decades, when they are ready.

"A fourth decade is now in hand which will illustrate the Crinoids of the collection."

The first and most important paper in the work is that by Mr. Billings on the Cystideæ; an able essay in which Mr. Billings is emphatically on his own ground, and gives an earnest of much good work in Canadian Palæontology. We cannot do better than allow Mr. Billings to explain the nature of these curious denizens of the ancient seas, only remarking that to introduce them in a popular style, is in the best possible taste. In a national work published at the public expense, it is more than pedantry to refrain from such popular explanations as may enable the non-scientific reader to understand at least the nature of the subject. Yet this has too often been done, much to the detriment as we believe of science, and we are glad that a better example is here set.

"As several elaborate and beautifully illustrated memoirs upon the structure and affinities of the Cystideæ have appeared during the last few years, it would be superfluous, on the present occasion, to enter upon a re-examination of the subject, were this decade designed to circulate only among scientific men, for whom it would be sufficient to give nothing more than the most concise technical descriptions of the species. But being intended also for the use of the students of Canadian geology—whose number is rapidly increasing throughout the Province—it appears necessary to commence with a general summary of what has been ascertained up to the present time concerning the zoological characters and distribution in time and space of this somewhat extraordinary group of extinct organisms. By this course it is hoped that, while the foreign geologists will receive all the intimation he desires of what we are doing, the growth of science in our own country will also be promoted.

"The Cystideæ were a race of small marine animals, which flourished vigorously during the Silurian period, but totally disappeared before the commencement of the Carboniferous era. They were closely allied to that interesting family, the lily encrinites, or Crenoids, and, like them, entirely covered, as with a coat of mail, by a dermal or external skeleton of thin calcareous plates, which were sometimes richly ornamented with radiating ridges or striæ. Attached to the lower extremity of the body was a short flexible stalk, usually called the column, that served to anchor the animal securely to one spot on the bottom of the ocean throughout life; and at the opposite, or upper end, a set of arms, which, in addition to their other functions, may have assisted in the collection of food by exciting currents of water towards the mouth. This latter organ was a circular or oval aperture, situated in the side, below or near the summit, and in some species must have been also the passage through which such matter as could not be digested was thrown out. The young were developed from eggs, which were, there is good reason to believe, generated in the grooves of the arms, or pinnulæ, where, as has been ascertained by actual observation, the organs of reproduction are situated in the Crinoids that exist in some of the seas of the present time.

"Concerning the food, habits, or other particulars of the natural history of the Cystideæ, we can never hope to acquire any great amount of information, as the race wholly perished many ages ago, and the only evidences we have of its existence are, with few exceptions, very imperfect skeletons, which exhibit nothing except the structure of the external hard parts. It is only probable that their nourishment was derived from minute particles of animal or vegetable matter diffused through the waters in which they lived. The structure and position of the mouth are such, that they could not have been highly carnivorous, while their nearly sedentary condition would altogether preclude the capture of any prey except such as might float by chance within their reach. Animals rooted to the ground like a plant would fare ill were they organized to support life by the predacious mode only.

"The fossil remains of the Cystideæ consist for the greater part of mere fragments of the plates and columns; but these, in certain localities, occur in such prodigious abundance, that they constitute the principal portion of strata of rock several feet in thickness. Of many of the species specimens of the bodies are exceedingly rare, and when these are discovered they are usually more or less crushed and distorted. While the fossil Corals, Brachiopods and Gasteropods may be collected in hundreds, few cabinets can boast of half-a-dozen good Cystideans, even in those countries where whole formations of rock are composed of the exuviæ of the race.

"With respect to their distribution in time, they have been discovered in Bohemia, by M. Barrande, in beds which lie in the very bottom of the oldest rocks containing traces of animal life; and therefore, according to the present state of our knowledge of the primeval fauna, they were among the first living things that made their appearance upon the surface of this planet. The Lower Silurian formation, in the several countries where it has been most studied, has at its base a great thickness of stratified rocks which are altogether without fossils—at least none have been discovered in them up to the present time. Then follows in conformable succession a series in which organic remains do occur, but not in any great abundance. This is the lower half of the fossiliferous portion of the Lower Silurian. In Great Britain these strata are the Lingula Flags of Sir Roderick Murchison; in Bohemia the Primordial Zone of Barrande; and in Norway and Sweeden the Alum Slates, or Regions A and B, of M. Angelin, the leading palæontologist of that country. In America they have not been distinctly recognized, although it is doubtfully anticipated that the Potsdam sandstone and the lowest sandstones of the western states may be of the same age. It is more probable that some of the ancient schists in the eastern states, where a large trilobite of the genus *Paradoxides* has been found, are of the age of this "primordial zone of life." In whatever way this point may be decided hereafter, it is only in Bohemia that Cystideæ have been found so low down in the geological series. Four species have there been discovered, together with twenty-seven species of Trilobites, one

Brachiopod (*Orthis Romingeri*, Barrande,) and one Pteropod (*Pugiunculus primus*, Barrande,) but no Crinoids.

"In Scandinavia the Primordial Zone has not yet yielded traces of either Crinoids or Cystideæ, but seventy-one species of trilobites, and eight Brachiopods of the genera *Lingula*, *Orbicula*, *Orthis* and *Atrypa*, have been discovered, with one or two graptolites and a small orthoceratite, near the top.

"In England the Lingula Flaga, which are regarded as the equivalents of the Bohemian and Scandinavian deposits, have furnished a very similar fauna of trilobites and rare mollusca, with one or two graptolites; but up to this date only a fragment of a crinoidal column and no Cystideans. It is also to be observed, that in none of these countries have any corals been detected in these lowest fossiliferous strata.

"In the upper half of the Lower Silurian, organic remains become exceedingly abundant, and it is in this part of the geological series that the Cystideæ attain their greatest development, both in the numbers of the species and of the individuals. This deposit is represented in England by the Llandeilo and Bala or Caradoc groups of Murchison; in Bohemia by the stage D. containing the "second fauna" of Barrande; in Scandinivia and Russia by the Regions BC, C and D of Angelin, and the "Pleta" or Orthoceratite limestone; and in Canada by all the groups from the base of the Calciferous Sandrock up to the top of the Hudson River group.

"While these rocks were slowly being deposited, the Cystideæ literally covered the bottom of the ocean in dense swarms in certain localities which were favorable to their existence, one generation growing upon the remains of another, until thick beds were formed In Russia, Norway and Sweden, Sir Roderick Murchison discovered them in the Pleta limestone, which appears to be of the age of the Chazy, Bridseye, Black River and Trenton limestones, packed together like "bunches of enormous grapes;" and in Bohemia M. Barrande has found them equally abundant. He says that the Crinoids and Star-fishes have left only insignificant traces, but the Cystideæ form entire beds of from one to two yards in thickness.

"In Canada they make their appearance rarely in the Calciferous Sandrock, but in the Chazy and Trenton their remains are more common, consisting however mostly of the detatched plates packed together in thick strata. They are not very generally distributed, but confined to certain localites. Throughout extensive regions occupied by these formations scarcely a vestige of a Cystidean is to be found; but in other places, such as the neighbourhoods of the cities of Montreal and Ottawa, they are exceedingly plentiful. Everywhere however good specimens are rare.

"M. Barrande, in comparing the European rocks of this age, observes that in Bohemia the Cystidean zone occurs about the centre of his stage of Quartzites D, which would be also the equivalent of Angelin's group C. In England the corresponding level would be about the Bala limestone, where the principal masses of Cystideæ are found. The abundance of their remains in the Chazy and Trenton of Canada confirms the views of M. Barrande, and at the same time tends to shew that these two American formations should be paralleled with the Bala rather than with the Llandeilo. This question however cannot be decided without more perfect lists of fossils than can be at present procured.

"The number of species of Cystideæ that occur in this zone are as follows, so far as I can ascertain, in these countries respectively:

Scandinavia and Russia	20
Great Britain	13
Bohemia, about	8
Canada	21
New York	1
	63

"In consequence of the imperfection of the specimens and some confusion in the descriptions of different authors, the above numbers may not be exactly correct; but from what I have seen it appears to me that there are more than sixty species, described and underscribed, belonging to this period.

"In the Upper Silurian there are in Great Britain nine species, and in Canada and New York about the same number, but none in either Bohemia or Scandinavia have yet been made public.

"According to the present state of our knowledge, then, in the lower half of the Lower Silurian there are four species, in the upper half sixty-three, and in the Upper Silurian eighteen.

"Very little dependence however can be placed upon numerical comparisons, such as the above, in dealing with questions relating to the Cystideæ or Crinoideæ, for the reason that new discoveries are every year being made which very materially change the aspect of these computations. For instance, six years ago only eleven Crinoids, one Cystidean, and one Star-fish, were known in the Lower Silurian of New York and Canada, but in the collection of the Geological Survey of Canada there are now twenty-one species of Cystideans, about fifty Crinoids, and ten Star-fishes, or in all eighty-one species of Echinodermata from this formation instead of thirteen.

"In the Devonian formation several forms resembling Cystideæ have been referred to that group of organisms; but it remains still to be shewn that they are true Cystideans. The weight of the evidence tends to shew that the race was ushered in with the first living inhabitants of the deep—attained its greatest development in the latter portion of the Lower Silurian era, and died out about the time of the commencement of the Devonian. Of its associates in the Primordial Zone, the Brachiopoda, Pteropoda and Bryozoa remain to the present day. The trilobites held their possession of existence until the Carboniferous period, and the graptolites disappeared early in the Upper Silurian. With the exception then of the graptolites, the Cystideæ were the first race that became extinct."

In the remainder of the paper the scientific reader will find much curious investigation of the structures of the Crinoids and Cystideans of the silurian rocks, and the differences between them and their nearest modern relatives. These things are interesting in themselves, and raise curious questions as to the use of these perished creatures, and the conditions of life to which they were adapted. These questions we can answer only in part, but it is only by patient investigation of the minutest structures that we can hope to have even a general idea of the part they played in the works of the Supreme. Certain it is at least that they had an important share in gathering the materials of some of those limestone beds on which our country is based, and that the study of our numerous Canadian species is contributing largely to our knowledge of their mode of life. The investigations in this volume of the true nature of the orifices of Cystideans are of especial importance in this respect. No less than nineteen species are described in this decade, and many of them are illustrated by admirable figures, which equal, and we rather think far surpass anything hitherto done for American fossils. Another valuable paper by Mr. Billings, relates to the fossil Star-fishes of Canada.

Mr. Salter's contribution to the volume is a description of a singular new genus allied to Cystideans or Star-fishes if not connecting these groups.

Mr. Jones gives descriptions and figures of nine species of little bivalve Crustacea allied to the Cypoits and Cytheridea that now swarm in our ports and on our sea coasts, and which in the Silurian Seas, no doubt formed a part of the food of the Crinoids and Cystideans.

We are glad to learn that this work is to be offered on sale at a low price, and we hope that by this means it will find its way into the hands of numerous collectors, who may by the discovery of new species, and more complete specimens, assist in still farther extending our knowledge of the subjects of which it treats. This educational use alone will repay the publication of the work, and we trust that its practical importance will be duly appreciated when we state that a plate of one of these Cystideans no larger than a kernel of wheat, might enable any one to distinguish a silurian limestone from one belonging to the coal formation.

ROBERT BROWN.

The distinguished botanist died on Saturday last, at his house in Dean Street, Soho, in the eighty-fifth year of his age. Though less popularly known as a man of science than many of his contemporaries, those whose studies have enabled them to appreciate the labours of Brown rank him altogether as the foremost scientific man of this century. He takes this position not so much from his extensive observations on the structure and habits of plants, as from the philosophical insight and the power he displayed of applying the well-ascertained facts of one case to the explanation of doubtful phenomena in a large series. Till his time botany can scarcely be said to have had a scientific foundation. It consisted of a large number of ill-observed and badly-arranged facts. By the use of the microscope and the conviction of the necessity of studying the history of the developement of the plant in order to ascertain its true structure and relations, Brown changed the face of botany. He gave life and significance to that which had been dull and purposeless. His influence was felt in every direction:—the microscope became a necessary instrument in the hands of the philosophical botanist, and the history of developement was the basis on which all improvement in classification was carried on. This influence extended from the vegetable to the animal kingdoms. The researches of Schleiden on the vegetable cell, prompted by the observations of Brown, led to those of Schwam on the animal cell; and we may directly trace the present position of animal physiology to the wonderful influence that the researches of Brown have exerted upon the investigation of the laws of organization. Even in zoology the influence of Brown's researches may be traced in the interest attached to the history of development in all its recent systems of classification. Brown had, in fact, in the beginning of the present century, grasped the great ideas of growth and development, which are now the beacon lights of all research in biological science, whether in the plant or animal world.

But whilst his influence was thus great, his works are not calculated to attract popular attention. They are contained in the Transactions of our learned Societies, in the scientific appendices of quarto volumes of voyages and travels, or in Latin descriptions of the orders, genera, and species of plants. The interest taken in these works by his countrymen was never sufficient to secure for them republication, although a collected edition of his works, in five volumes, is well known in Germany. He was of a diffident and retiring disposition, shunning whatever partook of display, and anxious to avoid public observation. Thus it is that one of our greatest philosophers has passed away without notice, and many will have heard his name for the first time with the announcement of his decease. But for him an undying reputation remains, which must increase as long as the great science of life is studied and understood.

Robert Brown was the son of a Scottish Episcopalian clergyman, and was born at Montrose on the 21st of December, 1773 He was first entered a student at Marischal College, Aberdeen, and afterwards studied medicine at Edinburgh, where he completed his studies in 1793. In the same year he was appointed assistant-surgeon and subaltern in a Scotch Fencible Regiment, which he accompanied to Ireland, and stayed there till the end of 1800. Having through his love of botany made the acquaintance of Sir Joseph Banks, he was through his interest appointed naturalist to Capt. Flinders's Surveying Expedition to New Holland. During this voyage the whole continent of Australia was circumnavigated many parts of the coast were visited, and eventually the ship in which the Expedition sailed was condemned as unseaworthy at Port Jackson in 1803. Mr. Brown, remained in New Holland, visiting different parts of the colony of New South Wales and Van Diemen's Land, and eventually returned to England in 1805. Australia was then an unexplored mine of botanical wealth. Brown returned with nearly 4,000 species of plants. He was shortly appointed Librarian to the Linnean Society. Here he quietly examined his plants, and evolved with philosophic caution and patience those views which were destined to produce so extensive and lasting an impression on science. One of his earliest papers was published in the Transactions of the Wernerian Society of Edinburgh, and was devoted to the family of plants called by him "Asclepiadæ." In this paper the character of mind of the author is well seen. The microscope had been used, the process of the development had been watched, a new series of facts important to the laws of reproduction had been discovered, and a new order of plants established. Such was the nature of most of his future communications to the Linnean and Royal Societies. Such was the character of his great work on the plants of New Holland, which he published in the year 1810, with the title 'Prodromus Floræ Novæ Hollandiæ et Insulæ Van Diemen.' This work contained not only a description of the plants which he had himself collected in Australia, but also those collected by Sir Joseph Banks during Cook's first voyage. This book abounded in new facts and new orders. It was published as a first volume, but it was never succeeded by a second, as appeared to have been originally intended by the author. At the time this work was published, it was the practice of English botanists to arrange plants according to the artificial method of Linnæus, and Brown's 'Prodromus' was the first English work devoted to a scientific and rational classification of plants. Although the Linnean system of classification survived some time after the publication of this work, it eventually succumbed before those principles of arrangement which were carried out in so masterly a manner by Brown, and the importance which had been recognized by John Ray and Adamson, and even by Linnæus himself.

In 1814 Capt. Flinders published a narrative of his voyage, and to this was attached an appendix by Brown, entitled 'General remarks, Geographical and Systematical, on the Botany of Terra Australis.' In subsequent years several important papers appeared in the *Transactions of the Linnean Society*. Amongst others may be named, 'On the Natural Order of Plants called Proteacæ,' —'Observations on the Natural Family of Plants called Compositæ' (Vol. xii.),—'An account of a New Genus of Plants called Rafflesia' (Vol. xiii.) In 1828 he published in a separate form 'A Brief Account of Microscopical Observations on the Particles contained in the Pollen of Plants, and on the general existence of active Molecules in Organic and Inorganic Bodies.' These movements, the full import of which is at present not understood, he was the first to point out, and draw attention to their importance. On the Continent it is the custom to allude to this phenomenon as the "Brownonian movement." He is the author also of the botanical appendices attached to the accounts of the voyages of Ross and Parry to the Arctic Regions, of Tuckey's expedition to the Congo, and of Oudney, Denham, and Clapperton's explorations in Central Africa. Assisted by Mr. Bennett, he has also described the rarer plants collected by Dr. Horsfield during his residence in Java.

After the death of Dryander in 1810, Dr. Brown received the charge of the library and collections of Sir Joseph Banks, who bequeathed them to him for life. They were afterwards, by his permission, transferred to the British Museum in 1827, and he was appointed keeper of Botany in that Institution. In 1811 he became a Fellow of the Royal Society, and has several times been elected on the Council of that body. In 1832 he received the degree of D.C.L. from the University of Oxford. In 1833 he was elected one of the eight Foreign Associates of the French Academy of Science. In 1839 the Royal Society awarded him their Copley medal for his discoveries during a series of years 'On the subject of Vegetable Impregnation.' In 1849 he was elected president of the Linnean Society, a post from which he retired in 1853. During the administration of Sir Robert Peel he received a pension of £200 as a recognition of his scientific merits. He also received the decoration of the highest Prussian civil order "Pour le Mérite," of which his friend and survivor at the age of 88, the Baron von Humboldt, is Chancellor. Humboldt long since called him "Botanicorum facile princeps," a title to which all botanists readily admitted his undisputed claim.

He died surrounded by his collections in the room which had formerly been the library of Sir Joseph Banks. In private, Dr. Brown was greatly admired by a large circle of attached friends for the singular soundness of his judgment, the simplicity of his habits, and the kindness of his disposition. He was buried on the 15th inst. at the cemetery at Kensal Green, when his funeral was attended by a large body of his scientific and personal friends.—*Athenæum.*

BOTANY, &c.

The Natural History of British Meadow and Pastoral Grasses. By James Buckman. Messrs. Hamilton & Adams, London.—This little epitome is represented as adding a large amount to our knowledge of British Gramineæ. Every portion of the book gives evidence of the author's practical acquaintance with the subject on which he writes. The work is divided into three parts:—1. The Natural History of British Grasses; 2. Their Structure and Economy; 3. Their Agricultural Economy. To the Agriculturist desirous of improving the character of his pasture-lands, this book will be found a useful guide:—

The Practical Naturalist's Guide, containing Instructions for Collecting, Preparing and Preserving Specimens of all departments of Zoology. By J. B. Davies. Messrs. Simpkin & Marshall, London.—To those who know how to use specimens aright, this manual will be invaluable. It contains ample instructions for the preservation of all sorts of animals and their parts, from the huge Proboscidea and Cetacea down to the microscopic forms of the Protozoa. The means of taking animals, both on the land and the water, are detailed. There is a good chapter on dredging, and the taking of marine animals by the haul-net and towing-net; also, a series of receipts for making solutions and pastes in which to preserve animals:—

A Manual Flora of Madeira and the adjacent Islands of Porto Santo and the Dezertas. By R. T. Lowe, M.A. Van Voorst, London.—Tolerably accurate lists of the plants of these islands have been published before; but none of them can be compared, for extent and accuracy, with the present work. It is only a first part, embracing the Thalamifloral Exogens, and contains a very full and complete description of every species, with the character of the genera, orders and classes. Mr. Lowe has also added notes on the rarer or more interesting species, which will be found most valuable to those studying the botany of this part of the world.—*Athenæum.*

Illustrations from the genus Carex. By Francis Boott, M.D. W. Pamplin, London.—In the preface, the author says: "My original design in this work was limited to the illustration of the Carices of N. America, which I had studied for several years under the advantage of frequent communication with my friend Mr. Carey, who had so ably described and grouped them in Dr.

Gray's "Manual of the Botany of the Northern States"; and the lithographed impressions were made in the prosecution of that design. The extensive and beautiful collection of specimens subsequently brought by Dr. Hooker from the East Indies, which were liberally placed in my hands by that eminent man, impelled me to extend my plan; and I have endeavored to illustrate the genus at large." Most of the species here figured are accordingly North American or East Indian. The ample list of North American will be found to comprise a very large share of the Carices of Gray's Manual, as well as of species of higher northern, more southern, and western regions. The figures of these fascinating plants are very truthful. The main object of the work is to give accurate representations of all the known Carices :—

A List of the Orchidaceous Plants collected in the East of Cuba, by Mr. C. Wright, with Characters of the New Species. by Prof. LINDLEY, (from *Ann. and Mag. Nat. Hist.*, May, 1838), —It appears that of the eighty species of Orchids gathered by Mr. Wright in his recent visit to Cuba, twenty-one are novelties (here characterised by Prof. Lindley), and several others have scarcely been seen since the time of Swartz;—showing "how rich in new species of the Order is the vegetation of that little-known island, and how much is still open to discovery by the diligent traveller." :—

Salices Boreali-Americanæ: a Synopsis of North American Willows. By N. J. ANDERSON, Professor of Botany in the University of Stockholm, Sweden.—In the March number of this Journal (*Silliman's*) we stated that Professor Anderson had undertaken to elaborate the *Salicineæ* for DeCandolle's Prodromus, and that materials in the form of complete specimens of Willows were earnestly solicited from every part of this country, in order that he might attain to something like the same full acquaintance with our species which he possesses of the European forms. We are happy to announce that Prof. Anderson has already made a preliminary study of our Willows, from such materials as he has been able thus far to examine; and that he has embodied the results in a memoir upon the subject, which is just printed in the Proceedings of the American Academy of Arts and Soiences, vol. iv., where it occupies thirty-two pages. The introduction and the conclusion, embracing a critical comparison of our Salices with those of Europe, are written by Professor Anderson in the English language (which he uses with remarkable facility); the descriptive and critical matter is in Latin. To render it accessible to all who take an interest in the subject, a small separate edition has been printed, and is sold by Messrs. B. Westermann & Co., No. 290 Broadway, New York. On the receipt by the Messrs. Westermann, of postage stamps to the amount of 36 cents, a copy will be sent by mail, prepaid, to any applicant:—

Systematische Untersuchungen über die Vegetation der Karaiben, in besondere der Insel Guadeloupe; von A. GRISEBACH, (from Trans. Roy. Sci. Göttingen, vol. xvii, 1857), pp. 138, 4to.—This sketch of the Flora of Guadaloupe is very interesting and useful in itself, and of good promise for the *Flora of the British West Indies*, upon which Prof. Grisebach is now engaged, and which is so greatly needed:—

Essai d'une Exposition Systématique de la Famille des Characées; par feu J. WALLMAN, *Traduit du Suedois;* par M. le Dr. W. NYLANDER. Bordeaux, 1856, pp. 91, 8vo.—This monograph of the *Characeæ* appeared in the Transactions of the Royal Academy of Sciences of Stockholm for 1852, published in 1854, a year after the death of the author, who barely lived to complete the manuscript. To render the monograph more generally accessible, M. Durien de Maisonneuve engaged Dr. Nylander, the lichenologist, a compatriot of the author, to translate the memoir from Swedish into French, and caused it to be reproduced in this form in the Transactions of the Linnean Society of Bordeaux, in the first volume of the third series, 1856, also publishing a small extra impression in a pamphlet form. The author characterises no less than fifty species of *Nitella*, and sixty-six of *Chara*:—

Elogio di Filippo Barker Webb, scritto da FILIPPO PARLATORE. Ficenze, 1856, 4to., pp. 118.—The late Mr. Webb, a celebrated English botanist long resident in Paris, bequeathed his vast herbarium and excellent library to the Grand Duke of Tuscany, along with some funds for the care and augmentation of the collection. The immediate charge of the collection was of course entrusted to Prof. Parlatore, a near friend of the testator, and a most zealous botanist. After coming into possession of this noble bequest, upon the occasion of opening his course of lectures for the year 1855, Professor Parlatore pronounced the eulogy here published. It is illustrated by interesting explanatory notes, and followed by a catalogue of the works and opuscula published by

Mr. Webb, twenty-four in number; by an account of his library and herbaria; and by selections from his correspondence with various botanists. The lithographed portrait in the frontispiece is a truer likeness of Mr. Webb, than that which was published in his great work, the *Histoire Naturelle des Iles Canaries*:—

Agricultural Botany in the Western States.—In the fourth volume of the Transactions of the State Agricultural Society of Wisconsin for 1854–7, Mr. Lapham has given a good popular account of the forest trees indigenous to that State, illustrated by outline wood-cuts. To the Transactions of the Illinois Agricultural Society for 1856–7 the same indefatigable author has contributed, 1. A Catalogue of the Plants of Illinois, prefaced by some historical and statistical details; 2. An account of the Native, Naturalized and Cultivated Grasses of Illinois, illustrated by three plates or pages of wood-cuts. These do not equal the figures in Mr. Lapham's Grasses of Wisconsin. We are disposed to doubt the statement on p. 559 about the difference in the specific gravity of the pollen of Indian corn and of wild rice, unless the author can vouch for it from his own proper observations. Perhaps it rests upon no better basis of fact than the statement on the preceding page, that "had the wheat crop been at any time entirely destroyed, this invaluable grain would have been restored to us from seeds preserved for more than three thousand years in the folds of an Egyptian mummy!" We ought perhaps to say, that the asserted cases of such germination will not bear examination; and that those best qualified to judge utterly disbelieve, not only the asserted fact, but also the possibility of any such occurrence:—

How Plants Grow: A simple Introduction to Structural Botany; with a Popular Flora, or an arrangement and description of Common Plants, both wild and cultivated. By Asa Gray, M. D., Fisher Professor of Natural History in Harvard University. 234 pp,, 16mo., illustrated by 500 wood engravings. New York, 1858. Ivison & Phinney.—Dr. Gray has prepared this little volume expressly for young beginners in botany, and for use in common schools, and has well carried out his purpose. The work is simple in style, and beautiful in its illustrations. While teaching with clearness the details of the subject, it is constantly bearing the mind, by simple explanations, above these details to higher thoughts and principles, and preparing it for the fuller survey of the science in the more extended works of the author's series. He considers in order—1st, How plants grow, and what their parts or organs are; 2nd, How plants are propagated or multiplied in number; 3rd, Why plants grow; what they are made for, and what they do; 4th, How plants are classified, named and studied. Then, in the second part, the work contains a "Popular Flora for Beginners," including descriptions of the common plants of the country, both those of the woods and fields, as well as those of our yards and gardens. It is arranged according to the natural system, and for the beginner in the science takes the place of the large Manual of Botany. The excellence of the volume consists in its being really "science made easy," not by culling out "interesting facts" to attract, and tying them artfully together, but by presenting the *system of fundamental truths* in a manner intelligible and attractive to the young mind.—*Silliman's Journal.*

REVIEWS AND NOTICES OF BOOKS.

How to Lay-out a Garden. Intended as a general guide in choosing, forming, or improving an estate (from a quarter of an acre to a hundred acres in extent), with reference to both design and execution. Second edition, greatly enlarged, and illustrated with numerous plans, sections and sketches of gardens and garden objects. By Edward Kemp, Landscape Gardener, Berkenhead Park. *London:* Bradbury & Evans. *Montreal:* B. Dawson & Son.

This book is of a thoroughly practical as well as scientific character. It gives directions as to the choice of a place for a country residence and the site and aspect for a house. It very clearly. sensibly, and fully informs proprietors what to avoid in laying-out or ornamenting their gardens or lawns. It states with appropriate illustrations the general principles of taste and style applicable to landscape gardening, with both the general and particular objects which by attention to these principles may be attained, as well in limited as in more extended grounds and gardens. It contains a chapter on special departments, such as the park with its trees and walks—the flower garden; its situation, design and contents—the rose garden—the pinetum—the kitchen garden, etc.; also a chapter of practical directions on a variety of points and matters pertaining to ornamental and useful gardening. The author has consulted with skill and judgment the well-known works of Price, Repton, and Loudon. The book is, however, essentially his own He writes with an evident enthusiasm, and an earnest love of his subject. The wood-cut illustrations are of a high order, and greatly heighten the interest of the volume. The style is clear, elegant, lively and forcible. We would cordially recommend this work to the attention of gentlemen who desire the grounds of their country residences to be a source of pleasure as well as profit to them. In this country, where wood is regarded as the enemy of the cultivator, and is cut down so frequently with a wanton disregard of good taste or even comfort, we need just such instructions as this book contains to direct us in the replanting and ornamenting of our waste places with leafy boscage and floral beauty.

THE FAMILY AQUARIUM, or AQUA VIVARIUM; a "New Pleasure" for the domestic circle, being a familiar and complete instructor upon the subject of the construction, fitting-up, stocking and maintenance of the Fluvial and Marine Aquaria, or "River and Ocean Gardens." By H. D. BUTLER. *New York:* Dick & Fitzgerald. *Montreal:* B. Dawson & Son.

THIS is a little book of 121 pages, written in a popular and rather florid style, intended to instruct amateurs in the construction and maintenance of Aquaria. It contains much that has been described before in European works, along with remarks suggested by the author's own experience. Although written in America, and expressly for American use, it does not appear to us to contain anything that may not be found in English books. It directs special attention to the Vivaria in "Barnum's Museum," New York, and to the manufacture and preparation of Aquaria conducted under the direction of the proprietor, from whom it appears much curious and interesting materials for "stocking" may be obtained. The book is well got-up, written with no pretence of scientific precision, and is illustrated by several well-executed wood-cuts. It has also the merit of being cheap, and will prove an interesting addition to the young naturalist's library.

MISCELLANIES.

8. *Geological Survey of Canada.*—The following deserved commendation of the last Report of the Canadian Survey is extracted from the last number of Silliman :—

"*Report of Progress for the years* 1853-56; by Sir W. E. LOGAN, Provincial Geologist. Printed by order of the Leislative Assembly, 494 pp., 8vo., with maps and a quarto volume of plans of various lakes and rivers between Lake Huron and the River Ottawa. Toronto, 1857.—This Report covers four years of exploration. As in all the labors of the author, there is evidence of careful research and sure progress. The Special Report of Sir W. E. Logan covers the first 50 pages. It takes up especially the arrangement of the crystalline limestone among the other Laurentian (Azoic) rocks, and especially its condition in the vicinity of Grenville. The limestone occurs in bands that are nearly parallel, and which are so related as to leave no doubt that one or more strata of limestone are there folded up among the crystalline rocks. In Grenville there are two such bands about two miles apart, having a N.N.E. strike, and dipping, like the included gneiss, to the N.N.W. 50° to 70°. To the rear of the township the two unite andhave a thickness of 500 to 1000 feet. Other similar bands and patches occur to the northward and eastward of these, which have approximately the same strike, and confirm the view that the Azoic rock of the region, before its crystallization, contained one if not two or more thick strata of limestone. The author discusses the precise character of these folds and illustrates the subject by means of a map of the region on which the bands of limestone are represented in color.

