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THE

CANADIAN NATURALIST

AND

Quarterly Journal of Science,

WITH THE

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CONDUCTED BY A COMMITTEE OF THE SOCIETY.

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THE
CANADIAN NATURALIST
AND
Quarterly Journal of Science.

NOTES OF A VISIT TO SCIENTIFIC SCHOOLS AND MUSEUMS IN THE UNITED STATES.

By Principal DAWSON, LL.D., F.R.S., &c.

Away from snow and frost, on the rail, rapidly sweeping through New England villages with their snug homes and busy factories, we approach the great western emporium, the lesser London, the commercial capital of the "greater Britain" of the western world—already numbering its million and a half of people, and rivalling old London in all the higher and lower phases of a city life. Our business is not with either its trade or its gaiety. We have first to tell to such of its people as care to know of such old world things, our story about "Primeval Forests," and then to scrutinise, under the guidance of our friend Dr. Newberry, the class-rooms, laboratories and museums of Columbia college, a workshop of mind, aiming to train young men to that practical grasp of science which shall enable them to apply its principles to the better extraction and working into useful purposes of the dark treasures of mother earth. Columbia College is a brick building in a quaint old fashioned square, once out of town, but overgrown by the rapid increase of the great city, which swallows up farms, estates, and country houses as if they were mere morsels to its voracious appetite. The building, which was intended for an asylum, forms three sides of a quadrangle, and has many long narrow rooms well lighted by windows in the sides. It is regarded as merely a temporary residence for the college, whose large endowment of nearly $1,500,000 is being in great part retained by its trustees as a basis for more extended operations than those of the present "School of Mines." Still it is well adapted to its use, and has been admirably arranged. Three of its long rooms, like the wards of a hospital, but with tables and shelves instead of beds, are fitted up as working laboratories in which a hundred and twenty students may at once pursue qualitative and quantitative analysis. Another room in the basement is furnished with furnaces and other appliances for assaying in the dry way. Another is arranged for drawing, and there are several plainly furnished but commodious class rooms. One of the rooms is devoted to the collection of minerals, which is very neatly arranged in flat cases, with abundant illustrations of crystalline forms interspersed. Another contains the collections of geology and palæontology, in great part consisting of the private cabinet of Professor Newberry, and especially rich in the flora of the coal period, and in illustrations of the ores and other economic products of America.

The staff of Columbia College consists of eighteen Professors, lecturers, and assistants, representing the subjects of mineralogy, metallurgy, chemistry, botany, mathematics, mechanics, physics, geology and palæontology, assaying and drawing. Its course extends over three years, and embraces the work necessary to qualify for practical operations in mineral surveying, mining, metallurgy and practical chemistry. Students are required on entrance to pass an examination in algebra, geometry and trigonometry. Though it has been in operation on its present basis only for a few years, it had in its last catalogue 109 students, the greater part of whom, on attaining to the degree of "Engineer of Mines" or "Bachelor of Philosophy," will go out as practical workers in mines and manufactories. An important feature of the course is that students are expected in the vacation to visit mines and metallurgical and chemical establishments, and to report thereon and make illustrative collections; while during the session short excursions are made to machine shops and metallurgical establishments in and near the city. It is probable that Columbia College is little cared for or thought of by the greater part of the busy multitudes of New York; yet if a map of the city were made on the principle of the missionary maps, but illustrating the places where true industrial progress is being provided for, it would be a very white spot, though but a very small one, in the great Babel.

From New York to New Haven is from a great city with small science to a small city in which science bulks relatively larger. On Christmas Day we looked in upon Professor Marsh, almost buried among all that is richest and rarest in new scientific literature and choice specimens, and enjoyed again the genial look and kindly greeting of our friend Silliman, and chatted for a little with the keen philosophic Dana, shattered indeed in health, but still growing inwardly in spirit. The Sheffield Scientific School is a modern outgrowth of the old University of Yale College; and originated in 1847 in the organization of the "Department of Philosophy and Arts," under Professors Silliman and Norton, representing respectively the subjects of Applied Chemistry and Agriculture. The scheme seems to have been devised by the elder Silliman, and to have had its birth in his private efforts in previous years to give practical instruction to special students. This department was maintained with moderate success for several years; but at length in 1860 Mr. Sheffield, a wealthy citizen of New Haven, came forward to its aid with the handsome gift of a building and apparatus valued at over $50,000 and a fund of $50,000 more to endow Professorships of Engineering, Metallurgy and Chemistry. This enlightened benefaction at once placed the school on a respectable footing, and in 1863 it was further enlarged by the application to its use of the share of the State of Connecticut in the large grants of land made by Congress in that year for purposes of scientific education,—grants which have borne similar good fruit in many other States. The Sheffield School will also be a large sharer in the benefits which the University will derive from the great Museum founded by Mr. Peabody, and endowed by him with the sum of $150,000. The present extremely valuable collections of Yale College are stored in rooms of quite inadequate dimensions, and are being rapidly augmented and improved. Prof. Marsh and Prof. Verrill alone have vast stores of fossils, corals and other specimens, in basements and cellars; and when the whole shall be arranged in Mr. Peabody's Museum, Yale College will be inferior to few Academic institutions in the world in regard to its facilities for teaching the science of nature through the eye. A special collection in the Sheffield School, very valuable and well worthy of study, is that of economic geology. It is admirably arranged, and gives at one view an idea of nearly all the sources of the mineral wealth of the United States from the Atlantic border to the Pacific.

The building of the Sheffield School is better than that of Columbia College, though it is an old medical school adapted to its present use; and the scope of the institution is wider, including six distinct courses, any of which may be followed by the student. These are: 1st, Chemistry and Mineralogy; 2nd, Engineering and Mechanics; 3rd, Mining and Metallurgy; 4th, Agriculture; 5th, Natural History and Geology; 6th, A Select Scientific and Literary Course. The class-rooms and laboratories struck me as remarkably ingenious and neat in all their arrangements, and combining in a great degree all possible contrivances for the convenience of Professors and students. The bungling and uncomfortable arrangements too often seen in Academic rooms had evidently here been replaced by the exercise of some engineering and mechanical skill and contrivance, and by a combination of lecture room and cabinet the means of illustration had been rendered extremely accessible. In token that the Sheffield School is not altogether a school of mines looking down into the bowels of the earth, its liberal founder has presented it with an Equatorial Telescope, made by Clark, with an object glass having an aperture of nine inches. It is placed in a tower constructed for it; and with a meridian circle and other instruments, enables students to learn all the work of a regular observatory, as well as the operations of astronomical geodesy. Any one interested in the training of the young men of Canada can scarcely avoid a feeling of envy in visiting such an institution as this, furnished with so many facilities for enabling the active mind of youth to grasp all that is of practical utility or provocative of high and noble thought in the heaven above and in the earth beneath. At this moment a Canadian Sheffield, judiciously aiding any University having an adequate and permanent basis, would do more to promote the trade and manufactures of this country, and its scientific reputation, than can be done by any other agency.

The faculty of the Sheffield School includes twenty-three names, and its roll of students numbers one hundred and forty. It is scarcely necessary to say that several of the Professors at Yale are active and successful original workers, and that the place is not only an effective scientific school, sending out each year a large corps of trained men into the higher practical pursuits connected with science, but also an important centre of discovery and original investigation, further materials for which are being constantly accumulated. More especially in geology, mineralogy, palæontology, zoology and chemistry, are such men as Dana, Silliman, Marsh, Brush and Verrill adding to the stock of knowledge for the whole world, as well as training their students. And this one of the results in all cases of a well appointed and efficient school of science.

Crossing the dark harbour of New York, cumbered with cakes of ice; and rapidly rolling over flat New Jersey, interesting for its curious deposits of the green-sand of the old Cretaceous Sea, now quarried as a manure, and to be seen in heaps green almost as grass, by the roadside, we reach pleasant, quiet Philadelphia, in which among chief objects of interest to a scientific traveller, are the collections of its old and useful Academy of Sciences, a scientific workshop as vigorous in its age as any of its more youthful rivals, though sadly in want of enlarged apartments for its collections. Hawkins had just been setting up here the skeleton of the Hadrosaurus of the New Jersey green-sand, one of the most portentous of those old reptiles of that Mesozoic age, when the giant "tanninim" were the lords of creation. It must have been a creature four-fifths reptile and the rest bird, standing upright twenty feet in height, on two enormous legs with three-toed feet, and an immense pillar-like tail, while its small fore feet were used as hands to aid it in obtaining the fruits or other vegetable substances on which it fed. It might be described as a gigantic reptilian kangaroo with the toes of a bird; and were it not for the actual bones proving that it had existed, a zoologist would scarcely have the hardihood to imagine such a creature in his dreams. We stand amazed beside the skeleton of the Mastodon or the Megatherium, but not with the feeling almost of disbelief in our senses excited by the strange combination of characters in this wonderful animal, which among other things shows how the apparent bird-tracks of the Mesozoic rocks, or some of them, may have been made by biped reptiles, strange and gigantic anticipations of the attitude of man himself. As a companion, or rather a formidable enemy, to this animal, Mr. Cope, who is studying these remains, showed me portions of the skeleton of a gigantic carnivorous reptile of the same age, with formidable teeth like those of Megalosaurus, and hooked eagle-like claws which must have been ten inches in length. The collections of the Academy are of immense value, and its Scientific Library is very complete, but it greatly lacks room and light. Efforts are now being made to secure a better building. Among other things it possesses an extremely valuable and very complete collection of American skulls, which have afforded materials to Morton, Wilson and Meigs for elaborate investigations on the cranial characters of races, and which are scarcely yet exhausted as sources of information on this very important subject.

Two works are now in progress in Philadelphia, which will be of great value to students of American Palæontology. One is a monograph on American fossil mammals, by Leidy; the other a monograph on American fossil reptiles, by Cope. One of these is to be published in the Transactions of the Philosophical Society; the other in those of the Academy,—both active Societies and fellow-workers in the cause of science.

Baltimore, though a queenly city, does not stand so high as Philadelphia in scientific work. It has, however, its Academy with a band of zealous naturalists, of whom Tyson, Morris and Dalrymple were old friends, and others I was glad to meet for the first time. The vicinity of the city presents a strange association of old and new rocks, characteristic of that line of junction of the more recent formations of the coast with old metamorphic rocks, on which so many American cities have been placed. In the quarries near the town are gneiss, hornblende schist and granite, which have much of the aspect of Laurentian rocks, and according to Mr. Tyson's sections may be of that age. To a northern visitor they are remarkable for the depth to which they have been decomposed by the weather. Similar rocks in Canada usually present a hard polished surface, as if incapable of decomposition; here there are many feet of "rotten rock" at the surface. The causes may be: 1st, the more rapid waste of felspathic rocks under a warmer climate and a larger rain-fall; 2nd, the want of a tenacious clay covering; 3rd, the absence of the great Northern drift and its ice-striation and polishing. There does not seem to be any evident difference in the composition of the rocks to account for it. Another point of interest is the extremely red colour of the sand formed from the decomposition of the hornblendic portions of the rock. The oxide of iron resembles anhydrous peroxide in its colour; and the sand formed from it would give a very good red sandstone. Many ages of subaerial decomposition of rocks like these, followed by rapid denudation, would give red sandstone rocks like those which appear in so many geological periods.

Among these ancient rocks, there appear beds of white, red and dark gray clay. In the latter there are numerous trunks of trees converted into lignite, and layers of nodules of carbonate of iron, which are extracted in large quantities as an ore of the metal. It appears that in the lower beds of this formation well preserved trunks of Cycads are found, and the whole are regarded by Mr. Tyson as possible representatives of the Wealden. In one of the fossil trunks I observed a portion of charcoal perfectly representing the mineral charcoal which occurs under similar conditions in the coal formation; and in this comparatively modern formation, deposited probably in a lagoon or estuary, the conditions of deposition of the clay-ironstones of the coal-measures are perfectly reproduced.

The Peabody Institute at Baltimore is a remarkable monument of the generosity of a man celebrated for his princely munificence. Mr. Peabody resided for some time in Baltimore, and, as an evidence of his regard for its welfare, he has presented to it the sum of one million of dollars, for the establishment of an Institute, the primary objects of which are stated to be—1st, an extensive library; 2nd, the delivery of lectures in science and literature, and in connection with this the provision of prizes and medals for competition in the high schools in the city; 3rd, an Academy of Music, and 4th, a Gallery of Art. In pursuance of these objects a plain but substantial and commodious building of white marble has been erected, and a library of the greatest possible excellence is rapidly being accumulated, while progress is being made in all the other objects contemplated. The Institute is already, in its Library, Lectures and Academy of Music, an inestimable boon to the city, and must speedily have a marked effect on the interests of literature and science. A museum is not at present contemtemplated; but if not otherwise provided for, it would be a worthy object to attempt, in such an institute, a representation at least of the geology and natural history of the State, which might do much to promote the development of its resources, as well as the education of its young men. The Provost, Mr. Morrison, is evidently earnest and enthusiastic in the good work in which he is employed, and the Librarian, Mr. Uhler, from his knowledg of

Natural Science, is specially fitted to take a practical view of the scientific part of the Library, and to be of service in the organization of a Museum should this be undertaken.

Such endowments as this of Mr. Peabody give to the United States an enviable eminence among the nations of the earth, in the promotion of popular culture and scientific progress. They constitute an unmistakeable evidence of the wisdom of the early American colonists in making provision for the general diffusion of education, and they show that in the future this great country is destined to be unrivalled in its means, whether in books, apparatus, collections, or teachers, for the development of the greatest of all the resources of nations—mind. Already it is outbidding the old world in the market of teaching labour, and of rare and costly specimens and books; and the growth, side by side, of its wealth and culture, must accelerate this more and more.

More fortunate than the belligerent Southerners, I found means to extend my peaceful raid into the heart of Washington itself; which, in a scientific sense, is the Smithsonian Institution, and in that of hospitality and kindly greeting, nowhere warmer than in Prof. Henry and his family. Washington seems to have grown and thriven on the war, but still presents the old contrast of massive and impressive public buildings with comparatively plain and even mean private residences, a point in which it differs from all the other great cities of America; but the reason readily appears from a consideration of its political circumstances. The Smithsonian Institution is cosmopolitan in its aims—its object being "the increase and diffusion of knowledge among men." This object, as wisely interpreted by Prof. Henry, is not to promote local ends, but those in which the world is interested; not to do that which any one can profitably do, but that which, while important in itself, cannot be done by other means. Thus peculiar in its aims, the Institution has to forego many tempting roads to popularity, yet like other good things it seems to be popular in spite of itself. Practically, as the great current of science on this continent necessarily runs much in the channel of discovery in Geology and Natural History, the work of the Institution lies much in this direction, and no institute in America has rendered more important aids to the prosecution of Natural Science. Its collections, under the skilful superintendence of Prof. Baird, are a marvel of system and careful arrangement; and are open to the inspection and study of naturalists from any part of the world; who are in some cases accommodated with rooms for their work as well as access to specimens. Its publications have given to the world a great mass of matter which would otherwise have been inaccessible to students. Its facilities for intercommunication and exchanges between scientific men, involving an immense amount of detail, have been of the utmost service, and its liberal disposal of duplicate specimens has strengthened the hands of students and teachers far and wide.

Prof. Henry and his assistants are at present giving much attention to the collection of American antiquities, and have accumulated a very large and instructive assemblage of objects of aboriginal art from all parts of the continent. The effort is a most important one America, with its modern stone age, must eventually furnish the clue to the right interpretation of the immense quantity of facts as to the stone and bone age of Europe now being accumulated, and of which the chronology is at present so strangely, and even absurdly, exaggerated by the majority of European archæologists.

It is a wide leap to pass from the arrow-heads and stone axes of the Aboriginal Indians to the multitudinous inventions of the modern Americans, but the transition is easily made by passing from the Smithsonian to the noble white marble building designated by the humble name of Patent Office, and inspecting its thousands of feet of glass cases crammed with machines and models, ingenious and stupid, useful and useless; but all monuments of the many inventions of scheming minds. The Patent Office is a vast and well arranged museum of useful art, but its cases are so numerous and so crowded with objects, that a non-professional visitor is simply bewildered, and contents himself with a general glance at the whole. In the lower hall there stands an object suggestive in several ways. It is the marble statue of Washington by Powers, sent during the late war by General Butler from Baton Rouge, in imitation, perhaps, of certain Generals of ancient Rome and modern France, in their treatment of works of art. It is a fine figure, somewhat idealised perhaps, but giving a far better conception of the temperament and aspect of the great American General than the current portraits.

A very interesting collection, known as the Army Medical Museum, has been formed in Ford's theatre, the building in which Lincoln was assassinated. It is a marvel of careful mounting and preparation, and in this respect alone is well worthy of a visit from any one interested in the best mode of exhibiting objects in a museum. It is of great professional value; and independently of this, it possesses a melancholy interest in its profuse exhibitions of the effects of shot, shell and other implements of destruction, on the poor human frame. Almost every conceivable form of injury received in war is here exhibited by preparations, every one of which tells not only the history of a surgical case, but a tale of suffering and death. A strange commentary it is on the humanity of a christian and civilized age to see these beautifully fashioned and fitted human bones, splintered by the rude violence of deadly missiles, and now mounted with all the dainty skill of the anatomical preparator. In flat cases, where they are much better seen than as ordinarily arranged in wall cases, are a few interesting American skulls—some of supposed mound-builders of the West, others of rude Indian tribes, and a few Mexican and Peruvian. One cannot fail to be struck, even on a cursory inspection of these skulls, as well of as the larger series in the Academy of Sciences in Philadelphia and in the Smithsonian, with such general views as the following;—1st. That there is one prevalent and somewhat long-headed form of skull very generally distributed in America; 2nd. That there are occasional and peculiar short-headed forms; 3rd. That some of the latter, as well as some of the long and narrow forms, are the results of artificial compression; 4th. That the skulls of the more civilized races are of a finer and more delicate type; 5th. That there is a strong resemblance between the ordinary American forms and those of the skulls of ancient and rude European and African tribes. These are general truths which rise out of the mass of details noticed by craniologists, and which are eminently suggestive as to the relationships and affiliations of men.

In leaving the museum I paused to look at two little glass cases containing two modern mummies of Indian children, in excellent preservation. One is a Flathead child, its skull compressed in the strange fashion of that tribe—its feet gathered up to its chest, its shrunken frame carefully wrapped in cloth, and on its breast bearing a necklace of beautiful Dentalium shells, the most precious treasure of the west coast, mixed with a few glass beads, perhaps almost as precious. The other is a Dakotah child, in full dress, with neatly made coat and leggins, and prettily worked mocassins, and a broad collar of white and blue beads and brass buttons neatly strung on leather. These, though quite modern, reminded me of the quantities of precious strings of wampum laid up in some ancient graves of Indian babes in British America, and which remain after the furs, no doubt clothing the bodies, have decayed. A higher phase of our humanity is represented by these remains than by the inventions of the Patent Office—the love that survives the death of its object, and which, in the absence alike of human philosophy and Divine revelation, preaches with a force stronger than sense and mere reason, that the loved one "is not dead but sleepeth," and will awake in another world, whither affection can follow it only by decking its poor remains in the best robe and burying it with the most costly treasures. Such faith in the Indian mother may be very simple and ignorant; but it is surely a better and holier thing than that cold skepticism which, while grovelling in a base selfishness, looks up in its higher flights of reason and imagination to tell us that man is but a better kind of brute, an aggregate of blind material forces.

NOTES ON THE GEOLOGY OF SOUTH-WESTERN ONTARIO.*

By T. STERRY HUNT, LL.D,, F.R.S., of the Geological Survey of Canada.

The paleozoic strata of the southwestern portion of the province of Ontario (late Upper Canada), are generally covered by a considerable thickness of clay, which has made their study extremely difficult. During the last few years, however, numerous borings have been made over a wide area in this region, in search of petroleum, and have disclosed many facts of geological interest. By frequently visiting the localities, and carefully preserving the records of these borings, I have been enabled to arrive at some important conclusions as to the thickness and the distribution of the underlying Upper Silurian and Devonian strata, to which I now beg to call the attention of the Association.

The rocks of the New York series, from the Oriskany sandstone to the coal, which are regarded as the equivalents of the Devonian of the old world, were shown by Prof. James Hall, in 1851, to constitute three natural groups. Of these, the first and lowest, some-

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* Read before the meeting of the American Association for the Advancement of Science, at Chicago, August, 1868.

times called the Upper Helderberg, and consisting of the Oriskany, with its overlying Corniferous limestone (embracing the local subdivision known as the Onondaga limestone) constitutes what may be provisionally called the Lower Devonian. The second group has for its base the black pyroschists known as the Marcellus shale, followed by the Hamilton shale, with the local Tully limestone, and terminated by another band of black pyroschist, the Genesee slate; the whole constituting what may be termed the Middle Devonian. The third group, embracing the Portage and the Chemung shales and sandstones, with the local Catskill sandstone, makes the Upper Devonian. (*)

The black Genesee slate, according to Mr. Hall, is paleontologically related to the Hamilton slates, and by him included as part of the Hamilton group, as recognized in the Geology of Canada. Similar black slates, though thicker, less fissile, and interstratified with greenish arenaceous beds, occur at the base of the Portage formation, marked by the remains of land-plants and of fishes which characterize the Upper Devonian. The black slates of this horizon thus constitute, as it were, beds of passage. The thickness of the lower and more fissile black beds, recognized by Mr. Hall as belonging to the Hamilton group, is, according to him, only twenty-four feet at the eastern end of Lake Erie.

There exists in south-western Ontario, along the River St. Clair, an area of several hundred square miles underlaid by black shales, in the counties of Lambton and Kent, of which only the lower part belongs to the Hamilton group. These strata are exposed in very few localities, but the lower beds are seen in Warwick, where they were, many years since, examined by Mr. Hall, in company with Mr. Alexander Murray of the Geological Survey of Canada, and were by the former identified with the Genesee slate forming the summit of the Hamilton group. They are in this place, however, overlaid by more arenaceous beds, in which Prof. Hall at the same time detected the fish remains of the Portage formation. The thickness of these black strata, as appears from a boring in the immediate vicinity, is fifty feet, beneath which are met the gray Hamilton shales. A similar section occurs at Cape Ipperwash or Kettle Point in Bosanquet, on Lake Huron, where bands of alternating greenish and black arena-

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(*) James Hall, in Foster & Whitney's Geology of Lake Superior, ii, 386.

ceous shales, holding Calamites, are met with. They strata also were recognized by Mr. Hall, who examined them, 'as belonging to the Portage formation ; and abound in the large spherical calcareous concretions which occur at the same horizon in New York. The entire thickness of the black shales at this point has not been determined, but in numerous borings throughout the region under notice, they are easily distinguished both by color and hardness, from the soft gray Hamilton shales which underlie them. At Corunna, near Sarnia, a thickness of not less than 213 feet of hard black shales, interstratified towards the top with greenish sandstone, were met with. In the northern part of Enniskillen, near Wyoming, they are about fifty feet in thickness ; at Alvinstone, eighty feet ; in Sombra, on the Sydenham river, 100 feet, and in two borings in Camden, 146 and 200 feet. A little to the north of Bothwell, on the Thames, their thickness was found to be seventy-seven feet, while southward, along the shore of Lake Erie, about sixty feet of the hard black slate overlie the soft gray Hamilton shales.

From these, and a great many similar observations, which are detailed at length in the Report of the Geological Survey of Canada, published in 1866, it has been possible to determine with considerable accuracy the distribution of these black strata beneath the thick covering of clay which conceals them through the greater part of the region. It being impossible, under the circumstances, to distinguish between that lower portion of the black strata which belongs to the Hamilton group or Middle Devonian, and the overlying Portage formation, the whole of these strata, down to the summit of the soft gray shales, are included with the Portage. In Michigan, according to Prof. Winchell, the whole thickness of the Portage (Huron) group, as just defined, including twenty feet of black shale at its base, is only 224 feet, which are represented in Ontario by 200 feet on the Sydenham river, and by 213 feet at Corunna on the St. Clair. Yet, Prof. Winchell, for some reason, doubts the existence of the Portage formation in Ontario.

The Hamilton shale, which in some parts of New York attains a thickness of 1,000 feet, but is reduced to 200 feet in the western part of the state, consists in Ontario chiefly of soft gray marls, called soapstone by the well-borers, but includes at its base a few feet of black beds, probably representing the Marcellus shale. It contains, moreover, in some parts, beds of from two to five feet of solid gray limestone, holding silicified fossils, and in one instance impregnated with petroleum, characters which, but for the nature of the organic remains, and the underlying marls, would lead to the conclusion that the Lower Devonian had been reached. The thickness of the Hamilton shale varies in different parts of the region under consideration. From the record of numerous wells in the south-eastern portion, it appears that the entire thickness of soft strata between the Corniferous limestone below and the black shale above, varies from 275 to 230 feet, while along the shore of Lake Erie, it is not more than 200 feet. Further north, in Bosanquet, beneath the black shale, 350 feet of soft gray shale were traversed in boring, without reaching the hard rock beneath, while in the adjacent township of Warwick, in a similar boring, the underlying limestone was attained 396 feet from the base of the black shales. It thus appears that the Hamilton shale (including the insignificant representative of the Marcellus shale at its base) augments in volume, from 200 feet on Lake Erie to about 400 feet near to Lake Huron. Such a change in an essentially calcareous formation, is in accordance with the thickening of the Corniferous limestone in the same direction.

The Lower Devonian in Ontario is represented by the Corniferous limestone, for the so-called Onondaga limestone has not been recognized, and the Oriskany sandstone, always thin, is in some places entirely wanting. The thickness of the Corniferous in western New York is about ninety feet, and in south-eastern Michigan is said to be not more than sixty, although it increases in going northward, and attains 275 feet at Mackinac. In the townships of Woodhouse and Townsend, about seventy miles west from Buffalo, its thickness has been found to be 160 feet, but, for a great portion of the region in Ontario underlaid by this formation, it is so much concealed that it is not easy to determine its thickness. In the numerous borings which have been sunk through this limestone, there is met with nothing distinctive to mark the separation between it and the limestone beds which form the upper part of the Onondaga Salt-group or Salina formation of Dana, which consists of dolomites, alternating with beds of a pure limestone, like that of the Corniferous formation. The saliferous and gypsiferous magnesian marls, which form the lower part of the Salina formation are, however, at once recognized by the borers, and lead to important conclusions regarding this formation in Ontario. In Wayne county, New York, the Salina formation has a thickness of from 700 to 1,000 feet, which, to the westward, is believed to be reduced to less than 300 feet, where the outcrop of this formation, crossing the Niagara river, enters Ontario.

At Tilsonburg, ninety miles west from Buffalo, borings have shown the existence of the Corniferous limestone directly beneath about forty feet of clay, while two miles to the south-west it is overlaid by a few feet of soft shales, probably marking the base of the Hamilton. From a depth of 100 feet in the limestone, at Tilsonburg, a flowing well was obtained, yielding an abundance of water, and a considerable quantity of petroleum. This boring was subsequently carried 854 feet in the rock, which at that depth was a dolomite. Numerous specimens from the upper 196 feet were of pure non-magnesian limestone ; but below that depth dolomites, alternating with pure limestones, were met with to the depth of 854 feet, from which salt water was raised, marking, it is said, from 35° to 50° of the salometer. The well was then abandoned. We have here a boring traversing 854 feet of solid strata, from what was, probably, near the summit of the Corniferous, without reaching the marls which form the lower part of the Salina formation.

In a boring at London, where the presence of the base of the Hamilton was marked by about twenty feet of gray shales, including a band of black pyroschist, overlying the Corniferous, 600 feet of hard rock were passed through before reaching soft magnesian marls, which were penetrated to the depth of seventy-five feet. Specimens of the boring from this well, and from another near by, carried 300 feet from the top of the Corniferous, show that pure limestones are interstratified with the dolomites to a depth of 400 feet. At Tilsonburg a pure limestone was met with at 524 feet from the top.

At St. Mary's, 700 feet, and at Oil Springs in Enniskillen, 595 feet of limestone and dolomite were penetrated, without encountering shales, while in another well near the last, soft shaly strata were met with at about 600 feet from the top of the Corniferous limestone, there overlaid by the Hamilton shales. It thus appears that the united thickness of the Corniferous formation and the solid limestones which compose the upper part of the Salina formation, is about 600 feet in London and Enniskillen, and farther eastward, in Tilsonburg and St. Mary's, considerably greater, exceeding by an unknown amount, in these localities, 854 and 700 feet. The Corniferous at its outcrop in Woodhouse, twenty-five miles to the east of Tilsonburg, measures only 160 feet thick, so that there is evidently, in the localities just mentioned, a great increase in the volume of the Salina formation from the 300 feet observed in western New York. At Goderich, on Lake Huron, the thickness of this formation is much greater. Here are found non-fossiliferous strata, having the character of the so-called Water-lime beds, which belong to the summit of the Salina formation, and are immediately overlaid by fossiliferous strata belonging to the Corniferous formation. At this point a boring in search of petroleum penetrated not less than 775 feet of solid white, gray and blue limestones, chiefly magnesian, with occasional thin beds of sandstone. Below this depth the strata consisted chiefly of reddish and bluish shales, with interstratified beds of gypsum, sometimes ten feet in thickness. After the 164 feet of these, rock-salt was met with, interstratified with clay, through a distance of forty-one feet, beneath which the boring was carried five feet in a solid white limestone, probably belonging to the underlying Guelph formation. We have thus, for the entire thickness of the Salina formation at Goderich, 980 feet, of which the upper 775 are hard strata, chiefly magnesian limestones, and 205 feet gypsiferous and saliferous shales. Several wells since sunk in this vicinity, one of them twelve miles to the south-westward, have given almost identical results, including the mass of rock-salt at the base. These borings now yield, by pumping, a copious supply of brine, nearly saturated and of great purity, so that this newly discovered saliferous deposit has already attracted the attention of salt manufacturers, both in Ontario and New York. A detailed description of the first well, with an analysis of the brine, will be found in the Geological Report for 1866, already referred to.

Brines are said to have been met with at this horizon in Michigan, where the formation will probably be found to have a much greater thickness than that hitherto assigned to it.

It thus appears that the Salina formation, after being reduced to less than 300 feet at the Niagara river, again assumes, to the north-westward, a thickness of nearly 1,000 feet, and becomes once more salt-bearing, as in the State of New York. The increased thickness of the formation, in these two regions, connected with accumulations of salt at its base, would seem to point to ancient basins, or geographical depressions in the surface of the underlying formation, in which were deposited these thicker portions. The existence of these Upper Silurian salt lakes, whose evaporation gave rise to the rock-salt, gypsum and dolomite of the Salina formation, shows a climate of great dryness to have then prevailed in this region. A similar conclusion is to be drawn from the more or less gypsiferous dolomites of the Calciferous and Niagara formations, the magnesian limestones at other horizons, and the gypsum and salt deposits of the Carboniferous period,—leading us to infer a very limited rain-fall over the north-eastern portion of this continent, throughout the Paleozoic period.