"The Reports of A. Murray for the years 1853 to 1856 occupy pages 59 to 190, and contain details respecting the topography and geology of the region west of the Ottawa and north of Lake Huron. These are followed by Mr. James Richardson's Report on the *Island of Anticosti*, and the Mingan Islands in the Gulf of St. Lawrence, and the Palæontological Report of E. Billings, Esq. The island of Anticosti is covered by fossiliferous starta referred to a period uniting the Lower and Upper Silurian; the rock is an argillaceous limestone 2300 feet in thickness, throughout conformable and nearly horizontal. E. Billings, Esq., observes, p. 249, "All the facts tend to show that these strata were accumulated in a quiet sea, in uninterrupted succession during that period in which the upper part of the Hudson river group [Lower Silurian], and the Oneida conglomerate, the Medina sandstone and the Clinton group [Upper Silurian], were in the course of being deposited in that part of the Palæozoic ocean now constituting the State of New York and some of the countries adjacent.' The fossils of the middle portion fill up the blank with the Upper and Lower Silurian, combining many of the Hudson river group with those of the Clinton, with the addition of other species unknown to both.

"In the two lower divisions (960 feet) the fossils that are of known species have been found in the Hudson or Trenton group, with three exceptions, the *Heliolites megastoma*, *Catenipora escharoides* and *Favosites favosa*, not before known to extend into the Lower Silurian. Singular tree-like fossils (*Beatricea*) occur 430 feet from the base. They are straight stems 1 to 14 inches in diameter, tubular, with the tube transversely septate, the structure in layers resembling in this respect an exogenous tree. 950 feet above the base there are three additional Upper Silurian fossils, *Leptæna subplana*, *Strophomena depressa* and *Atrypa naviformis*. In the upper 600 feet, 60 species of fossils were collected, and 20 out of the 24 hitherto described occur in the Clinton group, while 12 of the 24 are found also in the beds below. The following are the names of the 24 species; those in *italics* occur also in the lower beds of Anticosti, and those marked with an asterisk, are known as species of the Clinton group. *Chætetes lycoperdon*,* *Catenipora escharoides*,* *Favosites favosa*, Zaphrentis bilateralis,* *Orthis Lynx*,* O. elegantula,* O. flabellulum, *Leptæna subplana*,* L. transversalis, *L. profunda*, *Strophomena alternata*,* *S depressa*,* *Atrypa reticularis*,* *A. congesta*,* A. plicatula,* A. hemispherica,* *A. naviformis*,* Spirifer radiatus,* Pentamerus oblongus,* *Murchisonia subulata*,* Cyclonema cancellata,* Platyostoma hemispherica, *Calymene Blumenbachii*,* Bumastes Barriensis.*

"Mr. Billings describes a number of new Cystideæ and Asteriadæ from the Silurian of Canada, besides various Brachiopods and other molluscs. The genus *Huronia* he refers to Orthoceras (or *Ormoceras* if that genus be retained).

"Next follows the Report of T. Sterry Hunt, Chemist and Mineralogist to the Geological Survey. We have already quoted a few facts on minerals from this report; also at page 217 an article on Ophiolites, and page 361 a chapter on the Salines of Europe. We propose to cite farther on the subject of rocks at another time. There are also valuable chapters on the Metallurgy of Iron, Magnesian Mortars, the Purification of Plumbago, and Peat and its products, which we must pass by.

"The quarto volume of twenty maps of the various lakes and rivers between Lake Huron and the Ottawa, by Mr. Murray, show that the Canadian government is carrying forward the survey on the right plan—a union of geographical and geological investigations. The maps are of large size, nearly two feet by three, and contain particulars respecting the rocks of the regions, besides the usual map details, and in both respects a large amount of work has been ably performed."

Note on a Molar Tooth of the Horse in the Collection of the Natural History Society of Montreal.

In a collection of antiquities and fossils presented to the Society by Mr. Little of Newberry, C.W., is a specimen of a molar of an equine animal, labelled as having been found "on the margin of the River Sydenham, nine feet below the surface, near Hunt's Ferry, Township of Dawn. C.W." The question having arisen at the meeting whether this tooth is that of the common horse or of any of the fossil species whose remains have been found in American tertiary deposits, we have compared it with such specimens and figures as are within our reach. The specimen is a middle superior molar ; 3·5 inches in length, 1·2 in its extreme anterio-posterior breadth and 1·1 inch nearly in its transverse measurement. It is not more curved than the molars of the domestic horse, but the folding of its enamel is more complex, especially in the isolated folds. In this last respect and in the dimensions of its crown, it corresponds much more closely with Leidy's figure of the tooth of the extinct species named by him *Equus Americanus*, than with that of the common horse. The specimen is in a good state of preservation. It is stained black on one side, and the cement has become brown and is somewhat cracked and broken externally, but it has not experienced any change giving evidence of great antiquity. It would not be safe to affirm on the evidence of this single specimen, the occurrence of the fossil horse in Canada ; yet the form of the tooth and the circumstances in which it is stated to have been found render this not improbable, and it would be interesting to know whether the ground in which the specimen occurred had certainly been undisturbed previously, what was the nature of the bed containing it, and what its other organic remains if any. To these questions we would invite the attention of any collectors or naturalists visiting the locality.

We may add that there would be nothing extraordinary in the occurrence of the remains of the extinct American horse in Western Canada, since these remains have been found not only in various parts of the United States, but by Sir J. Richardson as far north as Eschsbholtz Bay in Arctic America. Should any further equine remains be found in the locality in question, we should like to have an opportunity of submitting them to Dr. Leidy, the best authority at present on this subject, for comparison with his specimens. We would caution collectors, however, to be very careful in distinguishing remains taken from undisturbed beds, from those that may have been mixed with modern debris.

The following interesting articles were added to the Museum of the Natural History Society at its last monthly meeting. They were procured by Edward Little, Esq., of Newbury, C. W., from Alexander Bell, Esq., of Euphemia, and forwarded to the Society by J. T. Dutton, Esq. :—

1. A Wart, taken from the root of a soft maple tree (*Acer dasycarpum*), fully 26 feet from the living trunk, the root to which it was attached not exceeding one inch in diameter at its junction in either end. 1856.
2. An Arrow, nearly one yard in length, one of a full quiver of fifty, from Upper California, now in possession of a gentleman who after being pierced with two of them despatched the Indian and brought the bow and arrow home. The quiver is made of tanned deer-skin, with the hair on. The arrow is made of two different kinds of wood, and spliced very neatly. It is also barbed with three feathers. The stone head is remarkably sharp and neatly made.
3. An Oak Deer-bleat, given to the donor by the Indian Shawnabee in 1846, and stated by him to be his own manufacture.
4. A Stone Arrow-head, 1½ inches long, found ten feet under ground on Lot 21, Euphemia, C.W., shewing a striking analogy between the Californian and Canadian weapon.
5. An oval Stone Hatchet ? about 4 inches long by 2½ broad and 1 thick, well polished and perforated across its breadth, the aperture ½ inch in width. The stone is a very hard jaspery slate, transversely marked with natural lines. This instrument was obtained in 1854 below the surface of the ground on the margin of the river Sydenham, Lot 12th, First Concession, Brooke, C. W.
6. The Molar Tooth of a Horse,—for description of which see page 318.
7. A piece of Fossiliferous Limestone, from Newbury, C. W.

Mr. Joseph T. Dutton lately presented to the Natural History Society a specimen of native loadstone or magnetic iron ore with polarity, from near Samakoff in Bulgaria, received from his brother, Samuel Dutton, Esq., of Constantinople, chief engineer to the Sultan. An analysis by Mr. Samuel Dutton accompanied the specimen, which has, according to him, a density of 4.223, and gives for 100 parts,—

Sesqui-oxyd of iron,	79.00
Titanic acid,	2.00
Red oxyd of manganese,	.50
Silica,	14.70
Alumina,	1.30
Volatile matters, water, sulphur, &c.	2.50
	100.00

To the Editors of the CANADIAN NATURALIST.

MESSRS. EDITORS,—I will send you by the Express to-morrow a specimen of the *Papilio philenor* (?) Butterfly, which was caught last month at West Flamboro'. These Butterflies appeared in countless numbers about the lilac trees as long as they continued in blossom, and then suddenly disappeared. They lasted from the 7th to the 18th of June, but very few appearing after that date.

I must apologize for not having ere this sent you a specimen; but I have only just brought them down from Flamboro', having caught but two in Toronto, though they were numerous there also. One specimen has a greenish tinge on the posterior wings, and not bluish as in the one I send you. The Caterpillar I have not yet met with.

I wrote to you from Toronto in the beginninng of last month, when I first caught a specimen of this butterfly. By informing me of your opinion respecting this insect, you will greatly oblige

Yours sincerely,

CHAS. J. BETHUNE.

Cobourg, 13th July, 1858.

[NOTE BY THE EDITORS.—The specimen sent with the above communication is evidently *Papilio philenor*, Fabr., a very beautiful butterfly common in the South, but not, in so far as we are aware, previously observed in Canada. It would be interesting to know if it is actually extending its range northward. It is due to our correspondent to state, that his information of the discovery reached us as early as June. To give collectors here an opportunity of inspecting the specimen, it has been left in the mean time with our publishers.]

MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF JUNE, 1858.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	29·907	29·781	29·840	55·1	80·9	65·6	·400	·481	·389	·84	·46	·63	S. by W.	S. by W.	S. W.	8·12	1·62	3·22	....	....	Clear.	Clear.	Str. 2.
2	933	862	878	60·6	78·0	63·6	·391	·416	·416	·87	·44	·72	S. S. W.	S. S. W.	S. S. W.	0·20	4·47	4·65	....	....	C. Str. 6.	C. Str. 2.	Str. 2.
3	30·002	861	951	54·0	75·7	61·0	·288	·413	·390	·70	·48	·74	N. E. by E.	E. S. E.	S.	4·45	4·26	0·61	....	....	Clear.	Clear.	C. Str. 8.
4	29·827	614	409	53·2	68·1	63·5	321	584	543	80	87	94	E. S. E.	S. S. W.	S. S. W.	0·15	14·90	13·52	0·175	....	C. Str. 10.	Ni. 10.	Ni. 10. Thunder.
5	612	678	861	60·7	72·0	62·8	367	390	399	71	50	72	W. S. W.	W. S. W.	W. S. W.	16·05	15·12	7·07	....	....	Clear.	Clear.	Clear.
6	727	431	672	54·6	63·6	61·0	355	543	511	84	94	97	S. E. by S.	S. E.	S. W.	0·96	0·09	3·22	1·136	....	C. Str. 10.	Ni. 10.	Ni. 10. Thunder.
7	777	657	678	60·9	84·6	72·1	511	663	631	97	57	81	S. S. W.	W. S. W.	W. by N.	3·96	6·17	11·11	....	....	" 8.	C. Str. 6.	C. Str. 7.
8	842	815	874	59·7	70·9	58·0	323	423	372	65	59	78	N. N. W.	W. N. W.	S. S. W.	3·99	8·81	6·98	....	....	Clear.	Cirr. Cum. 2.	Str. 2.
9	868	804	857	56·1	64·9	56·1	391	407	570	87	63	84	S. S. W.	S. S. W.	S. S. E.	1·00	0·46	1·02	....	....	C. Str. 10.	C. Str. 10.	Ni. 10.
10	729	446	342	57·0	59·2	57·4	445	498	445	99	99	99	S. S. W.	N. E. by E.	N. E. by E.	0·71	3·81	2·22	5·775	....	Ni. 10.	Ni. 10.	Ni. 10. Distant Thunder.
11	592	674	850	59·0	62·1	51·1	410	347	270	82	64	72	W. N. W.	W. by N.	W. N. W.	6·70	8·95	7·60	0·400	....	C. Str. 9.	C. Str. 6.	Clear. Aurora Borealis
12	948	861	812	50·8	66·1	57·2	210	346	407	58	54	87	N. E. by E.	E. S. E.	S. E.	6·96	4·05	0·12	....	....	Cirr. 4.	" 8.	C. Str. 9.
13	694	647	622	54·0	57·0	55·6	308	436	420	74	94	94	E. by S.	N. E. by E.	E. by S.	0·72	3·80	1·92	0·600	....	C. Str. 10.	Ni. 10.	" 8.
14	887	676	797	35·1	65·1	56·4	411	483	420	97	78	94	S. by W.	S. by W.	S. by E.	2·86	4·83	0·83	0·100	....	Ni. 10.	C. Str. 6.	Clear.
15	780	700	871	60·5	78·1	60·9	456	588	456	88	62	88	S. by W.	E. by S.	S. E. by S.	0·00	1·05	0·17	....	....	Clear.	Cirr. 6.	Str. 4.
16	733	714	991	55·9	76·1	63·7	420	541	569	94	60	97	S. E. by S.	S.	S. W. by S.	0·26	0·09	0·17	Inapp.	....	"	C. Str. 9.	Cum. Str. 6.
17	907	799	825	61·0	83·0	72·2	473	992	668	88	64	80	S. by W.	S. W.	S. S. W.	0·12	2·95	5·27	....	....	C. Str. 6.	" 9.	" 9.
18	816	603	842	70·0	92·1	65·2	531	908	483	74	60	78	S. W.	S. W.	N. E. by E.	5·31	6·70	7·00	Inapp.	....	Clear.	Clear.	C. Str. 10. Dist. Thunder.
19	892	755	800	60·0	69·0	60·9	374	496	473	73	70	89	N. E. by E.	E. S. E.	S. S. E.	3·61	2·62	0·76	....	....	C. Str. 8.	C. Str. 10.	Clear.
20	744	689	715	62·1	81·9	70·2	491	664	557	88	62	77	S. S. E.	S. by E.	W.	0·00	1·53	2·96	....	....	" 8.	" 4.	C. Str. 4.
21	838	797	716	65·9	85·1	66·2	444.	570	536	71	47	84	S. by E.	S. E. by S.	S. E. by S.	0·88	0·02	0·16	....	....	Clear.	Clear.	Str. 2.
22	802	844	928	76·8	85·4	68·1	476	610	516	69	50	77	N. E. by E.	E. S. E.	S. E.	0·00	0·00	0·00	....	....	"	C. Str. 4.	C. Str. 4.
23	925	824	779	58·2	87·0	77·2	446	836	907	90	65	77	E. by S.	S. E.	S. S. E.	0·01	0·30	1·02	....	....	C. Str. 2.	C. C. Str. 9.	" 6.
24	825	717	696	74·7	93·8	80·1	552	942	800	63	61	78	S. E.	S. W.	E.	0·50	4·42	4·18	....	....	" 2.	C. Str. 6.	" 8.
25	710	582	699	74·0	96·2	71·9	680	1·055	745	81	62	95	S. S. W.	S. S. E.	S. W.	0·23	2·47	3·06	0·351	....	C. C. Str. 6.	" 6.	Ni. 10.
26	714	778	814	73·0	97·2	79·2	695	1·256	612	84	72	62	N. E. by E.	N. E. by E.	S. S. E.	0·16	0·22	0·75	0·119	....	C. Str. 2.	Clear.	C. Str. 2.
27	815	805	800	70·5	89·0	78·5	578	809	738	78	59	76	N. E. by E.	E. by N.	E. by N.	0·32	0·65	0·02	....	....	" 10.	C. C. Str. 8.	" 4.
28	820	821	843	34·0	84·4	67·0	568	474	393	67	45	59	N. N. E.	W. by N.	W. N. W.	0·10	8·05	8·73	....	....	" 3.	Clear.	Clear.
29	881	811	868	59·5	83·0	62·3	462	597	523	91	55	94	S. S. E.	E. S. E.	E. by S.	0·86	0·00	4·20	....	....	Clear.	C. C. Str. 8.	C. Str. 4.
30	777	792	834	54·0	75·1	60·3	282	628	456	67	73	88	N. N. W.	W.	N.	1·42	4·67	4·22	....	....	"	Clear.	Clear.

REPORT FOR THE MONTH OF JULY, 1858.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2. p. m.	10 p. m.
1	29·872	29·717	29·823	50·0	80·9	65·6	·258	·470	·552	·71	·52	·70	N. by W.	S.	S. W. by W.	4·32	4·00	6·96	....	....	Clear.	Clear.	Clear.
2	747	679	853	56·5	84·4	60·2	·308	·545	·536	·74	·47	·84	S. S. E.	E.	E.	3·30	0·51	0·32	....	....	"	"	Str. 3.
3	569	388	413	68·2	87·0	75·0	·543	·928	·826	·29	·72	·95	S. E.	S. S. E.	W.	1·27	3·37	5·50	1·206	....	C. Str. 10.	Ni. 10.	Ni. 10.
4	555	650	822	73·7	75·6	59·0	655	693	410	81	79	82	N. by E.	N. E.	W. N. W.	1·76	3·36	9·22	0·533	....	Clear.	C. Str. 8.	Clear.
5	962	960	30·035	61·7	73·0	64·4	383	588	497	71	74	83	W.	S.	S. S. E.	8·88	1·43	1·70	....	....	"	Clear.	"
6	30·032	30·014	29·945	62·8	86·4	69·0	491	895	571	88	72	82	S. by W.	S. by W.	S. by W.	1·32	1·01	4·25	....	....	"	"	"
7	29·811	29·655	792	71·4	91·0	75·4	615	1·304	745	83	64	86	S. W. by S.	S. by W.	S.	2·48	8·80	6·06	....	....	"	"	"
8	758	735	800	72·1	66·0	58·3	566	476	452	74	75	94	N. N. E.	N. N. E.	N. E.	7·15	1·40	16·08	0·800	....	Str. 4.	C. Str. 10.	Ni. 10.
9	814	831	862	58·2	60·9	59·8	446	493	493	91	97	97	N. E. by E.	N. E.	E. N. E.	17·83	0·37	9·02	0·746	....	Ni. 10.	" 10.	C. Str. 10.
10	852	812	665	59·0	76·8	70·9	493	805	726	97	80	97	N. E.	S. S. E.	S.	4·40	0·70	1·16	0·279	....	C. Str. 10.	Str. 8.	Ni. 10. Thunder.
11	841	864	912	60·4	66·7	59·1	487	489	439	94	75	88	N. E.	N.	E. N. E.	9·43	6·06	5·70	0·273	....	Ni. 10.	C. Str. 8.	Cum. Str. 9.
12	877	772	727	54·0	56·2	55·5	390	429	430	93	97	98	N. E. by E.	N. E. by E.	N. E. by E.	9·91	1·40	13·17	5·048	....	Ni. 10.	Ni. 10.	Ni. 10. Thunder.
13	624	720	821	59·1	68·2	62·8	500	577	517	100	85	90	N. E. by E.	S. W.	S. S. W.	13·50	6·60	7·92	1·326	....	Ni. 10.	C. Str. 10.	C. Str. 9.
14	889	824	881	63·9	76·2	64·3	510	731	503	88	81	86	S. S. W.	S. S. W.	W. N. W.	2·68	5·22	5·02	....	....	C. Str. 6.	Str. 2.	Str. 2.
15	949	836	927	66·2	87·7	69·4	570	836	469	89	65	67	S.	S.	S. S. E.	0·28	1·95	0·23	....	....	" 8.	Clear.	C. Str. 2.
16	861	779	783	69·4	80·6	70·9	599	843	658	84	83	90	S.	S. S. E.	S. S. E.	0·63	1·40	0·22	....	....	" 3.	C. C. Str. 10.	" 6.
17	816	738	898	68·1	86·5	69·2	612	850	536	99	68	79	S. W.	S. W.	N. by E.	0·53	4·20	4·77	....	....	Clear.	Clear.	Str. 4.
18	30·006	922	30·082	68·9	80·0	61·1	463	557	442	77	77	83	N. N. W.	N. N. W.	W. N. W.	2·77	1·60	1·05	....	....	"	"	Clear.
19	011	914	29·886	63·0	81·2	64·5	517	547	563	91	52	94	N. E.	S. by E.	S.	0·00	0·02	0·60	....	....	"	C. Str. 2.	Clear.
20	29·821	858	716	63·0	84·6	65·4	498	746	583	91	64	94	W. by S.	S.	E. by S.	0·00	0·00	1·62	0·060	....	C. Str. 10.	C. Cir. 6.	C. Str. 8. Thunder. Hail
21	610	485	500	64·9	90·1	63·0	583	887	549	94	63	97	N. E. by E.	S.	E. S. E.	0·22	2·16	3·02	0·733	....	" 10.	C. Str. 8.	C. Str. 6. Thunder.
22	466	514	637	61·0	64·4	57·8	511	497	407	97	83	87	E. N. E.	W. by N.	W. by N.	0·11	6·31	12·61	1·030	....	" 10.	Ni. 10.	C. Str. 10.
23	665	658	889	54·6	67·0	55·8	362	496	405	87	77	92	S. W.	S. S. W.	S. by W.	4·51	2·08	13·02	....	....	" 10.	C. Str. 8.	" 3.
24	825	883	978	57·3	67·8	59·0	341	489	446	89	75	91	N. N. E.	N. E.	N. E. by E.	0·11	6·76	9·60	....	....	" 10.	Cumulus. 4.	" 9.
25	971	964	959	51·9	71·6	61·1	384	503	505	93	66	94	N. E. by E.	E. by S.	S. E. by S.	3·05	2·81	0·01	....	....	Str. 4.	C. C. Str. 6.	" 6.
26	927	714	643	55·8	84·2	71·8	420	269	682	94	83	90	S. E. by S.	S. E.	S. E.	0·02	1·13	6·15	....	....	Str. 2.	C. Str. 6.	" 9.
27	555	510	661	70·0	77·9	67·9	658	527	489	90	57	75	S. W.	W. S. W.	W.	0·00	0·08	16·12	....	....	C. Str. 4.	" 2.	Clear.
28	814	892	864	59·3	73·4	60·1	416	506	505	85	62	94	W. S. W.	W.	W. S. W.	16·81	15·82	4·05	....	....	Clear.	" 2.	Cum. Str. 4.
29	917	781	777	53·4	62·9	57·0	375	510	443	93	88	97	E. by S.	S. E. by S.	S. E.	0·12	0·26	0·56	Inapp.	....	C. Str. 10.	Ni. 10.	" 9.
30	648	692	658	51·1	76·8	62·4	354	614	523	96	68	94	E.	E. by N.	S.	0·28	0·37	0·22	....	....	C. C. Str. 6.	Clear.	" 2.
31	587	687	712	60·7	29·1	63·5	505	635	569	94	75	97	S. S. E.	S. S. W.	W.	0·00	1·05	0·08	0·180	....	" 6.	C. Str. 10.	" 6.

REMARKS FOR JUNE, 1858.

Barometer ....
- Highest, the 3rd day, 30·002 inches.
- Lowest, the 10th day, 29·342 "
- Monthly Mean, 29·771 inches.
- Monthly Range, 0·660 "

Thermometer ...
- Highest, the 26th day, 97°4.
- Lowest, the 12th day, 44°4.
- Monthly Mean, 67°21.
- Monthly Range, 53°0.

Greatest intensity of the Sun's rays, 108°4.
Lowest point of terrestrial radiation, 43°2.
Amount of Evaporation in inches, 3·09.
Mean of humidity, ·756.

Rain fell on 13 days, amounting to 8·656 inches; it was raining 49 hours 15 minutes, and was accompanied by thunder on 4 days. (From 5 to 6 p. m. on the 10th day there fell 0·933 inches.)

Most prevalent wind, S. E. Least prevalent wind, N.

Most windy day, the 5th day; mean miles per hour, 12·74.

Least windy day, the 23d day; mean miles per hour, 0·00.

Aurora Borealis visible on 1 night.

The Electrical state of the atmosphere has indicated high tension.

Ozone was in moderate quantity.

Fireflies first seen on the 18th day.

REMARKS FOR JULY, 1858.

Barometer. ......
- Highest, the 18th day, 30·082 inches.
- Lowest, the 3rd day, 29·388 "
- Monthly Mean, 29·750 inches.
- Monthly Range, 0·674 "

Thermometer.
- Highest, the 7th day, 99°3.
- Lowest, the 1st day, 41°3.
- Monthly Mean, 66°50.
- Monthly Range, 58°0.

Greatest intensity of the Sun's rays, 108°1.
Lowest point of terrestrial radiation, 40°6.
Amount of Evaporation in inches, 3·14.
Mean of humidity, ·818.

Rain fell on 13 days, amounting to 12·214 inches; it was raining 72 hours 44 minutes, and was accompanied by thunder on 4 days. (The rivers in this vicinity rose nearly 2 feet on the 13th day, owing to the heavy and continued rain.

Most prevalent wind, N. E. by E. Least prevalent wind, N.

Most windy day, the 28th day; mean miles per hour, 12·22.

Least windy day, the 19th day; mean miles per hour, 0·20.

The Electrical state of the atmosphere has indicated rather high tension.

Ozone was present in large quantity.

HEIGHT ABOVE THE LEVEL OF THE SEA, 57·07 FEET.

BY A. HALL, M. D.

Day of Month.	Barometer, Corrected and reduced to Fah., 32°.			Temperature of the Air.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction and Velocity of Wind at hour of observation.			Mean velocity of the wind in miles per hour.	Amo'nt of Rain in Inches.	Clouds and their Proportion, in Numbers, from 0, Cloudless, to 10, perfectly Overcast.			OBSERVATIONS.
	7 a.m.	2 p.m.	9 p.m.	7 a m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.		10 a.m.	7 a.m.	2 p.m.	9 p.m.	
1	29·973	29·938	29·950	65·5	74·8	66·0	·389	·415	·330	·63	·48	·50	W S W 3·1	S 1·0	Calm.	0·59	0·02	Cu. 2	0 0	0 0	
2	30·093	30·060	30·086	67·6	75·0	67·0	·330	·382	·346	·50	·44	·54	W 2·0	W S W 2·00	N W 7·0	3·25	....	0 0	Cu. St. 6	Cu. St. 6	
3	181	133	088	60·0	69·2	64·6	·390	·300	·314	·74	·41	·53	N 8·0	E N E 4·00	Calm.	2·05	....	0 0	0 0	0 0	Clouded during night.
4	29·984	29·752	29·534	59·4	65 0	64 0	317	451	464	62	73	77	Calm.	S 2·00	S 6·00	7·58	....	Cu. St. 10	Nim. 10	Nim. 10	Rain. High wind.
5	630	818	865	63·4	71 0	62·0	464	403	523	77	54	94	W 6·0	W S W 4·00	Calm.	2·45	0·15	Cu. 6	Cu. St. 2	Cir. Cum. 2	Aurora, clouded afterwards.
6	895	611	881	58 5	63 6	60 0	296	569	649	59	97	90	Calm.	Calm.	Calm.	0·87	....	Cu. St. 9	Nim. 10	Cirr. 1	Rain, with thunder.
7	928	841	392	60·8	80·2	72·2	255	664	559	49	62	72	S W 3·0	S S W 6·00	W S W 3·00	3·37	1·02	0 0	Cir. St. 6	Cu. 9	Rain. Distant thunder.
8	30·040	30·066	30·096	67·2	70·5	61·0	438	371	325	68	49	61	W 1·0	W N W 3·00	W N W 1·00	1·41	0·02	Strat. 1	Cu. 8	Strat. 4	
9	104	023	29·986	56·3	63·2	57·8	343	373	394	72	61	82	Calm.	S W 3·00	Calm.	0·62	Inap.	Cu. St. 10	Cu. St. 10	Nim. 10	Rain.
10	29·761	29·561	248	56·5	62·0	57·0	413	556	466	90	100	100	Calm.	Calm.	N N E 1·00	0·37	0·26	Nim. 10	Nim. 10	Nim. 10	Rain. Thunder.
11	731	853	947	58·0	65·0	56·0	423	359	282	88	58	63	N 2·0	N N W 3·00	Calm.	1·33	1·82	Cu. St. 10	Cu. St. 10	0 0	Slight rain early A. M.
12	30 092	30 060	947	59·0	63·0	59·5	323	242	317	65	43	62	N E 2·0	Calm.	Calm.	0·62	....	Cir. St. 8	Cu. St. 10	0 0	Solar Halo A. M. Meteor 10.15 P. M. Clouded night.
13	29·844	29·778	801	55·3	57·0	56·5	360	452	439	68	94	88	Calm.	Calm.	Calm.	0·72	0·01	Cu. St. 10	Nim. 10	Cu. St. 10	Clouded. Rain.
14	839	829	896	56·8	64·5	58·4	439	537	442	88	71	83	S W 4·0	S W 2·00	Calm.	1·04	0·26	Cu. St. 10	Cu. St. 10	Strat. 3	
15	924	868	853	59·5	71·0	62·5	464	638	502	77	62	78	Calm.	Calm.	Calm.	0·37	....	0 0	Cu. St. 6	0 0	
16	938	936	958	61·0	68·0	64·0	483	591	556	78	68	84	S S W 0·16	S W 6·00	S W 4·00	3·00	Inap.	Strat. 1	Cu. St. 10	Strat. 3	Clouded during night. Slight rain.
17	30 065	980	898	64·0	79·0	71·0	543	943	678	79	58	73	W S W 5·33	W S W 8·33	W S W 3·00	2·79	Inap.	Cu. St. 10	Cir. Str. 8	0 0	
18	29·872	847	818	73·0	79·5	67·0	731	868	568	74	66	67	W S W 4·00	W S W 3·66	W S W 2·66	3·66	....	Strat. 3	Cu. St. 10	Nim. 10	Slight rain. Clouded night.
19	946	901	914	61·0	66·0	61·0	457	541	413	69	60	77	N N E 2·00	N N E 1·00	W S W 1·00	0·58	0·01	Cu. St. 10	Cu. St. 10	0 0	
20	914	812	832	62·0	77·0	70·4	370	717	579	66	77	78	W S W 1·00	Calm.	W N W 1·00	1·54	....	Cu. St. 8	Cu. St. 8	Cu. 7	Distant lightning in S. at 11 P. M.
21	895	807	900	67·5	77·6	69·0	418	422	398	62	46	56	Calm.	E 1·00	S W 1·00	0·04	....	Cu. 4	Cu. 3	Cir. Cu. 8	
22	30·016	995	30·060	66·6	80·0	67·5	463	449	333	71	61	50	Calm.	Calm.	Calm.	0·58	....	Cir. 2	Cirr. 6	Cu. St. 2	
23	048	982	29 880	68·0	80·5	75·7	476	638	577	69	62	64	Calm.	Calm.	S W 7·00	2·08	....	Cu. St. 10	Cu. St. 10	Cu. St. 9	
24	29 879	770	811	73 8	89·0	79·0	718	855	772	76	62	78	W 3·0	W S W 8·00	S W 1·00	4·66	....	Strat. 2	Cu. St. 7	Cir. 7	
25	827	811	804	77·5	89·0	76·0	799	997	772	86	73	86	W 2·0	W 6·00	W 3·00	2·09	....	Cu. St. 9	Cu. St. 8	Nim 10	Thunderstorm.
26	793	846	764	74 8	85·3	80·0	785	733	785	90	61	74	Calm.	Calm.	Calm.	1·08	0·15	Cu. St. 10	Cu. 3	0 0	
27	905	863	811	73·0	83·0	79·0	610	677	751	63	00	66	N N E 2·00	N N E 1·00	N W 1·00	0·62	....	Cu. St. 10	Cir. 4	Cu. St. 10	
28	862	859	882	75·5	85·0	74·0	666	531	396	77	44	48	N 3·00	N W 3·00	Calm.	0·58	....	Cu. 5	0 0	0 0	
29	946	835	866	72·0	76·0	63·6	595	470	433	76	52	73	Calm.	Calm.	N E 8·00	1·83	....	Cu. 4	Cu. St. 10	Cu. St. 10	Rain.
30	941	862	959	68·5	75·0	63·0	469	350	356	67	40	62	N 3	E N E 2·00	N 9·00	3·50	0·01	0 0	0 0	0 0	

REPORT FOR THE MONTH OF JULY, 1858.

	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.			7 a.m.	2 p.m.	9 p.m.	
1	30·049	29·890	29·835	65 2	72·0	68·0	·451	·358	·411	·73	·46	·60	W 3	W 3	W N W 1	1·33	....	0 0	Cu. St. 3	Strat. 1	Aurora, with streamers.
2	29·489	842	878	67·8	76·2	71·0	·319	·336	·469	·47	·37	·62	Calm.	S S E 1	Calm.	2·28	....	Cu. St. 8	Cir. 1	Cir. 1	
3	728	554	497	69·5	84·0	75·0	·516	·802	·785	·70	·72	·90	Calm.	S 9	N W 1	1·37	....	Cu. St. 9	Nim. 10	Cu. 8	
4	522	827	30 016	72·5	72·0	62·0	588	644	502	74	86	78	Calm.	N E 1	Calm.	1·62	0·96	Cu. St. 5	Cu. St. 10	0 0	Auroral Light.
5	30·191	30·204	182	60·0	68·7	63·8	310	398	373	60	56	62	Calm.	Calm.	N 3	0·91	....	0 0	0 0	0 0	" "
6	212	132	070	66·8	80·0	66·0	489	487	470	75	48	73	W S W 1	S W 5	S W 5	1·91	....	0 0	Strat. 3	0 0	" "
7	29·993	29·864	29·777	72·0	84·8	76·2	524	623	639	56	53	69	W 6	W S W 10	W S W 5	6·50	....	0 0	0 0	0 0	
8	815	893	978	74·0	67·0	61·5	604	425	413	73	64	77	N 10	N N E 18	N N E 6	8·70	....	Cu. St. 5	Cir. St. 9	Cu. St. 10	
9	30·004	30·018	30·024	58·0	66·0	60·0	423	438	283	88	68	54	N E 5	N E 5	N E 7	5·05	0·46	Nim. 10	Nim. 10	Cu. St. 10	
10	29·904	29·865	29 788	59·8	73·2	70·5	487	732	695	94	90	95	N E 9	Calm.	S W 3	1·62	0·02	Cu. St. 10	Nim. 10	Cu. St. 10	Thunderstorm.
11	966	30·076	30·144	59·0	64·7	59·8	409	389	426	94	63	82	N E 9	N E 8	Calm.	6·45	0·46	Nim. 10	Cu. St. 10	Cu. St. 10	
12	30 092	29 912	29 876	54·0	57·0	56·7	390	466	420	93	100	94	N E 5	N E 6	N N E 4	4·41	0·78	Nim. 10	Nim. 10	Nim. 10	
13	29·973	820	946	61·0	68·0	63·5	537	543	478	100	79	83	N E 6	W 6	W S W 3	1·75	1·40	Nim. 10	Cu. 6	Cu. St. 10	
14	30 057	30 034	30 040	62·0	74·4	67·2	491	532	523	88	63	79	W S W 1	W S W 6	Calm.	1·83	0·01	Cu. St. 9	Cu. St. 8	Cu. St. 5	Imperfect Solar Halo.
15	098	032	044	65·2	80·0	70·0	516	487	482	84	48	66	S W 2	S W 3	Calm.	1·33	....	Cu. St. 8	Cu. St. 8	0 0	Faint Auroral Light.
16	043	29·970	29·940	70·4	79·0	72·0	621	651	595	85	66	76	Calm.	Calm.	S W 3	0·79	....	Cir. St. 1	Cu. 6	Cu. 8	
17	29·948	30 021	993	78·2	82·0	70·0	744	650	416	78	59	57	Calm.	Calm.	W S W 4	4·54	....	Cir. St. 4	Cir. St. 4	Cir. St. 2	
18	30 148	086	30·133	66·6	76·0	67·0	438	314	333	68	53	50	Calm.	W S W 2	Calm.	1·70	....	0 0	0 0	0 0	
19	218	140	29·990	66·8	75·0	67·0	303	449	425	46	52	64	Calm.	S W 5	Calm.	2·25	....	0 0	Cu. St. 6	0 0	
20	29·988	29·862	823	63·8	72·0	65·0	403	559	540	67	72	89	Calm.	S W 2	S W 1	0·91	....	Cu. St. 8	Nim. 8	Cu. St. 10	Thunderstorm. Hail.
21	723	622	688	64·4	78·0	63·5	529	588	529	89	62	89	Calm.	S W 1	Calm.	0·87	0·43	Cu. St. 10	Nim. 10	Cu. 2	Thunderstorm.
22	607	600	755	61·8	68·0	60·0	523	543	426	94	79	82	Calm.	Calm.	S W 1	0·87	0·85	Cu. St. 10	Nim. 10	Cu. St. 5	Distant Thunder.
23	820	838	901	58·8	65·9	58·8	380	353	380	76	48	76	W N W 10	N W 8	Calm.	5·35	0·64	Cu. St. 10	Cu. St. 8	Cir. 3	
24	912	30·024	30·094	56·8	69·0	59·3	407	367	242	87	52	48	Calm.	N N E 1	N N E 8	0·45	....	Cu. St. 10	Cu. St. 8	Cu. St. 9	
25	30·154	115	099	64·0	67·0	61·0	373	393	442	62	59	83	Calm.	N E 2	N E 1	0·62	....	Cu. 4	Cu. St. 9	Cir. Cu. 8	
26	30 064	29·873	29·842	63·0	76·0	70·0	416	541	621	77	60	85	N E 1	Calm.	S W 9	1·70	....	0 0	Cu. 6	Cu. 5	
27	29 632	592	782	78·0	77·0	68·7	626	492	462	65	53	65	W S W 1	W S W 2	Calm.	2·95	....	0 0	Cu. St. 10	Cu. St. 5	
28	951	943	983	64·5	72·0	66·0	451	559	438	73	72	68	N W 1	N W 3	Calm.	0·66	Inap.	0 0	0 0	0 0	Lunar Halo. Rad. 30°.5.
29	958	859	796	59·4	62·0	59·0	380	429	439	76	77	88	Calm.	Calm.	Calm.	0·04	....	Cir. Cu. 9	Nim. 10	Nim. 10	Aurora, with streamers.
30	781	724	705	56·5	68·8	64 0	413	190	433	97	68	73	Calm.	Calm.	Calm.	0·00	0·08	Cu. St. 10	Cir. St. 7	Cu. St. 5	Dense Fog early A. M.
31	710	750	813	65·8	73 8	66 0	470	497	438	73	59	68	Calm.	Calm.	N N W 1	0 15	....	Cu. St. 10	Cir. St. 7	Cu. St. 4	

REMARKS FOR JUNE, 1858.

Barometer ...... Highest on the 3rd day: 30·181 inches.
Lowest " 10th " 29·248 "
Monthly mean, 29·8879 inches.
Monthly range, 0·933 "

Thermometer. . Highest on the 25th day, 90°2.
Lowest " 16th " 52°50.
Monthly mean, 68°10.
Monthly range, 37°70.

Warmest day was the 25th, its mean temperature being 80°83.
Coldest " " 13th, " " " 56°36.
Greatest intensity of the sun's rays, 126°, on the 26th day.
Mean of humidity for the month, ·675.

Rain fell on 13 days during 73 hours 15 minutes, amounting to 3·73 inches.

The most prevalent wind was the W. S. W.
The least prevalent wind was the E.

No record of wind from the N.N.W., E.S.E., S.E., or S.S E.

Cloudless days occurred on the 3rd and 30th.

At observation hours it was calm on the 2nd, 6th, 13th, 15th, 22nd and 26th.

The most windy day was the 4th day, the mean velocity being 7·58 miles per hour.

The most windy hour between 2 and 3 p. m. of the 4th day; actual velocity being 20·66 miles per hour.

The Aurora was seen on 1 night. It was not visible on 17 nights, where, if existing, it must have been seen; and the remaining nights were cloudy.

Ozone was in moderate proportion.

Two thunderstorms occurred. Distant thunderstorm heard once, and distant lightning seen also once. A Solar Halo was seen on the 1st day. Lunar Corona on 2 nights. A Meteor is alleged to have been seen on the evening of the 12th.

N. B. The rain and snow guages are noted each morning at 10 a. m,

REMARKS FOR JULY, 1858.

Barometer ..... Highest on the 19th day: 30·218 inches.
Lowest " 2nd " 29·489 "
Monthly mean, 29·9197 inches.
Monthly range, 0·729 "

Thermometer. . Highest on the 7th day: 60°4.
Lowest " 1st " 17°5.
Monthly mean, 86°3.
Monthly range, 54°0.

Greatest intensity of the sun's rays, 128°8, on the 18th day.
Warmest day was the 7th, its mean temperature being 77°66.
Coldest day was the 12th, " " " 59°60.
Mean of humidity for the month, ·608.

Rain fell on 12 days during 69 hours 10 minutes, amounting to 6·09 inches. Hail fell on 1 day.

The most prevalent wind was the N. E.
The least " " were the S., S.S.E., and N.N.W.

No record of wind from E.N.E., E., E.S.E., S.E., and S.S.W.

The most windy day was the 8th, the mean velocity having been 8·70 miles per hour.

The most windy hour between 2 and 3 p. m. of same day, the velocity having been 19 miles per hour.

A calm day occurred on the 30th.

Cloudless days occurred on the 5th, 7th, 18th, and 28th.

Ozone was in moderate ratio.

N. B. The rain and snow guages are noted each morning at 10 a. m.

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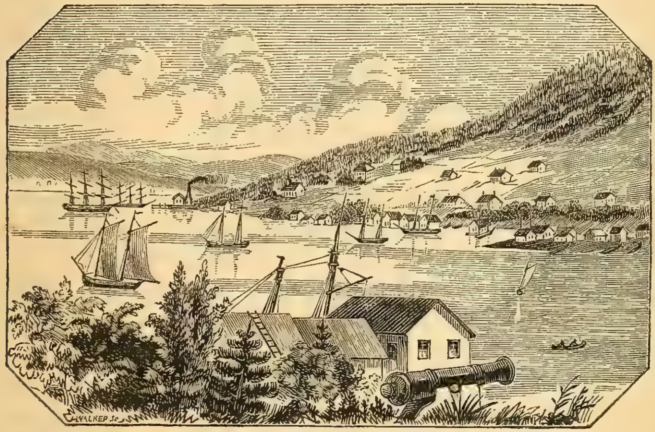
ART. XXVII.—*A Week in Gaspé.* Read in part before the Natural History Society of Montreal.



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

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* 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.

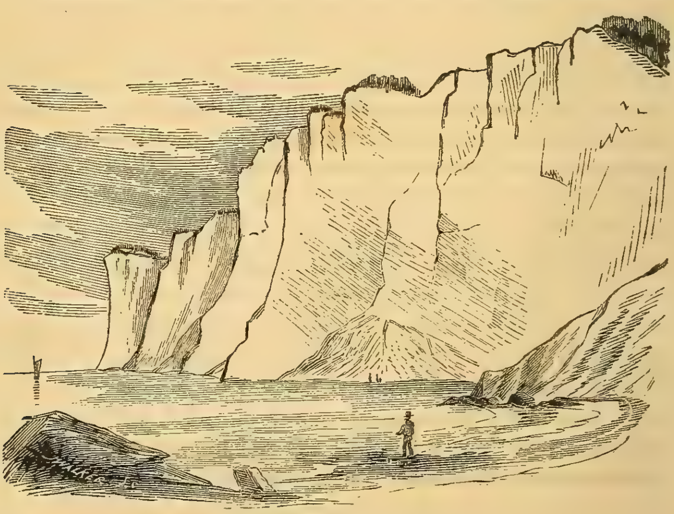
The fishing principally maintained in Gaspé Bay is that of the cod, the most safe and profitable of all our fisheries, and that which cultivates the most steady and orderly habits in the men engaged in it. Morrhua Americana himself and his congeners are steady-going animals, regular in their habits as 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.—Same source.

Lacuna vincta.—Very 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

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* 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 Couf.*, 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 Coufervæ.

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 *Couferva*, 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 all sides of it branches spring irregularly, 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 Mannal, 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 tube 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.*

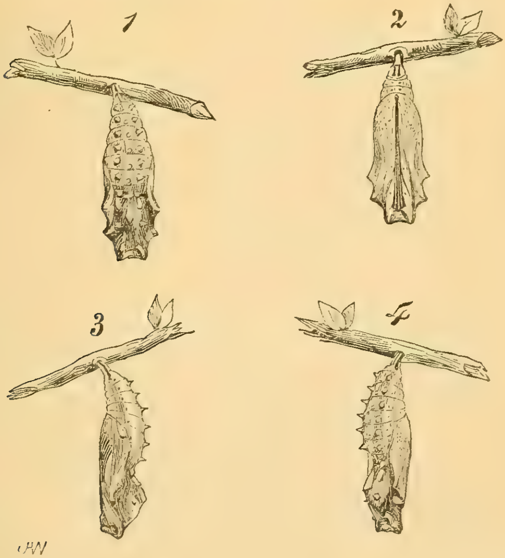
I. CYNTHIA CARDUI (the painted lady.)

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 davs. 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'Afrique 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 $2\frac{3}{4}$ 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

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[*] 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

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* Westood's Btitish 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 ⅝-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, 2¾ 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.

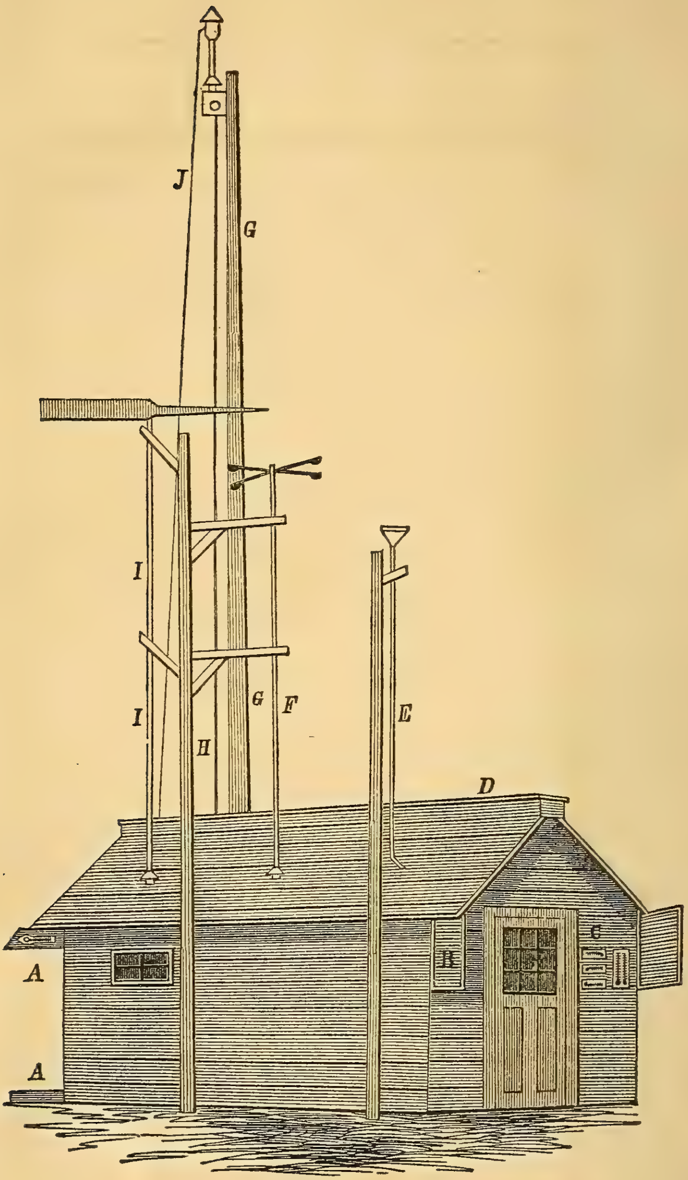
P. Evaporator—removed in winter and replaced by scales for showing the amount of evaporation from the surface of ice.

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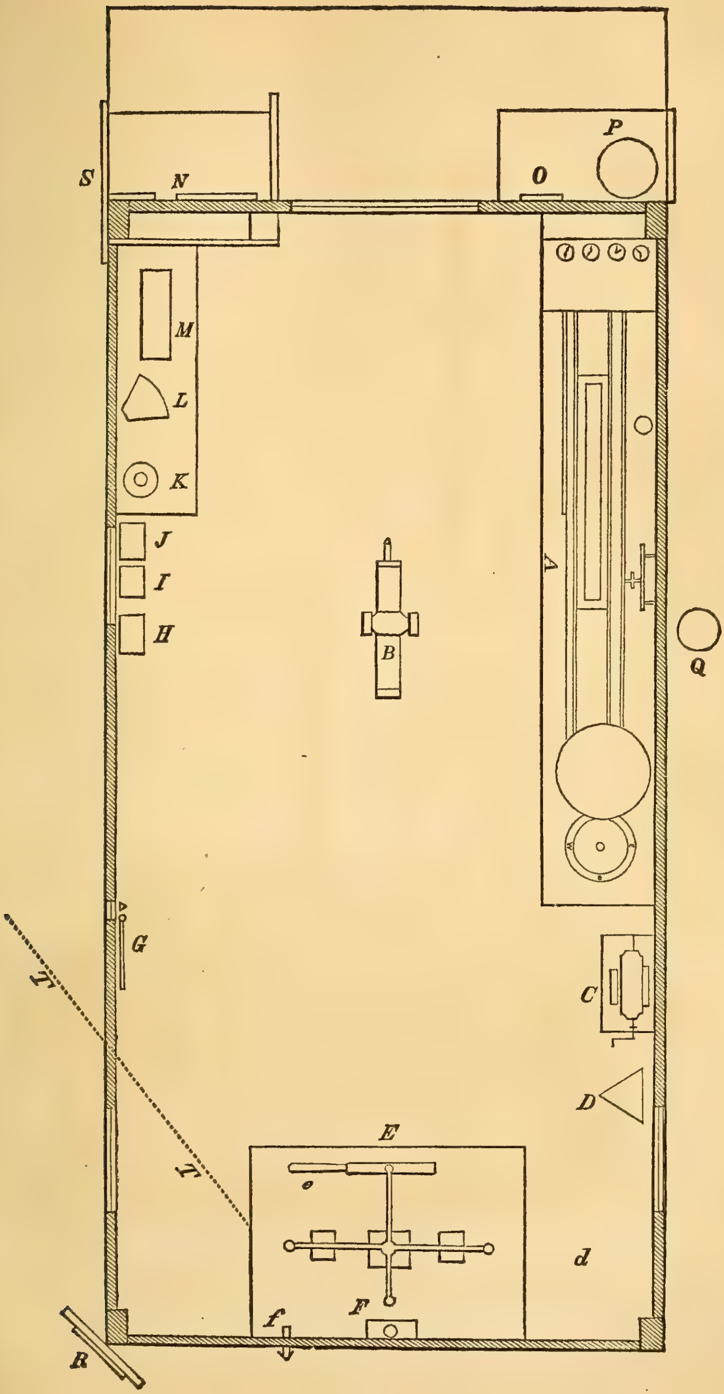
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ART. XXXI.—*Answers to Questions proposed to the Essex Institute on Lightning Conducting Rods.* By a Committee of the Institute. [*Vid.* "Proceedings," vol. ii., part i., p. 164.]

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 Renssalær, 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 North 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 twoaims; 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 iu 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 Mateucci 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 relation to any point of the divided or transverse section of the same nerve. Mr. Baxter, in still more recent researches, has deduced important 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, seleninm, 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 foundatiens 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 develop-mental 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 stimnlated 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, perhaps 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 Quadruman a 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. Humbolditi*) 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 singularitv 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 of 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 ràces, 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-

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* 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 imperfector 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

Graptolithus

Lower Silurian *Hudson River Group* Pl 2

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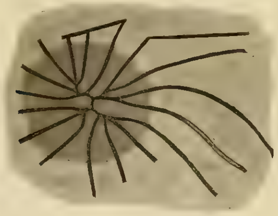

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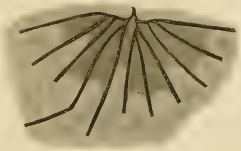

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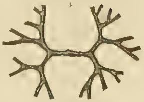

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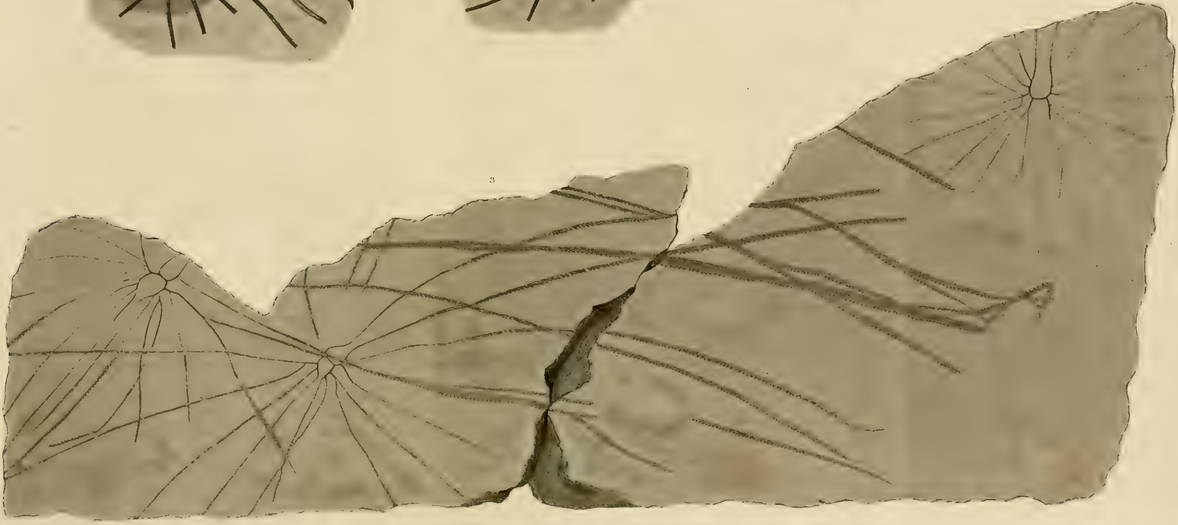

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THE

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NATURALIST AND GEOLOGIST.

VOLUME III. DECEMBER, 1858. NUMBER 6.

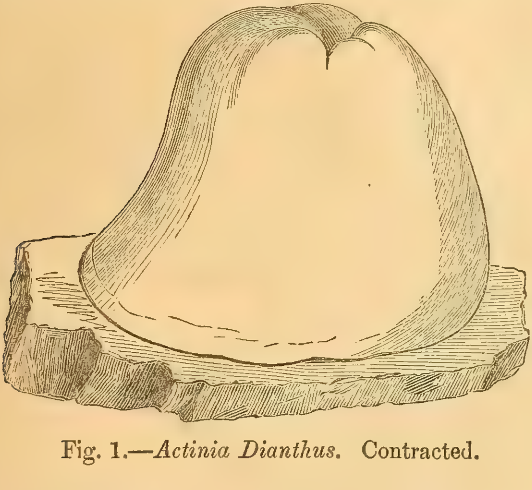

Fig. 1.—*Actinia Dianthus.* Contracted.

ARTICLE XXXII.—*On Sea Anemones and Hydroid Polyps from the Gulf of St. Lawrence.* Read before the Natural History Society of Montreal.

The creatures to which this notice relates are of great interest, whether we regard their singular and beautiful plant-like forms, their zoological relations, or the curious questions that concern their growth and reproduction. They are favourite subjects of study with all sea side collectors, and they have engaged and are engaging the most minute attention of some of the ablest naturalists. I do not propose in the present paper to add anything to their general natural history, but merely to record the occurrence on the coast of British America of some species found by myself in Gaspé, or collected at Metis and Murray Bay by Miss Carey of Perth, who has placed a number of interesting specimens in my hands for determination.

I.—*Sea Anemones collected in Gaspé.*

The Actiniæ, or Sea Anemones, belong to a large and important group of radiated animals, including the coral building polyps of the intertropical seas, and constituting the class *Anthozoa* of Owen's system, and the *Polypi* of that of Agassiz. The Actiniæ are the largest and most interesting representatives of this group in these latitudes. They derive their common name from their flower-like aspect, though they are truly animals, and are both complex in structure and voracious in their habits. When expanded they present a circular fleshy disc having the mouth in the centre, and at or near the circumference a fringe of tentacles

Fig. 2.—*Actinia Dianthus.* Expanded.

serving as organs of touch and prehension, and which can be extended or retracted at pleasure. The whole of the upper surface is tinted with gay or softly blended colours, often of great beauty. Internally the mouth leads into a sac-like stomach, surrounded by a space divided by a series of radiating membranous lamellae, between which are the organs of respiration and reproduction. Without the whole is a thick muscular skin.

Fixed by their flat bases to rocks or stones, the Actiniæ extend their tentacles and seize and devour any small animals that come within their reach. When at rest or when alarmed, the animal withdraws all its oral and tentacular apparatus, and the body shrinks into a cylindrical, spheroidal, or conical mass.

(1.)—*Actinia Dianthus.*

Near the mouth of Gaspé Basin is a patch of gravelly bottom at a depth of from eight to ten fathoms, which abounds in sea anemones, and especially in the fine species represented in Figs. 1 and 2, and which appears identical with the *A. dianthus* of the British coast. It falls within the characters of the published descriptions of that species, and cannot properly be separated from it, though it presents some points of difference. As compared with the British figures and descriptions, my Gaspé specimens show somewhat longer oral bands, with wedge shaped secondary bands between their extremities; the inner tentacles are more crowded toward the margin, and the range of colouring is different. These characters may however be within the limits of variation of the species.*

In the spot above referred to, not only were the Actiniæ abundant, but the stones to which they were attached could be taken up with the dredge; so that in a few hours dredging, about thirty perfect specimens were obtained, and being placed in basins of salt water, could be drawn and studied at leisure. Observed in this way, they presented a great variety of colouring, form, and attitude. I have selected the drawings copied in Figs. 1 and 2, from several others, as exhibiting the ordinary attitude of repose, and that of watching for prey, with the body extended to its full length. Both figures represent individuals of small size—the larger specimens being four inches in diameter when expanded. In their habits they corresponded with the accounts of the species given by Johnston and Landsborough, and like the British speci-

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* Johnston, British Zoophytes. P. 232.

mens they adhered very firmly to the stones, and could scarcely be detached without injury to the base. When disturbed, they ejected water forcibly from the pores of the skin, along with their long white filaments, probably organs of defence, and possessing an urticating or benumbing property.

The range of colouring was very great, and was quite independent of the age or size of the specimens; but when several specimens were attached to the same stone, they were usually of the same colour. The prevailing tint externally was umber brown of various shades, but some specimens were fawn coloured, and this passed in others into a very pale flesh colour; some were beautifully striped with brown on a fawn or flesh coloured ground. In every case the colours of the disc and tentacles corresponded in intensity with those of the outer coat. The following descriptions show this relation in the more conspicuous colour varieties.

(*a*) Body externally very pale flesh colour, sometimes nearly white; oral bands pale flesh colour; outer tentacles rich flesh colour. The inner tentacles in this and the other varieties were paler than the outer. The specimen represented in Fig. 1 was of this variety.

(*b*) Body flesh colour or fawn, striped with brown; oral disc flesh colour; outer tentacles rich dark flesh colour. The specimen represented in Fig. 2 was of this colour.

(*c*) Body reddish brown; oral bands reddish orange; outer tentacles deep purple.

(*d*) Body umber brown, lighter when expanded; oral bands fawn or dull orange; outer tentacles purplish slate colour. Some of the largest specimens were of this colour, and presented a lurid or dingy aspect, very strongly contrasting with their delicately complexioned neighbours.

I have not met with any notice of the occurrence of A. dianthus in America, except in Stimpson's Marine Invertebrata of Grand Manan, where it is stated that a specimen supposed to belong to this species was taken, but lost before it could be examined. As already stated, I believe the specimens above described to be referrible to this species, but should they prove on comparison to be distinct and previously undiscovered, I shall claim for them the name of A. Canadensis.

(2.)—*Actinia* ———— ? N. S.

With the specimens just described were found a few individuals of a very distinct species, not unlike *A. Mesembryanthemum*, or *A. Marginata*, but quite distinct. The largest specimens obtained were an inch in diameter. Specimens of this size have about 150 tentacles, conical, transversely striated, and uniform in size, placed at the margin of the disc in about three rows. The disc rises when expanded considerably above the plane of the tentacles. The body below the tentacles is short, and expands toward the base. When contracted the form is blunt conical, with a smooth outer skin, apparently destitute of tubercles and pores.

Fig. 3.

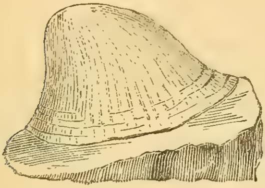


Fig. 4.

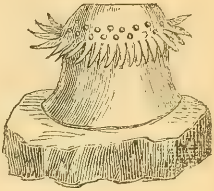
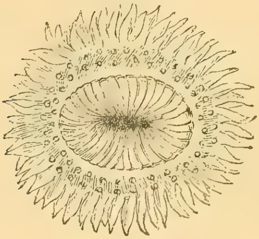


Fig. 5.



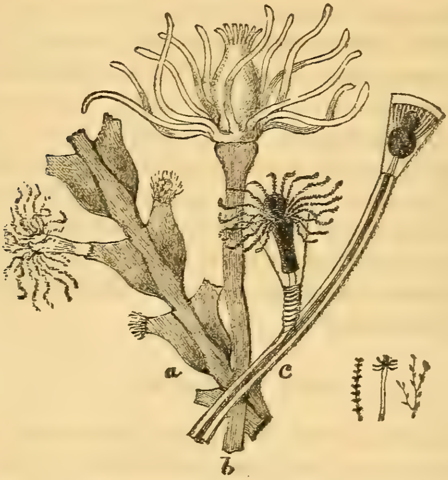
The colour, when contracted, is a fine reddish salmon, arranged in vertical stripes on a light ground. When expanded the lip and oral bands are reddish; the tentacles are salmon colour, deeper toward the tips. The disc between the tentacles and the oral bands is dull purple, with two rows of pure white spots This beautiful species is comparatively locomotive and active; and when placed in a basin, removed from its stone, and crept around in search of a more convenient situation.

I think it very probable that Stimpson's *A. Carneola* is the young of this species; but my specimens do not include any so small as that which he figures, and the colour and tentacles differ. If distinct from *A. Carneola* it is probably new. Its description is as follows:—

Body short, cylindrical, smooth; colour red, arranged in stripes; tentacles triserial, short, conical, striated, reddish; disk prominent, dull purple with two rows of white spots. Oral bands numerous, flesh colour.

Should it prove new, the specific name *Nitida* would well express the sleek neat appearance for which it is remarkable.

Fig. 6.



Group of Hydrozoa from the Gulf of St. Lawrence.

(*a*) Sertularia pumila.
(*b*) Tubularia ———.
(*c*) Laomedea dichotoma.