In this connection, a few remarks with regard to the horizon of the petroleum which issues from the Devonian rocks of Ontario, may not be out of place. In opposition to the generally received view, which supposes the oil to originate from a slow destructive distillation of the black pyroschists belonging to the middle and upper divisions of the Devonian, I have maintained that it exists, *ready formed*, in the limestones below.*—In addition to the well known fact of its frequent occurrence in the Corniferous limestone, I have cited the observations of Eaton, Hall and myself, as to the existence of both solid and liquid bitumen in the Niagara limestone, and even in the massive beds of the Hamilton. A remarkable example is afforded in the oleiferous beds of the Niagara formation in the vicinity of Chicago, † and still another in similar strata belonging to the Lower Helderberg period, in Gaspé. The deep borings already mentioned in Tilsonburg, St. Mary's and Enniskillen, showed in each case small quantities of petroleum in strata of the Salina formation, and the same was observed at considerable depths in the Goderich well already described.

Apart from the chemical objections to the view which supposes the oil to be derived from the pyroschists above the Corniferous limestone, it is to be remarked, that all the oil wells of Ontario have been sunk along denuded anticlinals, where, with the exception of the thin black band sometimes met with at the base of the Hamilton formation, these so-called bituminous shales are entirely wanting. The Hamilton formation, moreover, is never oleiferous,

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* Canadian Naturalist, June, 1861, and Silliman's Journal, March, 1863

† It is proposed to give, in a subsequent communication, the results of an examination of this remarkable limestone.

except in the case of the rare limestone beds already referred to, which are occasionally interstratified. Reservoirs of petroleum are met with, both in the overlying quaternary gravels and in the fissures and cavities of the Hamilton shales, but in some cases the borings are carried entirely through these strata, into the Corniferous limestone, before getting oil. Among other instances cited in my Geological Report for 1866, may be mentioned a well at Oil Springs, in Enniskillen, which was sunk to a depth of 456 feet from the surface, and seventy feet in the solid limestone beneath the Hamilton shales, before meeting oil, while in adjacent wells supplies of petroleum are generally met with at varying depths in the shales. In a well at Bothwell, oil was first met with at 420 feet from the surface, and 120 feet in the Corniferous limestone, while a boring at Thamesville was carried 332 feet, of which the last thirty-two feet were in the Corniferous limestone. This well yielded no oil, until, at a depth of sixteen feet in this rock, a fissure was encountered, from which, at the time of my visit, thirty barrels of petroleum had been extracted. At Chatham, in like manner, after sinking through 294 feet of shales, oil was met with at a depth of fifty-eight feet in the underlying Corniferous limestone.

We also find oil-producing wells sunk in districts where the Hamilton shale is entirely wanting, as in Maidstone, on the shore of Lake St. Clair, where, beneath 109 feet of clay, a boring was carried through 209 feet of limestone, of which the greater part consisted of the Water-lime beds of the Salina formation, overlaid by a portion of the Corniferous. At a distance of six feet in the rock a fissure was struck, yielding several barrels of petroleum. Again at Tilsonburg, where the Corniferous limestone is covered only by quaternary clays, natural oil springs are frequent, and, by boring, fissures yielding petroleum were found at various depths in the limestone, down to 100 feet, at which point a flowing well was obtained, yielding an abundance of water, with some forty gallons of oil daily. The supplies of oil from wells in the Corniferous limestone are less abundant than those in the overlying shales, and even in the quaternary gravels, for the obvious reason that both of these offer conditions favorable to the retention and accumulation of the petroleum escaping from the limestones beneath.

The presence of petroleum in the Lower Silurian limestones, and their probable importance as sources of petroleum, was first pointed out by me in 1861. The conditions under which oil occurs in these limestones in Ontario are worthy of notice, inasmuch as they present grave difficulties to those who maintain that petroleum has been generated by an unexplained process of distillation going on in some underlying hydrocarbonaceous rock. Numerous borings in search of oil on Manitoulin Island, have been carried down through the Utica and Loraine shales, but petroleum has been found only in fissures at considerable depths in the underlying limestones of the Trenton group. The supplies from this region have not hitherto been abundant, yet from one of the wells just mentioned, 120 barrels of petroleum were obtained. The limestone here rests on the white unfossiliferous Chazy sandstone, beneath which are found only ancient crystalline rocks, so that it is difficult to avoid the conclusion that this limestone of the Trenton group is, like those of Upper Silurian and Devonian age, already noticed, a true oil-bearing rock.

In concluding these observations on the geology of Ontario, it may be remarked that throughout the south-western counties, the distribution of the Middle and Upper Devonian rocks has been determined almost wholly from the results of borings undertaken in search of petroleum. From these it appears that the wide spread of these rocks in this region is connected, first, with a transverse north and south synclinal depression, which traverses the peninsula, and has been noticed in the Geology of Canada, p. 363, and secondly, with several small undulations, running north-east and south-west, on the north west side of the anticlinal of the Thames; which is a prolongation of that passing by Cincinnati, and may be regarded as part of the main anticlinal of the great axis of elevation which divides the coal field of Pennsylvania from that of Michigan.

The Devonian rocks are found, in the region under consideration, at depths not only far beneath the water-level of the adjacent lakes of Erie and St. Clair, but actually below the horizon of the bottom of those shallow lakes. Thus at Vienna, in Bayham, at a point said to be about forty feet above the level of Lake Erie, the underlying rock was met with beneath 240 feet of clay, while at Port Stanley, twenty feet above the lake, the Hamilton shale was struck beneath 172 feet of clay, and at the Rondeau, just above the level of Lake Erie, the clay was 104 feet thick. A similar condition of things exists on the south side of the lake, at Cleveland, where no rock is encountered at a depth of 100 feet below the water-level. Again in Sombra, on the banks of the Sydenham river, which is very little above the level of Lake St. Clair, a well ten feet above the river passed through 100 feet of clay before meeting the black shales of the Portage group, while in Maidstone, on the shore of Lake St. Clair, and a very few feet above its level, 109 feet of clay were found overlying the Corniferous limestone. The greatest depth of Lake St. Clair is scarcely thirty feet, and that of the south-western half of Lake Erie does not exceed sixty or seventy feet, so that it would seem that these present lake basins have been excavated from the quaternary clays which, in this region, fill a great ancient basin, hollowed out of the paleozoic rocks, and including in its area the south-western part of the peninsula of Ontario.

ON THE CHOICE OF A MICROSCOPE.

By J. Baker Edwards, P.H.D., F.C.S.

Much excellent advice has been given in English scientific periodicals on this subject. Meanwhile manufacturers have been improving the instrument in many respects, and probably a larger class now exists who desire assistance in the choice of a Microscope than could be found 20 years ago, when the variety of choice was less embarrassing. Since that period,—when the Exhibition of 1851 proved the superiority of our leading English makers over their foreign competitors—great improvements have been introduced and a large variety of forms have been strongly recommended as possessing peculiar advantages, such as the elegant light tube frame, and magnetic stage of Mr. Ladd, the solid body and elliptical stage of Mr. Pillischer, the useful and cheap instruments of Mr. Highley, and the Universal Microscope of Smith & Beck. These varieties are, however, rather curious and ingenious than desirable, and must be left to individual taste to select. I shall not, therefore, dwell upon their peculiar excellences, but describe only such general typical forms as may probably be obtained or easily procured in this country; and I shall address my remarks according to the probable requirements of my readers, as:—

1st. Young beginners.

2nd. Professional students.

3rd. Advanced students or Naturalists.

4th. Professors or wealthy amateurs.

I recommend the beginner to choose a light, portable but steady instrument with a good open stage and low powers. Let his first object be to prepare and mount objects and let him confine himself to those adapted for his instrument, such as organs of plants and insects, sections of wood and bone, etc. Let his first book be "Half hours with the Microscope," and when he has mastered this, let "Carpenter on the Microscope" be his constant work of reference. Now for the instrument to be chosen:—

The compound body should have two eye-pieces and two object glasses, the range of power should be from 25 to 250 diameters. The body should have two adjustments—coarse by rack work, and fine by lever—the stage as free and open as possible, the hole not less than 1 inch in diameter. The body should hinge upon its centre so as to balance into a favorable position for the sitter, and the mirror be both plane and concave. The bull's eye condenser should be on a separate stand, and a stage forceps and live box are necessary additions. This, in a box with lock and key, is worth from $15 to $20.

Nothing less than this is worth calling a "Microscope," and with such an instrument as this a large variety of objects may be mounted and good work done. The round boxed French Microscopes are mere toys, and no perpendicular Microscope will advance the student in the knowledge of the science for reasons which will hereafter appear. Should your local opticians not be able to fulfil all the conditions of the above instrument, I advise you to order a "Society of Arts prize Microscope," from Field & Son or from S. H. Parkes, Birmingham. Either firm will supply for £3 3s. a good useful instrument, giving full value for the money. To the professional student I should recommend something better than the above, both in stand and powers. The student's Microscope, made by Mr. Pillischer, New Bond St., London, price £5, is the best and cheapest I know of this class. It consists of a good steady well finished brass stand, the body tube screwing off so as to pack into a small case. Two eye pieces and a compound object glass—divisible into 1 in., ½ in. and ¼ in. powers—giving a range from 40 to 400 diameters. An opaque condenser on separate stand, stage forceps and live box are also packed in a neat mahogany box with lock and key. A polariscope is added for £2 extra and the whole is a thoroughly good working instrument. I have used one for years as an extra laboratory instrument, and have been well satisfied with a large number which I have examined and recommended to students.

Similar instruments for about the same price may be obtained from J. B. Dancer, Manchester, or Abraham & Co., Liverpool; but in the choice of such an instrument I call the attention of the student to certain requirements:—

1st. Steadiness of the instrument combined with inclined position.

2ndly. Correction and definition of object glasses.

3rdly. Enlarged field of view.

4thly. Free stage movement.

5thly. Good illumination above and below the stage.

6thly. Smooth rack work adjustments.

A few words on each of these points may be useful to the inexperienced.

The steadiness of your instrument and of the table or floor upon which you are working is essential to accurate observation, round stands are generally unsteady, and the tripod should therefore have the preference. Inclination of the Microscope has a tendency to increase any vibration, but it is a valuable motion which the student's Microscope should always possess. The upright position is not only fatiguing, but a source of error from the specs which float upon the watery humour of the eye and collect over the pupil, disturbing correct vision. All perpendicular stands should therefore be rejected by the student, and for prolonged work the Microscope should be inclined at the most convenient angle for the height of the sitter.

The definition of the object glasses is the test of their value. Probably the student must take them on the faith of the manufacturer; but if he has the judgment to select, he will give the preference to the glass which in its highest power will give him a good stereoscopic view of a raised object such as the pollen of mallow or hollyock, and which will define the markings upon starch granules, such as arrowroot and tous les mois, without coloured fringes or distortion of the forms; at the same time it is desirable to have as much light and as large a field of view as possible, and plenty of room upon the stage, to manipulate or dissect an object laid upon it.

The student can never be satisfied with mounted objects, he must dissect a tissue, a flower, or an insect upon the stage, and educate his hand to work his delicate mounted needles, (which look under the powers like flag-staffs),—with the greatest precision and nicety. This cannot readily be done with a contracted stage.

The illumination of the object above and below the stage, in the absence of costly apparatus, may be skilfully accomplished provided only that the stage is thin and the aperture large. Oblique light may be obtained by direct lamp light or by the opaque condenser, so as to give the most delicate effects.

Lastly, a rack work adjustment is always to be preferred to a sliding one, and the opaque condenser is most useful on a separate stand.

Thoroughly worked and studied, the instrument I have described will fulfil all the requirements of the medical student and practitioner; but the instrument implies *work*, *study*, and *perseverance*, and is not designed to be a mere library ornament. I am aware that in many English and Scotch Schools of Science, German and French Microscopes are imported for the use of medical students and recommended for excellence and economy, and no doubt Chevalier, Oberhauser, and Nachet turn out excellent work at a moderate cost. Yet I prefer the build of the English instrument, especially for room upon the stage and good rack movements. Dr. Lawrence Smith's inverted Microscope as made by Nachet, is however a very excellent form of working instrument, and with many useful accessories, is sold at the moderate price of £14 sterling.

Now I shall address the advanced student, the Naturalist: who says perhaps "I have deferred getting a Microscope until I could afford a really good one, and I should like to add to a first rate stand, various powers and accessories as I can afford or happen to meet with them." While I sympathise with these views and acknowledge that this was the plan upon which I started in 1851, yet I think upon the whole it is not the wisest one, especially if it should delay, even for a single year, the possession of an instrument which you can call your own. Not that I regret it in my own case, for I regard with peculiar pleasure the big baby which has grown up under my parental care for 18 years. It has been altered and adapted and improved in almost all its parts, but like our growing selves there it is, the good steady well finished stand of Pillischer, No. 2, first-class. I have learned a great deal in pursuit of improvements upon the instrument, and though probably, it has proved the most expensive way of procedure, yet I feel grateful for the experience it has brought me during the process.

But of late years the requirements of the Naturalist have been so well studied by the leading English manufacturers, that every essential is comprised in moderately priced instruments. Amongst these, I should select for a friend a Smith & Beck's popular Microscope. I have had several through my hands on the way to friends to whom I have recommended them, and I have been more than satisfied with their excellency. The stand and the powers are alike deserving of the highest praise.

The stand is of peculiar construction, having a hinged or folding foot attached to a triangular base, with studs to fix the instrument steadily in the perpendicular position for dissection, three positions of inclination for the sitter, and the horizontal for drawing or for direct illumination. It has excellent rack work and lever adjustments, and may be fitted with all the modern valuable accessories for varied illumination. With 1 in. and $\frac{1}{4}$ in. object glasses, 2 eye pieces, concave mirror and condensing lens, diaphragm, stage forceps, glass plate and pliers, in mahogany case, this instrument is sold at £10 sterling.

The same, with Wenham's binocular, 3 object glasses, 2 in., 1 in. and $\frac{1}{4}$ in., two sets of eye pieces, etc., etc., £15.

The whole complete, with binocular arrangement, Lieberkuhns, dark wells, acromatic condenser, parabolic reflector, polarizing apparatus, camera lucida, micrometer, live box, zoophyte trough, and an excellent $\frac{1}{8}$th objective, £25 sterling.

I should strongly advise any friend who was tired of a plain instrument, and who wished to get some of these charming accessories, to sell it, and invest in the above very complete set, and I am sure if he works the instrument thoroughly he need not envy the happy possessor of a "first class Microscope," three times its value.

I must now, in accordance with my plan, address myself to the fortunate man who wants a "first class instrument," or who, having a good stand and glasses wishes to know what he should add thereto. To the first I would say, you may, with equal confidence, purchase from the three great makers, Ross, Smith & Beck, or Powell & Lealand, and you will probably be equally satisfied with your instrument. For portability and extreme neatness and perfection you may prefer Powell & Lealand's stand. For rare excellence and brilliancy of illumination you may prefer Ross's lenses, and for general excellency and ready adaptation of accessories, you may give the palm to Smith & Beck. But the difference is one of taste rather than excellence when all are so good and about equally costly. I must say I have a strong leaning towards the Binocular, the best effects of which I have seen in those made by Smith & Beck, and I do not think their first class Binocular Microscope has been surpassed.

As great weight is to be avoided, I should prefer the second sized stands of either of these makers to the largest, and the cost of a complete instrument would be about £60 sterling.

I have a word to say to my friend who is already supplied with a Monocular instrument, and it is to the effect that a good Binocular becomes a necessity to the man who has studied its value, and therefore I would advise him to add this great improvement to his instrument, which will cost about £3 sterling.

This is not a mere luxury or toy but an agent of research of great value, in addition to which it possesses the great recommendation of relieving the strain upon the vision which has so often seriously affected the eyes of microscopists. By its aid prolonged investigation can be carried on without fatigue.

With regard to the discussions which have been carried on in the highest circles of the science in respect of the value of extreme apertures in the object glasses of high power, and the comparative defining power of such glasses as the $\frac{1}{12}$, $\frac{1}{20}$, $\frac{1}{25}$, and $\frac{1}{50}$, I must say that my experience leads me to rely on the general excellence of the glass rather than upon its angular aperture. Comparing a very fine $\frac{1}{20}$ (which is more properly a $\frac{1}{25}$) of Smith & Beck with a $\frac{1}{12}$ made some years ago by Mr. Ross, senr., which he considered the finest $\frac{1}{12}$ he had ever made, I have been unable to chose between them. The latter has much less angle of aperture, but such brilliancy and excellency of definition that it appears to me to leave nothing to be desired, and I have yet to meet with the object glass at all a rival to it. Again I have worked with an $\frac{1}{8}$ of Smith & Beck which seemed perfection and was of very easy manipulation. I think a man who has a first rate glass whether it be $\frac{1}{8}$, $\frac{1}{12}$, $\frac{1}{20}$, or $\frac{1}{}$, may be well content. But I never yet saw a ¼ in. or a ⅙, or a ⅛ (although wonderful for excellence and definition in their way) which would come up to the analytical standard of these high powers.

Finally, I may say that I have never seen any French combinations above ¼ in. worth much. French opticians produce high powers but a good English quarter will surpass them altogether. Mere amplification is of no benefit in the microscope without corresponding definition. I entertain also a decided prejudice against a "thin skinned" glass. That is, one whose corrections require the utmost nicety for the refraction of glass covers. In my experience I have not found these the best glasses, and all other things being equal I would reject a glass which was *too particular*. Perhaps the class of work upon which I have been engaged (crystals and tissues in fluid) has given me a strong bias, but it is one which becomes strengthened by time, and which the following incident will illustrate. Having a good Ross ¼ and ⅙, I wrote to Smith & Beck asking them to make for me a student's ¼, corrected to go through an ordinary round test tube. They sent me a glass so corrected, for which they charged £2 15s., one half the price of Ross' quarter with the adjustments. I found it in every respect an excellent power. It would go through the back of the slide and show the markings on a pleurosigma hippocampus or formosum, just as well as through the thin glass. It would dip into a water cell, and for no purpose for which I ever wanted a ¼ in. did I find it deficient. Again, when I acquired my old Ross' 1/12 I had a fashionable new Ross' ⅛, 152° angular aperture in my possession. I found by frequent comparison that in the former glass I had not only a higher power with better definition, but also a glass *much easier to work*, so I parted with my fashionable friend and held on to my second treasure. I would therefore counsel my friends who wish for satisfactory high powers, not to follow the fashion, but to give the preference to glasses of deep penetration and good definition, and which work without very nice adjustment.

In conclusion, I would take exception to the remarks of Mr. Plumer at the close of an excellent article on this subject in the Microscopic Journal, N.S., Vol. 4, page 167, viz., that his readers "may reap by a short and royal road, all the benefits that it had cost him years to acquire." I must confess my disbelief in this "royal road." The royal road to microscopic or to all other science is comprised in three words—work, work, work. Moreover, it is open to a doubt whether a man who starts as a Microscopist with a perfect instrument and all accessories, will ever become an accomplished manipulator. His royal road will probably be too easy to call his skill into exercise, and he may be outstript in the race by the student who, with a plain stand and good glasses, has had to exercise his ingenuity in the illumination of objects with the simple mirror and bull's eye condenser. The pleasure and satisfaction derived from a study of the instrument itself, more than repays the labour expended thereon, and is a necessary element in a sound Microscopic education.

ON THE COLEOPTERA OF THE ISLAND OF MONTREAL.

By A. S. Ritchie.

The list of Coleoptera appended to this paper, has involved considerable labour, mostly on account of the bulkiness of the nomenclature, a prevailing fault in this as in most other branches of Natural History. Calling the same species by many names, leads to great confusion; some of these insects have as many as six or seven synonyms.

I am indebted to Dr. Leconte, and to Dr. Horn, of Philadelphia, for their very kind assistance in the preparation of this list. Leconte's classification of the beetles of North America is the most authentic known to me for the simple reason that all his species are named from some special characteristic, as, structure, habits, or food, and not on tradition. His classification has therefore been adopted. The few remarks I propose to make on the Coleoptera of Montreal may be set forth under the heads of Nomenclature, Classification, and general remarks on the several families.

Nomenclature.—Insects are named from specific or generic characteristics of structure, or colour, from the particular food they live on, or from some other material characters—so that they may be readily identified. The confusion which often arises from so many names, may be illustrated by an example. Olivier finds an insect about the year 1789, and after describing it, calls it *Leptura Vittata*; Kirby finds the same species about 1828, and he calls it *Leptura semivittata* ; finally, Germar about 1834 has another *alias* for the same species, *Leptura Abbreviata.* These names are all very good in their way, the creature may be known by any one of them,—but why change the original? The name given by the person who first described the species, certainly has the preference, provided the insect can be identified by it, and should be the only one retained. Nor does the trouble end here; you may look over the drawers of fifty cabinets of insects without finding any two of them to agree, as to what is the correct name for a particular species.

It would be a great matter if something could be done towards having an uniform nomenclature for Canadian insects.

The list contains twenty-nine families, one hundred and fifty-two genera and two-hundred and forty-eight species, collected chiefly on the Island of Montreal; all not collected here, are marked in the margin.

Classification.—Entomologists and systematists have insisted on one or two peculiar characters, which they consider to be of primary importance and value, as the basis of classification. Swammerdam contended, that in the early, or preparatory states of an insect was to be discovered the solution of its natural position. His system was called the "Metamorphotic." Linnœus considered that in the structure of the wings, lay the basis of classification. His system was called the "Alary." Fabricius accepted neither of these views; and on the structure of the organs of the mouth created his system. His system was called the "Maxillary." Latreille, not knowing which to prefer, formed a fourth, combining the three, which he called the "Eclectic." The "Septenary system" is one which is followed by some to a great extent. According to this theory, "in every group of seven, whether the group be large or small, one of the seven is central, and the other six surround it and are each connected with it." All entomologists at the present day agree with these various systems to a certain extent as invaluable guides to classification. Leconte's classification comprises ten orders; this appears to be the most natural division. These orders are again divided into tribes, stirps, families, genera, and species.

The order Coleoptera (or beetles) contains, according to Latreille, not less than 25,000 species; the estimate was made about the year 1800, and included beetles from all parts of the world, as then known and described in European cabinets. Since then, according to the best modern authorities, the number has been more than doubled, and is now set down at 90,000 species. When we imagine each of these species differing in appearance and to a great extent in habits, the question naturally arises, what is the use of so many beetles?

We may divide the whole order into two principal groups; the Carnivorous and the Herbivorous species, with certain modifications.

It would seem that a portion of almost every substance in the animal and in the vegetable kingdom is assigned as food for beetles.

Among the carnivorous species we have cannibals, which prey on their fellows; others enjoy a repast on the remains of some unfortunate field mouse, or small bird, that death has overtaken; some, as for instance the Dermestes, feed in our kitchens, on lard and bacon, and destroy preserved specimens of Natural History. The last trace of the carnivorous habits may be seen in the ravages of the little beetles which infest the leather binding of books.

The Herbivorous division comprises those species which feed on leaves, flowers, fruit, and vegetables. Members of the large family of the Capricornes, feed on the solid wood of our forest trees. The last trace of the herbivorous habit may be seen in certain Scarabœidœ which feed on the excrement of herbivorous animals.

I shall now briefly notice the several families represented in the list. The first in order are the Cicindelidae (or tiger beetles) and very tigers they are, both in their larval and perfect states. They live by stratagem, and as they run and fly well, are more than a match for most insects of their size. They are found in sandy situations, especially when the sun shines.

The next family Carabidae, is one of the largest in the order; beetles of this group are principally carnivorous, some, however, prefer vegetable diet. Calosoma Calidum (commonly known as the "copper spot") is a good example of this family; it feeds on caterpillars, which it hunts with great avidity. Beetles of the genus Harpalus and Amara feed on vegetables. The distribution of species is very wonderful; for instance along the stone wall at the quarries, under stones, individuals of the genus Harpalus prevail in great numbers. The genus Brachinus is rare near

Montreal; to this genus belongs those beetles called "Bombardiers." They have the faculty of emitting volatile discharges, having a very pungent odour, accompanied with a slight noise and with a bluish smoke. They are to be found plentifully at the Back River under stones and decaying trees; as many as six or seven specimens may be taken under one stone. Four or five discharges are the greatest number I have seen them emit; after this process the insect appears quite exhausted.

Examples of the genus Chlaenius are also very plentiful along the banks of the St. Lawrence; at the Victoria Bridge, I have secured twenty specimens under one stone, comprising three species. They have a very pungent odour which remains on the hands for some time after washing.

The next three families are aquatic, viz., the Dytiscidae (or diving beetles), the Gyrinidae (or whirlgigs), and the Hydrophilidae. Their food is aquatic larvae and plants; some of the larger species attack even frogs, and small fish. The foot of the male Dytiscus has long been admired as a microscopic object. The Gyrinidae have two pairs of eyes, which is one pair more than their congeners possess; they are largely represented in the ponds and streams near the city.

The Silphidae (or carrion beetles) may be found feeding in the bodies of dead animals; they are flat bodied insects and are very useful in removing putrid carcases.

The next family Staphylinidae (or rove beetles) contains a great variety of species; some are microscopic in their dimensions, and none exceed an inch or so in length. These beetles are omnivorous; some feed on decomposing animal and vegetable matter, some on fungi, and others on flowers. The small insects which annoy us by getting into our eyes belong to this family.

The *Histeridae*, or "mimic beetles," are the next in order, they are found in excrements, in carcases, and under bark. They have the power of folding their legs close to the body on being disturbed, so as to counterfeit death.

Examples of the family *Cucujidæ* are apparently rare on the Island of Montreal. They are usually found under bark, and some are of a bright scarlet colour. The two specimens I have of *Cucujus clavipes* were captured on the board walk in St. Urbain St.

The *Dermestidae*, or skin beetles, are a group of insects of small size, generally about three quarters of an inch long. They are very destructive to furs, and to preserved specimens of natural history.

The *Byrrhidae*, or pill beetles, are of an oval shape, and are found in excrement, also under stones and bark. They possess the faculty of drawing up the legs close to the body as in Histeridae, and they remain in this way perfectly quiet as if dead.

The *Lucanidae*, or stag beetles, come next. They are entirely vegetable feeders; the large species feed mostly on leaves, the smaller on leaves and sap. Some of our largest Canadian beetles belong to this family, as for instance, *Passalus cornutus*, *Lucanus dama*, and *Lucanus placidus*. Neither of these species are found on the Island of Montreal. They are plentiful in Ontario, flying about oak trees. The smaller species, *Platycerus quercus* and *P. depressus*, are found near the city.

Next come the *Scarabaeidae*, a very large group, which feed on almost every thing. Some authors divide this family into, 1st, the ground or true *Scarabs*, which feed on excrement, 2ndly, the chafers and rose beetles, which live on leaves, flowers and sap. The Hermit Beetle, *Osmoderma*, belongs to this group.

The two following families, *Buprestidae* and *Elateridae*, are well represented on the Island. Some of the exotic species are adorned with splendid metallic tints. The Brazilian Buprestidae are gorgeous insects, their wing cases or elytra being very hard. A great many are mounted and sold for breast pins and for other articles of jewellery. A little black insect, about three quarters of an inch long (*Melanophila Longipes*), belongs to this family. In the warm days of summer it runs about the side-walk, and flies at intervals, alighting generally on the neck, where it bites very keenly, the bite leaving a feeling as if the flesh was burnt with hot sealing wax. The large Elater, *Alaus oculatus*, has rarely been found here; one I picked up on the side-walk on St. Paul St.;—the other was captured on a tree on St. Helen's Island last summer, on the occasion of the field meeting of the Natural History Society.

The family *Lampyridae* includes the fire flies, a group well represented in the district in question. They occur in great numbers in the early summer, and feed on the mucus of the birch trees on the mountain.

Cleridae is the next family; it is composed of insects of small size, which are parasitic in their larval state on bees, and in bees and ants' nests. In their imago or perfect state they are found on flowers.

The family *Tenebrionidae* contains a number of species that live upon vegetable matter in various conditions. A very common insect, *Tenebrio Molitor*, called in its larval state the meal worm, belongs to this family.

Meloeidæ: to this group belongs the *Cantharis Vesicatoria*, or Spanish fly. Examples of the genus Meloe are called oil beetles, on account of a yellow oily substance exuding from their joints on their being handled.

The different species of weevils or snout beetles, belong to the *Curculionidæ*. They feed upon plants, fruits, nuts and seeds, and are peculiar for their having the wing-cases, in many instances, covered with beautiful scales. This family requires careful study, as but little is as yet known of the species belonging to this interesting section.

The *Longicornes* belong to the family *Cerambycidæ;* this is a very extensive group. They are principally lignivorous, and in their larval and perfect states feed on solid and decayed wood.

Members of the genus *Leptura* are mostly floral species, feeding in their grub state on wood, and in their perfect state on flowers.

The leaf-eaters come next; they include the two families *Chrysomelidæ* and *Cassididæ*. These insects feed entirely on the leaves of plants, and are very destructive in gardens.

The last family we will mention is the *Coccinellidæ* (or lady birds); they are carnivorous and are very useful in gardens, ridding plants of the small green insects called *Aphidæ* or plant lice.

I have cursorily glanced at some of the leading characters represented in the families contained in the list, as regards their habits and their food. In concluding these remarks, I would state that looking at the insect world from an economic point of view, they are worthy the attention of mankind. Insignificant though insects appear, the wondrous results they bring about, are well known; the number of hands they keep busy are exemplified by the productions of the silk worm. We are indebted to them for ink, dyes, and lac; to the bee for honey and wax. Who knows but that an insect may yet be found in Canada that will be the means of developing some sphere of industry? In medicine we have the blister beetle or *Spanish fly*; that our Canadian Meloe and *Epicauta* may secrete Cantharadine I have no doubt, as it is an ally of the blister beetle of commerce. The oily matter exuding from the joints of Meloe warms the tongue considerably on applying it to that member. Then look how nature apportions her work; how she uses her handmaids. Look at those dead trees that lie decaying in our forests, and see how the agency of these little creatures is called in. They bore into and channel their decaying trunks, and thus allow the action of the atmosphere to hasten their decay, animal matter of all kinds has also many busy little hands and mouths ready to act as scavengers in clearing it away. Lift that dead quadruped or bird that has lain in the sun for a day or two in our streets or fields, the little insects are our friends, for above it, below it, and within it, they are at work and it will soon be gone, thus preventing the spread of gases noxious to the health of man. Every creature has its use, and to know their use is man's province.

LIST OF COLEOPTERA TAKEN ON THE ISLAND OF MONTREAL.

The list comprises twenty-seven families, one hundred and thirty-three genera, and two hundred and seventeen species. Synonyms are also appended, taken from Le Conte. I am indebted to Dr. Le Conte, of Philadelphia, and through him to Dr. Horn, for his kindness in comparing species, and naming them, and otherwise assisting me in the compilation of this list.

CICINDELIDAE.