II.—*Hydroid Polyps collected at Gaspé, Metis, etc.*

The hydroid polyps are of much simpler structure than the Actiniae, each animal being little more than a gelatinous sac, furnished with a circle or circles of tentacula. They constitute the class Hydrozoa of Owen ; and by Agassiz and some other naturalists are placed with the Acalephae, an arrangement which expresses their close relationship to the Medusae or Jelly fishes. The marine hydrozoa, though individually of simple structure, have a remarkable tendency to multiply by a process of gemmation or budding, the result of which is the formation of complex groups of little horny cells, each having its animal occupant, and the whole when dried resembling a small sea weed. In some of the tribes, by a different kind of budding from that which merely increases the polypary, locomotive individuals are produced, which detaching themselves from the parent, swim away in a form as different from that of the sessile polyp as the butterfly from the caterpillar. Others are not known to have this double kind of existence, but produce ova or little locomotive ovoid bodies which lay the foundation of new groups.

To a visitor to the sea side, provided with a microscope, these creatures form a very agreeable study. When taken up alive and placed in a vessel of sea water, the extension and retraction of their beautiful transparent bodies and crowns of tentacles looking like beads strung on a spider's thread, present a spectacle strikingly illustrative of the amount of life that exists hidden under plant forms in the sea. When a mere boy, I have spent many holiday afternoons in searching for these creatures that I might enjoy this curious spectacle, and I still treasure many rough sketches of their forms and structures made to perpetuate the wonders which they disclosed under the microscope. I am sorry that in the present notes I can refer not to the living animals but only to dried specimens.

Family *Tubulariadæ.*

1. *Eudendrium ramosum.*—The genus Eudendrium has tubular branches, at the ends of which are pretty reddish polyps, not retractile, and with one or two rows of tentacles. In Miss Carey's collection is a specimen not distinguishable from the species above named, which is a common British form. I have not met with it elsewhere.

2. *Tubularia indivisa.*—In the genus Tubularia the cells are simple horny tubes, with beautiful flesh-colored polyps, not retractile, and with two rows of tentacles. The *T. indivisa* occurs of large size at Sable Island, from which I have a specimen collected by Mr. Willis, of Halifax. It was attached to a sponge, Stimpson notes it as occurring at Grand Manan.

3. *Tubularia larynx.*—This pretty little species I found alive in great numbers at Gaspé, and covered with its little bead-like reproductive buds. The body is flask-like, of a red color, and covered with short tentacles At the base of the body is a second series of larger and lighter colored tentacles, and immediately above these the little gems are attached like flower-buds fastened by their smaller ends to the body.

4. *Tubularia* ———.—Another small species, about the size of *T. larynx*, but with a simple and very flexible tube, occurs in

the Gulf of St. Lawrence. I have not seen it for many years, and a drawing which I have preserved, does not correspond exactly with any described species known to me, but it closely resembles *T. Dumortierii* of Van Beneden. (See Fig. 6.)

The species both of Eudendrium and Tubularia, give birth in summer to beautiful medusiform individuals, or free polyparies, that swim on the surface of the water like little translucent balls or cups of jelly, and in turn give birth to the germs of fixed generations like their parents.

Family *Campanulariadæ.*

1. *Laomedea* (*Companularia*) *dichotoma*—The genera Campanularia and Laomedea, which perhaps should not be separated, have slender ringed branches supporting conical or bell-shaped cells, in which are beautiful tassel-like polyps. This species occurs in Miss Carey's collection from Metis, and I have also specimens from Nova Scotia, one of which is represented in the living state in Fig. 6.

2. *L. gelatinosa.*—In Miss Carey's collection from Metis. It is noted by Stimpson as found at Grand Manan.

3. *L. geniculata*, or a similar species is very common on seaweeds in the Gulf of St. Lawrence.

These creatures also produce medusiform progeny in immense abundance in the summer months, and it is partially through these means that they appear in countless multitudes on the leaves of marine plants, the bottoms of boats, and similar situations, in which they are developed as if by magic.

Family *Sertulariadœ.*

1. *Sertularia argentea.*—The genus Sertularia includes species that have two rows of cells placed like teeth or triangular projections on the opposite sides of the stalk. The polypary is horny, usually brownish and plant-like in appearance. S. argentea, known to British collectors as the "Squirrel's-tail coralline," is one of the most beautiful species, and was found in Gaspé Bay attached to shells of Pecten Magellanicus, and itself loaded with quantities of smaller Zoophytes, which somewhat mar its beauty though they add to its interest. This species is common to both sides of the Atlantic. Stimpson found it at Grand Manan.

2. *S. pumila.*—"Sea-oak coralline" is a small species which

clings to submerged wood and sea-weeds. I have seen in Nova Scotia sunken logs completely covered with a brown fleece of this creature, and specimens from Metis occur in Miss Carey's collection. It is said like many others of these little animals. to be very phosphorescent when agitated in the dark, and its polyps are exceedingly limpid and delicate when extended from the cells. In Fig. 6 is represented a portion of a stem with one of the polyps extended.

3. *S. latiuscula.*—This is a species discovered by Stimpson at Grand Manan, in the Bay of Fundy. A fine specimen from Metis in Miss Carey's collection corresponds so closely with Stimpson's description, that I cannot doubt it is the same species.

4. *Sertularia* ———.—In Miss Carey's collection from Murray Bay, is a small Sertularia, having the general aspect and mode of growth of S. pumila, but its color is gray or pearly, and its form is more delicate, the stem being very slender, so that the pairs of cells appear like a string of broad arrow heads. They are exactly opposite, the upper part projecting at right angles from the stem, the opening small and the lower part rapidly contracting. I have not seen the animals or ovicapsules. This species is possibly the same with that described by Desor in Proc. Bos. Socy. Nat. His., Vol. 4, as *S. plumea.*

5. *Plumularia falcata.*—In the genus Plumularia the cells are placed only on one side of the branchlets, which often have a fine feathered arrangement. A number of specimens in my own and Miss Carey's collections from Sable Island, the coast of Nova Scotia and Metis, all appear referrible to the species above named, which would thus appear to be very abundant and widely diffused on our coasts. It is also mentioned by Stimpson as occurring at Grand Manan.

In the collection of Miss Carey above referred to, there are seveveral species of Bryozoa, which I hope to notice in a future paper, in connection with species which I have recently found fossil in the tertiary clays and gravels, or living in the Gulf of St. Lawrence.

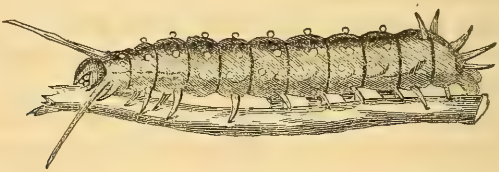
J. W. D.

ARTICLE XXXIII.—*Description of a Canadian Butterfly, and some remarks on the Genus Papilio.*

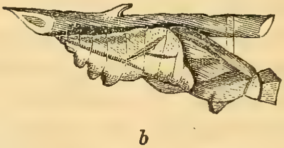
In the August number of this magazine, appeared a letter from Charles J. Bethune, Esq., of Cobourg, C.W., communicating the interesting fact of the occurrence of *Papilio Philenor* in great numbers at West Flamboro' and Toronto, between the 7th and 18th of last June. We subjoin a description of this insect, which is the fourth species of the Genus *Papilio* now known to inhabit Canada; and as seven occur in Ohio, there appears no reason why some additional species should not turn up in the more southern portions of the Upper Province. We therefore give synoptical tables of all the North American species described in Boisduval and Leconte, and which we hope will enable any collector to name his specimens, either of the Larvæ or Perfect Insects, at a glance.

GENUS PAPILIO.

Species 4—P. Philenor, Linn.



a



b

a The Larva. *b The Pupa.*

Papilio	Philenor,	Linnæus, Mantissa, p. 535, 1771.
"	"	Fabricius, Systema Entomologiæ, p. 445, No. 12, 1775, &c.
"	"	Herbst, Pap., tab. XIX, *f.* 2-3, 1785—1806.
"	"	Smith and Abbott, the Nat. Hist. Lepid. Ins. of Georg., Vol. 1, p. 5, tab. III, 1798.
"	"	Godart, Encyclop. Method, Ins., tab. IX, part 1, p 40, No. 47, 1819—1821.
"	"	Say, American Entomology, Vol. 1, tab. 1, 1824.
"	"	Boisduval et Leconte, Ico., &c., des Lepid., &c. de l'Amer. Sept., t. 1, p. 29, pl. XI, 1833.
"	Astinous,	Drury, Ins. I, tab. II, f. 1—4, 1775.
"	"	Cramer, Pap. XVIII, p. 26, pl. CCVIII, fig. a. b., 1770—1791.

Wings slightly denticulated, edged with cream color in the crenæ or notches.

On the upper side: the anterior pair are black, marked by a row of white spots (obsolete, or nearly so, in many specimens) parallel to the hind margin; the posterior pair are also black, glazed over with greenish or bluish, shining scales, except at the base, and have a row of six whitish lunules near the hind margin. Tails short and narrow, greenish, bordered with white at their base.

On the under side: the anterior wings are somewhat duller than on the upper, and are ornamented with a marginal row of four or five distinct yellowish spots. The posterior wings are washed with very brilliant greenish blue, except at the base, which is black and marked with a yellow spot; they are also distinguished by a marginal row of seven lunules of a lively yellow, surrounded by black, and all but the last bordered with white on their external margin; these lunules corrospond with the white ones of the upper surface. Inside this marginal row of lunules, are generally four white dots.

The body is blackish tinged with green, with a lateral line of yellow dots. The Antennæ are black. There is but little difference between the two sexes.

The Larva is brown, with two lateral series of small reddish tubercles. It is provided with two long spines on the first segment, and on the sides near the feet, it has nine of moderate length, and others, also of moderate length, are placed upon the three last segments. It lives on the Virginian Snakeroot (*Aristolochia Serpentaria*).

The Butterfly appears in Spring or the beginning of Summer, and, according to Boisduval, is common in all North America wherever the Snakeroot flourishes. In a paper " on the Diurnal Lepidoptera of Northern and Midland Ohio," read before the Cleveland Acadamy of Natural Sciences, January 17th. 1854, and to which we have frequently had occasion to refer, Prof. J. P. Kirtland observes, that this species " was among the most rare of our butterflies until I introduced into my garden a few plants of the *Aristolochia Sipho* and *pubescens*. Since then they have multiplied in immense numbers."

Aristolochia Sipho (Pipe Vine, or " Dutchman's Pipe ") grows most luxuriently in some of the gardens in the neighborhood of Montreal, climbing over verandahs, &c., the leaves frequently measuring 12 × 13 inches, and we are not without hopes that this beautiful butterfly may therefore eventually extend its range even into Lower Canada. Prof. Emmons describes it in his Insects of New York, but says nothing whatever regarding its natural history. It is not included in Dr. Harris's Catalogue of the Insects of Massachusetts. The figures of this Insect given by Cramer and Say, are very erroneously coloured, that in Boisduval is better, still it gives but a poor idea of the beautiful metallic lustre on the hind wings.

ON THE NORTH AMERICAN SPECIES OF THE GENUS PAPILIO.

The following pages embody such information as I have been able to collect with regard to the species of Papilio inhabiting North America. At the present day, all the old works on American Entomology have become so scarce and valuable, that it is rare to meet with a copy of any of them in this country, excepting the few, too often imperfect, contained in some of our public libraries, as will be presently shown. At the same time, unfortunately for the Canadian Entomologist, there is no modern work at all calculated to fill their place, and it is much to be regretted that there is no one capable of doing for Canadian Insects what Dr. Gray, in his admirable "Manual of the Botany of the Northern United States," has done for our Plants.

TABLE SHOWING THE RANGE AND FOOD-PLANTS OF THE NORTH AMERICAN SPECIES.

SPECIES.	HABITAT.	FOOD-PLANTS OF LARVA
P. Ajax, Smith & Abbott,............	Georgia, Virginia, Ohio (Kirtland),...	Plants of the order ANONACEA.
P. Marcellas, Cramer,.......	" " " (Kirt.) Europe?	
P. Sinon, Fabr.,. ...	South America, Cuba, Jamaica, Florida.	?
P. Asterias, Fabr	West Indies, Virginia, Georgia, New York, Massachusetts, Ohio, &c. Upper and Lower Canada, Newfoundland (Gosse),...................................	Plants of the order UMBELLIFERÆ.
P. Calchas, Fabr (Palamedes, Cramer,).......	Georgia, Virginia, and many of the Northern States,.............................	Plants of the genus LAURUS.
P. Troilus, Linn,	Jamaica, Georgia, Virginia, Mass. Ohio, Canada West,.........................	
P. Turnus. Linn, (Alcidamas, Cramer,).......	Virginia, Georgia, Carolina. Mass., N. York, Maine, Ohio, all Canada, Newfoundland (Gosse),..........................	Plants of the genus PRUNUS, *Liriodendron tulipifera* (Kirtland). *Ptelea trifoliata* (Abbot). *Tilia Americana*, Willow, Poplar, Brown Ash (Gosse), Alder & Elm.
P. Glaucus, Linn.,	Georgia and Virginia,......................	*Styrax Americana*, (Boisduval).
P. Thoas, Linn, (Cresphontes, Cramer,).......	South America, W. Indies, Florida, Georgia, Ohio (Kirtland),..................	Plants of the genera CITRUS & XANTHOXYLUM (Kirtland).
P. Villiersii, Godart	Cuba, Florida,................................	?
P. Polydamas, Linn.,...............	Brazil and Guiana, Cuba, Florida,....	Plants of the genus ARISTOLOCHIA.
P. Philenor, Linn., (Astinous, Cramer)	Most of the Northern States, Ohio, Canada West,................................	

SYNOPSIS OF THE SPECIES.

A. *Scarlet* spots on the *Posterior* wings.

a. Scarlet spots both on the *upper* and *under side.*
Also a scarlet *stripe* on the under side.

P. AJAX,........Black, banded with yellowish white; hind wings, upper side, with two blue lunules, and *two scarlet* and *one blue* spots at the anal angle.

P. MARCELLUS,..Black, banded with yellowish white; hindwings, upper side, with two blue lunules and *one blood-red* spot at the anal angle.

P. SINON,........Black, banded with *greenish white;* hindwings, upper side, *without* any blue lunules and with a large, bilobed, oblique, red spot at the anal angle.

b. Scarlet spots on the *under side only, no* scarlet stripe.

* Posterior wings *with tails.*

P. VILLIERSII,...Greenish black, bronzed and shining; all the wings on the upper side with a marginal row of bluish lunules, those on the hind wings very large.

* Posterior wings *without tails.*

P. POLYDAMAS,..Greenish black, bronzed; all the wings on the upper side with a band of deep yellow near the middle.

B. *No* scarlet spots on the wings.

a. General color of the wings, *black.*

* Posterior wings the *same color* as the upper.

† An *ocellus* at the anal angle.

P. ASTERIAS,....On the upper side, a band of yellow spots through the middle of each wing; posterior wings with a row of blue, and a marginal one of yellow lunules; ocellus fulvous, with a black pupil.

† † A *lunule* at the anal angle.

P. TROILUS,.....The marginal row of lunules on the upper side of the posterior wings *greenish-grey,* an orange spot at the apex of the wing, anal lunule *half orange, half greenish-grey.*

P. CALCHAS,....Marginal lunules of the upper side of the posterior wings *yellow,* lunule *blue, no other blue* spots on the upper side of the wings.

P. GLAUCUS,....Marginal lunules of the upper side of the wings *yellow, bordered with fulvous,* the apical and anal lunules *fulvous,* these wings also *powdered* with *blue.*

** Posterior wings *washed with metallic green.*

P. PHILENOR, ...On the upper side all the wings with a marginal row of *white lunules.*

*** *Under side* of the Posterior wings principally *yellow.*

P. THOAS, ...On the upper side a band of large yellow spots through each wing; at the anal angle of the posterior wings is a fulvous lunule, surmounted by some blue dots.

b. General color of the wings *yellow.*

P. Turnus, ...Upper side banded with black; a row of blue lunules on the posterior wings, and fulvous lunule at the anal angle.

SYNOPSIS OF THE LARVÆ.

A. Without Spines.

a. Cylindrical (nearly the same size throughout).

* Marked with transverse bands.

P. Asterias,....Larva apple-green; each segment with a transverse black band, interrupted with orange spots. It very much resembles that of the European *P. Machaon.*

** Colours distributed in blotches.

P. Thoas,......Larva brown, marked with three large patches of white.

*** Marked with ocellated spots.

P. Polydamas,..Larva brown, streaked with red; upon each segment 4 yellowish ocellated spots, having the anterior part red. *Tentacles brown.*

P. Villiersii,...Larva———?

b. 3rd and 4th Segments much thicker than the rest.

* 3rd or 4th Segment with transverse bands of various colors.

P. Ajax,.......Larva apple-green; at the juncture of the 3rd and 4th segment, a tri-color band, pale blue, dark blue and yellow.

P. Marcellus,..Larva whitish with transverse yellow bands and violet lines. On the 3rd segment two bands, white and black.

P. Sinon,.......Larva———?

** 3rd Segment with ocellated spots.

† Under side of the body of a different color from the upper.

P. Calchas,....Larva apple-green on the back and sides, with the under side and legs *red*, the two colors separated by a marginal yellow line. Head reddish-yellow with a black colar. Iris of the ocellus flesh color, pupil blue. Upon the 4th segment a flesh-colored spot.

P. Troilus,.....Larva green above, flesh color underneath; a yellow line separating the two colors. Head *flesh color*, with a black colar. Iris of the ocellus flesh color, pupil blue. Upon the 4th segment *two* flesh-colored spots.

†† Color uniform or nearly so.

P. Glaucus,....Larva apple-green. Head brown with a yellow colar; ocellus with yellow iris and a *single* blue pupil. Between the 5th and 6th segments a double transverse band, yellow and black.

P. Turnus, ...Larva apple-green. Head flesh-color with a yellow colar. Ocellus with yellow iris and a *double* blue pupil. Between the 4*th and* 5*th* segments a double tranverse band, yellow and black.

B. Spinose.

P. Philenor,....Larva brown with two lateral series of small reddish tubercles and spines.

On examining the above analytical tables, and comparing them with that showing the food-plants of the Larvæ, it will be seen that this extensive genus is naturally divided into various groups, characterized not only by peculiarities in the colors of the wings and structure of the Larvæ, but also by their geographical distribution and pabulum.

The Larvæ of the group represented by *P. Asterias*, feed exclusively on plants of the order *Umbelliferæ* (such as Parsley, Poison Hemlock, Carrot, &c.,). The species occur in Europe, Asia, Africa and America. This may be regarded as the typical group.

P. Thoas is the largest North American species. It represents a rather large and very natural group, almost peculiar to South America. The species all feed on plants of the genus *citrus* (such as Orange, Lemon, &c.,). This species was formerly considered as belonging exclusively to the Southern States, but according to Prof. Kirtland it occurs in Ohio, feeding there, however, on *Xanthoxylum* (Hercules Club and Prickly Ash).

P. Polydamas forms with some South American species a small but very natural group; they feed on plants of the genus *Aristolochia* (Pipe Vines). This is the only North American species without tails to the posterior wings, and the tentacular organ on the head of the of the Larva is brown, whilst in the other species it is yellow or orange.

P. Ajax, *Marcellus* and *Sinon*, bear a great resemblance to each other in the perfect state, though not in the Larva. They feed in America on plants of the order *Anonaceæ* or Custard Apples (such as *Acimina triloba*, North American Papaw, &c.,). This group is represented in Europe by *P. podalirius.*

P. Calchas and *Troilus* have very similar larvæ. They feed on plants of the genus *Laurus* (such as the Spice-bush, Sassafras, &c.,). *P. Calchas* is not unlikely to occur in Canada West.

P. Glaucus and *Turnus* are closely allied both in the Imago and Larva, the ground color of the wings of the first, however, is black, whilst that of the latter is yellow. The larva of *glaucus* feeds on *Styrax Americana* (Storax, a Southern plant), whilst that of *turnus* lives on a great variety of shrubs and trees, such as Ash, Elm, Plum, Tulip-tree, Basswood, &c.; while young it is bluish-grey at each extremity and white in the middle (Gosse), and just before changing to the pupa it becomes purplish-brown.

P. Philenor is the only N. American species with a spiny Larva. It feeds exclusively on plants of the genus *Aristolochia* (Virginian Snakeroot, Pipe-Vine, &c.,).

LIST OF WORKS TO BE CONSULTED BY STUDENTS OF CANADIAN DIURNAL LEPIDOPTERA.

Abbott & Smith. Natural History of the rarer Lepidopterous Insects of Georgia, including their systematic character, metamorphoses, and the plants on which they feed. 2 vols. folio. Colored plates. London, 1779. Text in French and English. Very scarce; advertised price in New York, $55.00.

This work contains figures and descriptions of many Canadian Butterflies and Moths. There is a copy in the Library of the Provincial Parliament, Toronto.

Agassiz, Louis. Lake Superior, its Physical Character, Vegetation and Animals, &c. 1 vol., 8 vo. Boston, 1850. Libraries of P. Parliament and Geological Survey.

There is a figure and description of *Pontia oleracea*, and of several other Canadian Lepidoptera, by Dr. Harris, in this work.

Boisduval & Leconte. Histoire générale et Iconographie des Lepidoptéres et des chenilles de l'Amerique Septentrionale. 2 vols. Text and plates (colored). Paris, 1833. French.

. This work is very scarce, but, through the kindness of E. Billings Esq., I have had access to a copy in his possession. It contains beautifully colored figures of nearly all the known Canadian species of Butterflies, besides many not included in our fauna; the letter-press is unfortunately incomplete. A newer edition in 1 vol. (1843), also very scarce, is advertised in New York at $25.00.

Cramer, Pierre. de nitlandsche Kapellen, ou Papillons Exotiques des trois parties du monde, L'Aise, L'Afrique, et L'Amerique. 5 vols., 4 to. Colored plates. Amsterdam, 1775—1791. Text in Dutch and French.

There is an incomplete copy of this fine and rare work in the Library of the Montreal Natural History Society. It has figures of nearly all the North American Papilios, and a great number of the Diurnal and Nocturnal Lepidoptera found in Canada. The descriptions are, however, very meagre and incomplete.

Duncan's British Butterflies (Vol. XXIX, Naturalist's Library). 1 vol., 8 vo. Colored plates. Edinburgh, 1836. Price in London, 4s. 6d. Libraries of P. Parliament and Montreal N. H. Society.

This may be consulted for such British Species as occur in this country. It is a very complete little work, though somewhat out of date.

Duncan's Foreign Butterflies (Vol. XXXI, Naturalist's Library). 1 vol., 8vo. Colored Plates. Edinburgh, 1837. Price in London, 4s. 6d. Libraries of P. Parliament and M. Nat. Hist. Society.

In this there are descriptions and figures of a few American species.

Ernst & Engramelle, Papillons d'Europe. 8 vols., 4to. Colored plates. Paris, 1770—1793. Libraries of the P. Parliament and Montreal Nat. Hist. Society.

This fine work may be consulted with advantage for such European species as occur in Canada.

Emmons, E. Insects of the State of New York (Vol. V of the Agriculture of New York). 4 to. Colored plates. Albany, 1854. Advertised price, $7.50 Libraries of P. Parliament and McGill College.

This work is so inaccurate and the figures so badly executed, that it is of little value to an Entomologist. It, however, contains figures and descriptions of some Canadian Butterflies, &c., and may assist a beginner in naming his specimens.

Fabricius, J. C. Systema Entomologiæ, &c. 3 vols. Flensburgi et Lipsiæ, 1775. Text in Latin.

This old work contains correct though short descriptions of a great number of Canadian Insects of all orders. It may be occasionally picked up cheap at second-hand bookstalls, but is a rare work. Mr. Billings possesses a copy.

Godart (Article Papillon). Encyclopedie Methodique. 8 vols., 4 to. Paris 1789—1825. Lib. Provincial Parliament.

Contains numerous Canadian Butterflies, &c.

Gosse, P. H. The Canadian Naturalist. 1 vol., 8 vo. 44 engravings. London, 1840. Price, $3.60. Lib. P. Parliament, McGill College, &c.

Mr. Gosse notices 26 species of Canadian Butterflies, and figures 5 of them. It is a most useful book to a Canadian Entomologist, furnishing him with accurate information regarding the habits, food-plants, seasons, &c., of many species in all orders.

Humphreys & Westwood. British Butterflies and their transformations. 1 vol., 4 to. Colored plates. London, 1841. Advertised price in New York, $15.00. Lib. Geological Survey.

Figures of the Larva, Pupa, Imago, and food-plants of all the British and of a few American species. The Text contains much valuable information regarding the Families, Genera and Species.

Kirby, Rev. W. Fauna Boreali Americana, vol. 4. The Insects; with colored figures. 4 to. Norwich, 1837. Lib. P. Parliament and McGill's College.

Some Canadian Butterflies and other Lepidoptera are described and figured in this work, which is now, unfortunately, rather scarce.

Linnæus, Systema Naturæ. Ed. 13. 3 vols., 8 vo. Vindobonæ, 1775. Lib. Mont. Nat. Hist. Soc.

In this there are short descriptions in Latin of all the Lepidopterous Insects known at the time of publication. It is of but little use at the present day, except as a reference in cases of doubt as to the priority of a name.

Say, Thomas. American Entomology; or Descriptions of the Insects of North America, illustrated by colored figures from original drawings, executed from nature. 3 vols., 8 vo. Philadelphia, 1824—28. Very scarce. Advertised price in New York, $30.00. Libraries of McGill's College and Lit. and Hist. Soc. of Quebec.

Contains figures and descriptions of a few Canadian Butterflies, &c.

Stainton, H. T. A manual of British Butterflies and Moths. Vol. 1 (comprising the Butterflies and Stout-bodied Moths), 12 mo. London, 1857. Price in London, 4s 6d. Vol. 2nd is in course of publication in monthly parts, price 3d. each. Can be obtained of B. Dawson, Bookseller, Gt. St. James St. Montreal.

This will be found a most valuable work to the Canadian student, and its extremely low price puts it within the reach of every one. It is illustrated with excellent wood-cuts of nearly every genus of British Lepidoptera, and enables a collector in this country to determine the genera of a large portion of our Lepidopterous Insects. It is much to be wished that there existed a similar work on Canadian species.

Turton's Translation of Gmelin's Edition of the Systema Naturæ of Linnæus (Insects, vols. 3 and 4). 7 vols., 8 vo. Lib. Mont. Nat. Hist. Society.

Short descriptions of the Lepidoptera of the world, known at the time of publication, with their Habitats, &c.

Westwood, J. O. Introduction to the Modern Classification of Insects. 2 vols., 8 vo., with 133 illustrations on wood. Price in London, 18s. Lib. of P. Parliament, Toronto.

A most useful work, now, I believe, nearly out of print. It is the best work of its kind ever published, and almost indispensable to any one wishing to investigate the Classification of insects in general. It contains figures of the Larvæ and Pupæ of every family of Butterflies.

The valuable works of Dr. Thaddeus Harris, Insects of Massachusetts injurious to vegetation, 1841, Treatise on the Insects of New England. 8vo. Cambridge, 1842, &c., are very scarce, and I have not as yet been fortunate enough to meet with them.

The prices of some of the above works have been derived from the Catalogue of Standard and Recent Books on Natural History of H. Bailliere, 290 Broadway, N. York.

For numerous modern works on the Lepidoptera of the world, and of which I know of no copies to be found in Canada, I must refer the reader to Stainton's Entomologist's Annuals for 1855—56—57—58 (price of each in London, 2s. 6d.), which contain a variety of useful information concerning the study of Entomology.

WILLIAM STEWART M. D'URBAN.

MONTREAL, November 22nd, 1858.

ARTICLE XXXIV.—*New Genera and Species of Fossils from the Silurian and Devonian formations of Canada.* By E. BILLINGS, F. G. S. &c.

(By the kind permission of Sir W. E. LOGAN, the following article has been extracted from the Report of the Geological Survey of Canada for 1857.)

Genus FISTULIPORA (McCoy).

(McCoy, *British Palæozoic Fossils*, p. 11.)

Generic Characters.—" Corallum incrusting, or forming large masses, composed of long, simple, cylindrical, thick-walled tubes the mouths of which open as simple, equal, circular smooth-edged cells on the surface, and have numerous transverse diaphragms at variable distances; intervals between the tubes occupied by a cellular network of small vesicular plates, or capillary tubules traversed by diaphragms."

This genus has no radiating lamellæ, a character which constitutes the only difference between it and *Heliolites* (Dana.)

1. FISTULIPORA CANADENSIS (Billings).

Description.—Corallum forming irregular, contorted masses, or wide, flat, undulating expansions or layers from one-half of an inch to one inch in thickness, which are based upon a thin, concentrically wrinkled epitheca. Cell-tubes half a line or less in diameter, and about one line distant from each other; the mouths of the tubes protruding a little above the general surface. Transverse diaphragms thin, horizontal or flexuous, and sometimes very numerous, there being in some of the tubes three or four in half a line of the length of the tube. The intercellular tubules are polygonal, and about four in the diameter of one of the principal cells; their transverse diaphragms are well developed, usually four or five to one line of the length.

F. Canadensis differs from the other described species in the following respects:—From *F. decipiens* (McCoy) in having the cell-tubes more distant and the diaphragms more numerous, and from *F. minor* (McCoy) in the same particulars, the cell-tubes of the latter species being still smaller and closer together than in *F. decipiens.*

This coral much resembles *Heliolites porosa* (Goldfuss), but can be readily distinguished by the absence of the radiating septa.

Locality and Formation.—Devonian; Corniferous or Onondaga limestone; lot 6, con. 1, Township of Wainfleet; at the east end of Lake Erie.

Collector.—A. Murray.

Genus COLUMNARIA (Goldfuss).

Generic characters.—Composed of large masses of elongated sub-parallel corallites, which when separate are round, but when in contact polygonal. Radiating septa either rudimentary, or well developed, sometimes reaching the centre. Transverse diaphragms numerous, usually complete, and either horizontal, oblique or flexuous.

COLUMNARIA GOLDFUSSI (Billings).

Description.—This species is found in large amorphous or subglobose masses composed of long straight or flexuous polygonal corallites with an average diameter of about half a line; transverse diaphragms from four to six in a line; radiating septa rudimentary, but distinctly striating the interior walls.

Formation and Locality.—Hudson River group? Snake Island and Traverse point, Lake St. John.

Collector.—J. Richardson.

COLUMNARIA BLAINVILLI (Billings).

Description.—Forming large sub-globose pyriform or hemispheric masses of polygonal corallites one line and a-half in diameter; about eighteen radiating septa which reach the centre; transverse diaphragms three or four to one line.

The radiating septa in fractured specimens where the interiors of the tubes are well exposed, striate the surface exactly as in *Columnaria alveolata*, from which species and from *Favistella stellata*, Hall, it only differs by its smaller size.

Formation and Locality.—Hudson River Group. Snake Island, Lake St. John.

Collector.—J. Richardson.

COLUMNARIA RIGIDA (Billings).

Description.—Forming large masses of polygonal corallites usually three lines in diameter, but with numerous smaller ones, and occasionally others of a larger size; radiating septa, about twenty, not reaching the centre; transverse diaphragms from two to four in one line.

This species also resembles *C. alveolata*, but differs in the greater development of the radiating septa which extend about half-way to the centre. The tubes are also about the same size as those of *Favistella stellata*, Hall, which differs in the septa not only reaching the centre, but also in their often being so strongly developed there, as to produce by their junction the appearance of a pseudo-columella.

Formation and Locality.—Hudson River group? Lake St. John.

Collector.—J. Richardson.

COLUMNARIA ERRATICA (Billings).

Description.—Forming large masses of corallites either in contact or separate. The separate cells are round, those in contact more or less polygonal, the radiating septa rudimentary, forming about four sulci in the breadth of one line upon the interior; diameter of corallites from two to five lines, in general about three and a-half lines. The transverse diaphragms are not visible in the specimens examined. The walls of the separate corallites are thick and concentrically wrinkled.

One specimen with corallites two lines in diameter appears to be a variety of this species.

Formation and Locality.—Trenton. Blue Point, Lake St John.

Collector.—J. Richardson.

Genus PALÆOPHYLLUM (Billings).

Generic characters.—Corallum fasciculate or aggregate; corallites surrounded by a thick wall; radiating septa extending the whole length; transverse diaphragms either none or rudimentary; increase by lateral budding.

This genus only differs from *Petraia* or *Streptelasma* by forming long fasciculate or aggregate masses instead of being simple.

PALÆOPHYLLUM RUGOSUM (Billings).

Description.—Corallum in large aggregations of scarcely separate corallites, which where they open out upon the surface of the rock are from one to six lines in diameter, the average adult size being about four lines. Radiating septa reaching the centre; about twenty-two septa in a corallite four lines in diameter, with an equal number in a rudimentary state between.

The great disparity in the size of the tubes in the same mass is owing to the mode of increase and gradual growth of the young corallites. These, of all sizes from one line in diameter and upwards, are uniformly intermingled with the adult individuals.

Formation and Locality.—Trenton. Lake St. John, Little Discharge.

Collector.—J. Richardson.

PETRAIA RUSTICA (Billings).

Description.—Straight or slightly curved, covered with a strong epitheca, which is more or less annulated with broad shallow undulations; radiating septa about one hundred or usually a little more; much confused in the centre, where they form a vesicular mass; every alternate septum much smaller than the others, only half the whole number reaching the centre. Length from two inches and a half to three inches and a half. Diameter of cup one inch to one inch and a half; depth of cup half an inch or somewhat more.

This species appears to be the same as that described by Edwards and Haime under the name of *Streptelasma corniculum.* The true *S. corniculum* of Mr. Hall is a very different species, being always shorter and much curved.

Formation and Locality.—Hudson River group. Snake Island, Lake St. John.

Collector.—J. Richardson.

Genus SYRINGOPORA (Goldfuss.)

Generic characters.—The fossils of this genus are fasciculated or composed of large aggregations of long cylindrical corallites somewhat parallel to each other and connected by numerous smaller transverse tubes. The exterior walls consist of a well developed solid epitheca; the cells circular; radiating septa rudimentary; transverse diaphragms infundibuliform or placed one within another like a series of funnels.

About twenty species of this genus are known, and these are found in the Upper Silurian, Devonian and Corniferous formations.

SYRINGOPORA DALMANII (Billings).

Description.—Forming large masses; corallites long sub-parallel, slightly radiating, occasionally a little flexuous, annulated one line or rather more in diameter, distant usually half a line, occasionally in contact or where flexures occur, more than one line apart; connecting processes very short, about two lines distant.

Formation and Locality.—Upper Silurian, Head of Lake Temiscaming.

Collector.—Sir W. E. Logan.

SYRINGOPORA COMPACTA (Billings).

Description.—Forming large hemispherical masses of straight parallel or slightly diverging corallites, which are so closely agregated as to compose a nearly solid mass; about six corallites in two lines.

This species differs from all others of this genus hitherto described in the closeness of the corallites. These are so small, straight and closely united that large masses broken in the longitudinal direction of the tubes have the aspect of some species of *Monticulipora.*

Formation and Locality. — Upper Silurian. L'Anse a la Vieille, Gaspé.

Collector.—Sir W. E. Logan.

SYRINGOPORA VERTICILATA, (Goldfuss.)

(Goldfuss, *Petr. Germ.*, vol. i. p. 76, note 25, 26.)

Description.—Forming large masses, corallites nearly straight, about two lines in diameter, and from two to three lines distant; connecting tubes three or four lines distant, verticilating, or three or four radiating from the main tube at the same level in different directions, like the spokes of a wheel.

Formation and Locality.—Upper Silurian. Head of Lake Temiscaming. Goldfuss' specimens were from Lake Huron.

Collector.—Sir W. E. Logan.

SYRINGOPORA RETEFORMIS (Billings).

Description.—Forming large masses; corallites much geniculated, frequently anastomosing or connecting by stout processes; diameter of corallites about two-thirds of a line, distant from each other from half-a-line to a line and a-half; distance of connecting processes one line to three lines, usually about two lines.

Formation and Locality.—Upper Silurian. Isthmus Bay; Lake Huron.

Collector.—A. Murray.

SYRINGOPORA DEBILIS (Billings).

Description.—Corallites a little more than half a line in diameter, distant one or two diameters; connecting processes slender, distant one or two lines.

Formation and Locality.—Upper Silurian. L'Anse à la Vieille.

Collector.—Sir W. E. Logan.

SYRINGOPORA TUBIPOROIDES, (Yandell and Shumard.)

(*Contributions to the Geology of Kentucky*, page 8; 1847.)

(M. Edwards and L. Haime, *Polypiers fossiles des terrains palæozoiques*, p. 292.)

Description.—This species is found in large masses of long slightly flexuous corallites. These have a diameter of about one line and a-half, and owing to their flexuosity, are at times in contact, and often two, three or four lines apart. In large colonies which have grown luxuriantly without the interference of disturbing causes, the corallites are more regular than in the smaller or stunted groups, in which the corallites are much bent and confused. The connecting processes are very short and distant, and appear to be sometimes mere inosculations of the stems. The corallites after growing separately for a short distance, approach each other and seem to grow together or adhere to each other for the space of a line and a-half or more, they then diverge and again unite. These points of contact occur at distances varying from three lines to six, nine, or even twelve lines. Externally they exhibit numerous indistinct annulations, and also faint indications of longitudinal striæ.

Formation and Locality.—Devonian; abundant in the Corniferous limestone of Canada West.

Collectors.—A. Murray, E. Billings.

SYRINGOPORA NOBILIS (Billings).

Description.—Corallites three lines in diameter, distant two to four lines. The connecting processes in this species have not been observed, but the size of the corallites is quite sufficient to separate it from any known species.

Formation and Locality.—Devonian. Corniferous limestone, near Woodstock Canada West.

Collector.—A. Murray.

SYRINGOPORA ELEGANS (Billings).

Description.—Corallites, one line in diameter, sometimes a little more or less, distant a little less than one line; connecting tubes half a line in diameter, and distant from one line to one line and a half, usually projecting at right angles, but sometimes a little oblique. Epitheca with numerous annulations, generally indistinct, but under certain circumstances of growth sharply defined and deep, so much so as to give to the corallites the appearance of the jointed stalk of a crinoid. The young individuals are produced by lateral budding, and in one specimen examined, the whole colony appears to be based upon a broad lamellar foot secretion like that which forms the base of a Favosite.

The distance of the corallites is usually about a line, but like all the other species, this one varies a good deal in this respect. When some cause has intervened to prevent their regular growth they are much flexed and consequently at times more distant than when they have been disturbed. The connecting tubes on the same side of the corallite are three or four lines distant, but generally on the other sides one or two others in the same space occur, making the average distance one line or one line and a half.

Formation and Locality.—Devonian. Corniferous limestone, near Woodstock Canada West.

Collector.—A. Murray.

SYRINGOPORA HISINGERI (Billings).

Description.—This species forms large masses of very long, nearly parallel or slightly varying, slender corallites, which are closely aggregated and present a rugged or knobby appearance from the great number of the connecting tubes. The diameter of the corallites is one-third of a line, or a little more. The tubes of connection are distant from two-thirds of a line to one line and a-half. The distance between the corallites is for the greater part less than their diameter. The young corallites branch from the sides of the adult individuals, and immediately become parallel with the parent, and connected with it again by the usual tubes of connection.

Formation and Locality.—Devonian. Corniferous limestone, Canada West. (common.)

Collectors.—A. Murray and E. Billings.

Affinities of S. Hisingeri.—Edwards and Haime have described two species from Ohio, collected in rocks of the age of the Onondaga and Corniferous limestones, which appear to be closely allied to this; the following are their descriptions:

" SYRINGOPORA VERNEUILLI. — Corallites long, distance betwen them twice or thrice their diameter, subflexuous and angular at the points of the origin of the tubes of connection, these are distant two or three millimetres ; diameter of the corallites two-thirds of a millimetre."—Devonian, Columbus, Ohio. (*Polypiers Fossiles*, p. 289).

" SYRINGOPORA CLEVIANA.—Corallites slightly flexuous, distant once or twice their diameter, which is two-thirds, of a millimetre." — Devonian, Carolton and Dayton, Ohio. (*Polypiers Fossiles*, p. 295.)

The first of these species is different from S. Hisingeri in the greater distance of the corallites. The description of the second is too incomplete to enable us to decide whether it refers to the same species or not. The authors state that their specimen was imperfect, and that they were not certain that it had not been previously described.

Genus MICHELINIA (De Koninck).

Generic characters.—" Corallum compound, forming rounded, or conoidal masses of inseparably united, thick-walled, polygonal tubes of large size, marked internally with numerous vertical, lamellar striæ, and communicating pores; base of cells filled up by very irregular, numerous, highly inclined vesicular plates, not forming distinct horizontal diaphragms; external or basal epitheca of the general mass, strong, concentrically wrinkled, and sometimes spinose."—*McCoy*, *British Palæozoic Fossiles*, *page* 80.

This genus differs from Favosites in the vesicular character of the transverse diaphragms, and in the radiating lamellæ being represented by vertical striæ on the inner surface of the cells instead of series of minute spines. The cells are usually much larger than in Favosites. The genus appears to be confined to the Devonian and Carboniferous formation.

MICHELINIA CONVEXA (D'Orbigny).

(*Prodr. de Paleont.*, t. 1, p. 107, 1850.)

Description.—Corallum forming hemispherical, or erect rudely cylindrical masses, several inches in diameter; the base covered by a strong wrinkled epitheca. Adult calices from four to five lines in diameter; about forty septal striæ in each; pores small, arranged in several vertical series in some of the tubes, irregularly distributed in others; distant from half a line to more than one line. Diaphragms very convex in the centre of the tubes, and usually with three or four smaller rounded prominences on their surface; a vertical section shews that they are more vesicular at the sides of the cells than in the centre, where they are from half a line to one line and a-half distant.

MM. Edwards and Haime in their description of this species say that there are two vertical series of pores on the larger plane sides of the cells and one on the smaller. Our specimen, however shews that this is not a constant character.*

Formation and Locality.—Devonian; Onondaga and Corniferous limestones. Rama's farm, Port Colborne. Savage's quarry, lot 6, con. 1, Wainfleet. Oxford, near Woodstock and in numerous other localities in Western Canada. This species occurs in Michigan and in Preston County, Virgina.

MICHELINIA INTERMITTENS (Billings).

Description.—Corallum forming large hemispherical masses; calyces nearly equal in diameter, with periodical constrictions

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* See Polypiers Fossiles des Terrains Palæozoiques, page 251.

within at the distance of half a line to one line and a-half. Diaphragms numerous, thin, slightly convex, sometimes shewing four or five vesicular swellings upon a single surface. The septal striæ are but slightly developed, about fifty to the inner circumference of the cell. Pores only visible in the intervals between the constrictions where the walls are thin, three or four series on each plane side of the tube. The cells are from three to four lines in diameter.

The constrictions give to the cells of this species a circular aspect, whereas they are in fact polygonal. I am not certain that this fossil is different from the species described by Edwards and Haime (op. cit. p. 299,) under the name of *Chonostegites Clappi.* If so it should I think be called *Michelinia Clappi*, as it exhibits all the characters of Michelinia. The constrictions appear to be occasioned only by the periodical thickening of the walls of the cells. Where not constricted the cells have the usual prismatic shape, with pores and septal striæ.

Formation and Locality.—The only specimen I have seen was collected by Mr. Murray, near Woodstock, C. W. It was found loose, but in lithological characters, it resembles the other species from the Corniferous limestone of that region.

MICHELINIA FAVOSOIDEA (Billings).

Description.—Corallum forming large hemispheric or flattened masses; cells unequal in size, adult diameter about two lines and a half; diaphragms, flat, horizontal, with small vesicular swellings, usually around the margins of the upper surface; septal striæ very obscure, six to eight on each plane side of the cells; pores, very small, irregularly distributed, sometimes in rows of five or six across the cell, about one-sixth of a line distant from each other in some places, and sometimes absent in spaces of half a line in width. This species has much of the aspect of *Favosite favosa*, Goldfuss, but is notwithstanding very clearly a true Michelinia.

Formation and Locality.—Corniferous. Rama's farm, Port Colborne.

Collector.—E. Billings.

GENUS ZAPHRENTIS (Rafinesque).

Generic Characters.—Corallum simple, elongated, free and turbinated, surrounded by a complete epitheca; cup more or less deep; no columella?; a single fossette well developed and occupying the place of one of the radiating septa; these are in general well developed, denticulated upon their margins, and extend upon the surface of the transverse diaphragms to the central of the visceral chambers.

Edwards and Haime in the *Polypiers Fossiles*, page 326, have in substance given the above definition of this genns. In some of the species there is a rudimentary columella, and sometimes even in the same species the radiating septa may or may not reach the centre in different individuals.

ZAPHRENTIS PROLIFICA (Billings).

Description.—Corallum simple, turbinate, curved, with a few broad shallow encircling folds. Septal fossette of a pyriform shape, gradually enlarging from the margin towards, but not quite reaching the centre, variable in its position in relation to the curvature of the fossil. Radiating septa in the adult specimens between sixty and seventy-five of the larger size, alternating with a like number of smaller ones, the former in some of the individuals extending to the centre on the bottom of the cup, where they are spirally twisted or irregularly contorted, in other specimens not reaching the centre, which is then occupied by a smooth space or often with a columella elongated in a direction from the septal fossette towards the opposite side. The septa are also sharp-edged for about half the distance from the bottom of the cup to the margin, then become gradually less projecting until at the edge of the cup they are reduced to mere flat rounded ridges. Length from four to five inches or a little more. Width of cup from two inches to two inches and a-half. Depth of cup about one inch.

Very numerous specimens of young individuals of this species one inch and a-half and upwards in length, and with fifty or more principal radiating septa occur along with those full grown. These small ones might perhaps be regarded as constituting distinct species, but when good specimens can be observed they all exhibit the characters which are persistent in the large individuals.

The presence of the columella seems at first sight to be a sufficient ground for placing the individuals in which it occurs in the genus *Lophophyllum* (Edwards and Haime). I have however examined a great number of specimens and have found every gradation between the following characteristics.

1st Specimens with a perfectly smooth space in the bottom of the cup, no columella.

2nd. With a columella slightly developed.

3rd. Columella large and prominent, with a smooth space all round.

4th. Columella well developed, but with a number of irregular often elongated tubercles in the surrounding smooth space.

5th. The septa reaching the columella, no smooth space.

6th. Septa covering the columella.

7th. Septa reaching the centre, with the columella either prominently, slightly or not all indicated beneath.

This last mentioned form must certainly be regarded as a true *Zaphrentis*, all other characters of the genus being present, and from it there is a regular series of forms leading in the seven or more directions above indicated. It appears to me therefore that so far from these specimens being divisible into several genera they only constitute one species.

The most persistent characters are the rounded edges of the septa near the margin of the cup, and the oval shape of the septal fossette, in the bottom of which where it reaches the side of the cup is a single septum which projects a little and partially divides the fossette.

This species somewhat resembles Z. *cornicula* (Lesueur), but differs in the edges of the septa, which are not dentated as in that species.

Formation and Locality. Devonian; Corniferous limestone. Extremely abundant at Rama's Farm near Port Colborne, Canada West.

ZAPHRENTIS SPATIOSA (Billings).

Description.—Corallum short, turbinate, moderately curved and very broadly expanding. At the margin of the cup about ninety radiating septa alternately a little unequal and with their edges broadly rounded as in Z. *prolifica.* Length measured on the side of the greater curvature, about three inches, width of cup two inches and a-half. Septal fossette unknown.

This species is closely related to Z. *prolifica.* and may perhaps be united with it when its characters become more fully known.

Formation and Locality.—Devonian; Onondaga and Corniferous limestones, Rama's Farm, near Port Colborne Canada West.

Genus CYSTIPHYLLUM (Lonsdale.)

Generic Characters.—Corallum simple, turbinate, entirely filled with vesicular celluliferous structure; radiating septa rudimentary or obsolete.

CYSTIPHYLLUN SULCATUM)Billings.)

Description.—Short, turbinate, much curved, expanding at the rate of between forty and forty-five degrees from the minute sharp curved point upwards; cup oblique, the lower margin being on the side of the lesser curvature, moderately deep and nearly regularly concave, the bottom covered with obscure course rounded radiating ridges; a shallow rounded groove or fossette extending from the centre to the higher margin, and in some specimens two others much less distinct radiating to the sides at right angles to the main groove. Exterior encircled by obscure undulations, and longitudinally striated by the rudimentary radiating septa, The vesicular structure consists of irregular sub-lenticular cells from half a line to two lines in width; length of the convex side from one inch and a half to three inches, the usual length appears to be about two inches or a little more; width of cup from one inch to one inch and a half; depth about half an inch.

This species when the interior cannot be seen might be mistaken upon a superficial examination for a small curved *Cyathophyllum* or *Zaphrentis.* It is about the size and shape of the curved specimens of *Petraia cornicula.*

Locality and Formation.—Rather common in the Corniferous or Onondaga limestone on Rama's farm, Port Colborne.

Collector—E. Billings.

Genus CYRTODONTA (Billings).

Generic Characters.—Equivalve, inequilateral; umbones near the anterior end; general form obliquely tumid, transversely subrhomboidal or ovate, posterior extremity larger than the anterior and usually broadly rounded; two muscular impressions, of which the posterior is superficial and the anterior sometimes deeply excavated; three oblique often more or less curved, anterior teeth, situated either beneath or a little in front of the umbones; two or three remote posterior lateral teeth parallel with the hinge line; pallial line simple; ligament external; some of the species have a narrow area between or behind the beaks.

CYRTODONTA RUGOSA (Billings).

Fig. 1.

Fig. 2.

Figure 1. Exterior of right valve.
" 2. Interior of same specimen.

Description.—Small, sub-rhomboidal or sub-quadrate, the dorsal and ventral margins being somewhat parallel, and the anterior and posterior extremities obtusely rounded, the latter broader than the former; obliquely tumid from the beaks to the posterior ventral angle; the beaks rather small and incurved; a broad, shallow, scarcely perceptible depression extending from the ventral margin obliquely forward and upward towards the umbones; surface concentrically striated, and also marked with several more or less prominent sub-imbricating concentric ridges of growth; hinge line nearly straight, a little curved; interior shewing in the right valve three anterior teeth, the central one of which is the largest; two posterior lateral teeth, In the left valve there appear to be four anterior teeth; but as the specimens are somewhat imperfect, this may not be the correct number. Width nine lines; length from the centre of the hinge line to the centre of the ventral margin, seven lines; depth of a single valve, three lines.

None of the specimens that I have seen are larger than the one, represented in figures 1 and 2.

Locality and Formation.—Fourth Chute of the Bonne chère Pauquette's Rapids, and La Petite Chaudière Rapids near the city of Ottawa north side, associated with numerous fossils of the Trenton and Black River formations.

Collectors—Sir W. E. Logan, J. Richardson, E Billings.

CYRTODONTA HURONENSIS (Billings).

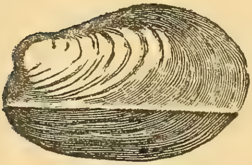

Fig. 3.

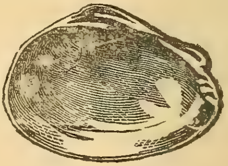

Fig. 4.

Figure 3. View of left valve from Lake Huron.
" 4. Interior of another specimen, same locality.

Description.—Transversely oval; anterior and posterior extremities rounded; ventral margin moderately convex, dorsal margin a little more convex than the ventral; umbones rather small, incurved; greatest tumidity extending from the umbones obliquely towards the posterior ventral angle; surface concentrically marked with fine striæ and ridges of growth. Width one inch five lines; length at the centre, one inch.

Locality and Formation.—The specimens are from an island in the group lying off Point Palladeau, Lake Huron, where they were found associated with Chazy, Black River and Trenton fossils; also at Point Claire, Island of Montreal.

Collector—A. Murray.

Cyrtodonta subcarinata (Billings)

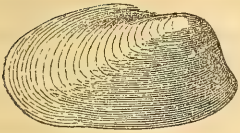

Fig. 5.

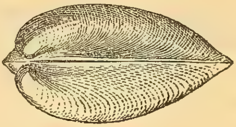

Fig. 6.

Fig. 7.

Figure 5. A specimen from Point Claire.
" 6. Dorsal view of same specimen.
" 7. A cast from lot 26, con. 5, Osnabruck.

Description.—Transversely sub-oval; ventral margin scarcely convex, straight or slightly sinuated for a small space of the centre; dorsal margin elevated in the centre and sloping with a slight curve towards the posterior end, which is narrowly rounded, or truncate in the casts of the interior; umbones moderately small, incurved, and somewhat carinate for a greater or less distance; surface marked with obscure concentric ridges of growth. The interior has not been seen. Width one inch three lines; length nine lines.

This species may perhaps be considered a variety of the last; but the proportions are somewhat different, and it is always characterised by the strong, rounded carina, which extends from the umbones to the posterior ventral angle.

Locality and Formation.—Occurs at Pointe Claire and in numerous localities in the valley of the Ottawa in the top of the Chazy, throughout the Birdseye and Black River limestones, and in the base of the Trenton.

Collectors—Sir W. E. Logan, A. Murray, J. Richardson, E. Billings.

Cyrtodonta Canadensis (Billings).

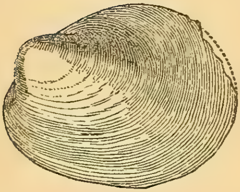

Fig. 8.

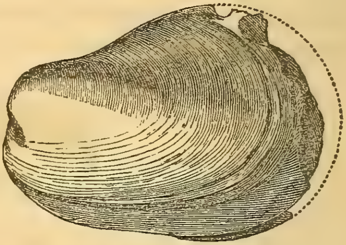

Fig. 9.

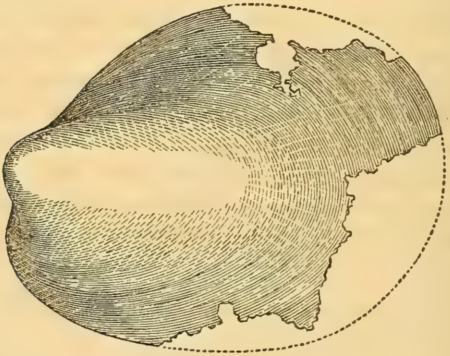

Fig 10.

Figure 8. A small specimen from the north side of St. Joseph's Island, Lake Huron.

" 9. An elongated variety from the lower beds opposite the foot of timber-slide, 4th Chute of the Bonne chère.

Fig. 10. A large specimen from Pauquette's Rapids.

Description.—Transversely broad-oval; anterior, posterior, and ventral margins, and also the posterior half of the dorsal margin regularly rounded; a portion of the ventral margin about the centre of the width is sometimes nearly straight; dorsal margin elevated, somewhat compressed; diagonally and rounded ventricose from the umbones towards the posterior ventral angle; beaks short, obtusely rounded, incurved; surface nearly smooth or obscurely marked with concentric ridges; a few strong imbricating lamellæ of growth near the margin of some specimens. Width from fifteen lines to two inches and one-fourth; length from eleven lines to twenty-one lines.

Some of the specimens are a little more transverse than others; but there are intermediate forms connecting the specimen, represented by Figure 9, with Figures 8 and 10.

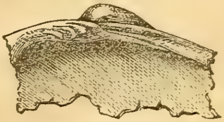

Fig. 11.

Fig. 11. A fragment, shewing the anterior teeth.

The anterior teeth are short, the central one being the longest and the most curved; the posterior teeth of the specimen represented by Fig. 10 are two in number, elongated and prominent.

Locality and Formation.—Island of St Joseph's Lake Huron; La Petite Chaudière Rapids near the City of Ottawa; Fourth Chute of the Bonne-chère and Pauquette's Rapids; associated with fossils of the Trenton and Black River formations.

Collectors—Sir W. E. Logan, J. Richardson, A. Murray, E. Billings.

CYRTODONTA SPINIFERA (Billings).

Fig. 12.

Description.—Small, sub-circular; greatest length and breadth about equal; moderately convex; hinge line much elevated; umbones small, incurved; dorsal margin nearly straight from the umbones about half way to the posterior extremity of the hinge line; anterior, ventral, posterior and posterior half of dorsal margins broadly and regularly rounded; surface smooth, with a few short stout spines.

The specimen figured shews the anterior teeth: they are three in number, and do not differ from those of *C. rugosa*, Length eight lines; breadth the same.

Locality and formation.—Pauquettes Rapids, and Fourth Chute of Bonne-chère, associated with fossils of the Trenton and Black River Formations.

Collectors—Sir W. E. Logan, J. Richardson, E Billings,

CYRTODONTA OBTUSA (Hall sp.)

(*Ambonychia obtusa*, Hall, Palæontology of New York. Vol. 1, p. 167. Plate 36; Figures 8*a*, 8*b*.)

Fig. 13.

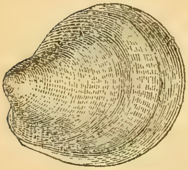

Fig. 14.

Figure 13. Left valve from Pauquette's Rapids.
" 14. Interior of same shewing the teeth.

Description.—The following is Professor Hall's description: "Obliquely ovate, short, gibbous; umbones short, obtuse, scarcely incurved or bending forwards; shell somewhat compressed towards the lower margin, convex on the centre and becoming inflated above; anterior side obtuse, rounded, scarcely extending beyond the umbones; posterior side compressed, scarcely alated; cardinal line straight, margin of shell curving from its posterior extremity; surface ?"

"The specimens seen are casts, where the markings of the shell are not preserved. This species is distinguished from the others by its short, ovate form, as well as the shorter, very obtuse and gibbous umbones. It departs somewhat from the typical forms of the genus (*Ambonychia*); but it has nevertheless the essential features, and cannot be referred to any other genus." (Pal. N. Y., vol. 1, page 167.)

Locality and Formation.—City of Ottawa, Belleville, and at Trenton on the bay of Quinte, in the Trenton limestone; at the Fourth Chute of the Bonne-chère, and also at Pauquette's Rapids very perfect specimens are common, associated with fossils of the Trenton and Black River formations.

Collectors.—Sir W. E. Logan, J. Richardson, and E. Billings.

CYRTODONTA SUB-TRUNCATA (Hall sp.)

Edmondia sub-truncata, Hall, Palæontology of New York, Vol. i., page 156, Plate 35, Figure 3 c, (not Fig. 9, Plate 34.)

This species is common in the Trenton and Black River limestones of Canada at all the localities above mentioned. The silicified specimens shew the internal characters of Cyrtodonta very clearly

CYRTODONTA SUB-ANGULATA (Hall sp.)

Edmondia sub-angulata, Hall, Palæontology of New York, Vol. i., page 156, Plate 35, Figures 2 a, b.

A specimen of this species from Pauquette's Rapids exhibits in the right valve two posterior lateral teeth and an area between the beaks. That portion of the hinge line occupied by the anterior hinge teeth is destroyed, so that their character cannot be observed. There is an anterior muscular impression as in the other species.

It occurs at Panquette's Rapids and at La Petite Chaudière.

CYRTODONTA CORDIFORMIS (Billings).

Description.—Sub-rhomboidal; cordiform; extremely ventricose; umbones strongly incurved; obtusely carinate on their upper side; the carination extending backwards and diagonally downwards, becoming more rounded and nearly obsolete before reaching the posterior ventral angle; the hinge-line is straight, short, and about at right angles to the direction of the carina; from the extremity of the hinge-line the posterior side slopes abruptly, but with a moderate curve, to the posterior ventral angle; ventral margin a little convex, and about as long as the posterior side; anterior margin half the length of the ventral, not much curved; anterior muscular scar oval and distinctly marked; surface concentrically striated. Length of largest specimen examined from the beaks to the posterior ventral angle, thirteen lines; length of hinge-line, seven lines; length of posterior and ventral sides, about ten lines each. The diagonal carina is not straight, but has a strong upward curve.

Locality and Formation.—East point of St. Joseph's Island, Lake Huron; Trenton limestone.

Collector.—A. Murray.

CYRTODONTA SIGMOIDEA (Billings).

Description.—Sub-rhomboidal, ventricose, a strong obtusely angular carina extending from the closely appressed beaks with a sigmoid curve to the posterior ventral margin; anterior end rounded, projecting a little in front of the beaks; ventral margin longer than the dorsal and moderately convex; posterior extremity obliquely truncate. Width one inch and a half; length from the umbones to the ventral margin thirteen lines.

Locality and Formation.—Hudson River group; Anticosti.

Collector.—J. Richardson.

Sub-genus VANUXEMIA (Billings).

Generic characters.—Ovate; beaks terminal or sub-terminal; posterior extremity rounded; anterior more or less acuminated; two muscular impressions; anterior teeth variable in number, sometimes curved and striated; posterior lateral teeth from two to four.

VANUXEMIA INCONSTANS (Billings)

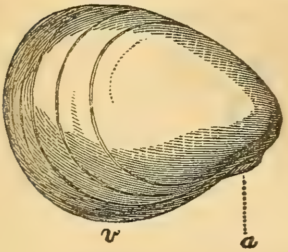

Fig. 15.

Fig. 16.

Figure 15. Right valve; *v*, ventral margin; *a*, the small anterior ear.
" 16. A fragment shewing the teeth obscurely; *m*, the muscular impression.

Description.—Ovate; moderately convex; beaks terminal gradually expanding from the beaks to the posterior extremity, which is broadly rounded ; dorsal margin slightly and uniformly convex from the beaks to the posterior angle; anterior extremity represented by a very small projection beneath the beaks ; ventral side regularly rounded, except a short pace near the beaks, which is sometimes concave and partly occupied by the small projection of the anterior extremity. Three strong curving anterior teeth ; two posterior lateral teeth ; shell very thick towards the anterior end ; a small area between the beaks ; the anterior muscular impression is apparently excavated in the edge of the very thick shell. Surface with a few more or less strongly marked concentric furrows of growth. The beaks are short, rounded, and closely incurved.

The proportional length and breadth varies. The specimens are usually an inch and a half in length from the beaks to the posterior extremity, the greatest width from the dorsal to the ventral side being an inch and three or four lines. There is a small variety, scarcely an inch in length, and more obtuse at the anterior end, than the specimen figured ; it is also more ventricose.

Locality and Formation.—Fourth Chute of the Bonne-chère, La Petite Chaudière Rapids near the city of Ottawa, and numerous localities in the valley of the Ottawa, associated with fossils of the Black River and Trenton formations.

Collectors.—Sir W. E. Logan, E. Billings, J. Richardson.

VANUXEMIA BAYFIELDII (Billings).