Cincindela, *Linn.*
patruela *Dej.*
(—consentanea *Dej.*)
sexguttata *Fabr.*
(—violacea *Fabr.*)
splendida *Hentz.*
(—limbalis var. *Lec.*
—marginalis var. *Dej.*)
purpurea *Oliv.*
(—marginalis *Fabr.*
var. audubonii *Lec.*)
vulgaris *Say.*
(—obliquata *Dej.*
tranquebarica *Herbst.*)

CARABIDAE.

Nebria *Latr.*
pallipes *Say.*

Calosoma *Fabr.*
calidum *Fabr.*
(—var. lepidum *Lec.*)

Cychrus *Fabr.*
Sphaeroderus *Dej.*
Canadensis *Chand.*

Harpalidœ.
Brachinus *Weber.*
fumans *Fabr.*
(—librator *Dej.*)
conformis *Dej.*
(—patruelis *Lec.*)

Lebia *Latr.*
fuscata *Dej.*

Cymindis *Latr.*
pilosa *Say.*
(—pubescens *Dej.*)

Platynus *Bon.*
sinuatus *Lec.*
(—anchomenus sin. *Dej.*)
extensicollis *Lec.*
(—feronia exten. *Say.*
anch. exten. *Dej.*
melanarius *Lec.*
(—agonum melan. *Dej.*
agonum maurum *Hald.*)
frater *Lec.*
cupripennis *Lec.*
(—feronia cupr. *Say.*
agonum cupr. *Dej.*)
subcordatus *Lec.*
lutulentus *Lec.*
chalceus *Lec.*
(—agonum chalceus *Lec.*)

Pterostichus *Bon.*
Poecilus *Bon.*
chalcites *Lec.*
(—feronia chalcites *Say.*
—poec. Sayi *Brulle*
—poec. chalcites *Kirby.*
—poec. micans *Chand.*)
lucublandus *Lec.*
(—feronia luc. *Say.*
—poec. luc. *Kirby.*)
Omaseus *Ziegl.*
caudicalis *Lec.*
(—feronia caudicalis *Say.*
—stereocerus caud. *Lec.*)
Argutor *Meg.*
patruelis *Lec.*
—(feronia patruelis *Dej.*)
Pterostichus *Bon.*
stygicus *Lec.*
(—feronia stygicus *Say.*
—fer bisigillata *Harris.*
—omaseus rugicollis *Hald.*)

Amara *Bon.*
fallax *Lec.*
Celia, *Zimm.*
obesa *Say.*
(percosia obesa *Hald.*)

Diplochila *Brulle.*
laticollis *Lec.*
(—rembus laticollis *Lec.*
—r. assimilis *Lec.*)

Anomoglossus *Ch.*
emarginatus *Chand.*
(—chlaenius emarg. *Say.*)

Chlaenius *Bon.*
sericeus *Say.*
(—carabus sericeus *Forster*)
chlorophanus *Dej.*
tricolor *Dej.*

Agonoderus *Dej.*
pallipes *Dej.*
(—carabus pallipes *Fabr.*)

Anisodactylus *Dej.*
discoideus *Dej.*
Baltimorensis *Dej.*
(—h. Baltimorensis *Say*)

BRADYCELLUS *Er.*
rupestris *Lec.*
(=trechus rupestris *Say.*
=acup. elongatulus *Dej.*
=trechus flavipes *Kirby.*

HARPALUS *Latr.*
viridiaeneus *Beauv.*
(=h. viridis *Say.*
=h. assimilis *Dej.*
Pennsylvanicus *Lec.*
(=o. pennsylvanicus *Degeer*
=c. bicolor *Fabr.*
=harp. bicolor *Say*)
compar *Lec.*
herbivagus *Say.*
(=ophonus mutabilis *Hald.*
=var. h. proximus *Lec.*)

STENOLOPHUS *Dej.*
ochropezus *Dej.*
(=feronia ochropezus *Say.*
=var. s. convexicollis *Lec*)

BEMBIDIUM *Latr.*
nigrum *Say.*

PERYPHUS *Meg.*
striola *Lec.*
(=ochthedromus stri *Lec.*)
lucidum *Lec.*
(=ochthedromus luc. *Lec.*
=var. o. substrictus *Lec.*)
rupestre *Dej.*
(=carabus rupestre *Latr.*
=bem. tetracolum *Say.*
=var. rupicola *Kirby.*)

NOTAPHUS *Meg.*
patruele *Dej.*

LOPHA *Meg.*
quadrimaculatum *Gyll.*
(=cicindela quadri. *Linn.*
=bemb. oppositum *Say.*)
pedicillatum *Lec.*

DYTISCIDAE.

HALIPLUS *Latr.*
immaculicollis *Harris.*
(=h. americanus *Aube.*

CNEMIDOTUS *Ill.*
edentulus *Lec.*

HYDROPORUS *Clairv.*
lacustris *Say.*
(=h. pulicarius *Aube.*)
modestus *Aube.*
(=h. ruficeps *Aube.*

LACCOPHILUS *Leach.*
maculosus *Say.*
(=dytiscus macu. *Germ.*)
proximus *Say.*
(=lac. americanus *Aube.*)

COLYMBETES *Clairv.*
CYMATOPTERUS *Esch.*
seminiger *Lec,*
exaratus *Lec.*
binotatus *Harris.*
(=macullicollis *Aube.*)

ACILIUS *Leach.*
praternus *Lec.*
(=dytiscus frater., *Harris.*
=ac. semisulcatus, *Aube.*)

DYTISCUS *Linn.*
anxius *Mann.*
fasciventris *Say.*
(=carolinus *Aube.*)
harrissii *Kirby.*
verticalis *Say.*

GYRINIDAE.

GYRINUS *Linn.*
—not determined.

DINEUTES *McLeay.*
—not determined.

HYDROPHILIDAE.

HYDROPHILUS *Geoffr.*
TROPISTERNUS *Sol.*
glaber *Herbst.*

HYDROCHARIS *Latr.*
obtusatus *Lec.*
(=hydrophilis obtu. *Say.*)

BEROSUS *Leach.*
striatus *Say.*

CERCYON *Leach.*
flavipes, *Er.*

CRYPTOPLEURUM *Muls.*
vagans *Lec.*

SILPHIDAE.

NECROPHORUS *Fabr.*
orbicollis, *Say.*
(=hallii *Kirby.*
=var. tibialis *Lec.*)
velutinus *Fabr.*
n tomentosus *Weber.*

SILPHA *Linn.*
NECRODES *Wilkin.*
surinamensis *Fabr.*

THANATOPHILUS *Leach.*
Lapponica *Herbst.*
(=caudata *Say.*
=tuberculata *Lec.*
=granigera *Cheer.*)
Marginalis *Fabr.*
(=nove boracensis *Forster.*)
inequalis *Fabr.*

NECROPHILA *Kirby.*
peltata *Lec.*
(=scarabeus pelt. *Catesby.*
=silpha americana, *Linn.*
=var. o. terminat. *Kirby.*
=var. o. affine *Kirby.*
=var. o. canadense *Kirby.*

STAPHYLINIDAE.

ALEOCHARA *Grav.*
—undetermined.

COPROPORUS *Kraatz.*
ventriculus *Kraatz.*
(=tachinus ventriculus *Er.*
=var. t. punctulatus *Mels.*)

TACHINUS *Grav.*
fumipennis *Er.*
(=tachyporus fumip. *Say.*
=t. axillaris, *Er.*

TACHYPORUS *Grav.*
jocosus *Say.*
(=arduus *Er.*)

CONOSOMA *Kraatz.*
crassum *Lec.*
(=tach. crassum *Grav.*
=conurus crassus *Er.*)

QUEDIUS *Stephens.*
molochinus *Er.*
(=staph. molochinus *Grav.*
=s. laticollis *Grav.*)

CREOPHILUS *Stephens.*
(=staph villosus *Grav.*)
villosus *Kirby.*

LEISTOTROPHUS *Perty.*
cingulatus *Kraatz.*
(=staph. cingulatus *Grav.*
=s. chrysurus *Kirby.*
=s. speciosus *Mann.*)

STAPHYLINUS *Linn.*
cinnamopterus *Grav.*
badipes *Lec.*

PHILONTHUS *Curtis.*
debilis *Er.*
(=staph. debilis *Grav.*)

LATHROBIUM *Grav.*
—undetermined.
—undetermined.

CRYPTOBIUM *Mann.*
bicolor *Er.*
(=lathrobium bic. *Grav.*)

PAEDERUS *Grav.*
littorarius *Grav.*

OXYTELUS *Grav.*
sculptus *Grav.*
(=moerens *Mels.*)

HISTERIDAE.

HISTER, *Linn.*
foedatus *Lec.*

PLATYSOMA *Leach.*
Lecontei *Mars.*
coarctatus *Lec.*

NITIDULIDAE.

NITIDULA *Fabr.*
bipustulata *Fabr.*

OMOSITA *Er.*
colon *Er.*
(=silpha colon *Linn.*
=nitidula colon *Fabr.*)

IPS *Fabr.*
fasciatus *Say.*
(=nitidula fasciata *Oliv.*)
sanguinolentus *Say.*
(=nitidula sanguin. *Oliv.*)

CUCUJIDAE.

CUCUJUS *Fabr.*
clavipes *Fabr.*

DERMESTIDAE.

DERMESTES *Linn.*
lardarius *Linn.*

ATTAGENUS *Latr.*
megatoma *Er.*
(=dermestes megat. *Fabr.*

BYRRHIDAE.

CYTILUS *Er.*
varius *Er.*
(=byrrhus varius *Fabr.*
=b trivattatus *Mels.*
=var. b. alternatus, *Say.*)

BYRRHUS *Linn.*
Americanus *Lec.*

LUCANIDAE.

Platycerus *Geoffr.*
quercus *Sch.*
(—lucanus Quercus *Weber.*
—pl. securidens *Say.*
depressus *Lec.*

SCARABAEIDAE.

Onthophagus *Latr.*
latebrosus *Sturm.*
(—copris latebrosus *Fabr.*
—scar. hecate *Panzer.)*

Aphodius *Ill.*
Teuchestes *Muls.*
fossor *Fab.*
(—scarabaeus fossor *Linn.)*
fimetarius *Ill.*
(—scar. fimetarius *Linn.*
—aph. nodifrons *Randall.)*

Euparia *Lep.*
—undetermined.

Geotrupes *Latr.*
semiopacus.
similis.

MELOLONTHIDAE.

Hoplia *Ill.*
trifasciata *Say.*
(—primaria *Burm.*
—helvola *Mels.*
—tristis *Mels.)*

Dichelonycha *Kirby.*
elongatula, *Fitch.*
(—melo. elongatula *Schonh.*
—melo. hexagona *Germ.*
—dich. elongata *Burm.)*

Serica *McLeay.*
Camptorhina *Kirby.*
vespertina *Lec.*
(—melolontha vesp. *Schonh.*
—omaloplia vesp. *Harris.*
—c. atricapilla *Kirby.*
sericea *Burm.*

Lachnosterna *Hope.*
fusca *Lec.*
(—melolontha fusca *Frohl.*
—mel. quercina *Kroch.*
—mel. fervens *Gyll.*
—l. quercina *Lec.)*

Ligyrus *Burm.*
relictus *Lec.*
(—scarabaeus relictus *Say.*
—heteronychus rel. *Burm.*
—bothynus rel. *Lec.)*

Xyloryctes *Hope.*
satyrus *Burm.*
(—geotrupes satyrus *Fabr.*
—scarabaeus satyrus *Ol.*
—s. nasicornis am. *Beauv.)*

Osmoderma *Lep.*
eremicola *Dej.*
(—cetonia eremicola *Knoch.*
—trichius eremicola *Say*)
scabra *Dej.*
trichius scabra *Beauv.*
(—gymnodus fov. *Kirby.*
—gym. rugosus *Kirby.)*

Trichius *Fabr.*
affinis *Gory.*
(—assimilis *Kirby.*
—bistriga *Newman.*
—var. viridans *Kirby.)*

BUPRESTIDAE.

Dicerca *Esch.*
divaricata *Lec.*
(—bup. divaricata *Say.*
—dicerca dubia *Mels.*
—di. aurichalcea *Mels.*
—d. parumpunctata *Mels)*
tenebrosa *Lec.*
(—bup. tenebrosa *Kirby.*

Ancylochira *Esch.*
fasciata *Dej.*
(—bup. fasciata *Fabr.*
—bup. 6 maculata *Herbst.)*
consularis *Dej.*
(—bup. consularis *Gory.)*
maculiventris *Lec.*
(—bup. maculiventris *Say.*
—bup sexnotata *Lap.*
rusticorum *Lec.*
(—bup. rusticorum *Kirby.)*

Melanophila *Esch.*
longipes *Gory.*
(—bup. longipes *Say.*
—apatura append. *Lap.*
—mel. immaculata *Gory.*

Chrysobothris *Esch.*
dentipes *Lec.*
(—bup. dentipes *Germ.*
—b. characteristica *Harris)*

ELATERIDAE.

Adelocera *Latr.*
marmorata *Germ.*
(—elater marmorata *Fabr.)*
obtecta, *Lec.*
(—elater obtectus *Say.)*

Alaus *Esch.*
oculatus *Esch.*
(—elater oculatus *Linn.)*

Elater *Linn.*
linteus *Say.*
(—ampedus lugubris *Germ)*
vitiosus *Lec.*
carbonicolor *Mann.*

Drasterius *Esch.*
dorsalis *Lec.*
(—elater dorsalis *Say.*
—monocrepidius dor. *Lec.*
—aeolus dorsalis *Cand.)*

Dolopius *Esch.*
pauper *Lec.*

Melanotus *Esch.*
fissilis, *Lac.*
(—cratonychus laticollis *Er.*
—cr. ochraceipennis *Mels.*
—cr. spheroidalis *Mels.)*

Athous *Esch.*
cucullatus *Cand.*
(—el. cucullatus *Say.*
—ath. hypoleucus *Mels.*
—ath. procericollis *Mels.*
—ath. strigatus *Mels.)*

Corymbites *Latr.*
aeripennis *Lec.*
(—el. aeripennis *Kirby.*
—el. appropinquans *Rand)*
cylindriformis *Germ.*
(—el. cylindriformis *Herbst.*
—el. appressifrons *Say.*
—el. brevicornis *Say.*
—cor. parallelop. *Germ.)*
vernalis *Germ.*
(—Elater vernalis *Hentz.)*
tarsalis *Lec.*
(—athous tarsalis *Mels.)*
spinosus *Lec.*
sagitticollis *Lec.*
(—pristilophus sag. *Esch.)*

Asaphes *Kirby.*
baridius *Lec.*
(—elater baridius *Say.*
—hemic. thomasi *Germ.)*

LAMPYRIDAE.

Photinus *Lap.*
Ellychnia *Lec.*
corruscus *Lac.*
(—lampyris corrusca *Linn.*
—el. latipennis *Motsch.)*

TELEPHORIDAE.

Chauliognathus *Hentz.*
Pennsylvanicus *Lec.*
(—telephorus penn *DeGeer*
—canth. rmer *Forster.*
—canth. bimaculata *Fabr.*
—cha. bimaculatus *Hentz.)*

Podabrus *Westw.*
Brachynotus *Kirby.*
rugosulus *Lec.*

Telephorus *Schaffer.*
Curtisii *Kirby.*

Rhagonycha *Esch.*
Carolinus *Lec.*
(—cantharis carolinus *Fab.*
—rha. carolinus *Motsch.)*

CLERIDAE.

Trichodes *Herbst.*
Nuttalli *Klug.*
(—clerus nuttalli *Kirby*)

Clerus *Geoffr.*
Thanasimus *Spin.*
nubilus *Klug.*

TENEBRIONIDAE.

Blapstinus *Waterh.*
metallicus, *Lec.*
(—blaps. mellicus *Fabr.*
—opatrum interrupt. *Say.*
—b. aeneolus *Mels.*
—b. interruptus *Lec.*
—b. luridus *Muls*)

Haplandrus *Lec.*
femoratus *Lec.*
(—trogosita femorat. *Fabr.*
—tenebrio femorat. *Beauv.*
—upis fulvipes *Herbst.)*

Upis *Fabr.*
ceramboides *Fabr.*
(—ten. ceramboides *Linn.*
—u. reticulata *Say.)*

Nyctobates *Lec.*
Pennsylvanica *Lec.*
(—ten. pennsylva. *DeGeer.*
—upis chrysops *Herbst.*
—ten. sublaevis *Beauv.)*

Iphthimus *Truqui.*
opacus *Lec.*

Tenebrio *Linn.*
molitor *Linn.*

Boletotherus *Cand.*
cornutus *Candèze.*
(—boletophagus cor. *Fabr.*
—opatrum cor. *Panzer.*)

Diaperis *Geoff.*
hydni *Fabr.*
(—maculata *Oliv.*)

MELANDRYIDAE.

Melandrya *Fabr.*
striata *Say.*
(—var. excavata *Hald.*)

MELOIDAE.

Meloe *Linn.*
rugipennis *Lec.*
augusticollis, *Say.*

Macrobasis *Lec.*
Fabricii *Lec.*

OEDEMERIDAE.

Nacerdes *Schmidt.*
melanura *Schmidt.*
(—cantharis melanura *Linn*
—necydalis notata *Fabr.*
—oed. analis *Oliv.*
—oed. apicalis *Say.*)

CERAMBYCIDAE.

Criocephalus *Muls.*
agrestis *Kirby.*

Arhopalus.
speciosus *Say.*
pictus *Drury.*

Callidium *Fabr.*
janthinum *Lec.*

Clytus *Fabr.*
undulatus *Say.*
ruricola *Oliv.*
campestris *Oliv.*
erythrocephalus *Fabr.*
muricatulus *Kirby.*

Enderces.
picipes *Fabr.*

Graphisurus.
pusillus *Kirby.*
fasciatus *DeGeer.*

Monohammus, *Latr.*
scutellatus *Say.*
confusor *Kibry.*

Saperda, *Fabr.*
calcarata *Say.*
lateralis *Hald.*
vestita *Say.*

Desmocerus *Serv.*
palliatus *Forster.*

Acmeops *Lec.*
proteus *Kirby.*

Typocerus.
sinuatus *Newman.*

Leptura *Linn.*
canadensis *Fabr.*

Trigonarthris.
proxima *Say.*

CHRYSOMELIDAE.

Donacia *Fabr.*
subtilis *Kunze.*

Lema.
trilineata *Oliv.*

Chelymorpha.
cribraria *Fab.*

Cassida *Herbst.*
bicolor *Fabr.*
guttata *Fabr.*

Diabrotica *Chev.*
vittata *Fabr.*

Oedionychis *Latr.*
thoracica *Fabr.*

Doryphora.
trimaculata *Say.*

Chrysomela *Linn.*
scalaris *Lec.*
labyrinthica *Lec.*
bigsbyana *Kirby.*
trivittata *Say.*
polygoni *Linn.*

Paria.
4-notata *Say.*

Chrysochus.
auratus *Fabr.*

Cryptocephalus, *Geoff.*
mucoreus *Lec.*

COCCINELLIDAE.

Hippodamia.
13-punctata *Linn.*
parenthesis *Say.*

Coccinella *Linn.*
9-notata *Herbst.*
lecontei (var).
bipunctata *Linn.*

Mysia *Muls.*
15-punctata *Oliv.*

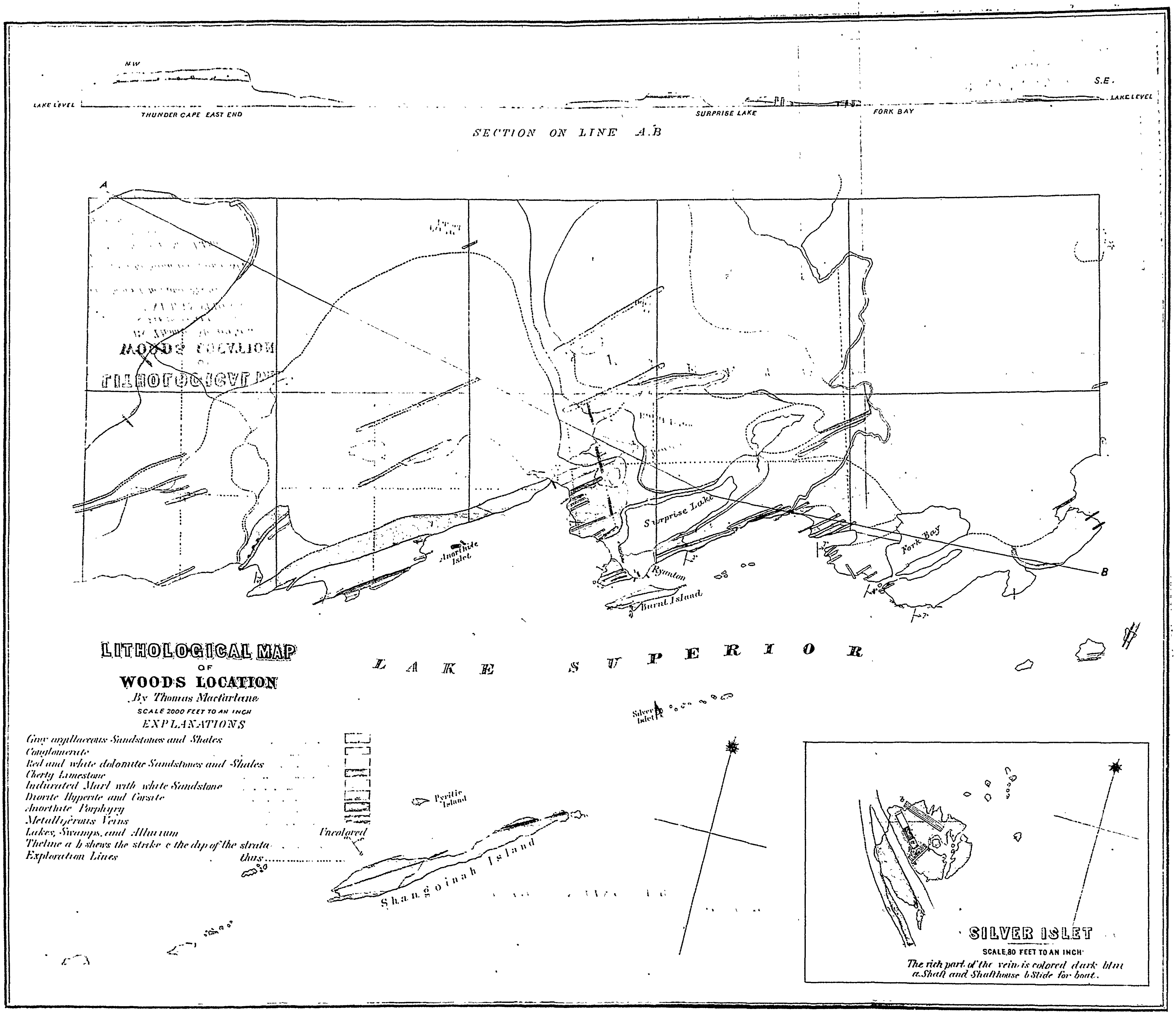
Chilocorus *Leach.*
bivulnerus *Mels.*

Psyllobora.
20-maculata *Say.*

Brachycantha.
ursina *Fabr.*

EROTYLIDAE.

Engis.
4-maculata *Say.*


N.W.
S.E.
LAKE LEVEL
LAKE LEVEL
THUNDER CAPE EAST END
SURPRISE LAKE
FORK BAY
SECTION ON LINE A.B
A
B
Surprise Lake
Fork Bay
Anorthite Islet
Ryunton
Burnt Island
LAKE SUPERIOR
Silver Islet
Peritic Island
Shangoinah Island
LITHOLOGICAL MAP
OF
WOODS LOCATION
By Thomas Macfarlane
SCALE 2000 FEET TO AN INCH
EXPLANATIONS
Gray argillaceous Sandstones and Shales
Conglomerate
Red and white dolomitic Sandstones and Shales
Cherty Limestone
Indurated Marl with white Sandstone
Diorite Hyperite and Corsite
Anorthite Porphyry
Metalliferous Veins
Lakes, Swamps, and Alluvium
Uncolored
The line a b shews the strike c the dip of the strata
Exploration Lines
thus
SILVER ISLET
SCALE 80 FEET TO AN INCH
The rich part of the vein is colored dark blue
a Shaft and Shafthouse b Slide for boat.

ON THE GEOLOGY AND SILVER ORE OF WOODS LOCATION, THUNDER CAPE, LAKE SUPERIOR.

By THOMAS MACFARLANE.

PART I.*

During the summer of 1868, an exploring party, under my charge, was sent by the Montreal Mining Company to examine their mineral lands on Lake Superior. On one of their properties, Woods Location, near Thunder Cape, a silver vein of some promise was discovered, and a good deal of attention was paid to the geology of its neighbourhood. The results of my observations are, with the permission of the Directors of the Company, made the subject of the present paper.

The accompanying map shews the geology of that part of the location lying nearest the lake.

The stratified or derived rocks which are found upon it, and which are indicated by the five first colours under the word "Reference," belong to Sir W. E. Logan's Upper Copper-bearing rocks of Lake Superior, the age of which is, perhaps, still a matter of doubt. The lowest group of this series found upon the location consists of grey argillaceous sandstones and shales, coloured lilac on the map. A general description of these will be found on page 68 of the Geology of Canada, to which I have to append the following additional particulars. The sandstone layers, varying in thickness from a few inches to several feet, are invariably small or fine-grained, and occasionally shew narrow, indistinctly limited bands of light and dark grey, running in planes parallel with the stratification. A specimen from Location Bay, more closely examined, yielded the following results. Before the blow-pipe it fuses at the edges to a greyish white enamel, and the adjacent parts become lighter coloured and slightly brownish. Hydrochloric acid causes a very slight effervescence. The powder is slightly reddish, or brownish grey, and on being examined chemically, gave the following results:—

Silicious matter (insoluble in Hydrochloric Acid and dilute Potash ley).	80·09
MATRIX—	
Protoxide of Iron	4·08
Alumina	4·86
Carbonate of Lime	1·15
Carbonate of Magnesia	0·56
Silica	4·80
Carbonaceous matter and water (loss on ignition)	1·75
Alkalis, etc. (by difference)	2·71
	100·00

Interstratified with such sandstones, there are sometimes found

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* The map will appear with the second part of this paper.—ED.

beds of a more calcareous nature, but, as Sir W. E. Logan remarks, "few of them pure enough to be entitled to the appellation of limestone." A specimen from a bed of this nature yielded the following results:—

Silicious matter	57·30
Soluble in Acid—	
Protoxide of Iron	3·45
Alumina	2·36
Carbonate of Lime	19·88
Carbonate of Magnesia	11·45
Soluble in Alkali—	
Silica	3·44
Carbonaceous matter and water (by difference)	2·12
	100·00

With the sandstones there are frequently interstratified shaly layers, generally of a darker colour, which behave before the blowpipe like the sandstone above mentioned, but never shew the slightest effervescence with acid. On analysis, a specimen gave:—

Carbonaceous matter (loss on ignition)	2·04
Silicious matter	65·71
Soluble in Acid—	
Protoxide of Iron	7·20
Alumina	8·58
Magnesia	0·43
Soluble in dilute Potash ley—	
Silica	11·56
Alkalis, etc. (by difference)	4·48
	100·00

These sandstones and shales are, for the most part, very evenly and regularly stratified, and only in the neighbourhood of the intersecting dykes are they at all contorted. In some places they appear almost horizontal, but they generally shew a dip of from 3° to 6° to the east or south of east. Nothing resembling transverse cleavage was found in these sandstones or shales, and, even in the latter, the schistose structure, which is developed by weathering, is more of a flaggy than of a slaty nature. The vertical jointing, mentioned by Sir W. E. Logan, is visible at almost every exposure of these sandstones and shales on the location. In this respect, and in general lithological characters, they much resemble the sandstones which occur to the north and south of Point aux Mines, on the east shore of the lake, and which, there, appear to overlie unconformably the traps and conglomerates of Maimanse.

Immediately and conformably overlying the sandstones and shales just mentioned, there is found a conglomerate bed from two to six feet thick (marked on the map yellow, with brown spots). The pebbles are generally quartzite, red coloured and jasper-like, and the matrix consists of coarse-grained red coloured sand. Red and white sandstones, coloured yellow on the map, succeed the conglomerate. The white sandstones make up the greater part of this group, but in many parts of its thickness, and especially in the part immediately overlying the conglomerate, layers of red sandstone are interstratified with the white beds, and the latter frequently shew spots and irregular patches of red. Sometimes, similar spots of white are observed in the red sandstone layers. The colouring matter of the red sandstone is peroxide of iron, and the difference in composition between it and the white is shewn in the following analysis. I. is the composition of a red-coloured, and II that of a white portion of a specimen, from a ridge of sandstone lying between Camp and Fork Bays:—

	I.	II.
Silica, insoluble in Hydrochloric Acid	73·45	72·89
Peroxide of Iron, with a little Alumina	2·41	0.91
Carbonate of Lime	12·54	13·04
Carbonate of Magnesia	10·94	11·94
	99·34	98·78

It will be observed that the cementing material of these sandstones has almost exactly the composition of dolomite. Sandstones of this composition are probably not unfrequent among the Potsdam and Calciferous rocks of Canada, but, in Europe, they are described as belonging exclusively to the Buntsandstein formation (Zirkel, Petrographie, ii., 581). In the upper part of the group, red shales are found in great quantity, interstratified with the sandstone, and apparently approaching in composition to the indurated marl hereafter to be described. This group of "red and white dolomitic sandstones and shales" has a general dip of 7° to 15° eastward. The sandstones very frequently shew ripple marks on the surfaces of the beds.

A bed of limestone, from two to six feet thick, coloured blue on the map, overlies conformably the group first described. In the upper part, it appears brecciated from intermixed cherty fragments, but in the lower part it is more crystalline.

Immediately overlying the limestone, and beautifully exposed on the shore eastward from Red Bay, there comes a considerable development of the indurated marl mentioned by Sir W. E. Logan on page 70 of the Geology of Canada. This rock is fine-grained and compact, generally of a yellowish grey colour, with red patches. Where the latter colour predominates, the rock assumes a slaty structure. The reddish-coloured spots or patches have generally a rounded contour, and although they sometimes resemble rounded fragments or boulders, it is found, on breaking them, that they consist of the same fine-grained material as the marl itself, differing from it only in colour. Occasionally, other enclosures occur in this rock, which seem more distinctly separated from it, some of them resembling pieces of the shaly sandstones of the lower group, but purple coloured. They are doubtless of a fragmentary nature. Specimens of indurated marl from Island No. 6 were subjected to analysis, the light coloured (I) and reddish portions (II) being examined separately.

	I.	II.
Silica (insoluble in Hydrochloric Acid and Potash lye)..	50·77	53·27
Peroxide of Iron and Alumina........................	2·48	5·78
Carbonate of Lime...................................	34·43	21·00
Carbonate of Magnesia...............................	7·68	13·43
Silica..	3·28	3·48
Water...	1·79	2·04
	100·43	99·00

On the eastern extremity of the location, the indurated marl is overlaid by white sandstone again, and this rock appears to be the highest in geological position upon the property.