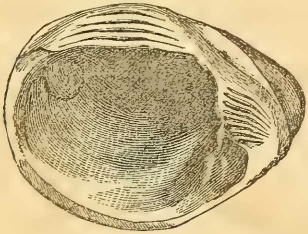

Fig. 17.

Figure 17. Interior of the left valve of *V. Bayfieldii.*

Description.—Very ventricose ; ovate ; the anterior extremity, including the beaks, narrowly rounded ; the posterior end broadly rounded ; shell very thick ; seven anterior teeth ; four posterior teeth ; anterior muscular impression large, deep, and excavated in the very much thickened edge of the shell ; posterior muscular impression sub-circular, superficial and situated just beneath the posterior extremity of the hinge line.

The specimen is deeply imbedded in a coral (*Monticulipora petropolitana*), and only exhibits the edges and inside of the shell. From the great thickness of the shell, casts of the interior must bear very little resemblance to a perfect specimen. The form is very like that of *Vanuxemia inconstans*, but the characters of the interior leave no doubt as to its distinctness.

Locality and Formation.—Bayfield Sound, Lake Huron a single loose specimen; Lower Silurian; appears to be of the Hudson River Group.

Collector.—A. Murray.

Genus MATHERIA (Billings).

Generic Characters.— Transverse; equivalve; inequilateral; beaks near the anterior end; dorsal and ventral margins subparallel; two small obtuse cardinal teeth in the left valve, and one in the right; no lateral teeth; two muscular impressions; ligament external.

This genus is dedicated to Mather, one of the Geologists of the New York Survey.

MATHERIA TENER.

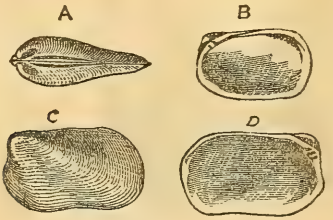

Fig. 18.

Figure 18. A, dorsal view of *Matheria tener;* B, interior of right valve; C, exterior of left valve; D, interior of left valve.

Description.—Small, oblong, depressed; dorsal and ventral margins nearly straight and parallel; upper half of posterior extremity obliquely truncate; lower half rounded; anterior extremity sub-truncate from the beaks nearly to the anterior ventral angle, which is rounded, and projects slightly beyond the umbones. From the beaks to the anterior ventral angle extends a prominent obtusely angular canina; surface marked with fine concentric striæ. Width eight lines; length four lines.

Locality and Formation.—Blue Point, Lake St. Johns; Trenton limestone.

Collectors—J. Richardson, R. Bell.

Genus OBOLUS (Eichwald).

OBOLUS CANADENSIS (Billings).

Fig. 19.

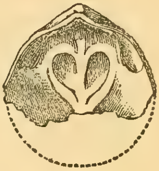

Fig. 20.

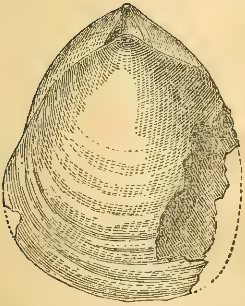

Fig. 21.

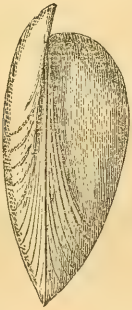

Fig. 22.

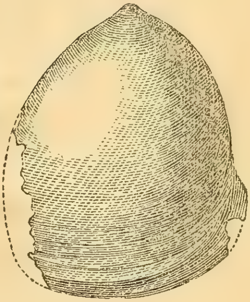

Fig. 23.

Figure 19. Dorsal valve.
20. Interior of dorsal valve.
21. Dorsal view of an elongated specimen which has both valves in place but a little distorted.
22. Side view of the same specimen.
23. Ventral view.

Description.—The form of this magnificent species is somewhat variable, the width being often greater than the length, and sometimes less. Usually, it is transversely broad-oval; the apex of the dorsal valve obtusely angular, and that of the ventral rather acute. The dorsal valve is moderately and pretty uniformly convex; the ventral valve depressed-convex. The beak of the ventral valve projects about two lines above that of the dorsal valve, and exhibits a wide, scarcely concave area, with a triangular excavation representing the obsolete foramen; the surface is smooth, or with a few concentric imbricating furrows of growth. In the inside of the dorsal valve there are near, but above the centre, two pyriform muscular impressions, with their pointed extremities close together and directed downwards, while in the upward direction they diverge outwards; they are separated by an obscure rounded ridge, and surrounded on the lower side by an elevated angular border, which forms a projecting point just below their lower extremities. Beneath and close to the hinge there is a narrow and deep flexuous furrow. The muscular impression at the cardinal angles figured by Davidson in *O. Apollinis* (Eichwald), *O. transversa* (Salter), and *O. Davidsoni* (Salter), are very indistinct in this species; the area of the ventral valve does not appear to be striated. The interior of the ventral valve is not clearly shewn in any of our specimens. Width usually about two inches, but some of the fragments undoubtedly belonged to individuals which were three inches wide. The length from the beaks to the base, is either equal to or a little greater or less than the width, the dimentions being variable.

Locality and Formation.—Occurs abundantly at the Fourth Chute of the Bonne-chère, Pauquette's Rapids, and in the Townships of Stafford and Westmeath, County of Renfrew, associated with fossils of the Trenton and Black River limestones.

Collectors.—Sir W. E. Logan, J. Richardson, and E. Billings.

Genus EICHWALDIA (Billings.)

Generic Characters.—Large valve perforated on the umbo for the passage of the peduncle; the place of the foramen beneath the beak occupied by an imperforate concave plate; the interior divided by an obscure medio-longitudinal ridge; interior of smaller valves divided throughout from the back to the front by a very prominent medio-longitudinal ridge; no hinge, teeth, sockets, or other articulating apparatus in either valve.

After a great deal of examination and comparison I have not been able to refer the species for which the above generic name is proposed to any of the described genera. Although several silicified specimens exhibiting the interior have been obtained, they do not show any muscular impressions. The perforation on the back of the beak was at first supposed to be a fracture, but we have now specimens which exhibit its characters so complete, ly that I do not think it possible there can be any mistake. The internal structure of the larger valve somewhat resembles that of *Pentamerus* or *Camarophoria*, the concave plate beneath the beak appearing to be the homologue of the floor of the triangular chamber found in these genera. I cannot make out however, that it is in any way connected with the medio-longitudinal ridge as is the case in both *Pentamerus* and *Camarophoria*. In removing the limestone from silicified specimens the delicate processes in the interior of species of brachiopoda are very often destroyed, and it is possible that the connection in question may exist in perfect specimens, but not appear after treatment with acids. It is therefore uncertain whether or not it is attached to the plate beneath the beak. If it should be hereafter ascertained that it is so connected, the foramen on the umbo would still be sufficient to show that this is a new genus, to the establishment of which the characters of the smaller valve and the absence of any articulating and apophysary apparatus would be additional characters. As other specimens can be procured and as the internal characters cannot be well shewn by wood-engraving, I shall for the present give figures of the exterior only.

Eichwaldia subtrigonalis (Billings.)

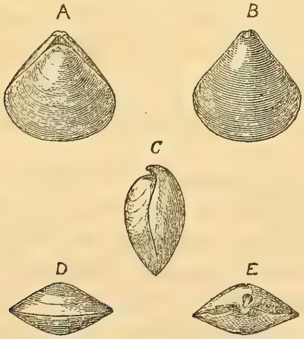

Fig. 24.

Figure 24. A, dorsal view; B, ventral; C, side; D, front; E, apex, shewing the foramen.

Description.—Sub-triangular; both valves moderately convex and smooth, apical angle about ninety degrees or a little less; sides from the beak to about one half the length straight, then rounded; front more or less broadly rounded; beak of larger valve extended, incurved at the point and with a moderately large concave area beneath; beak of smaller valve strongly incurved apparently entering the visceral cavity beneath the area of the larger valve; length and width about equal.

Locality and Formation.—Fourth Chute of the Bonne-chère and Pauquette's Rapids, associated with numerous fossils of the Black River and Trenton Formations.

Collectors—Sir W. E. Logan, J. Richardson, E. Billings.

ARTICLE XXXV.—*Some Observations on Donati's Comet of 1858.* By Charles Smallwood, M.D., LL.D., Professor of Meteorology in the University of McGill College, Montreal. (Presented to the Natural History Society.)

The measured limits that were set to the orbit of our earth by the Creator's fiat, and which tend to develop with remarkable regularity the budding flowers of spring, to ripen the golden fruits of autumn, and bring the returning seasons of "summer and winter," are instances of those permanent and perpetual laws which mark the wisdom, the power, and the beneficence of the Almighty Architect. To contemplate the starry host night after night, seems to have been the primitive and favourite occupation of the Chaldean shepherds while in the pursuit of their pastoral duties; and to admire and to study its grandeur is still the sublime occupation of many, who, when the dim veil of night invites the busy thoughtless world to slumber and spreads darkness over the resorts of pleasure, delight to search in the all but fathomless depths of space for some bright speck or point of light, removed from the observer to such a distance that the human mind cannot embrace even the thought of its immensity, and whose light has taken even thousands of years to reach us. This distant spot of light is to us fixed in its position ever since the human eye aided by the telescope has gazed upon it, and the micrometer has marked its position with the greatest accuracy. Hundreds too of those minute and distant objects have been yearly "catalogued." The earth has undergone its changes, but the glorious canopy of the heavens has thus remained unchanged.

Another class of heavenly bodies move—revolve in orbits like that of our earth—round the common centre of our system, the sun. The limits and courses of these wandering bodies, the night-watchings of the astronomer have pencilled and measured as with a span; he has also weighed them as in a balance. A very few years ago the number of these bodies—the planets—did not exceed *five*, but recently the catalogue has increased to *sixty-one*; and but a few years have passed away since Leverrier, as with a colossal stride, placed one foot as it were on the centre of the sun and the other on the surface of the remotest star of our system, and pointed out the spot where a new planet—Neptune—was to be found: such has been the modern progress of science.

At certain periods of the world's history another class of erratic bodies, called comets, have appeared in the celestial vault, whose perihelion passage was in comparatively close proximity to the orbit of our earth, while its aphelion circuit far exceeded the immense distance of those remote stars already mentioned. Bodies of this nature in all ages of the world have attracted the attention of astronomers, and filled the wondering inhabitants with awe and amazement, appearing for a few nights, and even at noon-day, with excessive splendour, and then *apparently* vanishing into the depths of space for ever. The written history of the appearance of comets has always been associated with some disaster, hence the popular fear at their appearance. (I need only call to recollection the panic which spread over the United States and the Continent of Europe last year.)

The description of the appearances of these bodies has often been distorted by the fears of the historian and the excited imagination of the ignorant. So far back as 596 years before Christ, the mother of the Chinese Emperor Yu, considered the comet of that year as auspicious for the future Empire and the yet unborn Emperor; but modern astronomy has robbed these bodies of their terrors, and they are now considered as forming a part of our solar system, and appearing at certain intervals of time. To trace the orbits of these bodies and predict their return involve calculations of no small labour. Their light density subjects them during their circuit to perturbations from all other bodies which can act upon them, and so deflects or retards their course: hence the difficulty in predicting their return. But here again science has once more triumphed, and a Halley, a Biela, and an Encke have traced their orbits, measured their distances, predicted their returns with the greatest accuracy, and even calculated their elements.

In July, 1264, a comet, whose tail was 100 degrees in length and of great brightness, made its appearance in the constellation *Cancer*, passing through *Auriga* and *Taurus*; its orbit was below the plane of the Ecliptic, and its aphelion extended twice the distance of Neptune. It disappeared on the night of the 2nd of October, the night that Pope Urban IV. died.

Hevelius, Fabricius, Lalande, Pingré, and others have collected numerous records of a remarkable comet which appeared in March 1566, which is described as blazing with uncommon splendour like a globe of flame about half the size of the moon, and displaying a vast train of light. It first was seen near *Spica Virginis*, and soon advanced with great rapidity and with a retrogade motion (a movement contrary to the motion of the planets), towards the north, as far as *Ursa Major*. It then advanced towards the south, when it was gradually lost to view. It was seen for nearly two months. Its position seems to have been marked with such accuracy as the instruments used in those days permitted, and it is said to have moved so rapidly as to have passed over 75 degrees from east to west, and 30 degrees from south to north, in four days. It is considered to have been one of the greatest comets ever seen.

A body of such a nature and with such appearances, was, as a matter of course, associated with some great disaster; and history has associated it with the death of two great German princes, diseases in cattle, famine, pestilence, and war. The emperor Charles V. taking fright, abdicated his throne, imagined that its appearance predicted his death, and actually made preparations for his final departure from this world; but Kepler says he survived some years after. Its distance from the sun, at its aphelion, was 8,500,000,000 miles, while its perihelion passage was within the orbit of Venus. This famous comet has received the name of Charles V.'s. comet, from the fact of his abdication at its advent.

Our object, in referring to the history and appearance of only two of these bodies, among some hundreds that have been recorded, is for the purpose of directing attention to their probable reappearance, and to contrast their movements with those of Donati's comet of 1858, as the impression has extended that Donati's comet was in reality the *expected* comet of 1566. As far back as 1751, Mr. Dunthorpe of Cambridge, England, in comparing the elements of the comets of 1264 and 1556, found them so similar, that the two were considered by him as identical, and that it was a comet whose period was about 292 years, making its re-appearance in 1848.

Mr. Barber of Etwell, in following up these calculations, found that Dunthorpe had not taken into account the perturbations occasioned by Jupiter and Saturn, and he found that between the years 1556 and 1592 their united attraction would diminish the period of its appearance 263 days, but that between 1592 and 1806 it would be increased, by the action of Jupiter *alone*, no less than 751 days, or more than two years.

Babinet of Paris has also published his results, and found that the orbits of the comets of the years 304, 685, 975, 1264 and 1556, have some appearances in common, and have always been marked with an extraordinary display.

Bomme of Middleburg has re-calculated their orbits, and says that the re-appearance of the last may be expected in August 1858, with an uncertainty of two years.

Hind of Bishop's Observatory, Regent's Park, has paid especial attention to the orbits of the comets of 1264 and 1556, and, after many intricate and careful calculations, taking into account the perturbations caused by Jupiter, Saturn, and Neptune, has also come to the conclusion that the comet of 1856 would probably appear in August 1858, with an error of two years.

The opinion of this eminent practical astronomer has often been the subject of severe criticisms, owing to the misrepresentation of what has been called his "predictions," which have in reality been nothing more than opinions, and probabilities reduced from deductions and calculations worked out by himself, upon the orbits of these comets, which are bodies of a very uncertain nature.

Hock of Leyden has recently raised some objection to the views of Hind on the identity of the comets of 1264 and of 1556; but Hind, in a letter written to me under the date of the 12th May, 1857, says: "*I still maintain the opinion that I have so long held respecting the identity of the comets of* 1264 *and* 1556."

The re-appearance of this remarkable comet will throw much light upon the perturbatory influences of those heavenly bodies, which may be in proximity to its orbit, and it can now be scarcely doubted that Donati's comet of 1858 was *not* the expected comet of 1556.

The comet which has so recently visited us, and which has now passed from view, was discovered by Donati at Florence, on the 2nd of June 1858, in Right Ascension 9h. 25m. 12s., North Polar distance 67° 13′. Its appearance was a round, bright, nebulous patch of light, with a condensed centre, and without any tail. It was seen at Berlin, by Bruhns, on the 7th of August; and on the 23rd of the same month it was visible at Cambridge, England. It was seen in Canada as early as the 6th or 7th of September. On the 12th at 8 p. m., M. T., its appearance was bright and nebulous, the tail was slightly curved upwards, and it was near the star *Xi* of the constellation *Ursa Major*, being nearly in a line with the pointers *Merak* and *Dubhe*. Its position (nearly*) was Right Ascension 11h. 20m., and North Polar distance 54° 23′. It was seen after sunset and before sunrise (which led to the supposition of two distinct visible comets). Its appearance gradually increased both in brightness and magnitude, until the 10th of October. On the 28th of September, at 8 p. m., its place was R. A. 12h. 32m., N. P. D. 57° 10′. Its tail extended over nearly thirteen degrees, and was calculated to be about eighteen millions of miles in length. It was then in the constellation *Canes Venatici*. On the 2d of October its R. A. was 13h. 30m., N. P. D. 66°. Its tail was nearly twenty-seven degrees in length, curved and reaching to *Eta Ursa Major* (Benetnach). It passed over a cluster of small stars in *Coma Berenices*, which were visible through it. Its calculated distance from us was 50,000,000 of miles, and its motion was at the rate of 20,000 miles per minute. On the 4th of October it was near the bright star *Arcturus*, and nearly rivaled it in brightness. On the 10th–11th of October it passed from North to South Declination. On the 10th, at 6:30 M. T., its R. A. was 15h. 56m., and N. P. D. nearly 90°. It was now at its maximum of brightness, and was a most brilliant and magnificent spectacle. Its tail was nearly 50° in length, curved like a Turkish sabre, and passing upwards through the constellation *Ophiuchus*, the star *Phi* of that constellation apparently bounding its concave edge. Its convex border was much brighter and better defined than its concave; it extended upwards nearly as far as *Zeta Herculis*. It crossed the Earth's path on the 18th, and was nearest the planet *Venus* on the morning of the 18th.

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* The measurements are taken only approximately from stars in its neighborhood.

On the evening of the 18th it was dim and near the horizon, and required the aid of powerful telescopes to distinguish it, although it was seen as late as the 22nd in some of the United States Observatories south of us. On the 21st its N. P. D. was 118 ° 15′, having passed over upwards of 100 ° in its path. At each observation a dark shade of light could be seen passing from the body of the central nebulous mass, triangular in shape, as though the body of the comet projected a shadow on the surrounding coma. The direction of this shadow was upwards.

From some recent calculations of Bruhns of Berlin, he is of opinion that the period of its revolution round the sun exceeds 2,000 years. Loewy has fixed its period of revolution at 2,494 years.

The Chinese records make mention of a comet which appeared 331 years before the Christian era, associated, as customary, with the popular belief of wars and disasters, and corresponding in date with the battle of Arbela. These records also make mention of the appearance of remarkable comets both at an earlier and a later date.

Donati's comet seems to have surpassed the comet of 1811 both in size and brightness; the extreme length of its tail, according to Sir Wm. Herschell, was only 25 degrees, while that of Donati's on the 10th of October was nearly 50 degrees in length. The night of the 10th was peculiarly fitted for observation, and nothing could have exceeded the magnificent blaze of light that proceeded from both the nucleus and tail.

Its appearance, course, motion, and disappearance would tend to the opinion that it is a distinct body from the comets of 1264 and 1556; so that the appearance of the body that excited so much wonder at those periods of time, and which has occupied the attention of mathematicians and astronomers up to the present date, may yet be looked for.

The superior advantages of observation that we now possess have not been lost upon Donati's comet, and its place has been so accurately laid down, that its reappearance cannot be mistaken; and the calculation of its orbit may in a measure tend to throw some light on the perturbations that may influence all such-like bodies.

Several other comets were also visible during the year, but excited little attention owing to their small size.

St. Martin, Isle Jesus, 1st Dec., 1858.

ARTICLE XXXVI.—*The Fresh Water Algæ of Canada.* A Paper presented to the Natural History Society of Montreal, by the Rev. A. F. Kemp.

(Second Part.)

In our previous paper it was said that "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." So far as the Eastern Province is concerned, this statement is still true: no specimen has rewarded our search up to this time. But we are happy to say that a correspondent and diligent collector in Paris, Canada West, has been more fortunate. A most beautiful example of this genus has been sent us, both in the moist and dry state. We have examined it with the utmost care, and, after the most careful comparison with the figures and descriptions of Hassall, our impression was that it did not bear any distinct resemblance to any of the species described or figured in that work. On referring, however, to Vaucher's "Histoire des Conferves," we find his species *B. moniliforme* described in such terms as to lead us to think that our plant is identical with it. The characters which he notes as belonging to it are: "Filaments *ramose*, *moniliform*; articulations, *globose*, *gelatinous*." Our specimen possesses all these characters, but also has another and a peculiar one, which this description does not embrace, namely, that of having branched moniliform fibrillæ on the internodes of the main stem between the whorled articulations. While this feature is not noticed by Vaucher in his specific characters of the plant, he yet in his appended notes says, that "this plant does not always present the same appearance: sometimes the ramifications are so very numerous, that the conferva resembles only an irregular filament; sometimes, on the contrary, they are so very rare, that the verticelli become quite distinct: but the shades which separate the two extremes are so very numerous, that they may be regarded as varieties of the same species."

A correspondent in Boston, U. S., having compared our plant with those in the collection of the late Mr. Bailey, says that it appears to be identical with some of his specimens marked *B. moniliforme*, some of which, he remarks, differ considerably from one another.

A further comparison with specimens from the collection of the late Dr. Landsborough convinces us that this Batrachosperm is none other than *B. moniliforme*. The species is very rare in Scotland, and was found by Dr. Landsborough only in one or two localities favorable for the warmth of their temperature,—in one instance in a stream in which the water from a condensing steam-engine flowed. As compared with ours, Dr. L.'s plants have a very poor and sickly appearance, and the figure given by Vaucher (natural size) is quite diminutive. It would thus appear that although we have not obtained a new species, we have yet to say that our plant is greatly more prolific and more distinct in its characters than any of the described European species. We deem it of sufficient importance and beauty to present to our botanical readers three illustrated figures of its principal parts, together with a full description of its characteristic features.

BATRACHOSPERMUM MONILIFORME. *Vauch.* Figs. 1–3.

Char.—Frond *dark green, very mucous, large.* Main branches *dichotomous;* secondary branches *irregular, partially secund, divaricate, beset with short ramuli, irregularly pinnate, occasionally compound.* Whorls of the stems *spherical, distinct, distant, large, those of the branches sub-distant, and those of the ramuli approximate.* The internodes *of the main stems and the base of the larger branches beset with short, minute, branched, articulate fibrillæ.*

Hab.—On stones, in a clear, rapid stream. Paris, Canada West.

This is really a most beautiful plant. A frond now before us covers, in its dried state, a space of six inches by five, and is very prolifically branched. Fig. 1 (p. 452) is a representation of one of the main stems. The extremities of the branches are rather more delicate than in the original, but otherwise it is an accurate likeness of the object. The whorls are as distinctly marked in the original as they are in this figure.

The *second* illustration (p. 453) represents the appearance of the whorls with the fibrillæ between the articulations, and a branchlet, as seen under a half-inch object glass. In the original the whorls are rather more distinct, and their filaments more crowded than they appear here to be represented; but, upon the whole, the wood-cut comes very near the appearance of the object itself.

The *third* figure (p. 454) represents a branched filament of the whorls, and is one of the most characteristic specimens selected from several equally proliferous and similarly branched. The dichotomous branching of the main filaments with the secund tendency of the extremities is very obvious. Some filaments are even more secund and more proliferous towards the extremities than this one; no two are indeed alike. They present to the eye under an object-glass of 400 diameters, objects of great variety of form and exceeding beauty. In some cases the cells are much more swollen, and have more of the club shape than those of the figure (3); others again are less moniliform. The mucous character

Fig. 1. *B. moniliforme. Branch, natural size.*

of this plant seems to arise, not from the extended ciliæ at the extremities of the filaments, as we find to be the case in *B. bombusinum* and others, but from the clear, and apparently lubricous sheath, in which the filaments are enclosed. This sheath we have not represented in the figure (3): its appearance is so clear and delicate that we despaired of expressing it in a wood-cut. Under the microscope it has the appearance of a line of light surrounding and uniting the cells, so that they do not come into contact with one another, as they appear in the figure, but are separated by this mucous integument. These cells contain a light-green endochrome, in which there are distinct and dark colored granules. The probability is that these granules are zoospores, which, on the maturity of the plant, break through the cells, and, becoming fixed, germinate like the mother plant. The proper fructification is however by glomerules, which grow in the whorls, and seemingly spring like buds from the articulations. They are in this specimen composed of three or four cells, much enlarged and swollen at the extremities, and very club-shaped. The two upper articulations emit numerous articulate branches, which radiate in all directions, and vary in length. This is a most distinct and curious object. It is surrounded with a very thin coat of mucous, and contains bright green granules. We are unable to say how it germinates. Whether it is a bud

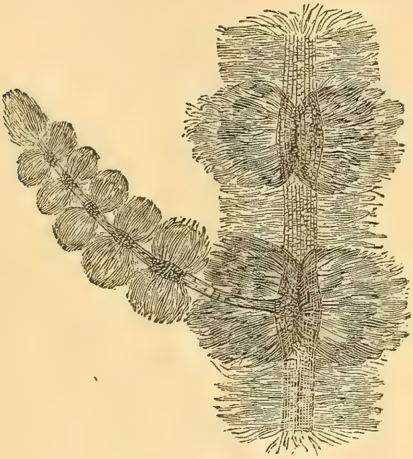

FIG. 2. *B. moniliforme. Whorls and fibrillæ, magnified.*

or a conceptable for seed, we cannot discover; but the latter is probably the case.

The fibrillæ of the internodes are branched in the same manner as the filaments of the whorls, only the cells are less moniliform and more delicate. The branches are besides not quite so proliferous as in the other, and they spring from the cells which form the outer membrane of the stem (fig. 2). The stem is thickly beset with them, and has much the appearance of a *Thorea*. This is the characteristic feature of this plant. It is evidently, too, much more proliferous in the filaments of its whorls (fig. 3) than any we have yet seen. This, however, may be only an effect of climate or situation, and need not be considered as a distinct or specific character. The stems of this plant are cylinders, the walls of which are composed of many small, articulated, tubular filaments, united together by a mucous integument. They swell out slightly at the articulations of the stem, from which the whorls spring, as may be seen in Fig. 2, and have much the appearance of a bamboo.

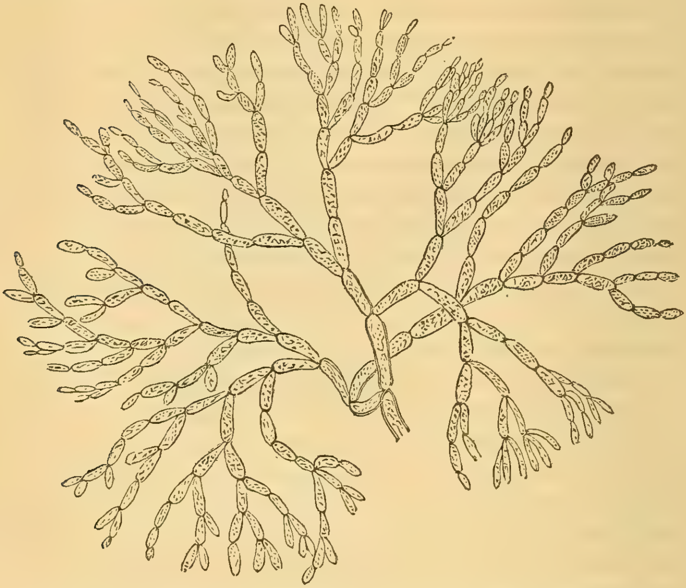

FIG. 3. *B. moniliforme. Filament of a Whorl, highly magnified.*

Some species of this genus are regarded as the most hardy of the

Algæ. They are frequently found in cold springs. And Bory mentions that he had carried, many times, individuals of the species *B. confusum* from one locality to another, and that they continued to prosper in spite of the change of habitation. He also steeped many of them in lukewarm water, afterwards in boiling, and no part of the *batrachosperm* appeared under the microscope to have undergone the slightest disorganisation; and certain sprigs replaced in their native place continued to vegetate after these experiments. "I do not think," says he, "that there exist other vegetables which boiling water does not immediately disorganise: there are not others that can resist temperatures so opposite." We have made a like experiment with our plant, and find that boiling water does not affect it in the least; probably some part of its mucous may be abstracted, but it remains in all its parts the same as before. It would appear, however, that the species *B. moniliforme* flourishes best, if not exclusively in warm temperatures, or in places where the winter is comparatively open and mild.

We have gone back in the order of arrangement to introduce this plant. It should have come in immediately before the *Chaetophoreæ.* According to the classification of Hassall, it is the only genus of the family *Batrachospermeæ*, We regret that we are not permitted the pleasure of mentioning the name of the collector. We, however, anticipate that much will yet be done by this diligent and painstaking correspondent to illustrate the Marine and Fresh-Water Algæ of Canada.

FAM. VIII.—CONJUGATEÆ.

> " *Char.*—Filaments *simple, equal, often conjugating.* Endochrome *mostly figured.* Sporangia *formed generally by the union of the contents of two cells, either in different or in the same filaments.*" Hass.

"This is perhaps the most curious of all the tribe of *Confervæ.* When viewed together they form an exceedingly natural group but one which is defined rather by the enumeration of a number of characters than by one in particular."

When examined by a microscope they are seen to be unbranched, and of uniform diameter. For the most part they are unattached, their natural home being quiet, deep, and clear pools. In the young state they are frequently rooted to stones. Those also that are found in streams are fixed to stones or wood. In their young condition they are smooth and unctuous to the touch, and of a deep green color. "They are composed of an assemblage of elongated cells placed end to end, and all of them enclosed and held in union by an investing membrane. The interior of these cells are chiefly filled with endochrome, which is variously disposed, sometimes in the form of spiral threads and stars, at others completely filling their cavities." Mixed up with the endochrome there are observed numerous vesicles, which are presumed to be unfertilized zoospores. Sometimes adjacent cells conjugate, (fig. 6, *a.*) and their contents coalesce; and sometimes the conjugation takes place with a cell of a contiguous filament, (figs. 4 and 6, *b*, p. 459) a passage of communication having been formed by the protrusion of little tubular processes from each cell. This phenomenon of conjugation is one of the chief characteristics of this large family of plants, and it is certainly a very curious process. The idea of most botanists is that it is necessary in order to the fecundity of the plant—that fertilization does not take place —sporangia are not formed—until this process has been completed. There is however no regularity in the passing of the contents of the cells of one filament into that of the other, neither is there anything analogous to the pistils and stamens of flowering plants; nor does it appear that the one plant is male and the other female, or that there is any difference in the physical character of the granules contained in either cell. The larger cell

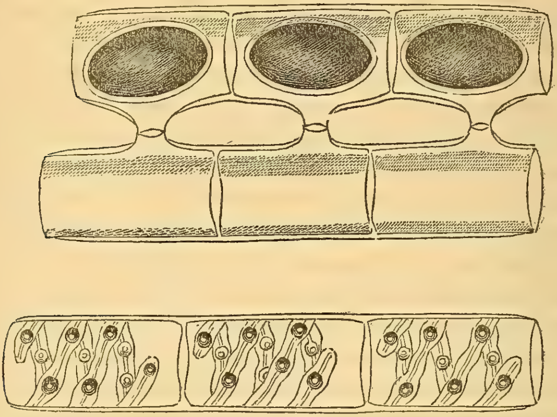

Fig. 4. *Zygnema varians, showing the spiral thread, the conjugation, and the sporangia.* Hass. Brit. F. W. Alg., pl. 29.

invariably attracts the contents of the smaller: sometimes this will happen in the one and sometimes in the other filament (fig. 6, b.). The same thing is observable in the conjugation of adjacent cells in the same filament; the cell wall of one is everted into the other and a channel of communication is thus formed, through which the smaller mass of endochrome passes into the larger. The united contents of two cells form a large circular or oval cist, (fig. 6, a.) most frequently of a deep green color, but occasionally becoming reddish brown. The endochrome soon becomes a mass of granules; and by and by the cist, or sporangium as it is called, breaks away from the filament and floats free in the water. The granules (zoospores) finally burst the cells walls, and, after moving about freely in the water, germinate into filaments.