These stratified rocks are intersected by numerous dykes of various thicknesses, running generally parallel with each other in a north-east and south-western course. Their outcrops are most numerous in the western part of the location, where they, and the enclosing argillaceous sandstones and shales, have been so acted on by the waters of the lake as to expose plainly their mutual relations. The dykes are coloured green on the map, and it will be plainly seen from it, that they, to a very considerable extent, determine the outline of the shore. The longer lines upon the coast run generally parallel with the strike of these dykes; the hard rocks of the latter invariably form the projecting points and headlands, while the bays are cut out of the softer stratified rocks. Although the dykes are best exposed among the grey sandstones, many of them can be followed into the area occupied by the red and white sandstones, where they are found to intersect these also. They are always either vertical or inclined at high angles, the dip in the latter case being generally to the south-east, but sometimes also to the north-west. They vary in thickness from a few feet to nearly a hundred, and they sometimes exhibit interesting phenomena as to joints of separation. Irregular columnar separation at right angles to the inclination is frequently observed, but it is on a ponderous scale, and although it reminds one of trappean jointing, it is not at all so regular. Sometimes the dykes are split up into large square blocks, or into large flat pieces, with their planes parallel to the sides of the dyke. Although the direction above given for these dykes is the prevailing one, it will be seen from the map that some of them have courses more or less divergent from this strike; indeed, some small dykes are to be seen branching off from the main ones. The rocks which constitute these dykes belong to the diorite family, but are capable of being subdivided into several species, according to the nature of the felspar they contain. The recognition of their constituent minerals is a matter of some difficulty, as they are, for the most part, small, or fine-grained. No instance was observed of a coarse or large-grained rock among these dykes, although a very distinct porphyritic rock was met with. As examples of the various species of rocks constituting these dykes, the three following may be particularized.

DIORITE.—The nearest approach to this species is the rock constituting Silver Islet. It is distinctly composed of a greenish black and a white mineral, the former being, however, duller in lustre and less hard than the hornblendic constituent of the rocks of many of the other dykes. Quartz is occasionally detected, copper and iron pyrites and a grain or two of schiller spar, also. Its specific gravity is 2·713 to 2·711. Its powder is greenish grey, changing on ignition to leather-brown, and yielding water. On digestion with hydrochloric acid, and then with weak potash ley, 52·6 per cent. of a residue is left, which is almost pure white in colour. The following is an analysis of the rock, shewing the composition both of the soluble and insoluble part:—

Water		5·02
SOLUBLE PART—		
Silica	15·11	
Alumina	5·82	
Ferrous Oxide	18·17	
Lime	1·07	
Magnesia	1·50	41·67
		46.69

Insoluble part—

		46.69
Silica	38·23	
Alumina	9·65	
Ferric Oxide	2.83	
Lime	0·57	
Magnesia	0·33	
Alkalis (by difference)	0·99	52·60
		99·29

From this analysis it would appear that almost the whole of the hornblende has been converted into a chloritic mineral. The insoluble, probably, consists of the felspathic constituent mixed with the quartz contained in the rock. The small rocky island called Pyritic Island, lying to the north of Great Shaginah Island, consists of diorite. In the centre, and running along its length, is a band of the same rock about thirty feet wide, more or less impregnated with copper, magnetic and iron pyrites.

Corsite.—By far the greater number of the rocks forming the dykes consist of a small-grained mixture of glittering hornblende in large quantity, with felspar, which, being easily decomposable by acids, is probably anorthite. The specific gravity of these rocks varies from 2·934 to 3·085. They sometimes shew a warty appearance on the surface, especially when much weathered, and, occasionally, they are found to break up entirely into small friable pebbles. Islet No. 5, although it seems to be part of the same intrusive mass as Silver Islet, consists of a rock with the mineralogical composition of corsite. It is small-grained and crystalline, shewing abundance of small glittering faces, belonging to its black-coloured constituent, which preponderates over the lighter-coloured felspathic grains. Its specific gravity is 2·916 to 2·933. Its powder has a slate-grey colour, which, on ignition, changes to dark brown. On digestion with hydrochloric acid, and afterward with dilute potash ley, it leaves 43·64 per cent. insoluble matter of a dark grey colour, and having a specific gravity of 2·955. The following is an analysis of the rock, the compositions of the soluble and of the insoluble portions having been separately ascertained:—

		46.69

Soluble Part—

Silica	21·77	
Alumina	11·69	
Ferrous Oxide	13·50	
Lime	3·99	
Magnesia	1·75	52·70

		52·70
INSOLUBLE PART—		
Silica	24·39	
Alumina	3·78	
Ferrous Oxide	11·38	
Lime	3·42	
Magnesia	0·67	43·64
Water	3·15	3·15
		99·49

The composition of the insoluble portion, calculated to 100 parts, is as follows:—

Silica	55·88
Ferrous Oxide	26·09
Alumina	8·66
Lime	7·84
Magnesia	1·53
	100·00

Judging from these figures, and the appearance of the black constituent in the rock itself, it would appear reasonable to regard it as basaltic hornblende. The large quantity of mineral present, decomposable by acid, would lead to the inference that the felspathic constituent is anorthite, although, doubtless, some chloritic substance is decomposed and dissolved with it. The presence of anorthite in these fine-grained rocks is confirmed by its occurring in some of them in well-developed crystals, constituting the rock which is referred to on page 72 of the Geology of Canada, and which is next described.

ANORTHITE PORPHYRY.—The dyke which forms the rocky islets, marked 1, 2, and 3 on the map, and which runs along the south-east side of Burnt Island, consists of this rock, although the anorthite crystals are but sparingly distributed. The most characteristic development of this porphyry occurs on the shore between Location Bay and Perry's Bay, constitutes Anorthite Islet, and then joins the mainland on the east side of Perry's Bay. The size of the crystals varies from one-quarter-inch to several inches in diameter; they are beautifully striated, and aggregations of them, two or three feet in diameter, are of frequent occurrence on Anorthite Islet. Indeed, at a distance, the rock of this islet resembles a breccia, so great is the number and size of the masses of anorthite. These masses seem to have been formed by the crowding together of numbers of anorthite crystals, and some of the spaces between these seem to have been subsequently filled up by quartz. The specific gravity of the mineral from these masses is 2·737. It was analysed by digestion with hydrochloric acid, which separated silica, which was afterwards dissolved out from the insoluble by weak potash lye. It was found to contain:—

Silica	45·13
Alumina	33·92
Lime	17·02
Insoluble	4·46
	100·53

The mineral probably contains also a small quantity of soda, as it colours the blow-pipe flame strongly yellow. The anorthite crystals frequently contain small brownish specks, and the matrix of the rock consists of a small-grained mixture of these with the anorthite. Sometimes a larger individual is perceived with a brownish black colour and glittering faces, and, besides such, there are dark green grains of chlorite, and occasional specks of iron pyrites. A piece of the rock, weighing 30·455 grammes, had a specific gravity of 2·806.

The influence of these dykes upon the bedded strata which they intersect is very marked. Both the argillaceous and the dolomitic sandstones become hardened and silicified, and enabled much more effectually to resist disintegrating influences. In many places, where they have been much acted on by the waters of the lake, the altered part of the sandstones is found remaining and adhering to the dyke, while traces of the unaltered strata are visible only among the debris on the shore. Instances are also to be found where the bedded strata have been much contorted in the neighbourhood of the dykes. One instance was observed of the rock of a dyke enclosing fragments of granite and quartzite, the longer dimensions of which run parallel with the side of the dyke. This dyke is the first one met with on the shore to the west of Boulder Point.

There are numerous veins on the location, connected, for the most part, with the dykes which have just been described. It may be doubted whether these veins, the most of which are indicated upon the map, possess in every case the characters of true metalliferous veins. Some of them appear to be mere fillings up of the separation joints in the rock of the dyke. Others, which appear more promising, are of greater width, and run parallel with the dykes, but were not observed to contain anything more valuable than specks of iron and copper pyrites. A third variety of vein, which is perhaps the most important, crosses the general course of the dykes, and it is to this class that the vein belongs in which silver, to a considerable extent, was discovered.

This vein occurs on a small island, marked Silver Islet on the map, and distant about a mile from the main shore. This islet (No. 4), the reef and larger island (No. 5) to the eastward, and the still larger island to the south-westward, marked Pyritic Island, appear to be all that remains of a large dyke or mass of diorite, which in all likelihood intersected the sedimentary strata which, in former times, occupied the space between the islet and the mainland. The width of this intrusion of diorite is at least 100 feet, but may be more in depth, as a good part of its thickness must have been worn away by the action of the waves of the lake. The nature of the rock of the islet has been already described. It differs from most of the rocks of the other dykes, not only mineralogically, but, also, in being destitute of the divisional jointing which so frequently characterizes them. A few square yards only of the islet, at its highest part, six feet above the level of the lake, shew any traces of vegetation. The remainder has been smoothed and rounded off by the action of the water, and here the rock seems exceedingly compact, no fissures being perceived. On the map will be found a plan, on a larger scale, of this islet, shewing the position and course of the vein which traverses it. The course of the vein is N. 32° to 35° W., and it dips to the eastward at an angle of about 80°. It has a width of about twenty feet on the north side of the island, and to the southward divides into two branches, each seven to eight feet wide. It consists mainly of calcspar and quartz. Galena, in little cubes, is visible in almost every part of it, and blende, iron and copper pyrites are not uncommon. The native silver, accompanied by silver glance, was only found in the west branch. It was first noticed by Mr. John Morgan, one of the exploring party, in the shape of small nuggets, on the east side of the vein. It was then traced to the water's edge, and out into the water for some distance, where, instead of merely scattered nuggets of native silver, large patches of veinstone, rich in galena, are visible, which galena, on closer examination, is found to be intermixed with small particles, and some large nuggets of silver. The thickness of the rich part of the vein varies from a few inches to two feet, and it keeps to the east or hanging side of the vein. By working in the water with crow-bars, some loose pieces of rich veinstone were detached, and in this way, as well as from one blast on the island, 1,336 lbs. of ore were obtained. This quantity of ore was sent to Montreal, where, in the month of December, it was carefully weighed and sampled. The richest pieces, varying in weight from a few ounces to 41 pounds, were picked out, weighing in all 93¼ lbs. Eight of these, supposed to represent the average, were placed in sealed bags and marked sample No. 1. A large piece of veinstone, measuring three feet by twelve to sixteen inches by six to twelve inches, and weighing 481 lbs., was sampled by drilling six holes through it at points as nearly as possible equidistant from each other. The borings, quartered down in the usual manner and then ground and well mixed together, constituted sample No. 2. The fragments of ore of ordinary quality, weighing 250¾ lbs., were sampled by chipping off pieces from them. The pieces, ground to powder and quartered down, made sample No. 3. The remainder of the ore was broken down into small pieces and well mixed with the ore which had broken off the larger fragments. It weighed 511 lbs., and was regularly quartered down, the resulting sample being ground fine, well mixed, and marked No. 4. Eight portions of each of the powdered samples were placed in sealed bottles, all properly labelled. The following table gives the results obtained by Professor Chapman, Dr. Hayes, and myself in assaying the various samples, the ton being taken at 2240 lbs., and the value of silver at $1.24 per ounce troy. This value is based upon the price recently quoted in England for bar silver, namely 5s. 0¾d. per oz. :—

PER CENTAGES.

	No. 1.	No. 2.	No. 3.	No. 4.	Average.
Professor Chapman	14·96	7·88	5·27	1·71	5·523
Dr. Hayes........	41·17	11·26	5·82	1·18	8·471
T. Macfarlane....................	13·14	7·3	4·94	1·82	5·168

OUNCES PER TON.

	No. 1.	No. 2.	No. 3.	No. 4.	Average.
Professor Chapman	4,886	2,574	1,721	558	1,804
Dr. Hayes.......................	15,064	3,678	1,901	385	2,767
T. Macfarlane	4,292	2,384	1,613	594	1,690

SILVER VALUES PER TON.

	No. 1.	No. 2.	No. 3.	No. 4.	Average.
Professor Chapman	$ 5,058	$3,191	$2,134	$691	$2,236
Dr. Hayes	18,679	4,560	2,357	477	3,431
T. Macfarlane....	5,332	2,956	2,000	736	2,095

If the average of these amounts be taken, it amounts to 6·387 per cent. silver = 2087 ounces, or $2,587.88 per ton of 2,240 lbs. The following experiments on samples Nos. 2 and 4 are confirmatory of the results of the assays:—1000 parts of No. 2 yielded, on being washed on the German 'Sicher trog,' 275 parts of ore, containing 24·82 per cent. silver; 1000 parts of No. 4, yielded on similar treatment, 87 parts washed ore, assaying 15·9 per cent. silver.

On the strike of the vein of Silver Islet, to the north-westward, two veins are seen to intersect the argillaceous sandstones which form the projecting part on the south-east side of Burnt Island. These sandstones are here much harder than usual, having resisted well the action of the waves. This is owing to their being penetrated by numerous thin veins of quartz, which mineral appears also to have permeated and hardened the side rock. The dip of the sandstones is 9° towards N. 58° E. Generally the veins are mere coatings of quartz on the vertical joints, but sometimes they are about an inch, and even three inches thick, showing cavities lined with quartz crystals. The most western of the large veins shews sometimes a thickness of seven or eight inches of quartz, but consists on the whole of a network of quartz veins enclosing fragments of the hardened sandstone. Galena, blende and iron pyrites are observed accompanying the quartz, but, although native silver was diligently sought for, none was found. On washing the galena from 1000 parts of this veinstone, 181 parts were obtained, containing 0·04 per cent. silver, or 13·052 oz. per ton. This quantity is of course too small to pay for working the vein. The strike of the latter is about S. 30° E., which direction points straight to the west side of Silver Islet. Its dip is 80° N.E. The eastern vein is filled mostly with calcspar, and contains galena also, 106 parts of which were washed out of 1000 of veinstone. The washed ore contained only a trace of silver. These veins seem to continue across Burnt Island, and are met with on the mainland, where small grains of galena are seen in them. They are more likely to be argentiferous where they intersect the dykes; but at these points large crevices filled with large stones and earth are invariably found.

With regard to the agricultural capabilities of the location, they are not very extraordinary. A large part of its area is occupied by the red sandstones, having only a covering of moss and scarcely any soil upon them, neither is there any soil upon the rocky ridges formed by the dykes. The indurated marl and the grey sandstones yield here and there some land which, on cultivation, might supply a few of the wants of a mining population. The lake itself, however, with its abundant supply of beautiful fish, would do far more to furnish food for the miners than any farms which it might be possible to establish on shore. The timber upon the location, although seldom of a size to furnish good saw-logs, would nevertheless be abundant for mining purposes. Balsam, spruce, cedar, and birch predominate. There are a few pines and poplars, and in the north-east part some tamarac. Maple is absent altogether. Since, therefore, the location is comparatively valueless for farming and lumbering purposes, it is to be hoped that the development of its mineral wealth will be taken in hand in a vigorous but judicious manner and carried to a successful issue. The only considerable mining settlement yet made in the district of Algoma—that of Bruce Mines—owes its establishment to the enterprise and money (however injudiciously expended) of the Montreal Mining Co. May their exertions towards creating a remunerative industry in this barren region be, in the future, attended with more substantial rewards to the adventurers than heretofore.

Actonvale, February 20th, 1869.

ON THE MARINE MOLLUSCA OF EASTERN CANADA.

By J. F. Whiteaves, F.G.S., etc.

Our knowledge of the distribution of the marine mollusca in Lower Canada is still very limited. In 1858 Principal Dawson published in this Journal (vol. iii., p. 329) a list of shells collected by him in Gaspé Bay; the number of species recorded is thirty-eight. In 1859 Prof. R. Bell gave a list of sixty-seven marine molluscs, collected in various parts of the Gulf of the St. Lawrence (see vol. iv., p. 197); a few of these were procured in New Brunswick. Since that time some additional species have been collected by other observers. In August, 1867, through the kindness of Messrs. John Luce and G. De Carteret, of the firm of W. Frewen & Co., I was enabled to carry on careful dredging operations at Grande Grève, in Gaspé Bay. In this paper it is proposed—1st, to give a list of the species dredged by myself at Grande Grève, and, 2nd, a catalogue of all the marine mollusca known to inhabit Lower Canada at the present date.

Grande Grève is a fishing station on the North-east side of Gaspé Bay, and is sheltered by the narrow strip of land of which Cape Gaspé is the extremity. The rocks of Oriskany sandstone here dip slopingly towards the sea, which deepens very rapidly from the shore, so that but few shells can be collected unless the dredge is used. A fortnight was devoted to a careful examination of this particular spot, and seventy-five species were procured, as follows:—

PALLIOBRANCHIATA.

Rhynchonella psittacea Gmelin:—Frequent, alive on stones in from 10 to 20 fathoms.

LAMELLIBRANCHIATA.

Anomia ephippium Linn.—On stones and shells with the above; the var. *aculeata* frequent.

Amusium tenuicostatum Mighels (= *Pecten Magellanicus* Lam.):—Alive in 1 to 10 fathoms.

Pecten Islandicus Chemnitz:—Living in from 5 to 40 fathoms water.

Nucula tenuis Montagu, and var. *expansa* (= *N. expansa* Reeve):—Alive in 40 to 50 fathoms mud. The *Nucula inflata* of Hancock, from Greenland, etc., is apparently only a variety of this species, and is probably the same as *N. expansa* Reeve.

Nucula delphinodonta Migh.:—With the above, but much more abundant. The shell is covered with a ferruginous coat like the British *Lucina ferruginosa.*

Leda pernula Müller:—Six fine living specimens in 50 fathoms mud.

Leda minuta Müll.—One, living, with the above.

Yoldia myalis Couthuoy:—Rare, with the two preceding; but not infrequent in the stomachs of flat fish caught off Grande Grève.

Crenella glandula Totten:—A few taken living in from 20 to 40 fathoms.

Crenella decussata Mont. (= *C. cicercula* Möll.)—Abundant, living in mud, in from 20 to 60 fathoms. Quite distinct from the preceding, but larger than the average of British specimens.

Modiolaria discors Linn. and var. *lævigata* Gray:—Rare, living with the above.

Modiolaria nigra Gray:—One fine living specimen on a stone, in about 20 fathoms.

Modiola modiolus Linn.—Fragments of large specimens in shingle at 20 fathoms.

Mytilus edulis Linn.—Common on the beach and in shallow water.

Cardium Islandicum Linn.—In sandy mud, at 30 to 50 fathoms, and abundantly from fishes' stomachs.

Cardium pinnulatum Conrad:—Alive, with the preceding.

Serripes Grœnlandicus Chemn.—Large and fine, in mud, at 20 to 50 fathoms. Found in the English Red-Crag deposits.

Astarte striata Leach, and var. *globosa*:—In 20 to 60 fathoms mud.

Astarte Banksii Leach:—With the preceding, but rarer. This species and the foregoing are barely specifically distinct from the *A. compressa* of English authors. They exactly correspond with the two so-called species from Greenland.

Astarte undata Gould (= *A. latisulca* Hanley):—Large and fine, in 50 to 60 fathoms mud. Very variable in sculpture. The New England variety, with prominent and distant ribs, which some of the Gaspé examples approach, can hardly be separated from the *Astarte Omalii* var. *undulata* of Searles' Wood's Crag Mollusca.

Astarte semisulcata Leach:—With the preceding a few specimens occurred, which I refer, with doubt, to this species.

Cardita borealis Conrad:—Living, at various depths.

Axinus Gouldii Philippi:—A few living, at 20 to 60 fathoms.

Venus fluctuosa Gould, sp.—Extremely abundant, living in 20 to 50 fathoms.

Macoma sabulosa Spengler (= *Tellina proxima* and *calcarea*, auct.):—Scarce, in 20 to 50 fathoms; also from stomachs of fishes.

Macoma Grœnlandica Beck, sp.—Scarce, in shallow water. Probably conspecific with the *Sanguinolaria fusca* of Say from New England, with the West Coast *Macoma inconspicua* of Brod. et Sow, and with the European *Tellina Balthica* of Linnæus.

Mya arenaria Linn.—Occasional, on the shore.

Mya truncata Linn.—One dead but fresh adult, and living fry taken in 10 to 20 fathoms.

Saxicava (*Panopœa*) *Norvegica* Spengler:—Six dead but fresh specimens, in 50 fathoms mud.

Saxicava rugosa Linn. and var. *arctica*:—Common, burrowing into stones in from 10 to 20 fathoms.

Anatina papyracea Say:—One alive, in 50 fathoms mud.

Thracia myopsis Möller:—A few taken with the above.

Lyonsia (*Pandorina*) *arenosa* Möll.—Living in sandy mud, in 30 to 50 fathoms. The shell is covered with particles of sand, as the specific name implies.

Pandora (*Kennerlya*) *glacialis* Leach:—Living with the above. Externally it closely resembles the *Pandora obtusa* of Forbes and Hanley, which is the *Solen pinna* of Montague. According to Dr. P. P. Carpenter, *P. glacialis* has an internal ossicle, which is wanting in the British shell.

GASTEROPODA.

Cylichna alba Brown:—Living in 40 to 60 fathoms.

Tonicia marmorea O. Fabr.—Common on stones, in 10 to 20 fathoms.

Leptochiton albus Linn.—With the above; frequent.

Tectura testudinalis Müll.—In very shallow water.

Lepeta cœca Müll.—On stones, in 20 to 50 fathoms, living.

Cemoria Noachina Linn.—Living with the above.

Margarita striata Brod. et Sow. (=*M. cinerea* Gould).

Margarita Grœnlandica Chemn. and var. *undulata*.

Margarita obscura Couth.

Margarita varicosa Migh.:—These four species were taken living, in from 30 to 50 fathoms mud, the last being by far the most abundant. The *M. varicosa* is the same as the *M. elegantissima* of Searles' Wood's Crag Mollusca.

Lacuna vincta Fabr.—On sea-weeds in shallow water.

Littorina littoralis Linn. fide Jeffreys (= *L. palliata* Say):—Common on rocks on the shore.

Littorina rudis Mont.—With the above. The varieties *patula* and *tenebrosa* were common, but I did not meet with the type. *L. Grœnlandica* Chemn. appears to be a variety of this species.

Scalaria Grœnlandica Perry:—One living specimen on a stone, in 20 fathoms water.

Mesalia (?) *erosa* Couth.—Abundant, living in 20 to 50 fathoms mud.

Mesalia (?) *reticulata* Migh.—With the above, but less frequent.

Aporrhais occidentalis Beck :—Alive, with the two preceding.

Menestho albula Möll.—Three living; adult specimens were taken on a stone, from about 20 fathoms water.

Velutina (Morvillia) Zonata Gould :—Three examples taken on stones in deep water.

Velutina haliotoidea Müll.—One taken living, with the above.

Natica affinis Gmelin (= *N. clausa* Brod. et Sow.):—Fine, in about 40 fathoms.

Lunatia Grœnlandica Möll.—Very large, living with the above.

Lunatia heros Say :—Frequent in sandy parts of Gaspé Bay, but rare opposite Grande Grêve.

Pleurotoma bicarinata Couth :—Rare, in 30 to 50 fathoms.

Bela nobilis Möll.—A few living, at the same depth as the above.

Bela exarata Möll.—One living, in about 40 fathoms.

Bela scalaris Möll.—In mud, at from 30 to 50 fathoms. I regard these three as good species, distinct from the British *B. turricula*, of which I have never seen typical specimens in Canada.

Bela decussata Couth.—Frequent, living in from 30 to 50 fathoms mud.

Bela pyramidalis Strom (= *Fusus pleurotomarius* Couth. *F. rufus* Gould and *B. Vahlii* Möll.) :—With the preceding, but rare.

Nassa trivittata Say :—Living, a little above the village of Gaspé Basin, where the water is brackish.

Buccinum undatum Linn.—Several varieties of this species were dredged in deep water. I regard the *Buccinum undulatum* of Möller and the *B. Labradorense* of Reeve, as varieties of this protean mollusc.

Buccinum tenue Gray (= *B. scalariforme* Möll.) :—Alive, in 60 fathoms mud.

Buccinofusus Kroyeri Möll. sp.—One living specimen, with the preceding; it is the *Buccinum cretaceum* of Reeve and the *B. Donovani* of Prof. Bell's list.

Chrysodomus decemcostatus Say :—One dead immature specimen was dredged in deep water.

Chrysodomus pygmæus Gould :—Not rare, living in about 30 fathoms.

Trophon Gunneri Lovén :—Living in about 30 fathoms.

Trophon clathratus Linn.—One taken with *T. Gunneri.*

Trichotropis borealis Brod. et Sow.

Admete viridula O. Fabr.—The two last species were fine, and frequent in 30 to 40 fathoms.

CEPHALOPODA.

?*Loligo illecebrosa* Lesuer:—Abundant; is used by the fishermen largely as a bait for cod.

Among other invertebrates dredged here were *Metridium marginatum* Edw. et Haime, *Alcyonium rubiforme* Ehrenb., *Echinarachnius parma* Linn., *Ophiopholis aculeata* Lutk., *Ophioglypha robusta,* and *O. Sarsii,* with other commoner forms, and some fine sponges.

It is thought desirable to place on record a list of the sea shells known to inhabit the River and Gulf of the St. Lawrence, north of New Brunswick, and south of north-eastern Labrador. The species enumerated in the preceding list are included, and only unrecorded localities are given for rare species. My thanks are due to Principal Dawson, to Drs. Stimpson, and P. P. Carpenter, and to Messrs. S. Hanley and J. G. Jeffreys, for their kind critical assistance in the identification of difficult species. At the same time, having carefully compared the Canadian shells with Möller's types in the British Museum, and in the cabinets of Messrs. Hanley and Jeffreys, this and the preceding list must be regarded as the expression of my own individual judgment on the several species.

LIST OF THE MARINE MOLLUSCA OF EASTERN CANADA.

PALLIOBRANCHIATA.

Rhynchonella psittacea, Gmel.

LAMELLIBRANCHIATA.

Anomia ephippium, Linn.
  and var. aculeata.
Limea subauriculata, Mont.
Amusium tenuicostatum, Migh.
Pecten Islandicus, Chemn.
Nucula tenuis Mont.
  and var. expansa.
Nucula delphinodonta, Migh.
Leda pernula, Müll.
—— minuta, Müll.
Yoldia myalis, Couthuouy,
  (is the Leda limatula of Principal Dawson's list).
Crenella pectinula, Gould;
  (Mingan, J. Richardson, Jr).
—— glandula, Totten.
—— decussata, Mont.
Modiolaria discors, Gray,
  and var. lœvigata.
—— nigra, Gray.

Modiola modiolus, Linn.
—— plicatula, Lamarck.
Mytilus edulis, Linn.
Cardium Islandicum, Linn.
—— pinnulatum, Conr.
Serripes Grœnlandicus. Chemnitz;
Axinus Gouldii, Phil.
Astarte borealis? Chemn.
(Marsouin, Prof. R. Bell).
—— undata, Gould.
—— semisulcata? Leach.
—— striata, Leach.
—— Banksii, Leach.
—— quadrans, Gould;
(Mingan, J. Richardson, Jr).
Cardita borealis, Conr.
Gemma Tottenii, Stimp.
(= Venus gemma, Totten).
Venus fluctuosa, Gould.
Mactra polynema, Stimp.
(= M. ovalis, Gould—name preoccupied).
Ceronia deaurata, Turton,
(= Mesodesma Jauresii, De Joannis): Little Metis, J. F. W.
Ceronia arctata, Conrad;
(This species I believe to be the young of the preceding).
Macoma Grœnlandica, Beck.
—— sabulosa, Spengl.
Tellina (Angulus) tenera, Say;
(collected in Gaspé Bay by Principal Dawson).
Solen ensis, Linn.
Machæra costata? Say.
Mya arenaria, Linn.
—— truncata, Linn.
Crytodaria siliqua, Spengl.
(Tadoussac, Principal Dawson; Little Metis, J. F. Whitheaves).
Panopœa Norvegica, Spengl.
Saxicava rugosa, and var. arctica.
Anatina papyracea, Say.
Thracia myopsis, Möll.
Lyonsia (Pandorina) arenosa, Möll.
(is the Osteodesma hyalina of Prof. Bell's list, but not of Conrad).
Pandora glacialis, Leach.
Zirphœa crispata, Linn.

GASTEROPODA.

Opisthobranchiata.

Cylichna alba, Brown.

Prosobranchiata.

Tonicia marmorea, O. Fabr.
Leptochiton albus, Linn.
Amicula Emersonii, Couthuouy;
(Gaspé Bay, Principal Dawson).
Lepeta cœca, Möll.
Cemoria noachina, Linn.
Margarita striata, Brod. et Sow.
—— obscura, Couth.
—— varicosa, Migh.
—— Grœnlandica, Chemn.
and var. undulata.
—— helicina, O. Fabr.
Adeorbis (Molleria) costulata, Möll.;
(Mingan, J. Richardson, Jr).
Rissoa minuta, Totten;
(Little Metis, J. F. W.)
—— castanea, Möller;
(Mingan, J. Richardson, Jr).
Lacuna vincta, Fabr.
Littorina littoralis, Linn.
Littorina rudis, Montagu;
vars. patula and tenebrosa.
Scalaria Grœnlandica, Perry.
Mesalia erosa, Couthuouy,
(= Turritella polaris, Möller).
—— reticulata, Mighels,
(= Turritella lactea, Möller).
Aporrhais occidentalis, Beck;
(Mingan, J. Richardson, Jr).
Menestho albula, Möll.
Velutina haliotoidea, Müll.
—— (Morvillia) Zonata, Gould.
Lamellaria perspicua, Linn.
Natica affinis, Gmelin.
Lunatia heros, Say.
—— Grœnlandica, Möll.
—— triseriata, Say.
Bulbus flavus, Gould.
Amauropsis Islandica, Gmelin,
(= Natica helicoides, Johnstone).

Pleurotoma bicarinata, Couth.
Bela nobilis, Möll.
—— scalaris, Möll.
—— exarata, Möll.
—— decussata, Couth.
—— pyramidalis, Strom.
Astyris Holbolli, Beck; smooth var. (= Columbella rosacea, Gould); Mingan, J. Richardson, Jr.
Purpura lapillus, Linn.
Nassa trivittata, Say.
Buccinum undatum, Linn. (varieties = B. undulatum Möll. and B. Labradorense, Reeve).
—— tenue, Gray.
Buccinofusus Kroyeri, Möll.
Chrysodomus tornatus, Gould.
—— decemcostatus, Say, (varieties occur with characters intermediate between this and the preceding species).
—— Islandicus? Chemn. (?=Fusus Spitzbergensis, Reeve).
—— pygmæus, Gould.
Trophon clathratus, Linn.
—— scalariforme, Gould.
—— Gunneri, Lovén.
—— craticulatus, O. Fabr. (= T. Fabricii, Beck); Mingan, J. Richardson, Jr.
Trichotropis borealis, Brod. et Sow.
Admete viridula, O. Fabr.

CEPHALOPODA.

Loligo illecebrosa? Lesuer.