A curious organ has been observed in this family of plants by Hassall, J. Agardh, J. S. Bowerbank, Kutzing and others, which they call a cytoblast. "It is solitary, and usually occupies a central situation in each cell of the genus Zygnema. It consists generally of two membranes, but sometimes there are three; the innermost of these being either circular or elliptical, and presenting a nucleated appearance, (as may be seen in Fig. 5, p. 458) The surface of the enclosed membrane is smooth, while that of the external is rendered irregular by the giving off of numerous tubular prolongations or radii which terminate in the spiral threads formed by mucous, and containing endochrome and large bright granules, which I regard as unfertilized spores."

"The structure of this curious organ explains with apparent satisfaction one of the offices which it is destined to discharge, viz., that of a laboratory or *stomach*, in which the materials necessary for the growth and vitality of the cell and its contents are received and digested, and from which they are conveyed by means of the tubular radii to those organs by which the materials are to be assimilated."

"The cytoblast, therefore, is at first fixed in the centre of the cell by the prolongations which proceed from it (see Fig. 5); but it happens that at a certain epoch these radii disappear, and then the cytoblast floats freely within the cavity of the cell; the disappearance of the rays, the cessation of the growth of the cells, and the assumption of the characters of reproduction, being almost contemporaneous, the two latter being readily accounted for by the disappearance of the radii."

"In addition to the organs above described two others have been noticed by Mr. Bowerbank in a species of *Zygnema*, which I transmitted to him, and subsequently by myself in a variety of other species. The one is cruciform, and adherent to the inner wall of the cell, (see Fig. 5). It, Mr. Bowerbank remarks, is the vegetable structure which secretes the raphides. They are probably not definite organs, but crystals. The other body is small, elongated, somewhat curved, and attached to or lying upon the plant, (see Fig. 5). This, Mr. B. observes, is certainly a string of minute cytoblasts."—*Hass.*

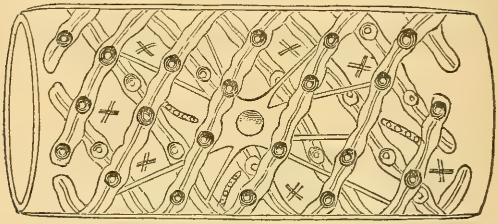

Fig. 5. *Cell of Z. nitidum, showing the spiral threads containing spores the cytoblast, and the cruciform raphides.* Hass. *F. W. Algæ, plate* 17.

We have collected and examined with great care multitudes of these plants—they are to be found in great abundance in almost every stagnant pool—and only in one instance (*Z. curvatum*) have we, during a period of two years, observed conjugation in the L. Canadian specimens. We eagerly looked for it last spring, the time of the year, at which, according to Hassall, it is most usually found in England, and have, up to the beginning of winter, almost every week examined specimens from various localities, and in all conditions of growth, but in no instance have we found conjugation, with the exception noted. We have also failed to discover in any case the cytoblastic organ.

A specimen has however been sent us of *Z. catenæforme* from Paris, C. W., about 360 miles S. West from Montreal, which curiously presents the three forms in which conjugation is sometimes found. In the following figure (6) it will be seen that at (*a*) the contiguous cells are in conjugation, while at (*b*) it is the contiguous filaments, and that the contents of the opposite cells pass alterately into each other.

From these considerations one would be led to infer that these characters are either very evanescent in their nature and rapid in their functions, or that they are mere accidental conditions of the plant and not necessary to its fecundation. In a few instances we have seen the sporangia very distinct, but only in a few. For the most part the spores, or zoospores, contained

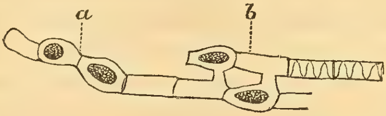

Fig. 6. *Z. catenæforme, in conjugation.*

in the spiral threads, becoming diffused through the cells break the walls and escape into the water. This simple process seems to be the one most commonly followed. If fertilization only takes place through the agency of sporangia and by the zoospores which it contains, or only by the action of the cytoblast, the plant, according to our observation for now two years, would soon altogether disappear. Apparently, however, without the conjugation of adjacent cells, or of cells of adjacent filaments, and without the cytoblastic organ, spores or zoospores are formed, and, escaping from the cells, immediately become fertile. From the facts which have come under our observation we are tempted to think that the union of cells is purely accidental, and results from the process of endosmosis, or by simple attraction. We are the rather confirmed in this conjecture by the fact that conjugation takes place chiefly in spring when life is most active and the membranes of the cells most delicate. The intrusion of the new matter into a cell may also under such conditions result in the formation of new cell membranes; and the occasional reddish color of the sporangia may be merely the effect of age. Not having seen the cytoblastic organ we can form no conjecture as to its function, bnt the fact that it is of so rare occurrence naturally leads to the inference that it is an accidental excess of mucous in the cell and by no means necessary for the fertilization of the spores. Hassall himself admits "that this combination (conjugation) is not an essential to the perpetuation of the species"; but he does this on the ground that the cytoblastic organ is that which fertilizes the zoospores, and thinks that by this means the permanence of species is explained where cells have broken up "before the union of endochrome, or the formation of spores, has taken place." But, allowing this to be the case, how again shall we account for the permanence, or the reproductive germs, of those species in which there are neither cytoblastic organs, nor conjugation of cells? That such species are permanent, and germinate from spores or zoospores produced in the cells, we entertain no doubt, or at all events, from the evidence before us, we regard it as highly probable. It is possible that future and more careful research may yield a different result. In the meantime, and with all humility, we propound these views. They are contrary, we know, to the inductions of naturalists of the highest distinction and most accurate observation; but we submit them to our botanical friends in the hope that they may lead to enquiry and the elucidation of the truth. Our intelligent correspondent in Paris informs us that the research of the past year has failed to discover any but one single instance of conjugation (fig. 6). There must therefore, we think, be either a specific difference between our plants and the European, or the characters referred to must not be essential to the reproduction of the species. In the absence of conjugation we have found a difficulty in fixing upon characters that may be regarded as *specific*, The length of the cells and the number of spiral threads frequently vary in the same filaments. Still it does appear that there is a normal size of the cells, and a normal number of spiral threads and coils in the several species, which may, after a little experience, be readily distinguished; other forms are obviously exceptional. The cells grow by sub-division, previous to which they are somewhat elongated, and afterwards considerably shortened, until they attain maturity. The normal length will consequently be that which lies between the two extremes. The same process of growth will naturally somewhat affect the spiral threads also, and produce anomalies in their form during their state of transition. So far, therefore, we know of no characters by which to determine our Canadian species except the size of the cells, the number of their spiral threads, and other normal arrangements of the endochrome.

Genus ZYGNEMA. Ag.

" *Char.*—Endochrome *arranged in spiral order within each cell. Sporangia generally oval, and never lodged in the transverse tubes of communication.*" Hass.

Derivation.—*zugos*, a yoke; *nema*, a thread.

Hassall, Brit. F. W. Alg.; Vauch. Conf. d'Eau douce; Bory in Dict. Class.

This genus is placed first in order in the family as being the most remarkable in its appearance and complicated in its structure.

The endochrome is arranged in the form of spiral threads, as may be seen in Figs. 4 and 5; the number of spires varying from one to eight, and the number of threads from one to six. These spiral cords are tubular, and contain at intervals, united together by a delicate cord, brilliant granules, which Müller, in his surprise on first discovering a species of the genus, likened to precious stones European naturalists have divided them into two sub-genera, in one of which the filaments unite, as in Fig. 4, and in the other no such conjugation takes place.

The structure of the joints of some species of the *Zygnema* has been a subject of special observation by European naturalists. Mohl, quoted by Hassall, says that "In *Z. elongatum* (Ag.) the dissepiments have a very peculiar structure which I have found in no other species. The terminal surface of each cell is not *even*, but elongated into a blunt conical process. This process can only be observed in its true state when two joints are separated one from the other; when on the contrary the threads are unbroken, the process is generally introverted, like the finger of a glove. This is the common condition, and in most threads no joint is found otherwise constructed." It is not quite accurate to say that the eversion is only truly observed when two joints are separated. Hassall remarks that it has nothing whatever to do with the separation of the cells, but depends upon the unequal internal pressure of the granular contents which occurs chiefly at the period of reproduction.

Z. CURVATUM. Hass.

" *Char.*—Filaments *nearly equal in diameter to those of Z. neglectum.* Conjugation *angular.* Cells *three or four times as long as broad*, *coalescing without the intervention of transverse tubes.* Spires *about four in number*, *faintly indicated.* Sporangia *oval.*" Hass.

Habit.—In pools at Moffatt's Island, St. Lambert, Montreal.

This species is remarkable for the direct conjugation of the cells without the intervention of tubes, and is the only species of the genus that does so. By this junction the filaments become geniculate, or bent at angles more or less obtuse, a very good idea of which may be obtained by bending the middle joint of a finger on each hand and bringing the knuckles together.

Z. PELLUCIDUM. Hass.

" *Char.*—Filaments *of rather less diameter than those of Z. curvatum; mucous almost transparent.* Conjugation *parallel.* Cells *six or seven times as long as broad.* Spires *indistinct* (*in our specimen very clearly developed*) *usually four in number.* Sporangia *circular, lodged in cells which are considerably enlarged for their accommodation.*" Hass.

Hass., Brit. F. W. Alg., p. 143, pl. 25, figs. 1 and 2.

Hab.—In pools at the Old Race Course, Mile End.

This is a very curious and beautiful species, and one by no means common either in Europe or Canada. The spires are very distinct, and cross one another at acute angles. We have not seen this plant in conjugation or sporangia, but we have no doubt as to its other characters, and these are sufficiently striking to render it easy of identification.

Z. DECIMIUM. Ag.

" *Char.*—Filaments *rather fine.* Cells *twice or thrice as long as broad.* Spires *two, crossing each other.* Granules *large.* Sporangia *oval, obtuse, not producing inflation of the cells in which they are lodged.*" Hass.

Hass., Brit. F. W. Alg., p. 144, pl. 23, figs. 3 and 4. Harv. Manual, p. 143.

Hab.—Frequent in stagnant pools throughout Canada.

We can only determine our specimens by the length of the cells, and the number and character of the spires. Concerning the Sporangia we can say nothing from our own knowledge, but we have no doubt whatever as to the identification of the species It is a very beautiful plant under the microscope, and very distinct in its characters.

Z. ÆSTIVUM. Hass. ?

" *Char.*—Filaments *very delicate.* Spire *single.* Cells *usually about four times as long as broad, but sometimes much longer and occasionally shorter.* Sporangia *oval, not producing any inflation of the cells in which they are found.*" Hass.

Hass., Brit. F. W. Alg., p. 146, pl. 28, figs. 3 and 4.

Hab.—Common in pools.

We have marked this species doubtful, because two of the characters are that the cells containing the sporangia are not inflated, and the sporangia are oval; neither of which appearances have we been able to observe or verify.

Z. CATENÆFORME. Hass.

" *Char.*—Filaments *a little finer than those of Z. malformatum Cells usually rather more than twice as long as broad. Sporangia largely inflating the cells in which they are contained, acutely oval.*" Hass.

Hass. Hist. F. W. Alg., p. 147, pl. 30, figs. 3 and 4.

Hab.—Paris, C. W., in pools.

This is the second species which has been found conjugated in Canada to our knowledge. It was collected during the last autumn, and had the appearance of age. We have represented it in fig. 6 (p. 459) as it appeared in conjugation under an object glass of 100 diameters. This species, Hassall informs us, cannot be distinguished from " *Z. commune* before conjugation. After this has occurred, the difference in the length of the cells, and the form of these is so obvious, as not to leave any doubt of its being distinct from that species." In *Z. commune* the sporangia do not, it would appear, occasion any inflation of the cells in which they are formed, whereas in this species the cells are considerably inflated, as may seem in the figure 6. It appears to us that this is a very doubtful difference. It is very questionable whether such a difference will uniformly characterise all the individuals of either species. We suspect that there is no real difference between the two, and that they are in fact one and the same plant. Berkeley remarks that " Characters like those in Hassall's F. W. Algæ, dependent simply on comparative size, are altogether inadmissible." Until, therefore, we can obtain some more thorough discrimination of the species belonging to this family; we must be satisfied with such as we have.

Besides these species named we have collected probably *Z. rivulare*, *Z. commune*, and *Z. gracile.* We have frequently observed several other—as we think—distinct species; but, in the absence of conjugation and sporangia, we have not been able to identify them with any of those described by Hassall. We hope in a future paper to enter more at large into the discrimination of the species to be found in the waters of Canada.

The species of this family are, with scarcely an exception, inhabitants of fresh water, and are probably distributed very widely over every region of the world. They have been found by Drs. Hooker and Thompson on the Southern Himalayas, and in the lower parts of India. The genus *Zygnema* ascends as high as 15,000 feet on the Himalayas. Species identical with the European are found in almost every part of the United States and Canada. South America is said to yield scarcely a trace of them, but this may be accounted for from the fact that few botanical explorers of these regions have thought the lowly Algæ worth observing. We doubt not that a diligent Algologist would reap a rich harvest of curious species in the everglades of that region, and in the waters and tributaries of its mighty rivers.

Passing over the other genera of the family CONJUGATEÆ, and also the family CYSTOSPERMEÆ, of which we have found no specimens as yet in Canada, we come to—

FAM. X.—MONOCYSTEÆ.

This family consists of three genera of fresh-water Algæ, viz., *Cladophora*, *Coleochæte*, and *Lyngbya*. In the species there is no union of the cells or intermingling of their contents; each cell contains all that is requisite for its reproduction in the way of fertilizing vesicles and zoospores. When the zoospores have been fertilized the cells swell up, until, by the increase of the size of the zoospores, the cell walls are ruptured, and the zoospores escape through the aperture thus produced. The plants of this family are for the most part attached to submerged stones or wood, and grow by the lateral and longitudinal development of their cells, aud the production of new branches at the articulations.

SUB-FAM. I.—CLODOPHOREÆ.

Genus 1.—CLADOPHORA. Kütz.

" *Char.*—Filaments *attached, much branched, not setigerous, and not invested with secondary cells.*" Hass.

Derivation.—From *klados* a branch, and *phoreo* to bear.

This genus is very marked, and easily distinguished; for the most part its species are prolifically branched, and very simple in the structure of their cells.

CLADOPHORA GLOMERATA. Dillw.

" *Char.*—Filaments *tufted, bushy; somewhat bright green, shining.* Branches *crowded, irregular, erect; the ultimate ramuli secund, sub-fasiculate.* Articulations *four and eight times longer than broad.*" Hass.

Hass., Brit. F. W. Alg., p. 213, pls. 56 and 57, figs. 1 and 2; Harv. in Manual, p. 134.

Hab.—Common over the whole length of the fresh-water portion of the St. Lawrence, the Ottawa, and their tributaries.

The characters by which to distinguish the species of this articulate genus of Algæ are very slight, and require great caution in the observer so as not to multiply species without cause. A great difference in the diameter of threads belonging to the same frond will constantly be found, and the proportions of length and breadth in the articulations are quite variable. Berkeley says, in his "Introduction to Cryptogamic Botany," p. 166, that "species, evidently of the most close affinity, cannot be separated from mere consideration of relative proportion without any other characters. Even the branching of the threads is not sufficient, or the mode of branching. *Cladophora glomerata* assumes a multitude of forms which it would be rash in the extreme to separate; and it may safely be affirmed that of published species of *Cladophora* and *Conferva*, at least one-half will ultimately be reduced." There is a normal character in the forms of the cells and in the style of branching which the practised eye soon detects. But, so variable are the appearances of Cladophora, and so modified are its characters by habitat, that it is hard to divide them into species at all. Hassall, not over scrupulous as to the multiplication of species, himself admits only two into his distribution of the genus. Under *C. glomerata* he includes *C. ægagropila* (Linn.) and *C. Brownii* (Harv.), and accounts for the appearance of the former by the force of the mountain streams rolling detached portions of *C. glomerata* into compact balls; and of the latter by the submmersed habitat in which it grows. It is also with doubt that he admits his second species, *L. crispata*, to a distinct place. The three British species, *C. nigricans*, *C. fracta*, and *C. flavescens*, he refers to this one; all being, as he thinks, different states of the same plant. He concludes by saying that "The suspicion also may, I think, be entertained that *C. crispata* itself is but a condition of *C. glomerata*, changed by the difference in its place of growth—it growing for the most part in still water, in deep ponds, and lakes. I have often seen specimens which it would be impossible to refer with certainty to either species."

The fructification of this plant is very simple. Every cell seems to contain fertile zoospores. At maturity they either burst through the cell walls, or a natural apperture is formed for their escape on one side of the distal extremity of the cells. We doubt, however, whether this last apparent aperture is destined for this purpose. It is only observable in those cells from the extremities of which the second ramuli have not been developed; and the slight lateral protrusion which they exhibit is rather, we think, to be regarded as the incipient state of future branchlets than channels for the passage of zoospores. That the zoospores escape by bursting the walls of the cells is doubtless the normal form of this stage of the reproductive process. No plants are more proliferous than these. Young branches continue to spring from old stems for years, so that in running water they sometimes stretch out to several feet in length. Very fine dark green fronds, of from 6 to 12 inches long, may be obtained in autumn from the rapid currents at the railway bridge St. Lambert, Montreal. Long and beautifully green fronds clothe the edges of the rock over which the Niagara rolls. It infests the bottom of ships and boats, and assumes there a delicate and pretty appearance. It grows readily in the aquarium, and is both a beautiful specimen and a valuable aerating plant.

REVIEWS.

Canadian Ginseng: Memoire presenté à S. A. R. le Duc d'Orléans, Regent de France, concérnant la precieuse plant du Gin-sing de Tartarie; par le Père JOSEPH-FRANCOIS LAFITAU, S. J.

The name of *Ginseng*, or *Jinchen*, is given by the Chinese to the *Aralia quinquefolia* (*Panax quinquefolium*, *Linn.*), to which they ascribe marvellous tonic and restorative powers, commemorated in its name of *panax*, and also in the Chinese appellation which is said to signify "dose for immortality"; although the experience of Europeans has not justified this high reputation. It has been used for ages by the Chinese, among whom it was often sold for thrice its weight in silver. Their supply of this root was obtained exclusively from Tartary; but the père Jartoux, a Jesuit Missionary, having described and figured the plant, the père Lafitau, at that time missionary at Sault St. Louis (Caughnawaga) in 1716, discovered the Ginseng on the banks of the St. Lawrence. This discovery led to an important commerce, and the Ginseng of Canada was exported in large quantities to China; in 1752 its price at Quebec was twenty-five francs the pound, and there was shipped of it to the value of 500,000 francs.

This new source of profit excited among the colonists so much cupidity, that in their haste, they gathered the roots at wrong seasons of the year, and drying them without care, the value of the product deteriorated, and it lost favour in the Chinese market, so that in 1854 the exportation fell to 33,000 francs; and the fallen credit of the Ginseng gave rise to a proverb still known among our peasants, "*Ça tombera comme le ginseng.*" Large quantities of Ginseng are however still exported from the United States, which in 1852 furnished 158,455 pounds, valued at 102,703 dollars; and, as the plant is still common in the Province, there is no reason why it might not again become a source of profit.

The pamphlet before us was addressed by Lafitau to the Duke of Orleans, then Regent of France, about the year 1718. It contains a curious history of the Ginseng among the Chinese, as gathered from the researches of père Jartoux and others; an account of its discovery in Canada, and a minutely detailed description of the plant, with figures. To this succeeds a learned disquisition upon the virtues of the plant, and an attempt to identify it with the *mandragora* of Theophrastus. This pamphlet had become very rare; and Mr. Hospice Verreau, Principal of the Jacques-Cartier Normal School, has had the good idea to reprint the memoir, which he has enriched with interesting notes, to which we are indebted for the above facts, prefacing it with a biographical sketch of the père Lafitau, one of those learned and zealous apostles whose labours form a noble chapter in the early history of Canada. After several years spent in this country, he returned to France about 1718, and in 1724 published a learned work, in two large volumes, with 41 plates, on the "Manners and Customs of the North American Indians," in which he endeavoured, by erudite and ingenious arguments, to prove their Pelasgic origin. He also published in 1733 a History of the Portuguese Conquests in America, in 4 vols. The Père Lafitau died about 1740. An engraving, copied from a portrait of him preserved at Sault St. Louis, forms the frontispiece to this curious and interesting pamphlet. T. S. H.

A General View of the Animal Kingdom. By Mrs. A. M. REDFIELD. New York: Kellog. Agent in Montreal: Mr. Telfer.

Many attempts have been made to represent the arrangement and forms of the Animal Kingdom on diagrams and charts for

Educational purposes, and all are more or less imperfect, partly because the classification in many departments is in an unsettled state, and partly because the true arrangement of the animal kingdom is probably not capable of accurate representation on a plane surface. For these reasons in the more modern zoological representations, as for instance in the admirable series of figures by Patterson, issued by the Department of Science and Art in England, the attempt to represent the classification to the eye has been abandoned; and instead, we have merely each group illustrated by an appropriate example. Mrs. Redfield, undeterred by past failures, has attempted to combine the form of the diagram with a sufficient amount of pictorial example, and has attained a very creditable measure of success. Her classification is in sufficient accordance with the views of the best naturalists for all practical purposes of instruction, and the illustrative objects are well selected and represented. The method of arrangement, likewise, has a certain degree of pictorial grace and beauty which commends it to the eye. It will be found very serviceable either for school or family instruction, more especially in giving a general view of the extent and variety of the animal kingdom.

The text-book intended to accompany the chart, is a thick volume of 700 pages, with a great number of additional illustrations, and a large amount of explanations of the classification and technical terms, and fact and anecdote. It would be easy, as in the case of all similar works, to refer to little inaccuracies; but, on the whole, we think the work an excellent one of its class, and cordially recommend it. One merit of considerable importance is, that where practicable, American examples are given, so that the teacher may often be able to refer to creatures known to the pupils.

SCIENTIFIC GLEANINGS.

TWENTY-EIGHTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In our last number we reprinted the greater part of the truly excellent address of Prof. Owen as President of the Association. Our space will not admit of our giving a detailed account of the proceedings of this Congress of Science. For those who are interested in the progress of scientific enquiry in its various departments, abstracts of the papers and observations which were the subjects of discussion will be found, more or less full, in the pages of the Athenæum, or in the annual volume of the Society's Proceedings. It may, however, be interesting to general readers to have an opportunity of perusing the addresses of the Chairmen of the various sections. These are of a highly interesting and instructive kind. In a few words they indicate the progress of the past year, and the chief points to which enquiry should be directed for the future. The gentlemen selected to fill the honorable position of Chairmen of sections are all celebrated in their special departments; words from their lips may, therefore, be regarded as the last oracles from the priests of nature. Having surveyed the field from its highest elevations they speak with authority as to its character and prospects.

MATHEMATICAL AND PHYSICAL SECTION.

President—Rev. Dr. Whewell.

The President, on taking the chair, addressed the Section:—The managers of the Association have assigned a small room to this Section. I hope that no one is at present inconvenienced by this. I shall be glad if it should be found that in this respect the managers have been mistaken. But the fact is, that we are very much in the habit in this Section of treating our subjects in so sublime a manner that we thin the room very decidedly. This is true, but this is no fault of ours. We seek the laws of Nature, and Nature presents to us her laws in a form which is to many persons repulsive,—namely, a *mathematical* form. It has been truly said, both by sacred and profane writers, that all things are made by number, weight, and measure. Now things which happen by number, weight, and measure, happen according to mathematical laws, according to the relations of number and space. According to such relations the laws of various of the appearances which Nature presents to us were studied at the earliest periods of the intellectual progress of man; and if the laws detected by man on such subjects are in some respects perplexing to many from their mathematical form and complexity, and are thus repulsive, they are at least attractive in another point of view,—for the extent and brilliancy of the success which has been obtained in these fields of speculation are such as could not have been in any degree anticipated at an early period. And the truths obtained in this way at an early period of man's intellectual progress are even still of great value and interest, and are essential parts of the body of scientific truth at the present time. The astronomy of the ancient Greeks, expressed in the mathematical forms which they devised, has been an important element in the formation of that astronomy of modern times of which I have several of the eminent masters near me. And this connected progress of knowledge from ancient to modern times has been exemplified in various portions of science, and still goes on appearing in new examples. You recollect, perhaps, that a Roman philosopher, Seneca, made a remark which, though conjectural, is striking. In speaking of comets, he said, these objects now appear to follow no law, as the planets do. They appear unforeseen and unexpected, filling us with perplexity and alarm. Yet these bodies, too, he said, shall disclose their laws to astronomers in future years. Their returns will be predicted, their laws known, and our posterity will wonder that we did not discern what is so plain. And this prophecy has been fulfilled. Comets have had their returns predicted, and have fulfilled their predictions. And though this is not always the case, for comets still shine forth unpredicted and unforeseen, yet still, even in such cases, we are not quite destitute of knowledge of their law and progress; for when an unexpected stranger of this class blazes forth in our sky, as soon as he has shown himself for a few days, we can mark the path which he will follow, the rate at which he will travel, and in a great degree the appearances which he will assume. And even objects which as yet are still more lawless and perplexing to our science than comets are, still not altogether extraneous to the domain of our knowledge. There is a class of such objects which has been especially attended to by the British Association. This is the subject of the first of the communications which are to be laid before this Section to-day. I speak of Prof. Powell's "Report on Luminous Meteors." These objects, falling stars, shooting stars, fiery globes, or whatever they may be commonly called, have attracted the attention of this Association for many years; and the Report which we are to have laid before us to-day is the continuation of several Reports of the same kind prepared by the same gentleman in preceding years. These bodies, as I have said, are in a great degree irreducible to laws and extraneous to our science; yet not wholly so. We have speculations of ancient times by some of our most eminent philosophers, in which these bodies play an important part. Prof. W. Thompson has been led, by his mathematical speculations on Heat, to the conclusion, that the heat of the sun is maintained by the perpetual falling in upon his surface of the abnormal bodies moving in the solar system, which appear to us as luminous meteors and shooting stars. And he conceives that he has shown that there is in those bodies an aboundable supply to keep up the heat of the sun; and that, by the effects of them, the sun may have gone on radiating heat for thousands and thousands of years without the smallest diminution. And this, again, is the result of profound and complex mathematical calculations,—so wide is the domain of mathematical reasoning, and so necessary is it in any line of speculation in which we are to convert our ignorance into knowledge. I may mention, as a public example of this, a case which is far removed from the vastness of astronomical phenomena,—a case of the manipulation of mathematical law upon a scale of the smallest dimensions, and in the work of a humble insect. I speak of the form of the cells of bees: a mathematical problem which already attracted the attention of the ancient Greeks, and which has been the subject of mathematical investigation by several of the most eminent mathematicians of modern times,—the most eminent, for being a problem involving the properties of space of these dimensions, it requires admirable powers of mathematical conception Upon this subject two communications are promised to the present Meeting, to be laid either before this Section or the Section of Natural History. And in order further to exemplify the advantages derived from the action of the British Association, I may mention another report upon a very different subject, Mr. Cayley's "Report on the Progress of Theoretical Dynamics." The generality, multiplicity, and complexity of the recent labours of analysts in this department of mathematics have been so great that ordinary mathematicians cannot hope to follow them by reading the original memoirs; and I am greatly obliged, as one of them, to Mr. Cayley for enabling us compendiously and easily to understand what has been done and how it has been done. Perhaps, after all, his report is not so very unlike that of Prof. Powell "On Luminous Meteors,—for the original researches of the great analysts who have treated this subject, though bright and objects of wonder, are so far above our head and so difficult to understand, that they are not unlike the things tabulated in the other report. And now, having explained that we must often be necessarily difficult to follow in this Section, I must ask the ladies and gentlemen here present, as the *Spectator* has his readers, to believe that, if at any time we are very dull, we have a design in it.

(*To be continued.*)

BREEDING SKYLARKS.

(*To the Editors of the Canadian Naturalist.*)

Sir,—A correspondent in your October number remarks that: "It would tend much to increase the practical value of your " Journal, if your subscribers were from time to time to communi- " cate facts relating to any department of the Natural History "of the Province." Adopting this suggestion, I beg to note a singular incident which has occurred in Quebec, in respect to the breeding of skylarks An amateur noted for possessing the best singing larks in the city, has succeeded in rearing in captivity six or seven healthy broods of these birds. The plan he adopted is as follows: in pairing season, the birds are removed from the cages to a quiet room, the floor of which is covered with green sod; a wire blind allows free access to the air; no one except the owner is allowed access during the period of incubation. The birds although wild when in cages, become so tame in the room that the owner has in some instances even removed them with his hand from the nest without their manifesting any alarm. Their nest was so artfully concealed in the thick grass that it was impossible to notice it, unless the old bird was seen coming from it. The young birds were wholly fed on grass-hoppers, until they were a week old. Should rainy weather set in and grass-hoppers become scarce, the young brood would wither and die. Many thriving birds were lost in this manner. Some of the larks thus bred were remarkable for the sweetness of their song. This is the only instance I know of, in which skylarks have been bred in captivity in Canada. Another instance of captive European birds breeding in Canada, occurred some years ago. A pair of English blackbirds, the property of the late Wm. Patton, Esq., *Seigneur* of Montmagny, being allowed the free range of a small room, built their nest in an old boot. The young were thriving and gave much promise, when one night old and young fell victims to the voracity of a cat. Should you reserve me a small corner in your Magazine, I may send you a short notice of our Wood Thrush (Tundus Melodus), and Veery, the Tundus Wilsonii, as observed in the pine Groves of Spencer Wood. Truly may it be said that the Canadian Fauna and its agreeable songsters are comparatively unknown. Although the birds of Canada cannot compare for sweetness of song with European warblers, still many of them are highly worthy of note. Who, ever, for example, can listen unmoved to the rollicking, jingling and merry song of the Boblink, when from the bough of some magestic elm, he pours forth his morning hymn?

J. M. L.

Spencer Grange, near Quebec.
October, 1858.