The following species have been found in Labrador, but have not yet been taken living in the area in question:—

Terebratella Labradorensis, Sow.
Yoldia sapotilla, Gould.
Leda buccata, Möll.
Mactra solidissima, Chemn.
Thracia Conradi, Couth.
Clione limacina, Phipps.
Limacina helicina, Phipps.
Bulla pertenius, Migh.
—— occulta, Migh.
Philine lineolata, Couth.
Pilidium rubellum, Fabr.
Scissurella crispata, Flem.
Turitella acicula, Stimps.
Bella violacea, Migh.
—— cancellata, Migh.
Buccinum Grœnlandicum, Hancock.
Ommastrephes todarus?

All of these, with the exception of the first species, are given on the authority of Dr. A. S. Packard, Jr. (this Journal, vol. viii., page 401. Throughout Dr. Packard's article, wherever the depth of water is given as "feet," read "fathoms").

Ostræa Virginiana? Lam., *Venus mercenaria* Say, *Crepidula fornicata*, *C. plana*, and *Nassa obsoleta* live in the Bay of Chaleur, but barely within the limits we have prescribed.

Machœra squama Blainv., *Fasciolaria ligata* Mighels, and *Fusus ventricosus* Gray, occur both north and south of Lower Canada, but they have not as yet been taken in its waters.

Lastly, a few shells are found in the post pliocene beds of Lower Canada, which, as yet, have not been detected as members of its recent fauna. These are:—

Terebratella Spitzbergensis? Dav.
Leda truncata, Brown.
Cardium Dawsoni, Stimp.
Astarte Laurentiana, Lyell.

Macoma inflata, Stimp.
Cylichna nucleola, Reeve.
Buccinum glaciale, Linn.
Buccinum Grœnlandicum, Hanc.
—— cyaneum, Brug.
—— Tottenii, Stimp.

The three last named species of Buccinum are quoted on the authority of Dr. Stimpson. The Terebratella has been referred to the *T. Labradorensis* of Sowerby. Having seen recent specimens of this shell from Halifax, N. S., and fossil examples from Rivière-du-Lonp, it seems to me to come nearer to Davidson's *Terebratella Spitzbergensis*.

At depths as great as fifty fathoms and upwards in Gaspé Bay, the mud or sand brought up by the dredge, even in July and August, is icy cold. It is not improbable that in this bay one of the branches of the cold northerly arctic current may flow. An experiment made by Dr. Fortin of trying to naturalize oysters in Gaspé Bay seems to have failed. Oysters are very sensitive to cold, and not only does extreme cold exist at the bottom in deep water all the year round, but the surface is frozen over along the shore during the winter.

The marine mollusca of the River and Gulf of the St. Lawrence are remarkable, first, for the extreme antiquity of many of the species, and secondly, for their wide geographical range. The majority of them belong to an arctic or sub-arctic fauna, which is to a large extent circumpolar. In time, some date back to a period as old as that in which the European coralline crag was deposited, and during the formation of the European tertiaries and post-pliocene beds, many species lived in the seas of Great Britain, etc., which are now extinct there but which still live on the western side of the Atlantic. There may be perhaps, in addition to this, a small local assemblage consisting of species apparently of a more recent date of creation and confined to a comparatively limited area. Nearly all of the Greenland shells will probably be yet detected in the River and Gulf of the St. Lawrence. When we possess more definite information as to the geographical distribution of the living marine invertebrates of the Dominion, we shall be better able to understand the conditions under which the Canadian post-pliocene beds were deposited. And further, a careful comparison is still required between the recent invertebrates of the northern seas, and the fossils of the tertiary and post tertiary beds of Europe and North America. Not only would the results of such investigations add to our knowledge of physical geology, and help to form a key towards the solution of the problem of the rationale of the geographical distribution of plants and animals, but it might also throw some light on that vexed question the origin of species. These arctic or sub-arctic molluscs are not only in many cases of high antiquity, but from their wide spread distribution we get an opportunity of studying the modifications of species caused by altered physical conditions.

ON CHEMICAL EXPLOSIVES.

GUNPOWDER—GUN-COTTON—NITRO-GLYCERINE—DYNAMITE.

By J. B. Edwards, Ph.D., F.C.S.

The rapid advance of gun-cotton and its congeners as formidable rivals to gunpowder, is a remarkable example of the industrial intelligence and enterprise of modern Europe. Gunpowder has long occupied a remarkable position as a projectile. The mechanical genius of the most advanced nationality, has been invoked for improvements in armaments and defences; but the chemical condition of this explosive projectile has remained the same during the past century. It would be rash to say that the days of gunpowder are over, as our past experience has shown that new inventions bring new appliances into action, and that in the spread of civilization over the globe, all are required. Hence it is probable that as much gunpowder will be consumed hereafter, as before the invention of gun-cotton, but the latter will, undoubtedly, be in large demand for mining industries, as well as for some forms of ordinance. On the comparative mechanical value of gun-cotton and gunpowder, Mr. Scott Russell has brought some valuable data before the members of the Royal Institution, and thus compares them: "Gun cotton, as prepared by the Austrian process, is uniform in quality and permanent in action; it possesses the greatest cleanliness in use, not fouling the gun as gunpowder does, and hence possesses great advantages for use with breech-loading arms."

Exploding in the open air it acts differently from gunpowder; if the latter is exploded in one pan of a pair of scales, the arm of the balance is violently depressed; an equal weight of gun cotton, on the contrary, can be ignited without moving the pan. In the same manner a bag of gunpowder will blow open the gate of a town, which would not be injured by the explosion of an equal weight of loose or unpacked gun cotton.

Enclosed in a case or gun, the effect of gun cotton is three times greater than that of powder, and for blasting purposes it is twelve times greater. When the cotton is converted into gun cotton in the state of twist or yarn, and afterwards plaited, it may be made into cartridges of almost any proportion of projectile force; and this force is increased per weight of cotton. The recoil is one-third greater in the case of gunpowder, than that caused by gun cotton. Gun cotton is found not to heat the gun to the same extent as as gunpowder; the former can be repeatedly wetted and dried again without injury, which is a great advantage over gunpowder. In confined places, such as mines and casements, the absence of sulphurous smoke, enables workmen and soldiers to continue firing for any length of time without inconvenience.

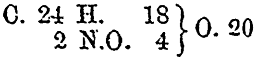
The relative power and proportions of gunpowder and gun cotton, may be inferred from the following tables, compiled by Mr. Scott Russell:—

GUNPOWDER.		GUN COTTON.	
100 lbs. occupy.......	1.8 C. ft.	100 lbs. occupy.... . .	4 C. ft.
55 lbs. "	1.0 C. ft.	25 lbs. "	1 C. ft.

PRODUCTS.

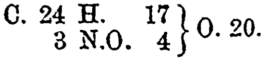
100 lbs. yields 68 lbs solid, 32 lbs. gases.	100 lbs. yields 25 lbs. steam, 75 lbs. gas.

Professor Abel, the able chemist at Woolwich laboratory, points out two distinct actions of nitric acid upon cotton. If the nitric acid be permitted to act at a high temperature, and in an energetic manner, the carbon and hydrogen of the cotton may be completely oxydized. When, however, the temperature is controlled, and the action moderated, the hydrogen is removed in gradations, peroxide of nitrogen being substituted for it, and various compounds formed in definite proportion. Thus, when the atoms of hydrogen are replaced by two of nitric oxide Xyloidine is produced



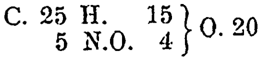
$$\left.\begin{matrix}\text{C. 24 H.} & 18\\ \text{2 N.O.} & 4\end{matrix}\right\}\text{O. 20}$$

When three atoms of hydrogen are replaced, pyroxiline, or collodion cotton is produced



$$\left.\begin{matrix}\text{C. 24 H.} & 17\\ \text{3 N.O.} & 4\end{matrix}\right\}\text{O. 20.}$$

By the precautions adopted in the Austrian army, a definite compound has been produced for martial purposes.



$$\text{C. } 25 \left.\begin{matrix}\text{H.} \quad 15 \\ 5 \text{ N.O.} \quad 4\end{matrix}\right\} \text{O. } 20$$

The cotton loosely spun with yarn, is boiled in a weak solution of alkali, in order to remove more easily oxidized materials which would consume a portion of the nitric acid. After this washing the yarn is dried in a centrifugal drying machine, and immersed in a solution of 1 part by weight nitric acid, Spgr. 1.5, and 3 parts sulphuric acid, 1.845. To secure uniformity of result, it is allowed to remain in this acid for forty-eight hours; great care being taken that the temperature does not rise during the operation. When loosely arranged the Austrian cotton inflames at a temperature of 300°, it burns without smoke, and leaves no ashes. When twisted into yarn its rapidity of combustion is diminished, and by varying the degree and tightness of the twist, various rates of burning may be obtained, from the rifle cartridge to the mining fuse. Economically, these results all tell in favor of the gun cotton over gunpowder, in every modification of its grain; and in many respects the actual manufacture of gun cotton is the safer of the two.

In competition with these substances are explosive derivatives of the same type from starch and sugar; but these have not at present shown any commercial capabilities. A formidable opponent to gun cotton has, however, appeared in the product of glycerine, the waste product from soap manufacture, which is converted by nitric acid into nitro-glycerine or glonoine. This substance was discovered in 1847 by Sobrero, but its manufacture on a commercial scale is due to the persevering enterprise of M. Nobel, a Swedish chemist, who has established six factories for its manufacture. The Nitro-glycerine Company in Stockholm, sold, in 1865, 32,258 feet, in 1866, 48,785 feet, in 1867, 76,575 feet, and in 1868, 150,009 feet, which shows the rapid increase in the demand for this explosive, this quantity being principally consumed in Sweden for mining purposes.

Nitro-glycerine is an oily fluid, having a specific gravity of 1.6. It is insoluble in water, but soluble both in wine and wood alcohol, and in ether. It freezes at 46° F. and explodes at 350° F. Flame will not always ignite it, and when struck on an anvil only the portion actually struck explodes. It is exploded by agitation, and by friction, which is a source of danger in its handling, and has been the probable cause of some of the serious and unexpected accidents to which its sudden explosion has given rise. Great caution is therefore necessary in its manufacture, as during the action of the nitric acid on the glycerine, the temperature rapidly rises, and has to be controlled by the use of a freezing mixture, otherwise the compound formed would explode; and, on the other hand, if frozen solid, the same danger exists from the friction of its particles.

Although, therefore, a highly dangerous process, it may, by care and precaution, be produced as we have seen in very large quantities. Fearful destruction of life has, however, arisen from ignorance and recklessness in its conveyance from place to place. In 1865, a small rudely formed box was found to be creating a suffocating smell in the baggage room of the Wyoming Hotel in New York, and which not being claimed was thrown into the street when it immediately exploded with great violence filling the air with nitrous fumes, and doing much damage.

One hundred pounds weight exploded at Sydney, and seventy cases exploded at Aspinwall, Panama, in the same year, on board the 'European,' which was nearly destroyed, a large ship near her greatly injured, the freight house blown down and 400 feet of the quay obliterated, upwards of seventy persons were killed and wounded and not a single pane of glass was left in the city. Similar casualties have followed in quick succession. Two boxes of oil were transmitted as ordinary merchandise through the most important and populous localities in Europe and finally landed in San Francisco, where it exploded, causing a fearful loss of life and the destruction of $200,000 worth of property. Such extraordinary and criminal recklessness has given rise to prohibitory legislation and probably induced an unnecessary panic in reference to the real dangers of transhipment and conveyance of the article. In the history of gunpowder and gun-cotton, we have been occasionally startled by fearful accidents with terrific loss of life, which has awakened us to the necessity of constant vigilance and the utmost precaution in handling and storing large quantities of such potential commodities. Nitro-glycerine has been prohibited in Belgium, and in Sweden it has been placed under restrictions of a similar class to those imposed on gunpowder. Some railway companies refuse to carry it, which has induced those requiring it to smuggle it through as ordinary merchandise, a most unjustifiable proceeding. The wisest policy is doubtless to carry it under special precautions, and thus a car load has been recently sent through from New York to the new Pacific railroad without being unladen, in perfect safety.

Much scientific attention has been bestowed on the important subject of rendering these substances non-explosive during their storage and transhipment.

Gunpowder was to be treated with sand and thus rendered non-explosive and when required for use the sand to be sifted out. This simple and ingenious idea was however found in practice less practicable than could be wished. The sand cut the grain of the powder, and caused loss by dust, while to an inconvenient extent it remained with the powder after sifting.

Gun-cotton can be kept wet until required for use and, when manufactured in yarn or cartridges, is much safer than powder. Prof. Abel has suggested some important modifications in the process for manufacturing mining cotton, which render it comparatively safe and in a very compact form.

Nitro-glycerine has received similar assistance from the hands of M. Nobel, which promises to give a new stimulus to its manufacture and which may enable it to outstrip all competitors for blasting purposes.

His first idea was to dissolve it in two or three volumes of Naptha, or methylated spirit. This renders it perfectly safe for transport, but adds of course to the cost the additional freight of extra bulk, and the value of the spirit. When the compound is dropped into water the nitro-glycerine falls to the bottom and may be collected or used in that state. A still more valuable suggestion, however, is to mix it with 25 per cent. of porous silica, and use it in this pasty condition. This is a form said to possess special advantage for blasting purposes over either the solid or liquid agents; it loses none of its power by dilution to this extent and is then called Dynamite.

Experiment have been made at Glasgow and Mertsham which leave no doubt of its safety. A box containing 8 lbs. of Dynamite (equal to 80 lbs. gunpowder) was placed over a fire where it slowly burned away. Another box containing the same quantity was hurled from a height of sixty feet on to the rock below and no explosion took place. At Stockholm, a 200 lbs. weight was dropped from a height of twenty feet on to a box containing Dynamite, which was completely smashed but without any explosion.

It may of course be much more easily packed that nitro-glycerine and is not liable to leakage which is a serious difficulty with all liquids of an oily nature. Its power is fully equal to the same bulk of nitro-glycerine and it has also several advantages. Thus it does not evaporate and give off fumes, which is a complaint made by workmen against nitro-glycerine, because in a close tunnel it gives rise to severe headaches.

The saving of time and labour by its use is said to be very great. The Dynamite is put up in cartridges, so that the workman has simply to put them into his bore-hole and fire. Mr. Nobel states, as the result of his experience, that the use of Dynamite or nitro-glycerine, reduces the general cost of blasting by at least one third. It is being largely used in Sweden, in Wales, at the Phœnix mine on Lake Superior, also in the construction of the Pacific Railway and the demand now considerably exceeds the ability of existing factories to supply it.

ON THE GREAT SNOW FALLS OF 1869.

BY C. SMALLWOOD, M.D., LL.D., D.C.L.

The more than usual amount of snow which fell during the winter 1868-9, renders it worthy of record for comparison with past and future observations.

The first snow of the winter (1868-9) fell on the 17th day of October, and though inappreciable in quantity, ushered in a season of very heavy snow falls.

The total amount which fell during the month of

October was	4.92	inches
During the month of November	17.28	"
During the month of December	27.96	"
During the month of January, 1869	28.07	"
During the month of February	73.76	"
Up to the 15th March	11.67	"
Total	163.66	"

The mean average depth of the snow fall for the past twenty years was 79.50 inches per annum.

The greatest depth which fell in one month during the above period fell in January, 1861, and was 31.80 inches.

The total depth which fell in 1861 (a year of great snow fall) was 99.58 inches.

Last year (1868) 105.27 inches of snow fell; this is above the yearly average, but is owing in a great measure to the unusual large amount which fell in November and December.

The first heavy fall commenced at 7 a. m. on the 3rd of February and ceased at 4 p. m. on the 4th day, 25.44 inches having fallen. The barometer fell from 29.751 inches to 28.841 (a range of 0.910 inches). The mean temperature of the 3rd day was 17 degrees, and of the 4th day 21 degrees; wind was from the N. E. by E.; greatest mean velocity 18.42 miles per hour.

The second heavy fall commenced at 3.15 p. m. on the 14th day, and ceased at 2.15 p. m. of the 15th; there fell 14.90 inches. The barometer stood at the commencement at 30.001 inches and fell to 29.175 (a range of 0.826 inches); the wind was from the N. E. by E.; greatest mean velocity 19.11 miles per hour. The mean temperature of the 15th day was 19 degrees.

A third fall, which was remarkable for heavy drifts and somewhat severe cold, commenced at 4 a. m. on the 10th of March and ended at 11 p. m., during which time there fell 8.82. inches. The barometer attained the lowest reading at 10 p. m., and indicated 29.119 inches; wind was from the N. E. by E., and was succeeded by a heavy gale from the West. The mean temperature of the day was 12.1 degrees; the thermometer at 7 a. m. stood at 16°.1 and fell to 8°.0 at 2 p. m., and at 9 p. m. it rose to 12°.2.

The heaviest fall of snow on record to which we have had access, occured on the 17th and 18th of January, 1827, when from 60 to 70 inches of snow fell. Drifts of from 12 to 15 feet high were common in many places.

February has not generally been characterized by very heavy snow falls, being for the most part dry and cold. The heavy fall of November last far exceeds the usual average for that month, which is about 6 inches. December, 1830. 1831 and 1834 showed a fall of 26.50 inches, 27.45 inches, and 27.70 inches respectively; large amounts fell in February, 1831, viz., 23.30 inches; in 1832, 25.85 inches; and in 1835, 21.80 inches, but these are exceptions; and March, 1832, shows an amount of 21.35 for that month. The amount of snow which fell in the month of December corresponds very closely to the above amounts.

We may state, for the purpose of illustrating our climatology, that from the year 1824 up to 1868, a period of 44 years, the ice left the River St. Lawrence in front of this city—varying from the earliest period, 16th March (1825), to the latest, April 28 (1855), showing a variation of 43 days during this period of 44 years, but these early periods are not confined to late dates, but occured in March 1825, 1828, 1834 and 1842; the intervening years vary from 3rd to the 28th of April inclusive.

NATURAL HISTORY SOCIETY.

MONTHLY MEETINGS.

(*From December 1st*, 1868, *to February 28th*, 1869.)

Third monthly meeting, December 28th, 1868; Mr. E. Billings in the chair.

The following donations were announced.

TO THE MUSEUM.

Twenty-eight species of coleoptera from the Mackenzie River; from G. Barnston. A named series of Canadian beetles, consisting of 733 specimens of 475 species; from E. Billings.

Fifty-four species of Canadian beetles; from A. S. Ritchie.

TO THE LIBRARY.

The 20th Annual Report of the Regents of the University of the State of New-York; from Prof. J. Hall.

Céphalopodes Siluriens de la Bohême. Groupement des Orthoceres, par Joachim Barrande; from the Author.

Annuaire de Ville Marie, etc., from L. A. H. Latour.

NEW MEMBERS.

Mr. C. C. Stewart B. A. was elected a member of the Society.

PROCEEDINGS.

Mr. Whiteaves made a communication on a collection of exotic birds recently added to the Collection. Ninety-two specimens have been acquired by purchase during the past summer. Of these sixty-three examples were exhibited, and the points of interest in each species were briefly pointed out. Two of the species belong to the order Raptores, and the rest to the various subdivisions of the large order Insessores.

Fourth monthly meeting, January 25th, 1869, the President in the chair.

DONATIONS TO THE MUSEUM.

A collection of Devonian plants (35 specimens of 22 species) from the Fern ledges, near St. John, New Brunswick: from the Natural History Society of St. John.

TO THE LIBRARY.

Catalogue of N. American Orthoptera described previous to 1867, by Samuel H. Scudder: from the Smithsonian Institute, Washington. Twenty eight volumes of the Zoological catalogues of the British Museum: from the Trustees.

Messrs Walter McOwatt and Walter Cross Cowan were elected ordinary members.

Mr. F. Mackenzie read a paper " on the prevention of cruelty to animals." A discussion ensued in which Principal Dawson, Rev. Dr. De Sola, Dr. Bernard, R. Moat, D. Mackay, Jas. Ferrier Jr. and Mr. Mackenzie took part.

Dr. P. P. Carpenter then made a communication " on some of the features of the Montreal mortality returns for 1868."

Some remarks were made on this subject by Dr. Girdwood, G. Stephens, and Principal Dawson.

Fifth monthly meeting, held February 22nd, 1869, the President in the chair.

DONATION TO THE MUSEUM.

Specimen of the silicious sponge (*Euplectella aspergillum*) popularly known as Venus' flower basket, from the Philippine Islands: presented by Jas. Ferrier, jr. Specimen of the Missouri pouched Rat, *Geomys bursarius*: from Mr. W. Hunter. Plaster models of five Indian pipes from the supposed site of the ancient Indian village of Hochelaga; from Principal Dawson.

TO THE LIBRARY.

Acadian Geology. Second edition. From Principal Dawson.

Five volumes and 8 numbers of the London Quarterly Journal of Microscopical Science; from Dr. J. Baker Edwards.

Messrs Bryce Scott, H. R. Gray, and E. Hartley were elected members of the Society.

Dr. John Bell read a paper entitled " Notes on a cruise in the Gulf of St. Lawrence."

Mr. A. T. Drummond read an essay "On the introduced plants of Ontario and Quebec.

SOMERVILLE LECTURES.

Four lectures of this series have at present been delivered, as follows:

1. January 21st, 1869. On Palœozoic land Animals; by the President.
2. January 28th, 1869. On the Chemistry of the Soap manufacture; by Dr. John Baker Edwards F. C. S.
3. February 11th, 1369. On the Zoology of the Bible; by Rev. A. De Sola L. L. D.
4. February 25th, 1869. On Primœval Chemistry; by Dr. T. Sterry Hunt F. R. S.

CONVERSAZIONE.

The 7th Annual Conversazione was held at the Rooms on Thursday evening, February 18th, and was well attended. Music was given by Herr Mayerhofer and pupils, by the Germania glee club, and by Mr. Brandt. Philosophical instruments were contributed by the authorities of McGill College, and microscopes, with objects, by members of the Microscopic club. Mr. C. Baillie illuminated the Museum with the electric light, and Dr. J. Baker Edwards exhibited Plateau's soap bubbles. Mr. Ross illustrated the operation of his new automatic fire alarm signal box, and contributed a small aquarium containing living sea anemones from the Clyde. Dr. Bell exhibited a series of the Plants of Newfoundland, Mr. J. P. Clark photographs and prints, and other gentlemen contributed interesting Zoological specimens. During the evening the following address was delivered by the President, Principal Dawson.

Ladies and Gentlemen :—It is my pleasing duty to bid you welcome to the Seventh Annual Conversazione of this Society—a Society which has not ceased, since its incorporation in 1832, to labour for the promotion in this city of a taste for natural science and allied subjects; and this, with marked success. In addition to its Lectures and meetings, I may mention as a permanent monument of its utility, the issue of nine volumes of its Proceedings, containing more than 4,000 pages of matter of the highest scientific value, and of the utmost importance to the knowledge of nature as it exists in this country, and to the development of our resources. No other institution in Canada can pretend to have made any contribution to the Natural History of this continent approaching this in value and extent. I may also mention its Museum, which has within the last few years made great progress, under the care of Mr. Whiteaves, and by the patient labour of our cabinet-keeper, Mr. Hunter. When I look through this museum today, and observe its admirable arrangement and the great amount of scientific material of real value which it contains, I can scarcely believe that it has grown from the confused and paltry collection which was huddled together in our former rooms in Little St. James street. Nor has its growth ceased. The additions made within the last six months amount to 200 species of vertebrate animals, a large number of invertebrates, and about 200 fossils, besides many other objects. Taking together, the collections of this Society, of the Geological Survey and of the McGill University, Montreal now stands far in advance of any other city of this Dominion in its museums of Natural Science; and thus affords greater facilities than any other to the student of Canadian Natural History and Geology. This is no mean advantage, and is especially appropriate to a commercial and manufacturing metropolis; and it will be far more strongly felt when we shall have in connection with the University, or with any other agency that may be established, Schools of Science for the training of our young men in the practical application of Science to the Arts. In this respect this Society has all along been in advance of the age; because here, as elsewhere, the accumulation of museums must always precede the establishment in any large and effectual way of the higher grade of scientific schools. A knowledge of this fact, has I confess stimulated my own efforts in behalf of this museum and that of the university, since I hoped that here, as in the old world, the collection of objects would afford a safe basis for the erection of scientific education. There are some branches of knowledge and culture, and these very valuable in themselves and the training they afford, which require nothing but teachers and books for their successful prosecution. But training in science, to attain to any useful results, must have large preparatory appliances in collections and apparatus. This along with the apathy which naturally exists as to anything of which the public has had no previous experience, is no doubt, a cause of the lamentable fact that Canada has not yet attained to the establishment of one scientific school, while in the mother country, in the various states of the continent of Europe, and also in the United States of America, such schools largely supported and admirably appointed exist in great numbers, and are productive of immense results in the promotion of the scientific arts and manufactures. In the Christmas vacation I enjoyed the pleasure of visiting some of these institutions in the United States, in which the means of old University foundations are made available, along with modern donations and grants, for the cultivation of practical science. Such institutions are furnished with laboratories, museums, scientific libraries and apparatus; and their courses of study embrance such subjects as Mining, Metallurgy, Agriculture, Botany, Zoology. Geology, Mineralogy, Engineering, Architecture, Drawing, Military Science and Tactics, Practical Mechanics, Astronomy; all eminently practical, and arranged so as to suit the wants of young men entering on a variety of useful trades and professions. Although these institutions are numerous and largely attended, they have not yet reached the limits of the demand for their work, and large grants in their aid have recently been made by Congress, while State Legislature and the munificence of private individuals are daily adding to their number and efficiency. It should be a fact that requires but to be mentioned to excite earnest inquiry and effort, that while all the older universities in the United States have scientific schools, and while multitudes of similiar schools are supported by the several States and the general government, we have in this Dominion four States, certainly equal in resources to any of those in the American Union, without a scientific school. In the mother country the subject is attracting great attention. I have just read a report presented to the House of Commons last year by a select Committee on Scientific Instruction, which after hearing the evidence of a number of leading Professors, Teachers and Educationists, strongly recommends to Parliament to proceed at once to organize the technical education of the country, and to add to the existing means as far as possible; and further, to recognize natural science as an indispensable element in such education. This report will, no doubt, be acted on soon, probably before anything can be done in this country, and we shall have the satisfaction of being another step behind the mother country in this most important matter. It may be asked what connection has all this with this Society, and with the present occasion. One such connection is, that this

Society would derive aid from every graduate of any Scientific school established here; and on the other hand, it can never attain for its collections their full utility, until there should be such schools. Another is, that while as President of this Society I have its immediate interests in view, I have also at heart the advantage of the young men growing up among us, and whom I should wish to see rising to something higher than the position of subordinates to men trained in other countries; and with this feeling, I propose, on every fitting occasion, and I regard this as one, to insist as strongly as I can on the necessity of schools of practical science to the welfare and progress of this country.

VISIT OF HIS EXCELLENCY THE GOVERNOR GENERAL.

At the Court House, on the morning of the second of February, the following address to His Excellency was presented and read by the President, Principal Dawson. The President was accompanied by Sir W. E. Logan, Dr. T. Sterry Hunt, Dr. Smallwood, Dr. J. Baker Edwards and other officers and members of the Society.

To His Excellency the Right Honourable Sir JOHN YOUNG, Bart., G.C.B., G.C.M.G., &c., &c., Governor General of the Dominion of Canada, &c., &c.

May it please your Excellency:

We, the President, Vice Presidents, and Members of the Natural History Society of Montreal, beg leave to approach Your Excellency with our most respectful salutations and most cordial welcome on this your first visit to Montreal, and to tender our hearty congratulations on your assumption of the government of this Dominion.

The Institution which we have the honour of representing is one of the oldest in Montreal, and has ever had for its chief object the advancement of the study of Natural Science in this city and throughout Canada. To this end it has striven amid much difficulty, but with some success, to establish a museum of Natural History and Archæology, and a library of scientific works, to which we respectfully invite the inspection of Your Excellency. It also, by its papers periodically read, its lectures, and its organ the Canadian Naturalist, and such other means as it may command, seeks to promote original investigation and to foster a taste for the study of nature so far as it can make its influence extend.

Believing that the objects of our Society, and especially that which tends to diffuse a knowledge of the products of this country, will command the sympathy of Your Excellency, as they did that of Your Excellency's predecessors, who took a warm interest in its operations and success, we venture now to solicit the honour of being allowed to name Your Excellency as Patron of the Natural History Society of Montreal.

We beg, in conclusion, to express our hope that the residence of Your Excellency in this country may prove as agreeable to yourself and Lady Young, as we are assured it will be beneficial to all its best interests.

We have the honour to be,
Your Excellency's very obedient Servants:

(Signed) J. W. Dawson, LL.D., F.R.S.
A. De Sola, LL.D.
E. Billings, F.G.S.
W. E. Logan, LL.D., F.R.S.
T. Sterry Hunt, L.LD., F.R.S.
C. Smallwood, M.D., LL.D., D.C.L.
J. F. Whiteaves, F.G.S.
J. Baker Edwards, F.C.S.
(And other Members.)

To which His Excellency delivered the following reply.

To the President, Vice Presidents, and Members of the Natural History Society of Montreal.

Mr. President and Members:—In the study of Natural Science, which is the object of your Institution to encourage, I recognize one of the most agreeable exercises for the intellectual faculties, as well as a rich mine for exploration in the interests of the practical arts and of the material comfort and advancement of the community. I hope to have, either now or at some future early occasion, the pleasure and advantage of visiting the Museum which you worthily laboured to establish.

I tender you many thanks for the complimentary terms of your welcome, as well as for the kind wishes you express, that Lady Young's and my residence in Canada may prove useful to the country and agreeable to ourselves.

(Signed,) John Young.

His Excellency also stated verbally that he should be happy to become Patron of the Society.

On the afternoon of February 3rd, His Excellency visited the Society's Museum. He was accompanied by His Worship the Mayor, Col. McNeil, A.D.C., Lieut. Col. Duchesnay, P.A.D.C., Mr. Turville, Lieut. Gov. Howland, Hon. A. Campbell, Hon. John Rose and C. E. Lee, Esq. At the Society's rooms His Excellency was received by the President, Principal Dawson, Rev. Dr. De Sola, Hon. Jas. Ferrier, Dr. Smallwood, Dr. J. B. Edwards, and others. He examined with care the collection of North American and exotic mammalia and birds, the more interesting features of which were explained by Principal Dawson, and Mr. Whiteaves. The visit lasted about an hour, during which the Governor General expressed his gratification at the interest taken in the study of Natural History in Montreal, and the pleasure which his visit had afforded him.

GEOLOGY AND MINERALOGY.

THE WAKEFIELD CAVE.—Though Sir Duncan Gibb has enumerated no less than thirty Canadian caverns, they are for the most part insignificant and scarcely deserving of the name. The Wakefield Cave, recently described by Dr. Grant, F. G. S., in a paper read before the Natural History Society of Ottawa is more important. It is thus described by Dr. Grant:—

"North from Ottawa, in an almost direct line, *viâ* the Portland Road distant eighteen miles, on the farm of Mr. Pellessier, is the "*Wakefield Cave.*" It is situated on the side of one of the Laurentian Mountains, and faces the North. The mouth of the cave is fully eighteen feet in diameter, of an oval shape, beautifully arched and having overhanging it pine and cedar trees of considerable size. The entire height of the mountain is about 300 feet, and the entrance to the cave is about 100 feet from the summit. At the base of the mountain is a small lake, which discharges into the Gatineau River through a mountain gorge of exquisite beauty. Looking inwards from the mouth of the cave it is funnel shaped, directed obliquely forwards and downwards, a distance of seventy-four feet, at which point it is contracted to a height of five feet and width of fifteen feet. This contraction forms the entrance to the first "*Grand Chamber*," eighty feet in length, twenty-one feet across and nine feet in height thoughout. At the posterior part of this chamber, in an oblique direction to the left, is an opening five feet in height, forming the entrance to the third chamber, which is about eighteen feet in diameter and five feet high. The floor, however, is covered with *calcareous breccia* to a depth of three feet or more. Looking outwards, two openings are to be seen to the left of the first chamber, one anterior, broad and elevated, and one posterior, contracted and shallow, passing obliquely upwards and backwards, a distance of fully twenty-five feet. This chamber is entirely encrusted with carbonate of lime of a cheesy consistence, and in the centre, a perfectly white column reaches from the floor to the ceiling, about six inches in diameter, formed by the union of a stalactite and stalagmite. The antero-lateral chamber passes in an oblique direction upwards, a distance of thirty feet, at which point the ceiling is fully fifty feet high, of a gothic shape, and beautifully ornamented with stalactites and fringe like encrustations of carbonate of lime. About sixty feet from the mouth of the cave to the right, is a narrow passage, rough, uneven, and forming the entrance to a chamber the floor of which ascends obliquely upwards a distance of thirty feet, the height of this point being about fifty feet. On the way up a beautiful arch is to be seen, above and beneath which this chamber communicates with the one entered by the antero-lateral opening from the "*Grand Chamber*," and the light reflected from a lamp through the opening below this arch illuminates the entire ceiling of the adjoining chamber and presents a rich appearance as seen through the opening above the arch. To the right of the oblique floor of the antero-lateral cavity. is an opening horse-shoe shaped, scalloped, about five feet in diameter, and considerably obscured by the over-hanging rock. From the body of the cave, the passage leading from this opening takes a direction at an angle of about 25° to the right. Its entire length is about 270 feet, height between four and five feet, and width the same. The floor is rough and covered with small fragments of rock of various sizes and from the ceiling hang many small stalactites. At the inner terminus of this passage is an opening more or less circular, about twenty feet in diameter, and the rock over it is concave, and fully fifteen feet in height. Stones thrown into this well or cavity give rise to a loud rumbling noise. Its depth is thirty.seven feet, and the bottom measured nine feet by thirty feet, on either side of which are two openings, one five feet by twelve feet, twenty-two feet in depth, the other two feet by three feet, and forty-five feet in depth. The floors of these lower cavities are covered with fine sand, and on every side are to be seen beautiful stalactites. On the right and left of the main passages of this well are to be observed several smaller passages, which from their narrowness, are entered with difficulty. The entire cavern presents a water-worn appearance, more or less smooth on the surface, of a light gray color, and considerably excavated at intervals. Here and there, in each chamber, particularly from the ceilings, are to be seen rough projecting portions of rock of various shapes and composed chiefly of quartzite, pyroxene, serpentine, iron pyrites, and various mineral ingredients peculiar to the Crystalline Laurentian limestone formations. In many parts of the cave the walls, particularly those to the right of each chamber entered, were covered with moderately uniform sheets of carbonate of lime. The cavern is entered by descending on talus or broken rock; this is succeeded by a floor, partly flat, smooth and presenting also a water-worn appearance. Generally speaking, the floor is uneven and strewed with fragments of rock of various sizes, more or less mixed up with broken stalactites and shelved portions of carbonate of lime. The entire cave, excepting the entrance, is perfectly devoid of light; the atmosphere moist, but exceedingly pure, even to the extent of our explorations, and a uniform temperature of about 45° Fahrenheit. The only organic remains so far discovered were those of the *Vulpes Vulgaris* or common fox, Castor Fiber (Lin) or Beaver, Lutra Vulgaris (Lin) or Otter, and a few drift shells. From the purity of atmosphere in the entire cave, the opinion formed from that fact is, that any accumulating carbonic acid is absorbed by water in some part of the unexplored portion of the cave, and it is not unlikely that parts already visited are only an entrance to vast labyrinths yet to be explored."

It is to be hoped that Dr. Grant will pursue the exploration of this cave; more especially with the view of ascertaining whether any remains of pre-historic man, or of post pliocene animals occur in the accumulation on its floors. J. W. D.

GEOLOGICAL TIME.—Mr. Croll, of the Geological Survey of Scotland, has published a series of suggestive articles in the Philosophical Magazine on the "Date of the Glacial and the Upper Miocene Period." He presents a number of very interesting calculations, not only bearing on these questions, but also on the entire age of the earth, and on the relative duration of geological periods. Of course in such inquiries much is conjectural, and the most precise calculations may be vitiated by uncertainties as to the data. Still anything having even the aspect of arithmetical results is preferable to the vague assumption of indefinite periods, and may at length lead to reliable conclusions. In the meantime we give the following as an illustration of the manner in which Mr. Croll deals with the subject:—

"But is it the case that geology really requires such enormous periods as is generally supposed? At present, geological estimates of time are little else than mere conjectures. Geological science has hitherto afforded no trustworthy means of estimating the positive length of geological epochs. Geological phenomena tell us most emphatically that these periods must be long; but how long, these phenomena have, as yet, failed to inform us. Geological phenomena represent time to the mind under a most striking and imposing form. They present to the eye, as it were, a sensuous representation of time; the mind thus becomes deeply impressed with a sense of immense duration; and when one under these feelings is called upon to put down in figures what he believes will represent that duration, he is very apt to be deceived. If, for example, a million of years as represented by geological phenomena and a million of years as represented by figures were placed before our eyes, we should certainly feel startled. We should probably feel that a unit with six ciphers after it was really something far more formidable than we had hitherto supposed it to be. Could we stand upon the edge of a gorge a mile and a half in depth that has been cut out of the solid rock by a tiny stream, scarcely visible at the bottom of this fearful abyss, and were we informed that this little streamlet was able to wear off annually only $\frac{1}{10}$ of an inch from its rocky bed, what would our conceptions be of the prodigious length of time that this stream must have taken to excavate the gorge? We should certainly feel startled when, on making the necessary calculations, we found that the stream had performed this enormous amount of work in something less than a million of years.

If we could possibly form some adequate conception of a period so prodigious as one hundred millions of years, we should not then feel so dissatisfied at being told that the age of the earth's crust is not greater than that.

Here is one way of conveying to the mind some idea of what a million of years really is. Take a narrow strip of paper an inch broad, or more, and 83 feet 4 inches in length, and stretch it along the wall of a large hall, or round the wall of an apartment somewhat over 20 feet square. Recall to memory the days of your boyhood, so as to get some adequate conception of what a period of a hundred years is. Then mark off from one of the end of a strip $\frac{1}{10}$ of an inch. The $\frac{1}{10}$ of the inch will then represent one hundred years, and the entire length of the strip a million of years. It is well worth making the experiment, just in order to feel the striking impression that it produces on the mind.

The methods which have been adopted in estimating geological time not only fail to give us the positive length of geological periods, but some of them are actually calculated to mislead. The method of calculating the length of a period from the thickness of the stratified rocks belonging to that period can give no reliable estimate; for the thickness of the deposit will depend upon a great many circumstances, such as whether the deposition took place near to land or far away in the deep recesses of the ocean, whether it took place at the mouth of a great river or along the sea-shore, whether it took place when the sea-bottom was rising, subsiding, or remaining stationary. Stratified formations 10,000 feet in thickness, for example, may, under some conditions, have been formed in as many years, while under other conditions it may have required as many centuries. Nothing whatever can be safely inferred as to the absolute length of a period from the thickness of the stratified formations belonging to that period. Neither will this method give us a trustworthy estimate of the *relative* lengths of geological periods. Suppose we find the average thickness of the Cambrian rocks to be 26,000 feet, the Silurian to be 28,000 feet, the Devonian to be 6000 feet, and the Tertiary to be 10,000 feet, it would not be safe to assume, as is sometimes done, that the relative duration of those periods must have corresponded to these numbers. Were we sure that we had got the correct average thickness of all the rocks belonging to each of those formations, we might probably be able to arrive at the relative lengths of those periods; but we can never be sure of this. Those formations all, at one time, formed sea-bottoms; and we can only measure those deposits that are now raised above the sea level. But is it not probable that the relative positions of the sea and land during the Cambrian, Silurian, Old-Red-Sandstone, Carboniferous, and other early periods of the earth's history differed more from the present relative positions than the relative positions of sea and land during the Tertiary period differed from the relative positions which obtain at present? May not the greater portion of the Tertiary deposits be still under the sea-bottom? And if this be the case, it may yet be found at some day in the distant future, when these deposits are elevated into dry land, that they are much thicker than we now conclude them to be. It is simply asserted that they *may* be thicker for anything that we know to the contrary; and the possibility that they may, destroys our confidence in the accuracy of this method of determining the relative lengths of geological periods.

The palæontological method of estimating geological time, either absolute or relative, from the rate at which species change appears to be even still more unsatisfactory. If we could ascertain by some means or other the time that has elapsed from some given epoch (say, for example, the glacial) till the present day, and were we sure at the same time that species have changed at an uniform rate during all past ages, then, by ascertaining the percentage of change that has taken place since the glacial epoch, we should have a means of making something like a rough estimate of the length of the various periods. But without some such period to start with, the palæontological method is useless. It will not do to take the historic period as a base-line. It is far too short to be used with safety in determing the distance of periods so remote as those which concern the geologist. But even supposing the palæontologist had a period of sufficient length measured off correctly to begin with, his results would still be unsatisfactory; for it is perfectly obvious, that unless the climatic conditions of the globe during the various periods were nearly the same, the rate at which the species change would certainly not be uniform. But we have evidence, geological as well as cosmical, that the climate of our globe has at various periods undergone changes of the most excessive character.

The palæontological method, as we have already seen, will give 60 millions of years or 240 millions of years as the period that has elapsed since the commencement of the Cambrian period, just as we choose to adopt 250,000 years ago or 1,000,000 years ago as the commencement of the glacial epoch.

It is the modern and philosophic doctrine of uniformity that has chiefly led geologists to overestimate the length of geological periods. This philosophic school teaches, and that truly, that the great changes undergone by the earth's crust must have been produced not by great convulsions and cataclysms of nature, but by those ordinary agencies that we see at work every day around us, such as rain, snow, frost, ice, and chemical action, &c. It teaches that the valleys were not produced by violent dislocations, nor the hills by sudden upheavals, but that they were actually carved out of the solid rock by the silent and gentle agency of chemical action, frost, rain, ice, and running water. It teaches, in short, that the rocky face of our globe has been carved into hill and dale, and ultimately worn down to the sea-level, by means of these apparently trifling agents, not only once or twice, but probably dozens of times over during past ages. Now, when we reflect that with such extreme slowness do these agents perform their work, that we might watch their operations from year to year, and from century to century, if we could, without being able to perceive that they make any very sensible advance, we are necessitated to conclude that geological periods must be enormous. And the conclusion at which we thus arrive is undoubtedly correct. It is, in fact, impossible to form an adequate conception of the length of geological time. It is something too vast to be fully grasped by our conceptions. What those to whom we have been alluding err in is not in forming too great a conception of the extent of geological periods, but in the way in which they represent the length of these periods in numbers. When we speak of units, tens, hundreds, thousands, we can form some notion of what these quantities represent; but when we come to millions, tens of millions, hundreds of millions, thousands of millions, the mind is then totally unable to follow, and we can only use these numbers as representations of quantities that turn up in calculation. We know, from the way in which they do turn up in our process of calculation, whether they are correct representations of things in actual nature or not; but we could not, from a mere comparison of these quantities which the thing represented by them, say whether they were actually too small or too great. It is here that some geologists have erred: they have not made the necessary calculations, and found by the known rule of arithmetic that 100,000,000 is to small' a number to represent in years the probable age of the earth's crust; but they look first at the phenomena and then at the figures; and as the two produce totally different impressions, they pronounce the figures to be too small to represent the phenomena.

If the geologist could find a method of ascertaining the actual rate at which these denuding agents do perform their work; if it could be ascertained at what rate the face of the country is at present being denuded, how much, for example, per annum the general level of the country is being lowered and the valleys deepened, then we should have a means of ascertaining whether or not the agents to which we refer were really capable of producing the required amount of change in the earth's surface in the allotted time. But mere conjectures in the absence of some positive determinations are worse than useless."

Mr. Croll then proceeds to state that there is an available method afforded by the measurable rate of denudation of our continents by sub-aerial and oceanic agencies, and enters into elaborate calculations as to this rate in different regions, and at different geological times. The results are very curious and interesting, but the completion of the series of papers, containing the final conclusions of the writer, has not yet reached us.

J. W. D.

DEEP-SEA DREDGING IN ITS RELATIONS TO GEOLOGY.—The proceedings of the Royal Society contain a most interesting Report of Dr. Carpenter and Dr. Wyville Thomson, of dredgings conducted by them in 1868, at depths previously reached only by the comparatively inefficient means of the sounding line. In their deepest dredgings, 650 fathoms, they brought up not only Foraminiferœ, but sponges and star-fishes allied to Ophiura, thus showing that a somewhat varied life exists at these great depths. At this great depth, also, they found the calcareous mud of the bottom penetrated and covered with that diffused protoplasmic or sarcodic substance which Prof. Huxley has named *Bathybius*, and which seems to be an organism even less specialised than the ordinary Rhizopods, and to be, perhaps, a representative in the modern seas of the primeval Eozoon of the Laurentian rocks. Another remarkable discovery is that of the existence of a minimum temperature of 32° Fahrenheit at the sea-bottom, in depths of 500 fathoms or more, in the ocean westward of Great Britain. This is a proof by actual thermometric observation of a fact on which the writer of this notice has long insisted on other grounds, viz., that cold and dense currents of water flow over the sea bottom; and must be taken into the account in our reasonings as to erosion and the distribution of life in the glacial period. Those who have hitherto denied this will now have an opportunity to modify some of their views with regard to Post-pliocene Geology. Other applications of these researches to Geology will be seen in the following extract:—

"It can be scarcely necessary to point out in detail those various important applications of the foregoing conclusions to Geological Science, which will at once occur to every Geologist who endeavours to interpret the past history of our globe by the light of the changes it is at present undergoing. But this Report would not be completed without some notice of these.—In the first place, it may, I think, be considered as proved that no valid inference can be drawn from either the absence or the scantiness of Organic Remains in any unmetamorphosed sedimentary rock, *as to the depth at which it was deposited.* So far from the deepest waters being *azoic*, it has been shown that they may be peculiarly rich in Animal life. On the other hand, comparatively shallow waters may be almost *azoic*, if their temperature be low or their currents be strong; and thus even littoral formations may show but few traces of the life that might be abundant on a deeper bottom at no great distance.—Again, it has been shown that two deposits may be taking place within a few miles of each other, *at the same depth and on the same geological horizon* (the area of one penetrating, so to speak, the area of the other), of which the Mineral character and the Fauna are alike different,—that difference being due on the one hand to the *direction of the current* which has furnished their materials, and on the other to the *temperature of the water* brought by that current. If our "cold area" were to be raised above the surface, so that the deposit at present in progress upon its bottom should become the subject of examination by some Geologist of the future, he would find this to consist of a barren Sandstone, including fragments of older rocks, the scanty Fauna of which would in great degree bear a Boreal character; whilst if a portion of our "warm area" were elevated at the same time with the "cold area," the Geologist would be perplexed by the *stratigraphical continuity* of a Cretaceous formation, including not only an extraordinary abundance of Sponges, but a great variety of other Animal remains, several of them belonging to the warmer Temperate region, with the barren Sandstone whose scanty Fauna indicates a widely different climatic condition, which he would naturally suppose to have prevailed at a different period. And yet these two conditions have been shown to exist *simultaneously* at *corresponding depths*, over *wide contiguous areas* of the sea-bottom; in virtue solely of the fact that one area is traversed by an *Equatorial* and the other by a *Polar* current *. Further, in the midst of the land formed by the elevation of the "cold area," our Geologist will find a hill of some 1800 feet high, covered with a Sandstone continuous with that of the land from which it rises, but rich in remains of Animals belonging to a more temperate province; and might easily fall into the mistake of supposing that two such different Faunæ, occurring at different levels, must indicate two distinct climates separated in time, instead of indicating, as they have been shown to do, two contemporaneous but dissimilar climates, separated only by a few miles horizontally, and by 300 fathoms vertically.—It seems scarcely possible to exaggerate the importance of these facts, in their Geological and Palæontological relations, especially in regard to those more localized Formations which are especially characteristic of the later Geological epochs. But even in regard to those older Rocks, whose wide range in space and time would seem to indicate a general prevalence of similar conditions, it may be suggested whether a difference of bottom-temperature, depending upon deep oceanic currents, was not the chief determining cause of that remarkable contrast between the Faunæ of different areas in the same Formation, which is indicated by the abundance and variety of the Fossils of one locality, and their scantiness and limitation of type in another; as is seen, for example, when the "Primordial Zone" of Barrande is compared with its equivalent

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* It may be said that the asserted existence of these Currents is a mere hypothesis, until an actual movement of water in opposite directions has been substantiated. But, as Prof. Buff has pointed out, the existence of such deep currents is a necessary consequence of the difference of surface-temperature between Equatorial and Polar waters; and those who raise the objection are consequently bound to offer some other conceivable hypothesis on which the facts above stated can be accounted far.

in North Wales.—Further, in the case of those Calcareous deposits which owe their very existence to the vast development of Organisms that possessed the power of separating Carbonate of Lime from the ocean-waters, *temperature* may be pretty certainly assumed to be the chief condition, not merely of the character of the Animal remains which those formations may include, but of the very production of their solid material."

CALAMITES AND CALAMODENDRON.—(*Flora of the Carboniferous Strata.*)—Binney, Memoirs of Palæontographical Society, vol. xxi.

A wit who had been bored with the inspection of the stony treasures of a "fossil" botanist, once said that the latter had shown him all his "Calamities and felicities," and Mr. Binney would seem to agree as to the character of the *Calamites*, since he endeavours, though apparently with some scruples, to extinguish the genus altogether. On this point we must take issue with him, and try to maintain the cause of the proscribed Calamite. The case stands thus: In the coal formation, one of the most common kinds of fossil plants is that on which the genera *Calamites* and *Calamodendron* or *Calamitea* have been founded. They have cylindrical stems, with longitudinal narrow ribs and transverse joints. This is the common character of the whole, but when more narrowly examined they resolve themselves into two distinct groups. The first and most common is that including stems with somewhat flat ribs, coated with a very thin coaly bark, and having, when well preserved, at the top of each rib where it reaches one of the transverse joints, a round or oval mark or cicatrice from which a leaf or branchlet has been broken off. Plants of this kind are seen erect in the sandstones, with their outer bark perfectly preserved, and with their roots and leaves attached. The writer has specimens of two species in his collection, showing the leaves in one species and the thin branchlets bearing leaves in another, attached to the surface of the cylindrical jointed ribbed stem, and he has other specimens as unequivocally showing the bases of such stems, giving off roots and also budding out into secondary stems. Farther, such stems were described and figured by him in the Journal of the Geological Society, vol. x., p. 35, in a paper to which Mr. Binney does not refer, though he mentions other papers in which the fact is less explicitly noticed. It may be added that Goeppert and Geinitz have shewn that these plants had a thin internal investment of vascular tissue, having somewhat large vessels with numerous rows of pores, a curious and peculiar form of scalariform tissue which will be found figured in Acadian Geology, page 442, where leaves of Calamites actually found attached to the stems are also figured.*

The plants above described are the true *Calamites*, of which several species occur in the Devonian and Carboniferous; though except when the stems are very well preserved or have the leaves attached, it is difficult to fix the limits of these species; and it is probable that many have been named which are merely varieties, depending on the age of the stems or their state of preservation.

But beside these there occur striated and jointed stems of a very different character. Their internodes are usually, though not always, short, they have no distinct scars at the nodes, their ribs are usually narrower and more angular; and when found well preserved, instead of being entire stems, they prove to be casts of an internal cavity surrounded by a thick woody envelope disposed in radiating wedges, and exhibiting not true scalariform tissue, but wood-cells with bordered pores under that transversely elongated variety in which they occur in the axes of Cycads and the inner layer of the axes of Sigillaria, along with round pores,—also similar to those of Cycads. Stems of this kind have usually been described as Calamites, and many of them have been included under the species *C. approximatus*, but they are evidently very different from the ordinary Calamites, and of much higher organization, approaching in this respect to Sigillariæ. Unfortunately their external surface is not well preserved, but it appears to have been destitute of transverse joints, and to have been irregularly ribbed, at least near the base of the stem. Brongniart places them with the Asterophyllites,† and suggests that some of the leaves referred to that genus may have belonged to Calamodendron; but so far there is no certain evidence of this. Brongniart has on the whole very accurately stated the distinction between the two genera, Calamites and Calamodendron, in the work already cited; as the writer has amply satisfied himself by the study of the beautiful Calamite brakes so well exposed in the cliffs of the South Joggins section, and of several

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* See also paper on Structures in Coal. Journal of Geological Society 1860, p. xviii., fig. 11.

† Tableau des genres, 1849.

stems of Calamodendron showing structure. Cotta, who originally described the structure of Calamodendron, named the genus *Calamitea*, and figured what he regarded as four distinct species in his "Dendrolithen." Brongniart regards two of the four species as probably coniferous; and for this reason, as well as the too close resemblance of the names Calamitea and Calamites, proposes for the genus the name *Calamodendron.*

Mr. Binney, in the monograph before us, has figured portions of four specimens having internal striated or ribbed axes, and radiating bundles of wood-cells with transversely elongated pores, of the type already referred to, and which also occur in the remarkable *Protopitys* of Goeppert from the lower carboniferous of Silesia. Mr. Binney refers all his specimens to one species, *Calamodendron commune,* though one of them certainly appears to differ sufficiently from the others to warrant a specific distinction. The question what these specimens really are, with relation to described genera of carboniferous plants, is, however, somewhat difficult to settle, in the absence of the alternating zones of wood-cells and peculiar medullary rays of Calamitea as described by Cotta and Unger, and characterized by Brongniart as an organization "*toute speciale.*" This difference should have suggested some doubt as to the identity of these curious specimens with Calamodendron; and we think it not improbable that they will be found on further investigation to be entirely distinct from Calamitea of Cotta or Calamodendron of Brongniart. On the other hand it is perfectly clear that they have no connection whatever with Calamites proper, and cannot even belong to the same family with that genus, with which they have in reality no closer connection than that of accidental similarity of markings. Mr. Binney's specimens are, however, evidently nearer to Calamodendron than to Calamites; and this is all that can be said of them with safety with our present information.

It is singular that Mr. Binney, who described erect Calamites in 1847, and who is well acquainted with erect Sigillariæ, should not perceive that the fact of the former standing erect in sandstone, with their roots attached as Mr. Binney has observed, and even with their leaves attached to the nodes as the writer showed in his paper of 1854, is absolute proof that they are not internal axes, but in reality casts of entire stems.

It is also somewhat strange to find such a statement as that on page 17 that "for many years Asterophyllites has been known as "the leaves of Calamites." This will be new to most Palæobotanists, more especially when they turn to plate xv. and find a plant figured as "*Asterophyllites longifolia*" which appears, if correctly represented, to be an *Annularia*, not far removed from, if not identical with Annularia longifolia, a plant usually regarded as distinct from Asterophyllites. Now it is true that Brongniart has suggested that Asterophyllites may be branches of Calamodendron, and it is possible that this may be the case, as the leaves of Calamodendron are not certainly known, but the leaves of Calamites are well known, and have been figured by Lindley and Hutton, by Geinitz and by the writer, and they may be easily distinguished by very simple characters from those of Asterophyllites and Annularia, which they resemble merely in their verticillate arrangement. The leaves of the species C. Cistii and C. Suckovii and C. Nodosus, all of which the writer has seen, are aculeate, thick and apparently triangular in cross section, and finely striate without any distinct rib. Those of Asterophyllites and Annularia are flat, and with a conspicuous median nerve. Badly preserved specimens of leaves of such species as *Asterophyllites longifolia* might be mistaken for Calamite leaves, but the characters of the genera are sufficiently distinct, and in so far as the writer's experience has extended, there is little evidence even of the association of Calamites and Asterophyllites in the same localities.

We had intended to make some remark on the curious statement at page 15, as to fossilization, in connection with Professor Graham's discovery of Dialysis, which seems to ignore the fact that this whole subject has been again and again illustrated most fully both microscopically and chemically. We may, however, content ourselves with remarking in general, on this and some similar statements, that they are not so much matters of blame to Mr. Binney personally, as evidences of the remarkable neglect in England of the scientific pursuit of fossil botany. Though we cannot admit that Mr. Binney has in his monograph added much that is new to our knowledge of Calamites and Calamondendron, yet he has figured well several curious specimens of stems and some remarkable strobiles, the interpretation of which will come in due time; and for that we have good reason to thank him. More especially have we reason to do so, in view of the almost incredible fact that this is the first time the Palæontographical Society, in the twenty-one years in which it has flourished, has recognized the existence of vegetable fossils; and this at a time when the coal mines of England have probably reached their maximum of production, and when precious specimens, in quantity unsurpassed in any other country, are weathering on the rubbish heaps of the mines, or lying unnoticed in collections public and private. We should add that this omission is not to be remedied by the repetition of isolated and imperfect efforts like that in the present monograph; but by associating the few competent cultivators of fossil botany into a committee of discovery, to ransack the existing collections and to prepare monographs exhaustive of their material with reference to each genus. J. W. D.

PRE-HISTORIC MAN IN FRANCE.

(*Reliquiæ Aquitanicæ*, by Edouard Lartet & Henry Christy.)—Of this valuable work, which is intended to be completed in twenty parts, seven are now published. Though the name includes a large part of the south-east of France, it is more particularly devoted to the interesting pre-historic antiquities which have been collected in that part of Périgord which comprises the Arrondissement of Sarlet in the Department of Dordogne.

The remains are usually found in caves or "rock shelters" overlooking the rivers, and formed by the action of the atmosphere in wearing away the softer beds of rock.

"The two sides of the valley rise in great escarpments of massive rock, more or less interrupted by ancient falls. Their summit is usually crowned with projecting cornices, below which are great horizontal niches, or hollow flutings. These great flutings are strikingly evident at the same level on the two sides of the valley where the escarpments overlook the river, and where they are continued in the rocks bordering the lateral valley, down which small streams run into the Vézere."

The implements found in these caves consist wholly of chipped flint, and reindeer horn; associated with large quantities of bones of reindeer, horse, aurochs, &c. No polished stone implements have been found, nor bones of domesticated animals, which are supposed to have belonged to a much later period. The flint implements are principally of four kinds; nuclei or cores, flakes, worked spear and arrow heads, and scrapers. The nuclei are blocks of flint which have been used to supply flakes from time to time, and have thus been gradually split down to long or conical shapes. Flake is a word used to designate any rough chip of flint of undeterminable form, which may have been used for any household purpose from a knife to an awl. The spear and arrow-heads are of all sizes, and sometimes very neatly worked, and finely chipped along the edges, they are of all forms, from long and tapering to very short and blunt. There seem also to have been different modes of fastening them to the haft, as some are equally pointed at both sides, others simply rounded, and others again notched. The scrapers are generally somewhat blunt at the edges, more or less pointed behind for fastening into a handle, and often rounded for the hand. They were used mostly for preparing and dressing skins.

A considerable number of water-rounded, flattish pebbles, bearing a shallow artificial hollow on one side, have been found. These may have been used for preparing paint for personal decoration, or grinding up small quantities of grain; but some of them seem too small for even such purposes.

The most curious and interesting implements are those of bone, and reindeer and stag antler. On these great labour seems to have been expended, and some of them are not only neatly finished but highly ornamented, mostly with drawings of animals of the period. These very interesting works of art are sometimes executed with great spirit, and though often much out of proportion, are drawn in all essential points with fidelity to nature. The bone and horn implements comprise spear heads, harpoon heads, clubs, and other minor kinds of not very well defined uses. Among these last, is a very curious style of implement, made of deer antler; flat and thin, and usually pierced with a row of holes, sometimes large enough to admit the finger. They seem too thin and weak to have been used for any kind of work; and concerning them, a variety of conjectures have been hazarded, among others that they have been used as sceptres or symbols of authority. Their use, however, is still considered undeterminable.

The bone spear heads are usually very long and pointed, and circular in section. These, however, are rare, in comparison with the harpoon points, which have been found in great number. They are long and narrow, with a succession of barbs extending sometimes almost from end to end. They are generally somewhat blunt at the point, which seems to indicate that they were used for harpooning fish; some of the smaller ones may, however, have been arrow heads. The barbs differ much in size, shape, and arrangement, but nearly all agree in having notches or grooves on their surface; these, it is thought, may have served for holding some poison. The club is simply the beam of an antler, so arranged that the stump of one of the side antlers served as a point with which a very severe blow might, no doubt, be struck. The clubs are often very neatly made, and smoothed, and notched at the small end to afford a firm grasp to the hand. They bear a great analogy to the "Puck-â-maugun" of the Indians of North West America.

The drawings found on these implements of bone and antler, usually represent the horse, reindeer, stag, and auroch; these animals seeming to have been the staple food of the cave-dwellers. There appear also, though more rarely, drawings of fish. On one piece of bone there is a rough representation of a human figure, certainly not very flattering to the man of the period.

A description of the opening of one of these bone caves, (that of Cro-Magnon), is given in great detail. It was discovered by the removal of the accumulated talus from the foot of one of the cliffs overlooking the Vezère, for the construction of a railway embankment. It was a broad, but deep natural cavity, sheltered by a projecting ledge of hard rock. This cave was systematically worked out, and the history of its occupation by pre-historic man read by the deposits of ashes, etc., contained in it.