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MONTHLY METEOROLOGICAL REGISTER, SAINT MARTIN'S, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF AUGUST, 1858.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer corrected and reduced to 32° F. (English inches.)			Temperature of the Air. F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Mean Velocity in Miles per hour.			Amo'nt of Rain in inches.	Amo'nt of Snow in inches.	Weather, Clouds, Remarks, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	29·864	29·740	29·840	65·0	80·3	62·1	·460	·677	·498	·85	·66	·91	N. N. E.	E. by N.	N. E.	2·36	1·60	0·85	......	......	Clear.	C. Str. 6.	Clear.
2	817	996	941	56·7	74·0	62·4	·420	·469	·517	·90	·57	·91	N. E. by E.	N. E. by E.	N. E. by E.	3·77	12·16	4·56	Inapp.	......	C. Str. 9.	Cirr. 4.	Clear. Aurora Borealis.
3	922	818	892	55·2	69·1	89·6	390	529	461	90	75	91	N. E. by E.	S. E. by E.	S. E.	1·80	1·18	0·71	0·070	......	" 6.	C. Str. 10.	Rain.
4	647	668	654	60·4	67·0	64·3	487	550	536	94	84	92	W. N. W.	S. by E.	S. by W.	7·17	16·76	12·23	0·860	......	Rain.	" 8. Distant Thunder.	C. Str. 6.
5	626	629	685	61·0	77·0	69·0	480	646	671	91	71	95	W. by S.	W.	W. S. W.	6·80	3·67	0·55	......	......	C. C. Str. 8.	Cirr. 4.	C. Str. 4.
6	671	693	672	65·4	74·7	64·7	570	614	550	89	68	92	N. W.	N. N. W.	S. S. W.	2·77	9·62	0·87	0·200	......	Str. 9.	C. Str. 9.	Clear.
7	806	842	963	60·2	78·1	65·6	480	550	576	88	58	92	S. E. by E.	W. by S.	S. E. by S.	5·45	1·08	0·95	......	......	Clear.	Clear.	Clear.
8	977	960	925	57·0	87·8	72·3	438	902	745	94	74	92	S. E. by E.	S. by E.	S. S. E.	0·00	1·53	0·11	......	......	C. Str. 2.	Clear.	C. Str. 8.
9	896	795	814	67·1	88·3	74·9	563	915	751	87	69	88	S. E. by S.	S. by E.	S. S. E.	0·00	0·08	0·10	......	......	" 8.	C. C. Str. 6.	" 10.
10	871	812	762	69·0	93·0	74·2	628	942	751	88	61	88	S. E.	S. E. by S.	S. E.	0·20	0·06	0·01	......	......	Str. 10.	Clear.	" 4.
11	711	713	750	66·9	69·0	68·1	570	665	655	89	92	97	S. E.	E. by S.	S. by E.	0·17	2·10	0·95	0·490	......	C. C. Str. 4.	Rain.	Ni. 10. Distant Thunder.
12	867	840	30·098	67·2	85·0	62·8	522	558	429	79	80	77	N. by E.	N. by E.	N. N. E.	1·65	12·20	0·70	......	......	Clear.	Clear.	Clear. Aurora Borealis.
13	30·138	30·119	113	60·7	85·5	63·0	426	897	549	82	33	97	N. E.	E. N. E.	E. N. E.	0·11	1·33	0·00	......	......	"	Clear.	"
14	070	29·875	29·832	56·8	95·6	70·4	413	992	628	90	64	85	N. E. by E.	S. E. by S.	S. E.	0·00	0·02	0·00	......	......	"	Clear.	Clear.
15	29·848	842	853	67·0	87·7	68·2	619	785	577	92	69	85	S. E.	S. S. W.	W. N. W.	0·00	0·00	0·00	Inapp.	......	C. C. Str. 9.	Cirr. 4.	C. Str. 10.
16	881	861	949	60·0	79·0	59·8	374	574	469	75	58	94	W.	W. S. W.	S. S. W.	1·01	0·01	0·73	......	......	Clear.	Clear.	Clear. Aurora Borealis.
17	914	788	725	56·8	88·3	68·9	391	778	600	87	59	88	S. S. W.	S. W.	S. S. W.	0·00	0·46	0·83	......	......	"	Clear.	Clear.
18	621	559	494	62·0	87·6	60·1	491	741	473	88	57	88	S. W.	S. W. by S.	W. S. W.	0·11	6·23	8·45	......	......	"	C. C. Str. 6.	C. Str. 10.
19	577	672	700	45·0	57·6	50·9	251	332	309	84	69	85	N. N. W.	W. by S.	W. S. W.	0·70	0·12	0·02	0·160	......	Str. 4.	" 10.	" 8.
20	680	600	892	50·7	70·5	57·0	328	551	443	89	75	97	S. W.	S. by E.	S. E. by E.	0·00	0·00	0·00	0·650	......	C. Str. 9.	" 6.	Ni. 10. Rain.
21	696	687	646	50·7	71·0	62·4	384	537	523	96	71	94	W. S. W.	W. S. W.	S. by W.	0·00	0·00	5·12	0·100	......	Rain.	" 6.	Ni. 10. Rain.
22	707	485	880	86·9	66·1	55·0	443	470	295	97	73	68	W.	W.	W. N. W.	0·53	7·23	7·00	0·410	......	C. Str. 10.	C. Str. 10.	C. C. Str. 9.
23	851	830	885	49·4	68·0	19·9	240	411	272	68	60	78	W. N. W.	W. N. W.	S. W. by W.	9·07	11·81	3·40	......	......	" 4.	" 3.	Clear.
24	907	882	887	49·0	60·4	56·1	278	480	443	71	91	97	W. S. W.	W. by S.	S. W. by W.	0·62	14·00	1·40	Inapp.	......	Clear.	" 4.	Str. 2.
25	30·061	30·029	30·117	80·0	76·6	55·3	303	640	348	89	71	86	N. N. E.	S. S. W.	S. by W.	0·00	0·08	0·02	......	......	Clear.	Clear.	Clear.
26	078	29·998	29·933	45·0	81·0	64·1	258	644	803	88	64	86	N. E. by E.	N. E. by E.	S.	0·20	1·17	1·27	......	......	Clear.	Clear.	Clear. Aurora Borealis.
27	29·852	783	804	60·3	71·6	63·5	420	503	569	82	66	97	S. E. by S.	S. E. by S.	S. E. by S.	0·78	6·21	1.30	0·076	......	C. Str. 10.	C. Str. 10.	C. Str. 10.
28	704	614	535	64·6	80·1	69·0	590	677	642	97	66	92	S. E. by S.	S. E. by S.	E. S. E.	0·00	0·00	0·00	......	......	" 10.	C. C. Str. 6.	Ni. 10. Rain.
29	471	424	581	59·5	75·0	63·0	469	673	577	94	79	90	S. W. by W.	W. S. W.	W. S. W.	0·42	4·02	3·03	1·100	......	" 10.	" 4.	C. Str. 9.
30	439	545	654	60·4	75·2	61·0	511	648	511	97	79	97	S. W.	S. by W.	S. E. by S.	0·00	0·00	0·00	0·101	......	Rain.	Cirr. Cum. 4.	C. Str. 9.
31	787	719	754	65·9	79·4	63·6	420	651	549	94	60	96	E.	E.	S. by W.	6·03	0·05	0·18	......	......	C. Str. 10.	C. Str. 6.	C. Str. 6. Aur. Bor.

REPORT FOR THE MONTH OF SEPTEMBER, 1858.

	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.			6 a. m.	2 p. m.	10 p. m.
1	29·757	29·797	29·827	64·0	71·0	60·6	·525	·572	·511	·86	·76	·97	S. W.	S. W.	S. W.	0·02	1·67	0·31	0·220	......	C. Str. 3.	C. Cir. 6.	C. Str. 2. Aur. Borealis.
2	872	863	600	60·0	81·4	65·7	·450	·623	·549	·88	·55	·89	S. W. by S.	S. by W.	S. by W.	0·03	0·51	0·67	......	......	Clear.	Clear.	Clear.
3	554	623	892	63·5	69·3	61·8	543	671	557	97	95	97	S. by W.	S. W.	S. S. W.	2·73	0·27	1·43	0·300	......	C. Str. 10.	C. Str. 10.	"
4	606	552	898	89·0	79·5	65·0	446	651	503	91	66	86	S. W.	S. W. by S.	S. by W.	0·22	0·86	0·90	......	......	Clear.	" 4.	C. Str. 6.
5	585	578	694	55·9	66·1	58·1	420	536	452	94	84	94	S. S. W.	N. W. by W.	W. by S.	0·09	6·73	3·01	0·310	......	"	" 4.	Clear. Thunder.
6	740	815	956	56·1	73·7	58·6	413	476	452	90	59	94	W. S. W.	N. N. W.	W. S. W.	1·73	0·20	1·86	1·201	......	"	" 6.	Clear.
7	947	849	883	52·0	85·0	68·2	334	643	577	86	58	85	S. W.	W. S. W.	S. W.	0·00	1·51	3·77	......	......	"	Light Cirri.	Clear. Aurora Borealis.
8	839	815	852	64·0	86·1	74·2	529	721	614	89	55	68	S. W.	S. W.	S. W.	7·50	0·52	6·08	......	......	"	C. Str. 4.	C. Str. 4.
9	813	823	814	70·7	67·6	60·1	621	584	511	85	87	96	W. S. W.	N. E. by E.	N. E. by E.	0·70	2·98	4·75	Inapp.	......	C. Str. 10.	" 8.	" 8.
10	734	614	529	65·0	89·0	76·2	549	721	731	97	53	81	E. S. E.	E. S. E.	S. S. E.	0·00	0·00	0·00	0·017	......	" 10.	" 4.	Clear. Lightning.
11	749	638	679	61·1	69·1	60·4	480	457	420	91	63	82	W. S. W.	W. S. W.	W. S. W.	0·01	2·74	1·92	0·066	......	" 3.	" 6.	C. Str. 2. Aur. Borealis.
12	787	674	519	50·0	70·2	52·1	341	516	321	96	70	86	W.	W.	W.	0·08	1·23	19·01	0·200	......	Rain.	C. C. Str. 4.	Str. 3. " "
13	860	885	30·092	40·7	66·4	50·0	219	316	302	87	49	82	W. by S.	W. S. W.	S. W.	0·26	0·77	0·81	......	......	Clear.	" 3.	Clear.
14	30·075	30·047	017	40·1	76·4	56·6	221	614	413	91	68	89	E. S. E.	S. E.	S.	0·00	0·10	0·62	......	......	"	Clear.	C. Str. 6.
15	29·934	29·815	29·782	54·0	72·6	62·7	369	483	399	89	61	72	S.	S.	S.	0·00	6·43	6·51	......	......	C. C. Str. 6.	C. Str. 4.	" 9.
16	557	129	033	52·6	58·4	55·7	384	476	427	90	97	97	N. E.	N. E. by E.	W. by N.	3·60	11·77	1·05	2·799	......	Ni. 10.	" 6.	" 6.
17	433	562	783	54·2	58·1	49·7	362	309	290	87	64	82	W. by N.	W. by N.	S. W. by W.	5·40	6·75	3·61	0·636	......	Rain.	C. C. Str. 6.	" 10.
18	30·024	30·097	30·118	40·0	59·7	49·6	219	588	272	87	73	78	W.	W.	W.	0·00	4·00	0·00	......	......	Clear.	Clear.	Clear. Aurora Borealis.
19	206	161	153	49·0	67·0	52·0	265	522	334	75	79	86	N. E. by N.	S. by W.	S. by W.	0·00	0·04	0·08	......	......	"	Cir. Cum. 3.	C. Str. 10.
20	29·948	29·750	29·720	48·3	83·5	71·0	285	630	644	85	54	86	S. W. by S.	W. S. W.	S. W.	3·67	2·60	1·26	......	......	"	C. C. Str. 4.	" 10. Aur. Borealis.
21	731	707	652	60·1	68·1	48·0	426	658	316	82	90	95	N. E. by E.	N. E. by N.	W.	8·50	4·76	5·31	0·680	......	C. Str. 10.	Rain.	Rain.
22	864	924	997	42·2	44·6	40·0	308	166	182	79	56	73	N. W.	N. W.	W. N. W.	1·06	0·12	0·03	Inapp.	......	Clear.	C. C. Str. 10.	Clear. Aurora Borealis.
23	976	910	871	31·0	70·1	50·0	161	586	265	95	80	75	W.	W. S. W.	W. S. W.	2·96	2·16	0·87	......	......	"	C. Str. 6.	C. Str. 6.
24	698	30·054	30·001	47·4	60·3	43·2	292	285	209	92	54	75	S. W. by W.	S. W. by W.	N. W.	2·11	1·62	0·00	Inapp.	......	C. Str. 10.	Clear.	Clear.
25	30·132	29·885	163	32·4	57·8	45·2	168	236	269	89	50	88	W. by S.	N. N. W.	S. S. W.	2·22	0·00	0·26	......	......	Clear.	Cirr. 3.	"
26	187	30·214	246	37·7	68·1	50·1	193	411	335	86	60	93	W. S. W.	S. S. E.	S. S. E.	0·00	0·01	0·00	......	......	C. Str. 4.	" 4.	C. Str. 2.
27	254	194	189	49·7	69·7	48·7	219	423	303	87	59	89	W. by S.	S. E.	S. E.	0·00	0·05	0·00	......	......	" 8.	C. Str. 2.	Clear.
28	126	015	29·964	41·8	69·9	54·3	235	391	362	91	54	87	E. by N.	S. E.	S. E. by E.	0·01	0·25	0·61	......	......	C. C. Str. 8.	" 4.	C. Str. 10.
29	29·785	29·610	505	47·1	69·8	58·0	256	456	416	81	63	85	S. by E.	S. S. E.	S. E. by E.	0·42	2·22	1·22	0·410	......	C. Str. 6.	" 8.	" 10. Thunder.
30	594	579	624	54·6	63·0	52·9	390	392	321	93	69	86	W. by S	W. by N.	N. E. by E.	0·61	2·35	0·00	......	......	" 4.	" 2.	C. Str. 10.

REMARKS FOR AUGUST, 1858.

Barometer .... Highest, the 13th day, 30·138 inches.
Lowest, " 29th " 29·424 "
Monthly Mean, 29·789 inches.
Monthly Range, 0·714 "

Thermometer ... Highest, the 14th day, 93°7.
Lowest, the 19th day, 38°8.
Monthly Mean, 66°12.
Monthly Range, 54°9.

Greatest intensity of the Sun's rays, 117°0.
Lowest point of terrestrial radiation, 37°9.
Mean of humidity, ·818.

Amount of Evaporation in inches, 2·68.

Rain fell on 14 days, amounting to 4·023 inches; it was raining 34 hours 59 minutes, and was accompanied by thunder on 5 days.

Most prevalent wind, S. E. by E. Least prevalent wind, S.

Most windy day, the 4th day; mean miles per hour, 12·05.

Least windy day, the 20th day; mean miles per hour, 0·00.

Aurora Borealis visible on 6 nights.

The Electrical state of the atmosphere has indicated moderate intensity.

Ozone was present in moderate quantity.

REMARKS FOR SEPTEMBER, 1858.

Barometer. ...... Highest, the 27th day, 30·254 inches.
Lowest, " 16th " 29·033 "
Monthly Mean, 29·830 inches.
Monthly Range, 1·221 "

Thermometer. Highest, the 10th day, 90°2.
Lowest, " 23rd " 30°5.
Monthly Mean, 59°13.
Monthly Range, 59°7.

Greatest intensity of the Sun's rays, 104°1.
Lowest point of terrestrial radiation, 30°1.
Mean of humidity, ·804.
Amount of Evaporation in inches, 2·34.

Rain fell on 14 days, amounting to 5·839 inches; it was raining 43 hours 25 minutes, and was accompanied by thunder on 3 days.

Most prevalent wind, S. W. Least prevalent wind, S. E.

Most windy day, the 21st day; mean miles per hour, 6·19.

Least windy day, the 10th day; mean miles per hour, 0·00.

Aurora Borealis visible on 7 nights.

The Electrical state of the atmosphere has indicated feeble intensity.

Ozone was present in moderate quantity.

First Frost on the 14th day.

Comet first seen on the 5th September.

MONTHLY METEOROLOGICAL REGISTER, AT MONTREAL, (LATITUDE 45° 30′ N., LONGITUDE 73° 36′ W.,) FOR THE MONTH OF AUGUST, 1858.

HEIGHT ABOVE THE LEVEL OF THE SEA, 57·07 FEET.

BY A. HALL, M. D.

Day of Month.	Barometer, Corrected and reduced to Fah., 32°.			Temperature of the Air.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction and Velocity of Wind at hour of observation.			Mean velocity of the wind in miles per hour.	Amo'nt of Rain in Inches.	Clouds and their Proportion, in Numbers, from 0, Cloudless, to 10, perfectly Overcast.			OBSERVATIONS.
	7 a. m.	2 p. m.	9 p. m.	7 a m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.		10 a. m.	7 a. m.	2 p. m.	9 p. m.	
1	29·952	29·926	29·974	60·6	71·9	64·3	·442	·455	·433	·83	·58	·73	N E 2.	E N E 1.	N E 1.	1·00	....	Cir. St. 5	Cu. 3	0 0	Meteor at 2·23 A. M., from constellation "Aquila."
2	30·053	30·051	30·063	56·0	69·2	62·9	·420	·496	·478	·94	·70	·83	Calm.	Calm.	Calm.	2·37	....	Cu. St. 10	Strat. 4	0 0	
3	069	034	29·999	66·0	78·0	60·0	·470	·310	·456	·73	·32	·88	E S E 2.	E S E 6.	Calm.	2·75	....	Cu. St. 6	Cu. St. 10	Nim. 10	Rain.
4	29·898	29·809	761	61·0	66·1	64·4	442	536	536	83	84	92	S 2.	S 1.	Calm.	2·08	0·56	Nim. 10	Nim. 10	Nim. 10	Rain. Distant lightning at night.
5	760	742	745	63·5	75·2	68·0	536	628	577	92	73	85	S W 1.	Calm.	Calm.	0·62	0·58	Cu. St. 6	Cu. 5	Cu. St. 7	
6	808	830	900	68·5	75·0	66·5	349	591	425	51	68	64	Calm.	Calm.	Calm.	0·04	....	Cu. St. 8	Cu. St. 5	Strat. 3	Rain.
7	30·030	30·038	30·097	62·7	73·8	67·4	478	363	450	83	43	67	Calm.	Calm.	Calm.	0·04	Inap.	0 0	0 0	0 0	
8	174	078	059	75·0	78·0	70·0	554	478	449	64	50	61	Calm.	Calm.	Calm.	0·00	....	0 0	0 0	Strat. 1	
9	056	29·979	000	69·0	75·0	73·0	599	666	581	85	77	72	Calm.	Calm.	Calm.	0·00	....	Cir. St. 7	0 0	Cu. St. 8	
10	29·948	884	29·871	75·0	83·0	75·0	591	520	519	68	46	60	Calm.	Calm.	Calm.	0·04	....	Cir. St. 8	Cir. 1	Strat. 1	
11	882	886	888	68·8	75·0	70·0	367	785	658	52	90	90	Calm.	Calm.	Calm.	0·45	....	Strat. 2	Nim. 10	Nim. 10	Rain. Distant Thunder.
12	30·041	30·100	30·187	69·0	77·2	68·2	529	422	380	75	46	56	N E 3.	N E 1.	Calm.	1·25	0·19	0 0	0 0	0 0	Auroral Light.
13	304	260	260	63·0	79·0	70·0	446	574	449	77	58	61	N E 1.	N E 1.	N E 1.	0·12	....	0 0	0 0	0 0	
14	238	130	29·984	67·0	79·8	72·6	459	677	524	75	66	66	Calm.	Calm.	Calm.	0·08	....	Cir. 2	0 0	0 0	Auroral Light.
15	29·899	29·780	910	65·0	80·0	69·0	516	523	529	84	51	75	Calm.	W S W 1.	W S W 1.	0·75	....	Cir. Cu. 6	Cir. Cu. 8	0 0	
16	30·183	30·068	30·092	60·0	70·2	61·0	456	385	442	88	53	83	Calm.	Calm.	Calm.	0·00	....	0 0	0 0	0 0	Faint Auroral Bank.
17	104	29·992	29·884	58·8	78·9	70·0	416	501	621	85	51	85	Calm.	Calm.	Calm.	0·08	....	0 0	Cu. 3	0 0	
18	29·745	547	555	69·0	83·8	80·0	635	623	977	90	53	96	Calm.	S 2.	W S W 2.	0·95	....	0 0	Cu. 5	Nim. 10	Rain, with thunder.
19	803	851	863	55·0	59·4	55·0	362	323	321	87	65	74	N W 1.	N N W 1.	N N W 1.	0·29	0·12	Cu. 10	Cu. St. 10	Cu. St. 9	
20	853	791	777	52·8	65·4	58·5	295	359	483	73	58	100	W N W 0·5.	W S W 0·5.	W 1.	0·03	....	Cu. St. 10	Cu. St. 7	Nim. 10	Rain.
21	860	859	904	55·7	68·0	63·5	420	476	483	94	69	78	N W 0·5.	N W 0·5.	W 0·5.	0·01	0·79	Cu. St. 9	Cu. St. 10	Cu. St. 10	Rain.
22	812	758	897	55·0	64·0	55·0	295	464	321	68	77	74	W 1.	W 6.	W N W 3.	0·95	0·37	Cu. St. 10	Cu. St. 10	Cu. St. 10	Rain.
23	30·017	982	30·019	54·0	58·0	52·0	282	255	257	67	53	56	N W 1.	W N W 1.	W N W 7.	2·29	0·08	Cu. 7	Cu. 5	Cu. 3	
24	29·920	917	012	61·0	61·0	58·0	442	396	337	83	76	70	W S W 1.	W S W 1.	N W 1.	2·00	....	Cu. 5	Nim. 10	0 0	Rain. Lunar Corôna.
25	30·210	30·244	257	52·4	63·8	56·6	276	257	302	70	43	66	Calm.	Calm.	Calm.	0·00	0·05	0 0	0 0	0 0	
26	057	118	051	53·5	75·0	64·6	315	449	464	77	52	77	N W 3.	Calm.	Calm.	0·95	....	0 0	Cir. Cu. 6	0 0	
27	29·984	29·929	29·921	54·0	70·0	64·0	335	482	529	80	66	89	S 1.	S 10.	S S E 2.	3·91	....	Cu. St. 10	Cu. St. 10	Nim. 10	Rain at night.
28	829	735	647	69·0	72·0	68·3	529	631	648	75	81	95	Calm.	Calm.	Calm.	0·16	0·30	Nim. 10	Cu. St. 10	Nim. 10	Rain.
29	588	592	624	68·0	71·0	64·3	577	508	433	85	66	73	W S W 1.	W S W 1.	Calm.	0·45	0·33	Cu. St. 9	Cu. St. 9	Cu. St. 10	
30	678	713	758	60·5	67·0	63·0	480	457	478	91	69	83	Calm.	S W 1.	Calm.	0·75	0·05	Nim. 10	Cu. St. 5	Strat. 2	Rain early A. M.
31	861	858	885	55·8	67·0	63·0	363	489	510	81	75	88	Calm.	Calm.	Calm.	0·00	....	Cu. St. 10	Cir. St. 10	Cu. St. 10	

REPORT FOR THE MONTH OF SEPTEMBER, 1858.

	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p. m.	7 a. m.	2 p. m.	9 p.m.			7 a. m.	2 p. m.	9 p. m.	
1	29·944	29·926	29·951	62·0	70·0	63·6	·533	·516	·433	·94	·70	·73	W 1.	W 1.	W 0·5.	0·29	....	Cu. St. 10	Cu. St. 8	Strat. 1	Aurora, with streamers.
2	964	838	795	58·8	74·0	67·5	·439	·429	·556	·88	·51	·84	Calm.	S 0·8.	Calm.	0·03	....	Cir. 2	Cir. 2	0 0	
3	718	678	705	66·0	67·0	63·0	·570	·662	·543	·89	·100	·94	S 0·7.	S W 0·5.	S W 0·5.	0·37	....	Cu. St. 10	Nim. 10	Cu. St. 3	Rain.
4	762	718	692	69·0	71·0	65·2	497	608	483	70	80	78	W S W 0·5.	W S W 0·5.	S W 0·5.	0·12	0·78	Nim. 10	Cir. Str. 5	Cu. St. 9	
5	659	864	804	60·2	73·8	59·5	456	641	403	88	77	79	Calm.	W S W 3.	Calm.	0·87	....	Strat. 1	Cu. 9	Strat. 2	Distant lightning in the evening.
6	954	30·016	30·148	63·0	70·0	60·3	478	516	426	83	70	82	N W 1.	W N W 1.	Calm.	0·79	0·45	Cir. St. 9	Cu. St. 8	Cu. St. 5	
7	30·189	031	29·988	57·2	75·0	69·0	407	484	496	87	56	70	S W 1.	S W 9.	Calm.	2·75	....	Cu. St. 7	Cu. St. 2	0 0	Auroral Light.
8	005	29·919	885	62·6	82·0	73·6	416	730	561	72	67	65	Calm.	W 8.	W 1.	4·25	....	Strat. 3	Strat. 1	0 0	Faint Auroral Light.
9	29·982	30·001	988	72·3	66·0	62·0	601	502	491	78	78	88	W 2.	N N W 4.	Calm.	5·79	....	Cu. St. 10	Cu. St. 10	Cu. St. 7	Rain.
10	901	29·740	612	61·0	76·0	72·5	511	722	745	97	86	95	Calm.	S E 5.	S E 4.	3·29	0·08	Nim. 10	Cir. St. 6	Strat. 1	Rain.
11	775	750	655	61·7	67·8	60·0	429	380	396	77	56	76	W 6.	W S W 1.	Calm.	2·29	0·20	Cu. St. 10	Cu. St. 9	0 0	Rain.
12	765	828	968	54·0	63·0	55·0	362	327	295	87	57	68	W 1.	Calm.	Calm.	1·79	....	Cu. St. 10	Cu. St. 8	Cu. 7	Rain. Aurora, with streamers.
13	30·222	30·192	30·257	55·0	62·0	53·0	295	256	321	68	46	80	Calm.	W N W 1.	Calm.	0·29	0·18	Cu. St. 5	Cu. St. 5	0 0	Auroral Light.
14	297	212	196	60·0	66·0	64·0	367	316	314	71	49	53	Calm.	W S W 1.	W S W 1.	1·25	....	Cu. St. 7	Strat. 4	0 0	
15	142	29·994	29·906	56·2	67·0	61·6	363	393	530	81	59	97	S 2.	Calm.	S 6.	6·95	....	Cu. St. 8	Cir. St. 6	Cu. St. 10	
16	29·526	264	232	53·0	57·8	56·0	403	474	420	100	100	94	N E 5.	N E 11.	W 2.	6·00	0·39	Nim. 10	Nim. 10	Nim. 10	Rain.
17	523	766	871	53·8	60·0	50·0	369	310	335	90	60	93	W N W 5.	W S W 15.	W N W 1.	1·87	1·00	Nim. 10	Cu. St. 8	Nim. 7	Rain in showers.
18	30·224	30·220	30·270	46·6	58·9	52·0	256	242	232	81	48	60	W S W 1.	W S W 5.	W S W 1.	1·79	0·29	Cu. St. 10	Cu. St. 8	0 0	
19	423	317	301	49·0	59·0	53·9	272	323	335	78	65	80	Calm.	E N E 3.	Calm.	0·25	....	Cir. Cu. 7	Cir. 9	Cir. Cu. 8	Solar Halo.
20	120	29·954	29·882	54·0	76·0	70·2	362	577	586	87	64	80	S W 1.	S W 7.	S W 5.	5·50	....	Cir. Strat. 1	Cir. 5	Strat. 1	
21	29·848	821	952	66·0	52·0	49·0	604	388	322	94	100	92	N E 4.	N N E 12.	N N E 1.	5·66	Inap.	Cu. St. 10	Nim. 10	Cir. St. 10	Rain, thunder, and lightning.
22	30·044	30·038	30·095	45·0	46·8	43·0	182	156	186	61	48	67	N N W 5.	N N W 3.	W 1.	1·54	0·64	Cu. 5	Cu. St. 10	0 0	
23	143	123	29·981	40·4	52·7	49·0	154	201	247	61	51	71	Calm.	W 5.	Calm.	2·45	....	0 0	Cu. 6	0 0	
24	29·844	29·928	30·152	49·0	55·0	46·0	322	218	238	92	50	77	W 1.	W 3.	N 3.	2·16	0·06	Nim. 10	Cu. St. 6	0 0	Rain.
25	30·281	30·251	261	41·3	55·0	45·0	147	295	228	57	68	76	N 2.	Calm.	W 1.	1·12	....	Strat. 1	Strat. 2	0 0	
26	331	319	355	44·7	55·9	49·0	258	203	272	88	39	78	Calm.	Calm.	Calm.	00·0	....	Cu. St. 10	Cu. 2	Cu. 4	Faint Auroral Light.
27	365	278	327	46·0	58·0	49·0	262	255	272	84	53	78	W S W 1.	Calm.	Calm.	0·04	....	Cu. 9	Cu. St. 7	0 0	
28	321	147	187	47·8	60·0	56·0	273	255	309	85	49	64	S W 1·	Calm.	Calm.	1·75	....	Cu. St. 8	Cu. St. 4	Cu. St. 10	
29	29·983	29·717	29·787	51·5	63·0	58·6	341	386	446	89	67	91	Calm.	S 3.	S 1.	1·41	....	Cir. Cu. 5	Nim. 10	Nim. 10	Rain.
30	682	755	730	57·4	63·3	53·0	429	386	219	91	67	44	W 1.	W N W 4.	W N W 12.	5·87	0·13	Strat. 1	Cu. 3	Nim. 10	Rain.

REMARKS FOR AUGUST, 1858.

Barometer ...... Highest on the 13th day: 30·304 inches.
Lowest " 18th " 29·547 "
Monthly mean, 29·0564 inches.
Monthly range, 0·757 "

Thermometer. . Highest on the 10th day, 85°2.
Lowest " 24th " 49°0.
Monthly mean, 66°37.
Monthly range, 36°2.

Warmest day was the 10th. its mean temperature being 77°66.
Coldest " " 23rd, " " " 54°66.
Greatest intensity of the sun's rays, 137°5, on the 13th day.
Mean of humidity for the month, ·712.
Rain fell on 13 days during 51 hours 20 minutes, amounting to 3·42 inches.

The most prevalent wind was the W. S. W.
The least prevalent wind was the E. N. E. and S. S. E.
The mean Monthly Dew Point, 56°55.
The most windy day was the 27th day, the mean velocity 3·91 miles per hour.
The most windy hour between 12 and 1 p. m. of the 27th day; the mean velocity, 14 miles per hour.
There occurred calm days on the 8th, 9th, 16th, 25th and 31st.
No record of wind from the N., N.N.E., E., S.E., or S.S.W.
Cloudless days occurred on the 7th, 12th, 13th, 16th, and 25th.
The Aurora was seen on 3 nights. It was not visible on 14 nights.
Ozone was in moderate proportion.

N. B. The rain and snow guages are noted each morning at 10 a. m.

REMARKS FOR SEPTEMBER, 1858.

Barometer ...... Highest on the 19th day: 30·423 inches.
Lowest " 16th " 29·232 "
Monthly mean, 1·191 inches.
Monthly range, 29·969 "

Thermometer. . Highest on the 3rd day: 89°0.
Lowest " 26th " 40°0.
Monthly mean, 59°08.
Monthly range, 49°0.

Warmest day was the 8th, its mean temp. having been 77°56.
Coldest day was the 24th, " " " 43°33.
Greatest intensity of the sun's rays, 129° on the 2d & 10th days.
Mean of humidity for the month, ·747.
Rain fell on 13 days during 60 hours 45 minutes, amounting to 4·30 inches.

The most prevalent wind was the W.
The least " " were the N.W. and E.N.E.
No record of wind from the E., E.S.E., S.S.E., or S.S.W.
No cloudless day occurred.
A calm day occurred on the 26th.
The most windy day was the 15th, the mean velocity having been 6·95 miles per hour.
The most windy hour between noon and 1 p. m. of 16th day, the actual velocity having been 18 miles per hour.
The Aurora was seen on 5 nights. It was not visible on 13 nights when it could have been seen, if existing; the remaining nights were clouded.
Ozone was in moderate ratio.

N. B. The rain and snow guages are noted each morning at 10 a. m.