The first visit paid to this cave by the hunters of the reindeer, is represented by a broad but shallow deposit of ashes and charcoal, containing worked flints and broken and calcined bones, and in its upper portion the stump of an elephant's tusk. After this first visit, it seems to have been unoccupied for a long period of time which is represented by a thick layer of debris, slowly accumulated by the weathering of the roof and walls. Above this is another thin layer of ashes, and then another layer of calcareous debris. Lastly, there is a thick series of beds of ashes, which seem to indicate that the cave was from this time used continuously as a place of residence; or at least so continuously as not to allow of the intercalation of any roof debris. These beds of ashes are full of pieces of charcoal, bones, pebbles of quartz, worked flints, flint cores, and bone implements. The cave, in fact appears to have been used as a place of residence till the accumulated ashes and rubbish of the inhabitants, had rendered it too small and narrow. It was then abandoned, and above the last ash bed there is another thick deposit of roof debris. After this last deposit had increased to a considerable thickness, and the cave was just high enough to crawl into, it was used as a place of sepulture. At the very back of the cave and partly buried in calcareous debris, were found bones referable to five human skeletons. Among these, the most perfect skulls were those of an old man and of a woman. The woman's skull had been pierced by some pointed instrument (in shape answering very well to that of one of the flint lance heads) which had been the cause of her death. Death did not, however, ensue immediately, as the edges of the cut were partly healed up; indeed, it is the opinion of physicians to whom it has been referred that she survived several weeks.

M. Louis Lartet writes, at p. 70, "Amidst the human remains lay a multitude of marine shells (about 300) each pierced with a hole, and nearly all belonging to the species *Littorina littorea*, so common on our Atlantic coasts. Some other species, such as *Purpura lapillus*, *Turritella communis*, *&c.*, occur, but in small numbers. These also are perforated, and, like the others, have been used for necklaces, bracelets, or other ornamental attire. Not far from the skeletons I found a pendant or amulet of ivory, oval, flat, and pierced with two holes. M. Laganne had already a smaller specimen; and M. Ch. Grenier, schoolmaster at Des Eyzies, has kindly given me another, quite similar, which he had received from one of his pupils. There were also found near the skeletons several perforated teeth, a large block of gneiss; also worked antlers of reindeer, and chipped flints of the same types as these found in the hearth layers underneath." The bones found in this cave comprised, besides the commoner kinds as those of the reindeer, horse, &c., those of an enormous bear, of the mammoth, of the great Cave-Lion, &c. Another peculiarity of this cave is the absence of any engraving or carving. "Hence, we may refer this station of Cro-Magnon to the age immediately preceding that artistic period which saw in this country the first attempts of the engraver and the sculptor"

Dr. Pruner Bey gives a very full and elaborate description of the skulls and other anatomical details found in the cave of Cro-Magnon, he considers the inhabitants of this cave, "as decidedly affiliated to the other Mongoloids of the age of the Reindeer," and in their cranial character to approximate most nearly to the Esthonians. He also writes, "Lastly, as to the data of philology, the skulls are mute enough; nevertheless, the conformation of the bony plate leads us to conclude that, at least phonetically, the language of our cave-dwellers was neither Aryan nor Semitic. In fact we find their peculiar palate low and extending forwards, only in those modern races which have a weak phonology, and sweet at times; and such are the Finnish idioms."

All the various implements and remains described in the *Reliquiæ Aquitanicæ* are profusely illustrated with excellent lithographs.

Great attention is now given in the Old World to archœological studies, and large quantities of valuable facts and collections have been accumulated. And though some of the theories founded on these facts are rather wild, still the facts themselves always remain, and nothing can tend more to the elucidation of the habits and customs of the ancient pre-historic man in Europe, and the uses of their implements, than the study of still existing tribes of savages, or those which have but lately died out. Especially as it is always found that the customs and implements of all savage people of little intelligence, wherever found, are so nearly identical.

A great deal more attention might profitably be given to such studies in America, more especially in Canada, where we have so many interesting remains of its former possessors, and their immediate descendants still living among us. G. M. D.

NOTE ON THE BLASTOIDEA.—The remains of the Blastoidea have as yet proved to be extremely rare in the Canadian formations. The whole collection in the Museum of the Survey consists of only five small specimens, two of *Codaster*, and three *Pentremites.* The study of these with a view to their description led me to inquire into the subject of the functions of the summit apertures of the several genera that have been referred to the order. As our material was not sufficient for such an investigation, I applied to S. S. Lyon, Esq., of Jeffersonville, Indiana, one of the Geologists of the Kentucky Survey, and he supplied me with a large collection from which I shall endeavor to prove:—

1. That the tubular apparatus beneath the ambulacra of *Pentremites* is the homologue of the so-called "Pectinated rhombs" of the Cystidea,—that the five orifices heretofore supposed to be ovarian apertures were respiratory in their function—the larger of the five being also the mouth and the vent, and that the central

aperture is not the mouth, but the homologue of the ambulacral orifice of the Cystidea and Palæozoic crinoids.

2. That in the summit of the genus *Nucleocrinus*, there are sixteen apertures—ten respiratory, five ambulacral, and one which is both mouth and vent. There is no aperture in the centre of the summit.

3. That *Codaster* does not belong to the Blastoidea. E. B.

BOTANY AND ZOOLOGY.

English Plant Names.—That most troublesome weed to farmers, the Couch-grass (*Triticum repens*), has a variety of names. In Cumberland and Essex it is Twitch; in Cheshire and Shropshire, Scutch; in North Buckinghamshire, Squitch; in South Buckinghamshire, Couch, or Cooch-grass; all evidently having the same derivation, but an obscure one. In the Norfolk "Quicks," and Warwickshire "Quicken-grass" we have a clue. No plant is so retentive of vitality as this *Triticum repens;* the smallest piece left in the ground will grow. All these names are but forms of the A-S *cwic*, living, a word with which we are familiar as occurring in the Apostles' Creed in the English Prayer-book, where "the quick" are referred to in opposition to "the dead." The words "quicks" and "quickset" are applied to living hawthorn hedges as distinguished from dead-wood fences; *cwic-beam*, the living tree, was, according to Dr. Prior, the A.-S. for the Aspen (*Populus tremula*), on account of its ever-moving leaves; and Quick-in-hand was an old name for the Touch-me-not (*Impatiens Noli-me-tangere*), from the suddennes with which its seeds discharge themselves when handled.

Many north-country names are derived from Swedish and Danish sources. The black heads of the Ribwort Plantain (*Platago lanceolata*) are, in the northern countries, called kemps. We find the origin of this in the Danish *kæmpe*, A.-S. *cempa*, a warrior. Children often play with the flower-stalks, each endeavouring to knock the head off the other's mimic weapon; and this game is still known in Sweden,, where the stalks are called kam par (Prior). The same game is very popular with the Cheshire children, who term it "playing at conquerors;" the heads themselves they call "fighting cocks." Rushes (*Junci*) are called sivs and seaves, from the Da. *siv*, Sw. *saf*, a rush. The name Roan, Ran, Royne, or Rowan-tree, by which *Pyrus aucuparia* is known in Scotland and the northern counties, comes from Da *rönn*, Sw. *runn*, which is traceable to the "O. Norse *runa*, a charm, from its being supposed to have power to avert the evil eye" (Prior). *Vaccinium Myrtillus* is, in Cumberland and Yorkshire, known as Blue-berry, in Scotland Blackberry, from Sw. *bloa-bær*, or Da. *böllebär*, a dark berry; its more ordinary name, Bilberry, is probably from the same source.

From the German and Dutch we obtain several of our commonest plant-names. Buckwheat (*Polygonum Fagopyrum*), for instance, is from Da. *boekweit*, G. *buchwaitzen*, beechwheat, "from the resemblance of its triangular seeds to beachnuts, a name adopted with its culture, from the Dutch" (Prior). The Figworts (*Scrophularia aquatica* and *S. nodosa*) take their name, Brown-wort, from G. *braunwurz*. probably in reference to their dark foliage and brown stems and flowers. Dr. Prior thinks it more probable that it is from the plants "growing so abundantly about the *brunnen*, or public fountains of German towns and village;" but the former derivation seems to me the more likely, especially as neither species is peculiar to these localities. In Devonshire the name Brunnet is applied to one or both species; this is probably a corruption of brownwort, or possibly an abbreviation of brown-nettle; the word Burnet is not very different from this, and that is applied to a brown-stemmed plant (*Poterium Sanguisorba*),

Names of French origin are yet more frequent. The Dandelion (*Leontodon Taraxacum*) gives us a familiar example; it is in French *dent-de-lion*, lion's tooth, although the reason for the name is not satisfactorily known. At Glasgow the Gooseberry (*Ribes Grossularia*) is called groset; in other parts of Scotland, grosert, grose and groser: the Black Currant (*R. nigrum*) is gazles in Sussex; and in Kent the same name is applied to the White Currant. We find the origin of all these words in the Fr. *groseille*. In the Ayscough MSS., as quoted in *Notes and Queries* (Series IV. i. 532), we read that the Raspberry (*Rubus Idæus*) is called framboise by the country people in Dorset; and the St. George's Mushroom (*Agaricus Georgii*) is known as champeron to the people about Abingdon. Mushroom itself, by the way, is but an anglicised form of Fr. *mousseron*, formerly *mouscheron*. "One of the most conspicuous of the genus (*Agaricus*), the *A. muscarius*, is used for the destruction of flies, *mousches;* and this seems to be the real source of the word, which by a singular caprice of language, has been transferred from this poisonous species to mean, in the popular acceptation of it, the wholesome kinds exclusively" (Prior.) Tutsan (*Hypericum Androsæmum*) is from Fr. *toute saine*, a name by which it has been known since the time of Gerarde, who gives this explanation of it. In Buckinghamshire a corrupted form of this is still in use in the words Tipsen-leaves and Touch-and-heal; in Hampshire it is Touchen-leaves. In the second of these we have an example of the tautology so frequently found in English names where foreign words have been translated and then both original and translation have been combined. The "Touch-and" is the same as Touchen, and is evidently a corruption of *toute saine;* the "heal" is a translation of *toute saine.* It has been converted into Touch-*and*-heal to make sense of it; and the word is now, perhaps, supposed to indicate the rapidity with which the healing properties of the plant take effect.

From Latin names, the transition to another class, in a measure connected with them, and introduced by the same agency, is an easy one; I refer to what I may term religious plants, such as have been in some manner associated with, and have taken their titles from, the pious observances of former times. The Church taught by the eye as well as by the ear; and by natural objects sought to recall not only, as we shall presently see, her more solemn seasons, but the saints whose festivals she kept. The coincidence, for example, of the flowering of a plant with the feast of a saint led to a connection between the two, and eventually, in many cases the name of the latter was bestowed upon the flower. A natural feeling of reverence seems to have prevented at any rate in England, the dedication of plants to either person of the Blessed Trinity; and the few exceptions to this rule with which I am acquainted, are associated with our Lord in His human nature exclusively. The Blessed Virgin, however, who held a foremost place among the saints, is commemorated, under the title of 'Our Lady,' by which she was formerly more generally known in England, in the Lady's Bedstraw or Bedestraw (*Galium verum*), Lady's Smock (*Cardamine pratensis*), Lady's Finger (*Anthyllis vulneraria*), Lady's Tresses (*Spiranthes autumnalis*), Lady's Comb (*Scandix pecten*), Lady's Mantle, (*Alchemilla vulgaris*), and very many more. During Puritan times it became the custom to substitute the name of Venus for that of the Blessed

Virgin. Thus Lady's Comb became Venus's Comb, and so on; and this substitution was fostered by the false classical spirit which became fashionable during and after the reign of Charles II. Among plants popularly dedicated to other saints, we may notice St. John's Wort (*Hypericum* especially *H. perforatum*), in many places corrupted into Sinjonswort, which blossoms about St. John the Baptist's day, June 24; St. James' Wort (*Capsella bursa pastoris*), and many more will be found in herbals. In some cases, however, we must admit that names referred by modern writers to a similar dedication have really a very different origin. Herb Bennett, for instance, is said to commemorate St. Bennet or Benedict, although, as I have shown, it has a very different origin; Timothy-grass, (*Phleum pratense*), which really took that name by being brought into cultivation by one Timothy Hanson, is supposed to have been dedicated to St. Timothy; Paul's Betony (*Veronica officinalis*), which, according to Dr. Prior, refers to an old author, Paul Ægineta, who described it as a betony—to St. Paul; and so on. In the floral kalendar, the Church's seasons were duly noticed. The Holly (*Ilex aquifolium*) from its use in church decorations at that season, is in many places still called Christmas; the Snowdrop (*Galanthus nivalis*) in its old name "Fair Maid of February," commemorates the Feast of the Purification (Feb. 2); Lent brings its Lent lillies (*Narcissus pseudo-Narcissus*); Palm Sunday its "palms," as the willow catkins are pretty generally called; Easter, its Paschal, or Pasque, flower (*Anemone Pulsatilla* ; the days preceding the Ascension are referred to in Rogation-flower or procession-flower (*Polygala vulgaris*), which received its name from its use in the garlands which were carried in the religious processions which marked Rogation-week; Herb Trinity (*Viola tricolor*) pointed to Trinity Sunday; the Virgin's Bower (*Clematis*), to the Assumption; and the Michaelmas Daisy (*Aster*) to the feast of SS. Michael and All Angels.

But we must pass on to the consideration of another class. Many plants take their names from a resemblance, real or imaginary, to animals or parts of animals. The tail-like inflorescense of some has suggested many names; amongst which are Mouse-tail (*Myosurus minimus*), with the carpels arranged on the long slender receptacle; Cat's tail (*Typha latifolia*) with a thick stout spike, a name applied also to *Phleum pratense*; Hare's-tail (*Lagurus ovatus*), remarkable for its soft flowerheads; Squirrel-tail

(*Hordeum maritimum*, in Canada to *H. jubatum*); and Dog's-tail (*Cynosurus cristatus*). The Horse-tails (*Equiseta*), flowerless plants, have their long slender branches growing in whorls up the barren stem; the name is particularly appropriate to *E. maximum*. The gaping corolla of the Snapdragon (*Antirrhinum majus*) has suggested, not only that appellation, but the allied ones, Rabbit's-mouth, Lion's-snap, and Dog's-mouth. The Hound's-tongue Fern (*Scolopendrium vulgare*) took its name from the shape of the fronds; the narrow slender spike of *Ophioglossum vulgatum* accounts for its name, Adder's tongue. The long projecting nectary of many species of *Delphinium* suggested the name Lark's-spur, or Lark's-claw, a name which is applied in Buckinghamshire to the Toadflax (*Linaria vulgaris*), from a similar peculiarity in its blossoms. The soft heads of *Trifolium arvense* render Hare's-foot appropriate; those of the Kidney Vetch (*Anthyllis vulneraria*) are called Lamb-toes; *Dactylis glomerata* is Cock's foot, from the shape of the panicle (Prior).

Any one who will take the trouble to look through a list of English plant-names will not fail to observe that many of them have the name of some animal entering into their composition, used in a different sense from those which we have been considering. Formerly I alluded to the meaning which "horse" has in composition—*i. e.*, large, or course. as in horse-chestnut, horse-blobs, horse-gowans, and many more. "Dog," as an affix, usually conveys worthlessness: thus we have Dog-Violet, a scentless species, Dog's-grass (*Triticum repens*), a useless species of a genus which contains wheat (*T. sativum*); Dog's Camomile (*Matricaria Chamomilla*); etc. This is not always its meaning; the Dog-wood (*Cornus sanguinea*) means dagge-wood, *dagge* being the old English equivalent for a dagger, and the wood having been used for skewers (Prior). Dog Rose (*Rosa canina*) may mean, *par excellence*, Prick-flower, a very appropriate name for it; but cultivated roses are equally prickly, so that is probably implies a worthless rose. "Ox," "bull," or "cow," differ somewhat from "horse," in composition: they imply something large but not of necessity coarse. Bulrush (*Scirpus lacustris*) is thought by Dr. Prior to have been originally *pool*-rush, "from its growth in pools of water, and not, like the other rushes, in mire;" but Mr. Holland considers that the name simply denotes a large rush. 'Toad' means false or spurious: Toadflax, for example, means, as I have before endeavoured to show, a false flax, from its superficial resemblance, when out of flower, to the flax of commerce; Dr. Prior, however, favours a different derivation.—Abridged from *Science Gossip.*

THE WOOLHOPE NATURALISTS' FIELD CLUB introduced a novelty into its proceedings by devoting a day to explore the Fungi of the district where the Club meets, and after a critical examination of the species collected, closing its meeting by a feast, the principal feature of which was the edible species which were the spoil of the days 'foray.' Such excursions will certainly bring into notice many species of a tribe of plants which are not only extremely fugacious, but also very enigmatical in their appearance. They will also overcome popular prejudices against a wholesome and nutritious source of food almost entirely overlooked, and introduce additional valuable species to those who already have found out their virtues, as will appear from the report of the dinner which follows, and for which, as well as that of the excursion, we are indebted to the kindness of Dr. Bull.

The members met at the Mitre Hotel, at 9 o'clock, Friday, October 9, 1868, and after transacting the ordinary business of the Club, they set out for Holme Lacy Park, accompanied by Mr. Edwin Lees, F.L.S., and Mr. W. G. Smith, F.L.S. Leaving their conveyance, and entering the grounds of Sir E. L. S. S. Stanhope, a beautiful group of the maned Agaric (*Coprinus comatus*) attracted attention. It took almost the form of a circle, though not one of those that usually do so. It is very common, and as interesting and handsome in appearance as it is good to eat, if people did but know it. The pretty crested Agaric, (*Agaricus cristatus,*) also edible, and *A. vulgaris,* were next gathered, and on a bank under Scotch fir-trees several specimens of the not very common *Boletus granulatus* were found, and, as a matter of course, some bunches of the common poisonous *Agaricus fascicularis.* A flower-bed in the garden had a fine crop of *A. infundibuliformis* in it, and a cluster of *Boletus subtomentosus* was gathered below the terrace walk. This Boletus was also seen many times during the day.

The Club had a part of their dinner to procure in the park, not in the shape of venison from the deer, but as vegetable beef-steaks from the trees. Several specimens of *Fistulina hepatica,* the 'liver fungus,' or 'vegetable beef-steak,' as it has been called, were met with—one nearly two feet in diameter, and weighing ten or twelve pounds—on nine different trees, and had the search for it been continued many more might doubtless have been found.

Scattered about in proper hunting order the members climbed the hill. They were specially directed to look out for the very rare *Cantharellus cinereus*, which was found here three years since, but which Berkeley marks as "not found since the days of Bolton." It was not found, however. The delicate *Agaricus prunulus*, 'vegetable sweetbread,' as it has been termed, was met with, together with *A. campestris*, *A. arvensis*, and its smaller and more delicate variety *A. cretaceus*, all, of course, edible; also the small puff-ball, *Lycoperdon gemmatum*, the large rough-stemmed *Boletus scaber*, the buff gilled *Russula alutacea*, the less common *R. vesca*, and the Parasol Agaric (*A. procerus*). Some others were collected here not quite so good in character. Some fine pale orange specimens of this last poisonous Agaric were gathered, which at first sight resembled the delicious edible 'orange milk Agaric,' so highly recommended, and figured in the Club's Transactions last year. It had, however, a shaggy woolly margin, without the orange gills and the orange-coloured milk.

As the hour for dinner approached, the party remounted and returned to Hereford. Some time was devoted to an examination of the spoil, and then twenty-one sat down to partake of a dinner which fitly closed the 'Foray among the Funguses.'

With the fish and the soup came the first novelty in the form of Oreades ketchup. It was good with either, and as guest after guest helped himself to an experimental taste, it was curious to hear one after the other ask again for "that bottle." It was a brilliant success. Hie every one with a regard for table luxuries, and that should include all sensible people; hie to your lawns and grassplots and gather while still you may, the pretty little fairy-ring Champignon (*Marasmius oreades*), and make for yourselves a ketchup, that is as superior to the ordinary vile black compound you meet with as champagne is to gooseberry. Don't you know it? Then get a member of the Woolhope Club to point it out to you, or better still, borrow the last volume of the Club's Transactions, and there you will find a pretty coloured picture of it, and receipts, moreover, for cooking it in many ways. Have a care to keep down the spice, however, for if in too great abundance, it destroys the true delicate delicious flavour of the Agaric itself.

A side dish of stewed kidneys narrowly escaped being mistaken for a dish of sliced Agarics, and another of sweetbreads with buttons of the Horse Mushroom (*Agaricus arvensis*) was too good to travel far. Next followed a dish of beef-steak, animal and vegetable, deliciously mingled, to the advantage of both, and at the same time a dish of the *Fistulina hepatica*, the 'liver fungus,' or 'vegetable beefsteak,' by itself was handed round. The slices were cut from the large one gathered in the morning.

The next Agaric to appear was *Hydnum repandum*, 'the spiked Mushroom,' from Haywood forest. It was stewed and broiled, and those members of the Club who had resolved themselves into a committee of critical taste, and to whom, therefore, all dishes were immediately brought fresh and hot, quickly separated the Agarics from their gravy, and found them excellent, and particularly the broiled ones, not at all unlike the oysters to which they have been compared. Then followed the Parasol Agaric, *Agaricus procerus*, but its delicious flavour, perhaps the lightest and best of all of them, not excluding the common Mushroom, was drowned in its over-condimented gravy.

The fairy-ring Champignon (*Marasmius oreades*) appeared then, broiled on toast, after the admirable receipt of Soyer. We give it here in full, for it is the very best receipt for broiling Agarics, or Mushrooms, of every kind.

" Place young fresh Agarics, or Mushrooms, on toast freshly made and properly divided. Salt, pepper, and place upon each one a small piece of butter (or a little scalded or clotted cream). Put one clove on the toast, then cover with a glass and bake for a quarter of an hour, or broil before a quick fire for twenty minutes. Do not move the glass until it is served up, by which time the vapour will have become condensed and gone into the toast, and when the glass is removed a fine aroma of Mushroom will pervade the table." (N.B.—A common kitchen basin will answer the purpose of a glass as a cover for baking, though it is by no means so elegant.)

A dish of *Agaricus prunulus* was served simply stewed. The Agaric had fair play—salt and spice were kept in due abeyance—and "delicious" was the unanimous verdict. This dish never reached a third of the way down the table!

Many other Agarics might have been dressed, but it was thought best not to tax too highly the patience of the cook; and so with the distribution of dried specimens of the fairy-ring Champignon to all who wished it, the feast of Agarics was over for the day. This excellent Agaric will keep well, when threaded on string and dried and kept dry, through the winter, readily imparting its flavour to soups or made dishes as required.—Condensed from the *Journal of Botany*.

MIMICRY IN NATURE.—The few remarks on so-called "Mimicry in Nature," which I introduced in my new work on Central America, particularly relate to the predominance of the Willow form on river-banks. It is almost unnecessary to say that in the work from which the extract is taken it was undesirable to insert more than a few names in support of my observations, but it might not be difficult to show that most plants bearing leaves of a true Willow form do grow by running streams. To say nothing of those species of Salix having Willow leaves (or those Salices not having Willow leaves, and not growing by running streams, as *S. herbacea*, etc.), I would remind you of the different species of Nerium (Oleander), our *Epilobium angustifolium* (*vulgo*, Willow herb), *Lythrum Salicaria*, etc. That some plants are found by rivers which do not have Willow leaves (as pointed out) has, in my opinion, nothing to do with the question, how it comes to pass that the Willow form predominates to so great an extent in such localities. The answer may be very simple, but at present it has not come forth. About the term 'mimicry' there should be a clear understanding. It is, so far, a thoroughly objectionable one, as by employing it either in zoology or botany, the whole question is prejudged; indeed, it is assumed—1, That organisms have the power to mimic other organisms; and 2, That they have come in contact with those organisms which they are supposed to mimic. Employ the terms 'outer resemblance' instead of mimicry, and we are on neutral, undisputed ground. The subject of these external resemblances of species and whole genera to others having an entirely different organic structure, is a wide and complicated one; and I think that the best way to approach it is to go through the whole vegetable kingdom, and take note of every case where the outer features of one species or genus are reflected in any other. Some years ago my late lamented friend, Dr. Schultz-Bipontinus, read a paper on his favourite order, the

Compositæ, in which he pointed out that in this, the largest of all phanerogamous orders, the habit of almost every other order of the vegetable kingdom cropped up again. In Euphorbiaceæ, and other large orders, similar instances are noted. Sometimes this outer resemblance is perfectly startling. I remember finding a Sandwich Island plant, which looked for all the world like *Thomasia solanacea* of New Holland, and well-known Buettneriacea of our gardens, but which on closer examination turned out to be a variety of *Solanum Nelsoni;* the resemblance between these two widely separated plants being quite as striking as that pointed out in Bates's Travels on the Amazon, between a certain moth and a humming-bird. This outer resemblance between plants of different genera and orders has played us botanists many a trick, and is one of the many causes of the existence of some almost incomprehensible synonyms in our systematic works. Wendland in his monograph on Acacia described many good species, and thought he knew an Acacia when he saw one; yet one of his new ones (*A. dolabriformis*) which he referred to the genus from habit alone, turned out to be a Daviesia. Few men had a better knowledge of Ferns than Kunze, yet 'mimicry,' Puck-like, played him a trick when, relying on the nature of the leaf and venation, he referred *Stangeria paradoxa*, a Cycad, to true Ferns; and Sir W. J. Hooker, good botanist as he was, would never have figured a Veronica as a Conifer, if 'mimicry,'—using the term for the last time—had not been at play. At present I have no theory to propose on this subject, but whoever has, ought to both bear in mind that it must apply with equal force to the animal and vegetable kingdoms, and to say that these resemblances are merely accidental, counts for nothing until it shall have been proved that there are such things as "accidents in nature."—Seemann, in *Gardener's Chronicle.*

THE ORDEAL POISON-NUT.—In a recent number of the *Journal of Botany* Dr. Bennett, of Sydney, says that "this elegant tree is now naturalized in New South Wales, and is readily propagated. There is a noble specimen of it in the Sydney Botanical Gardens, which attracts attention from its bright green foliage, delicate and fragrant blossoms and pendulous, egg-shaped fruit. The label, close to the tree, inscribed 'Madagascar Ordeal Poison Tree,' occasions it to be treated with some respect by visitors to the gardens, for while other things suffer from their depredations it has been remarked that this is the best preserved tree in the collection." This specimen is twenty feet high, and the circumference of the branches full fifty feet. It flowers in November and December, and is often at the same time covered with fruit in different stages of maturity. The fruit, which is oviform and about the size of a hen's egg, contains a hard nut with a dark brown shell,* the white kernel of which is in size, appearance and taste like a bitter almond. The *Tanghinia veneniflua* is a specific poison for the heart and muscles, acting powerfully on the heart. Some of the natives of Madagascar say that there are two kinds of these trees, the one poisonous, the other only emetic, and so similar in appearance that none but the administrators know the difference, and that even they sometimes err and kill when they intend only to sicken. Dr. Bennett suggests that there may be two species of Tanghinia found in Madagascar, one of which may be analogous to the *T. Manghas* of India, the milky juice of the fruit of which is used as a purgative.

CANADIAN WILD FLOWERS.—Under this title Mrs. Fitzgibbon has published a very pretty volume for the parlor table, consisting of ten lithographic plates of some of our showiest wild flowers, drawn on stones by herself and afterwards coloured by hand. The letter-press, consisting of popular descriptions of each plant, is by Mrs. Traill, and is part of a work by that authoress still in MS. "descriptive of the most remarkable of the wild "flowers, shrubs and forest trees of Canada." Mrs. Traill's English names of flowers are excellent; in lieu of the vulgar Dutchman's Breeches for *Dicentra Cucullaria* she proposes the characteristic Fly-flower. The elegant name Gossamer-fern for *Dicksonia punctilobula* is also hers. The publisher's portion of the work is the least satisfactory. The plates are on poor paper, and the text needs the supervision of a proof-reader. The following is the list of species illustrated by the ten plates:—

Anemone nemorosa *Linn.*
Hepatica acutiloba *DeC.*
Aquilegia Canadensis *Linn.*
Nymphæa odorata *Aiton.*
Nuphar advena *Aiton.*
Sarracenia purpurea *Linn.*
Trientalis Americana *Pursh.*
Penstemon pubescens *Soland.*
Veronica Americana *Linn.*
Castilleia coccinea *Spreng.*
Arisæma triphyllum *Torr.*
Orchis spectabilis *Linn.*

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* Some of these nuts are in the Society's museum.

Dicentra Canadensis *DeC.*
Claytonia Virginica *Linn.*
Geranium maculatum *Linn.*
Rubus odoratus *Linn.*
Rosa blanda *Aiton.*
Rudbeckia fulgida *Aiton.*
Campanula rotundifolia *Linn.*
Pyrola elliptica *Nuttall.*
——— uniflora *Linn.*
Cypripedium parviflorum *Salisb.*
———— pubescens *Willd.*
———— spectabile *Swartz.*
Iris versicolor *Linn.*
Trillium grandiflorum *Salisb.*
——— erectum *Linn.*
Uvularia grandiflora *Smith.*
Lilium Philadelphicum *Linn.*
Erythronium Americanum *Smith.*

ZOOLOGICAL NOTES.—We have received an analytical chart of the birds of Canada, by J. J. G. Terrill, of Hamilton, C. W. The classification of Dr. Baird is adopted, and the orders, sub-orders, families, genera, species, &c., are given in a tabular form. It will prove very useful to schools, and to students of Canadian ornithology generally. The list contains 242 species, which have been principally recorded from Western Canada. Some few additional species of marine birds occur in the Gulf of the St. Lawrence, and on the other hand a few birds have been catalogued from Western Canada that have not as yet been found in the Province of Quebec.

Dr. Elliot Coues' monograph on the American Alcidœ, published in the journal of the proceedings of the Academy of Natural Sciences of Philadelphia for January and February, 1868, is of considerable interest to the student of North American ornithology. It is not yet very certainly ascertained whether the Great Auk has ever been taken on the coast of Eastern North America. The species is reported to breed on a low rocky island to the south-west of Newfoundland. Mr. J. Wolley has shewn that this species is not a bird of high latitudes, as was at one time supposed, and an interesting account by this author is quoted of its supposed extinction in Iceland; also his statement that the last specimens of the species known to have been taken were captured in 1844. The Razor Bill and the common Puffin both breed in the River and Gulf of the St. Lawrence, and it is not unlikely that the "large-billed" puffin, *Fratercula glacialis,* may be met with in Eastern Canada. The tufted puffin, it appears, occasionally occurs on the East Coast of North America, it has been thought an almost exclusively western species. Other Canadian examples of the order are the Sea Dove, *Mergulus alle,* and four species of Guillemot, of each of which detailed descriptions are given in Dr. Coues' essay.

In Silliman's Journal for November, 1868, Prof. Marsh shews that the Siredon lichenoides of Baird is the immature form of Amblystoma mavortium of the same author. An interesting account is given of the gradual metamorphosis of the species, showing its various changes of colour, the absorption of the dorsal and caudal membranes, and finally that of the external branchiœ. The author states that there can be little doubt that this creature breeds in its immature or Siredon state. Dumeril's researches on the Mexican Axolotl seem to prove this; also that all Siredons are larval Salamanders, a circumstance which Cuvier appears to have suspected.

Prof. Cope's review of the species of Amblystomidœ, a genus of tailed batrachians, from the 4th number of the Proceedings of the Academy of Sciences of Philadelphia for 1868, is a valuable contribution to our knowledge of North American Amphibia. Two species of this genus, so far as we are aware, occur in Lower Canada. The Amblystoma punctatum is the species formerly known as Salamandra subviolacea, and A. Jeffersonianum is the Canadian form which used to be called by Dekay, Salamandra granulata.

The seventh volume of the British Museum Descriptive Catalogue of Fishes, by Dr. Gunther, published in 1868, contains some matter of special interest to our local zoologists. Descriptions are given of several of the Canadian species of the difficult and intricate family of the Cyprinidœ, a group which includes the suckers, chubs, minnows, dace, &c. The following species are described from the neighbourhood of Montreal, and examples of each of them were forwarded to Dr. Gunther by the writer of this summary.

Catastomus teres, *Mitchill.*
Catastomus carpio, *Cuv. & Val.*
Hyborhynchus notatus, *Agassiz.*
Rhinicthys marmoratus, *Agassiz.*
Leuciscus cornutus, *Mitchill.*
Leucosomus pulchellus, *Storer.*

In addition to these Catastomus hudsonius, Lesuer; Carpiodes cyprinus, Lesuer; and Rhinicthys atronasus, Mitchill; also inhabit the vicinity of Montreal. A little fish common in the St. Lawrence, which used to be referred to the Abramis Smithii of Richardson, is the Hyodon tergisus of Lesuer, and is not a true bream. From various parts of Western Canada the following species are recorded, and full descriptions are given in the volume under consideration.

Catastomus aureolus, *Lesuer*. Lakes Erie and Superior.
Catastomus macrolepidotus, *Lesuer*. Lake Erie.
Ceraticthys plumbeus, *Agassiz*. Lake Superior.
" dissimilis, *Kirtland*. Lake Erie.
Leuciscus Hudsonius, *Clinton*. Lake Superior.
" rubellus, *Agassiz*. " "
Leucosomus corporalis, *Mitchill*. Lake Erie.

The common herring of the Gulf of St. Lawrence, and of the Atlantic Coast of N. America, is looked upon as identical with the European species; and, as Dr. Gunther states positively that whitebait are young herrings, there would seem to be no reason why this delicacy should not be procurable in Eastern Canada.

We notice also that in Dr. Gunther's Catalogue of the Tail-less Batrachians of the British Museum, he considers that the Rana sylvatica of Leconte, a land frog which is frequent on Montreal mountain and elsewhere in Lower Canada, is only a variety of the commonest European frog, the Rana temporaria.

Recent investigations have shewn that the late Prof. E. Forbes' theory that animal life would not be found at great depths in the sea is untenable. Living examples of all the great divisions of the invertebrata have been taken at depths of over one hundred fathoms outside of the Florida reef, and crustaceans, annelids and radiates were dredged in 517 fathoms water in the same locality. Researches off the Coasts of Portugal and Norway give similar results, as also do the investigations of Dr. Carpenter and Prof. Wyville Thompson, off the Faroe Islands, and quite a new zone of animal life has been thus recently revealed to us. J. F. W.

A BUTTERFLY PARASITE.—At a meeting of the Montreal Microscopic Club, one of the members exhibited specimens of a vegetable parasite on the tibia and tarsus of the dark swallow-tailed Butterfly, Papilio Asterias. The insect was captured at Brantford, Ont., last summer, along with three other specimens, at the same time and place. The parasite was only found on one of these, growing on the spines of the tibia, tarsus and tips of the ungues. Attention is at present directed to the circumstance, and a full description will be given in the next number of this journal.

MOSQUITOES IN ENGLAND.—Most of the readers of *The Naturalist* will remember the outcry last summer in reference to the appearance of the Mosquito in England. Some of the observers maintained that they were simply English gnats, and not the genuine insect. The following is a short paragraph from "Science Gossip," for January, 1869 :—" WOOLWICH MOSQUITOES.—At the Entomological Society's meeting of November 2nd, 1868, the Secretary exhibited a specimen of the so-called Mosquito sent from Woolwich, which proved to be a species of *Chrysopa*." Hence it will be evident that two or three different insects have been confounded together under the designation "Mosquitoes" in that locality, and to none of them does the name strictly apply.

" GUIDE TO THE STUDY OF INSECTS," BY DR. PACKARD.—Part V. of this excellent work is out, and contains a continuation of Lepidoptera. An account is given of the transformation of several species; also, two full-page illustrations of the male and female and female moth, "*Telea Polyphemus*." This work is one of the most valuable of its kind in North America; the subject is treated of scientifically, yet in a popular manner. The cuts are excellent; and this number is evidently one of the results of the labors of a practical and experienced Entomologist. The "Guide" is invaluable for the use of schools and of agriculturists. One of the ways to interest our farmers and add to their success may be learnt in the pages of this work. Its perusal might make them acquainted with those insects which are injurious or beneficial to their crops, so that they might know their friends from their enemies. In order to interest this class in advancing scientific agriculture, it would be well to put such works into the hands of their children at school. A. S. R.

" THE CANADIAN ENTOMOLOGIST," TORONTO.—The January number contains notes on Canadian Lepidoptera, by the Rev. C. J. S. Bethune, Secretary of the Entomological Society of Canada; also, a list of Diurnal Lepidoptera collected by Mr. B. Billings, Ottawa. In this list, under the name " Vanessa Milberti," the writer states " that sixty individuals of this species had remained in the pupa state in the breeding cage only four days. What was the temperature of the vivarium which caused so rapid a metamorphosis ? A. S. R.

CHEMISTRY AND PHYSICS.

ON HYDRAULIC CEMENTS.— It is well known that the calcination of argillaceous limestone gives rise to cements which have the power of hardening under water. Various explanations of this property have been proposed. An alkaline silicate, like soluble glass, is known to harden by silicifying calcareous rocks and cements; and Kuhlmann supposed that a silicate of this kind, formed during the calcination of argillaceous and more or less alkaliferous matters, might play an important part in the hardening of hydraulic limes. According to Rivot and Chatonnay, on the other hand, there are formed during the calcination of mixtures of carbonate of lime and clay, three new compounds, a silicate of lime, a double silicate of lime and alumina, and an aluminate of lime. These three compounds they supposed to combine directly with water, so that the solidification of the cement was like that of calcined gypsum, a simple hydratation. According to the recent experiments of Frémy, only one of these compounds, the simple silicate of lime, has the property of thus combining with water. Further, he has shown that although pure clay or kaolin, a hydrous silicate of alumina, does not produce a hydraulic cement when mixed with lime, yet, after exposure to a low red heat it forms, with lime, a perfect cement. The foreign matters often present in clays are without action in this process. The explanation of this curious result seems to be furnished by the observation of Frémy, that a clay which abandoned nothing to hydrochloric acid yielded abundance of alumina to the same acid after calcination. From this it whould appear that a heat, even of low redness, produces a partial decomposition or dissociation of the silicate into alumina and silica.

Both free alumina, and silica in the amorphous condition are shown by the experiments of Vicat to communicate hydraulic properties to lime. This decomposition of the hydrated aluminous silicate by heat is analogous to that many years since observed by Frémy for silicate of potash, whose solution at an elevated temperature is partially decomposed, with separation of pure crystalline silica. In this connection should be noticed the observation of Kengott, that many mineral species acquire a strongly alkaline reaction after having been calcined. The natural pozzuolanas are nothing more than volcanic ash or argillaceous matter calcined by volcanic heat; and it has long been known that similar products artificially prepared by calcination possessed, like the natural pozzuolanas, the power of rendering pure limes hydraulic; but the true mode of their action, which has not hitherto been understood, is now rendered intelligible by this investigation of Frémy.—(*Comptess Rendus de l'Acad. des Sciences, Dec.* 21, 1868.)

In this connection may be mentioned the peculiar power of hardening under water presented by imperfectly calcined dolomites or magnesian limestones. By heating these to a temperature of 400°-500° centigrade the double carbonate is broken up; and the magnesia, losing its carbonic acid, remains mixed with the carbonate of lime, but when moistened with water, is converted in a few hours into a crystalline hydrate, which gives to the mass a great degree of hardness. In like manner a condensed form of magnesia, such as is obtained by calcining at a gentle heat, the native anhydrous carbonate, gradually assumes, by the action of water, a great degree of hardness. T. S. H.

ON THE DECOMPOSITION OF GRANITE BY WATER. (R. HAUSMANN, *Jour. fur Prakt. Chem.*)—The granite employed in these experiments was reduced to a powder so fine that it had a diameter of not more than 0.01 millimeter. This digested for a week, with twenty-five times its weight of pure water, at the ordinary pressure and temperature, yielded an amount of soluble alkali equal for 100 parts to 0.03 or 0.04, and when the mixture was kept in continual agitation, to 0.05 parts. A longer digestion did not sensibly increase the amount of matter dissolved. The solvent power of water, saturated with carbonic acid, was found to be about twice that of pure water. Calculating from the surface exposed in these experiments, the author concludes that the rains of a year would remove about fifteen grammes of alkalies from a surface of 100 square metres of granite. T. S. H.

OXYCHLORID OF COPPER.—Hydrous oxychlorid of copper, to which the name of atacamite is given, is abundant in some regions, especially in Chili, where it is supposed to be formed by the action of sea-water on oxydizing copper pyrites. A late experiment of Prof. Church throws further light on the origin of this compound. He found that two grammes of the native blue hydrous carbonate of copper, azurite, after four years digestion in 200 cubic centimeters of a solution holding ten per cent of pure chlorid of sodium, had lost the whole of their carbonic acid, and become converted into a green oxychlorid, allied in composition to atacamite, carbonate of sodium being formed at the same time. (*Chem. News*, Nov. 27, 1868.) For further observations on the artificial production of oxychlorid of copper, see Dana's Mineral., 794. The power of oxyd of lead to decompose chlorid of sodium with the formation of hydrate of soda and oxychlorid of lead, is familiar to chemists. T. S. H.

CHROMIC IRON.—Clouet has shown that when an admixture of protosulphate of iron and sesquichlorid of chromium, in the proper proportions, is precipitated by ammonia, and the resulting oxyds are fused with borax, the compound ($Cr_2\ O_3,\ Fe_2\ O_2$) crystallizes in octohedrous, having the aspect, the hardness, density and chemical indifference to acids which belong to the native chromite, some varieties of which have the formula just given.

T. S. H.

REDUCTION OF NITRATES AND SULPHATES IN CERTAIN FERMENTATIONS.—The reducing action of fermenting organic matters on these salts is well established; in the case of nitrates, ammonia, and in the case of sulphates, sulphydric acid is formed. According to Bechamp this process is, in all cases, due to the intervention of minute organic germs of a peculiar species, to which he applies the name of *Microzyma.* These, under ordinary conditions, absorb from the air the oxygen which they require; but if this source is excluded they take oxygen from the sulphates or nitrates present. These germs are found in the mud of towns, in which sulphid of iron forms, and also in common chalk. Hence, the addition of chalk to solutions of sugar or starch, with sulphate of lime, gives rise to reduction of the salt. T. S. H.

EFFECTS OF GREAT COLD ON TIN.—In a note to the French Academy of Sciences, Nov. 30, 1868, Mr. Fritschze of St. Petersburg, described the effect of intense cold upon ingots of Banca tin weighing from 50 to 60 pounds. The metal had acquired a fibrous structure, and showed fissures like prismatic basalt, besides cavities of considerable dimensions. In this connection Mr. Dumas recalled the brittleness of iron when exposed to great natural cold. T. S. H.

ANALYSIS OF GRAPHITE.—A known weight of graphite in powder is dried between 150° and 180° C., intimately mixed in a glass tube with twenty times its weight of pure oxyd of lead, and then heated before the blow-pipe until complete fusion and the disappearance of all froth. The loss in weight corresponds to the carbonic acid formed from the graphite, with the oxygen of the litharge. The pulverized graphite, may also be fused with pure nitrate of potash in a platinum crucible, and the carbonate formed determined in the usual manner.—(*Giutl. Acad. of Vienna.*)

T. S. H.

ON PHOSPHORUS IN IRON.—The importance of manganese as an element in iron ores has long been known, and the experiments of Caron have shown that the addition of manganesian minerals to the charge of the blast furnace has, for effect, to reduce notably the amounts of sulphur and of silicon which pass into the pig metal. At the same time, however, it does not, in any way, diminish the proportion of phosphorus. This element generally exists in the ores as a phosphate of lime, or in combination with alumina or oxyd of iron. These latter are generally decomposed by the addition of lime, which in its turn requires silica to give a liquid slag. The reaction of silica and carbon, at a heat of fusion, on phosphate of lime, sets free the phosphorus, which unites directly with the metallic iron; so that, while the slag is free from phosphorus, the pig metal contains it in quantities often so large as to be very prejudicial.

A solution of the problem of the treatment of phosphuretted ores would seem to require some flux capable of dissolving or rendering fusible the phosphate of lime without liberating its phosphorus. Such a power is possessed by fluor-spar; and the experiments of Caron show that while a mixture of phosphate of iron, lime and silica, fused in a charcoal-lined crucible, gave a button of brittle metal highly charged with phosphorus, a mixture of phosphate of iron, lime and fluor-spar, fused under similar conditions, was somewhat malleable, and contained only one-third as much phosphorus as the first assay. In operating in this way on natural and less phosphated ores, it was found that the substitution of fluor-spar for silica always produced a notable diminution in the amount of phosphorus in the metal; but the improvement became less marked with ores holding small amount of phosphorus. Fluor-spar has also the effect of dissolving alumina in the furnace.

It is questionable how far this process could be applied in the metallurgy of iron, inasmuch as few ores are free from silica.

Moreover, the cost of fluor-spar in many localities would be such as to preclude its use. The experiments of Caron, however, deserve notice as a partially successful attempt to solve a very important problem in metallurgy. T. S. H.

NATURAL INFLAMMABLE GASES.—The recent investigations by numerous chemists of the composition of petroleum from various sources have shown it to consist in great part of homologues of marsh gas, hydride of methyl, CH_4 ($C=12$, $H=1$), the most hydrogenated series of the hydro-carbons. In addition to these, small portions of benzene and its homologues, and of hydrocarbons of the ethylene or olefiant gas series have been detected in the petroleums of certain regions. Cahours and Pelouze have isolated from the products of the distillation of Pennsylvania petroleum not less than thirteen homologues of marsh gas, having the general formula $Cn\ Hn2+2$, in which the value of n increased from 4 to 15, and the boiling point from 0° centigrade to 160°. The lower members of the series in which n equals 2 and 3, and which are gases at the ordinary temperature and pressure, were found by Ronalds in solution in crude Pennsylvania petroleum. The denser and less volatile liquids of petroleum, as well as the various solids included under the name of paraffine, appear to belong to the same series.

Inflammable gases are well known to issue from the palæozoic rocks in many localities in the great Appalachian basin. Steiner (Amer. Jour. Science [2] xxxiv, 46,) examined some years since the gas from a well yielding salt water and petroleum, in the carboniferous rocks of Alleghany county, Pennsylvania, and found it to consist essentially of marsh gas, with a little carbonic acid, and traces of oxygen and nitrogen, but could detect no olefiant gas. My own examinations, many years since, of the inflammable gases from the saline springs of Varennes and Caledonia in Canada, which rise from Lower Silurian limestones, led to the same result.

Some two years since M. Felix Foucou, a French engineer, visiting the oil regions of this country, was furnished with exhausted tubes, in which he was enabled to collect the gases from various localities. These gases were afterwards examined by Mr. Fouqué in the laboratory of the College of France, and the results of the analyses, as well as the observations of Mr. Foucou, are contained in the *Comptes Rendus* of the French Academy of

Sciences for November 23, 1868. The gases examined were from five localities.

1. The so-called Burning spring, just above the falls of Niagara, where an inflammable gas issues in considerable quantity from a spring of slightly sulphuretted water which rises from the strata of the Medina formation, here overlaid by a few feet of clay. This gas consists of marsh gas, with traces of carbonic acid, nitrogen and oxygen, the latter two being in all cases probably accidental impurities arising from imperfections in the apparatus used in collection.

2. Petrolia, Enniskillen, Ontario; the gas was collected from an intermittent oil-well, where petroleum had been reached five days previously, at a depth of 377 feet in the Hamilton formation. Its composition corresponded to a mixture of about equal parts of marsh gas, $C\ H_4$ and hydrid of ethyl, $C_2\ H_6$.

3. Fredonia, New York. This town on the shore of Lake Erie, with a population of 3,000 souls, has been for many years lighted with the gas which issues from a boring about eighty feet deep in the Genesee slates, which occur at the summit of the Hamilton formation. The gas is not accompanied by petroleum, and appears to be like the last, a mixture in nearly equal proportions of the hydrids of methyl and ethyl.

4. Pioneer Run, Venango county, Pennsylvania. This gas, from an oil-well about 600 feet deep in the sandstone of the Chemung formation, was more carburetted than the preceding and had nearly the composition of hydrid of propyl $C_3\ H_8$. A fractional analysis by means of alcohol, which dissolves more readily the more highly carburetted compounds of the series, showed however that this gas was a mixture, consisting in part of hydrid of butyl, $C_4\ H_{10}$; besides a portion of hydrid of methyl, and the two intermediate bodies of the series.

5. Roger's Gulch, Wirtz county, West Virginia. The gas in this locality was from a flowing oil-well 320 feet deep in the carboniferous conglomerate, and consisted of hydride of methyl with an admixture of 15.86 per cent of carbonic acid gas.

Careful examinations showed the absence from all of these gases of acetylene, $C_2\ H_2$, of olefiant gas, $C_2\ H_4$, and its homologues, as well as of oxyd of carbon and free hydrogen. T. S. H.

Spontaneous Ignition.—"The spontaneous ignition of pyrotechnical compositions made with chlorate of potash is indeed a very serious subject as regards the safety of both life and property. I know not if any reliable observations have been made in the matter, but the following facts were noted by myself some years ago, and may throw some light upon the probable origin of various terrible fires which have occurred on the premises of firework-makers in London. Mixtures of the three ingredients—nitrate of strontia (or barytes), sulphur, and chlorate of potash—if made up at once from *freshly* and strongly desiccated materials, are certain to take fire spontaneously within a few hours, especially if placed in a rather damp situation. The action, which I twice had the patience to watch for and witness, begins with the evolution of an orange-coloured gas; afterwards a liquefaction is set up at several points in the mass; a hissing noise and a more rapid disengagement of the gaseous matter comes on, and the composition takes fire. It is a curious thing that the addition of a small proportion of sulphuret of antimony at once prevents the occurrence of these phenomena; whether charcoal has the same effect I am not quite sure. Moreover, if such compositions, being damp, are, in order to dry them, placed oo near the source of heat, the same phenomena will take place even when the antimony is used in their composition. Also, compositions to produce a purple flame, if made with black oxide of copper, are almost sure, sooner or later, to take fire of themselves at uncertain periods, whether kept in a damp or dry place. The carbonate should always be used in preference.—R. TREVOR CLARK."—*Chemical News*.

NEW CHEMICAL TOY.—"Pharoh's serpents" and "Vesuvian tea" have paved the way for the reception of a new Chinese wonder in the shape of "ferns growing out of burning paper.' This is a neat little experiment free from many of the disadvantages appertaining both to the "Devil's tears" and the lozenge-shaped crystals of bichromate of ammonia, which may chance to prove too inviting to children's tastes. The instructions direct us to crimp or fold the yellow papers backwards and forwards, so that when opened out they may be supported upright in a zigzag form. One of these slips is then placed upright on a plate, and ignited in two or three places along the upper edge, but without being allowed to blaze. It will burn slowly down with a red glow, diffusing an agreeable perfume, whilst the ash of the paper assumes the most fantastic arborescent shapes, together with a green colour, which, to a lively imagination, may be suggestive of the growth of ferns or lichens. We had no difficulty in imitating this effect by saturating thin cartridge paper, in the first instance, with an alcoholic solution of gum benzoin, and, when dry, applying an aqueous solution of the bichromate of ammonia. The decomposition of the latter substance by heat in contact with burning paper affords an explanation of the phenomena observed.—*Chemical News.*

METEOROLOGY.—We had fondly anticipated that one of the results of Confederation would be the establishment of a system by which the corps of observers now scattered (or to be scattered) throughout British North America would receive their instructions from, and transmit their experiences to, some part of the Dominion By this means a critical examination of them could readily be made, which would at once advance our material interests and conduce to the advance of climatological science. Up to the present moment nothing has been done in this direction. This may be owing, in some measure, to the incipient character of the new regime, and to the uncertainty prevailing with regard to Government aid. Still the Dominion Govermennt has allowed to the various observatories a small annual grant. Every lover of science must feel grateful that amid the din of politics, of commerce, and of railway legislation, our public men have not forgotten the encouragement due to science; and we hope that ere another year has rolled by, our expressed wishes may be fully realized.

In the science of Meteorology unity in action is much needed in its modes, measures and purpose; also in the co-operation of observers, whether individually or collectively,among the various nations. Up to the present time (if we except Admiral Fitzroy's efforts in this department of science) there has been little or no system in Meterology. It is essentially a science of observation, yet observers proceed upon no fixed plan. It is a science coeval with man himself, one which must have furnished the means of observation to the earliest races of mankind, and which has furnished matter for investigation and comparison through all time. Records of a very early date are preserved in our own language. The Bodleian library at Oxford (England) contains registrations of the weather for seven years, from January, 1337, to January, 1344, recorded by Walter Merle. It is believed that this is the earliest available record. The invention of the barometer in 1643, and of the thermometer in 1590, seemed destined to throw new lustre on the progress of the science. Astronomy it is true has given to the world more lasting and fixed results, for the celestial orbs have undergone but little change; while the nature of the ever-changing elements is still unfixed. At the present time every nation has its own measure of temperature, atmospheric pressure, rain, wind, &c.; and above all, a point of the most vital importance, each has its own hour for observation. In this way the results obtained are vitiated, and the great aim of modern science, unity of purpose, is lost. Science is knowledge reduced to order, and the object in Meteorology is to obtain a correct knowledge of the cosmical laws which regulate and influence the universe.

What influence have the sun, moon, and planets on the weather?—is a question which science must answer.

If the sun and moon have so much influence upon the ponderable fluids in our seas, and great lakes, how much more may they not exert over such an elastic and easily moveable body as our atmosphere? Meteorology should embrace the study of such ideas as these, our united efforts should tend towards their solution, from which we may hope to gain practical advantage. At all events, if there are impediments to final results, let such be the means by which they will be detected and exposed.

Observations made either by individuals, colleges, observatories, or nations, must be brought together into a limited space of time. They must each be reduced to one common standard before they can serve the general purposes of science. Self registering instruments are the best and most suitable for this object. By means of them the science itself is at once traced and left indelible on the register. They form at the same time a natural measurement of time, space, and amount; while nothing short of a large area of country will furnish the necessary means and extent of survey. Let our observations, if possible extend beyond the Rocky mountains, and this is a matter of much consequence. This chain separates North America, as it were, into two portions. It influences the climate of British America in no small degree, and seems to produce the ebb and flow of the great atmospheric sea, and to absorb our heat and moisture, At least our instruments at this distant point appear to indicate this.

Another important source of inquiry, especially in reference to storms, is into the history of that "river in the sea" the Gulf stream,—and its reservoir, the Gulf of Mexico. Sailors have been active in the daily notices of occurrences in connection with this subject, but as yet little has been done by individual observers on land in carrying out that unity of purpose so necessary in the pursuit of meteorological science.

Much may still be said in reference to this subject, but immediate action is required. Let us, of the Dominion, no longer procrastinate, a central station should be at once established, to which all observations may be referred; if Montreal, then let a simultaneous system be at once adopted as to time, measure, and amount. Our Telegraph lines have been always ready to aid in the enterprise, the press has also offered its aid. If, for this Dominion, the pressure of the atmosphere, temperature, winds, etc., could be observed at distinct and fixed intervals of time and space, and their connection with other atmospherical phenomena alike be transmitted to this central point for reduction and examination, we should, as a nation newly issued as it were into life, be forming one link in that important chain, which must ere long encircle the whole earth. With the new appliances of science and art in our sub marine telegraph, our storm signals and weather-casts, we should endeavor to unravel the hidden mysteries of those laws which meteorological science has not yet been able to reveal from want of unity of purpose.

If by these united efforts and by these investigations we can predict the ebb and flow of our atmosphere as we can now the ebb and flow of the tide, we should then be in a position to foretell with a great amount of certainty any of those changes that have so direct a bearing on our maritime and agricultural pursuits. We could then at once establish at our principal seaports and head-lands those beacons which might warn the sea-faring man of his impending danger and prevent by timely notice that loss of life and property which every year it is our misfortune to witness and which we feel sure so soon as science is properly and duly applied, may be averted.

The neglect of the study of Meteorology in the Universities of Great Britain is much to be regretted. Its assiduous study in such countries as the United States, Austria, France, Russia, Norway and the Netherlands stand out in striking contrast. In the United States alone we have 800 observers, in Austria 118, and in Switzerland 83. There are now 1,500 rain-gauges in

England employed to ascertain the amount of the rainfall, and we can boast that in British North America the science of Meteorology is taught in our Colleges and Grammar Schools. Observatories have been established through the generosity of our Government at those points of great importance, Halifax and St. Johns, N. B. All that we now require is unity of purpose so as to bring our united efforts to a useful end. We propose to offer suggestions in reference to the organization of some plan of action in a future number. C. S.

METEOROLOGICAL REPORT FOR THE YEAR 1868.—The following summary embraces the principal meteorological phenomena for the past year (1868) condensed from the records of the Montreal Observatory. The geographical co-ordinates being latitude 45° 31′ North, longitude, 4h. 54m. 11 sec. west of Greenwich; the cisterns of the barometers are 182 feet above mean sea level.

The readings have all been corrected from instrumental errors, and the readings of the Barometer have been also corrected for temperature (32 ° F.)

ATMOSPHERIC PRESSURE.—The highest reading of the year occurred at 7 A.M. on the morning of the 30th of October, and indicated 30.400 inches. The lowest reading during the year was at 5 A.M. on the 7th day of December, and indicated 28.687 inches, shewing an annual range of 1.713 inches. The yearly mean was 29.537 inches.

Below is a table for each month, shewing the highest and lowest readings:—

	January.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches,	Inches.
Highest............	30.146	30.248	30.347	30.034	29.999	29.998	29.902	30.061	30.100	30.400	30.249	30.212
Lowest............	29.149	29.033	29.250	28.867	29.247	29.247	29.446	29.271	29.362	29.250	29.161	28.687

TEMPERATURE OF THE AIR F°.—The highest reading of the Thermometer during the year was on the 13th July and was 98·7; the lowest reading was on the 11th of February and was 22·4 degrees (below zero.) The mean temperature for the year was 42·45. This agrees exactly with the observations on the mean annual temperature made by the late Hon. Mr. Justice McCord, also with my own, but it is nearly 2° degrees lower than the mean annual temperature furnished from observations of the late Dr. A. Hall.

The yearly range or climatic difference for the year was 121·1 degrees.

The extreme heat of July was marked by a mean temperature of 76° which exceed by 5° degrees the *Isothermal* for Montreal, deduced from observations continued during a long series of years, and there were during the month *two distinct* hot terms, including the 2nd, 3rd, 4th, and 5th days, when the mean temperature was 82·3, 84·7, 84·4, and 83·1 respectively. The Thermometer never indicated less than 72·7 during the 24 hours.

The *second* hot term includes the 11th, 12th, 13th, 14th, 15th, and 16th days; their respective means being 84·0, 87·6, 87·1, 87·9 and 85·5, and the temperature during this term was never below 71.4 during the 24 hours.

Below is a table shewing the months' highest and lowest readings, also the monthly means, together with the amount of rain and snow in each month:—

MONTHS.	Mean Temperature in F.°	Highest Temperature.	Lowest Temperature.	Rain, depth in inches.	Snow, depth in inches.
January......	10°80	37°2	—13°2	....	12.63
February.....	9°49	33°1	—22°2	....	22.20
March........	31°90	67°0	—15°6	1 429	5.34
April........	38°95	68°2	12°9	0.241	14.93
May..........	53°89	82°3	36°4	3.462	.....
June.........	66°40	95°7	40°0	0.486	.....
July.........	76°00	98°7	59°1	2.124	.....
August.......	69°94	87°9	52°2	2.362	.....
September ...	57°94	80°7	37°2	3.494	.....
October......	44°82	69°1	22°1	0.794	4.92
November.....	33°30	53°0	20°7	4.473	17.28
December.....	16°00	32°1	—10°2	....	27.96

The following table shews:—

MEAN TEMPERATURE of the Quarters, with the amount of Rain and Snow, in inches, for the year ending 1868.

MONTHS.		Temperature.		Rain	Snow.
Winter	December.....	10°99	....	0.518	26.16
	January.......	10°80	....	....	12.64
	February.....	9°49	....	....	22.20
	Mean.	10°42	Amounts.	0.518	61.00
Spring	March........	31°90	....	1.429	5 34
	April.........	38°95	....	0.241	14.93
	May..........	53°89	....	3.462	....
	Mean.	41°58	Amounts.	5.132	20.24
Summer	June..........	66°40	....	0.486	....
	July..........	76°00	....	2.124	....
	August.......	69°94	....	2.462	....
	Mean.	70°78	Amounts.	5.972	....
Autumn	September.....	57°94	....	3.494	....
	October.......	44°83	....	0.794	4.92
	November.....	33°30	....	4.473	17 28
	Mean.	45°45	Amounts.	8.761	22.10

RAIN AND SNOW.—The amount of rain which fell was very much below the average, when compared with previous years. In the month of July there were 16 days on which no rain whatever fell. Rain fell on 31 days during the year, and amounted to 18.865 inches on the surface.

Very few observations of a reliable kind on the rain and snow fall have been recorded for Montreal, but the few to which we have had access would give the mean annual amount of rain somewhat above 36 inches, or about double the quantity which fell during the past year (1868.) This unusual dryness was also felt in Great Britain and on the continent of Europe.

Snow fell on 61 days, amounting to 105.27 inches on the surface. The first snow of Autumn fell on the 17th of October. The first frost of Autumn occurred on the 17th of September, and winter fairly set in on the 7th of December. The first steamer arrived in the port of Montreal on the 17th of April.

WINDS.—The most prevalent winds during the year were the West and W.S.W. The next in frequency were the N.E. and N.E. by E. The least frequent wind was the East.

There were 177 nights clear at 9 P.M., suitable for astronomical observations; this is somewhat above the usual average.

The year was not distinguished by any remarkable displays of the Aurora Borealis, although these phenomena were visible on several nights during each month. Several slight shocks of earthquakes were felt both at Montreal and in its immediate vicinity.

The grand meteoric display was well seen from 11h. 35m. P.M. on the 13th November, to 3h. 45m., A.M., of the 14th, and was most profuse and brilliant.

MISCELLANEOUS.

Illumination of Microscopic Objects.—Notwithstanding the many ingenious methods of microscopists for the illumination of the minute objects they study, none of them seem hitherto to have been based on thoroughly artistic, if, indeed, even on sufficiently correct principles. The new hemispherical condenser, invented by the Rev. J. B. Reade, is certainly, in one point of view, the most correct in principle, and practically the best as far as the proper delineation of objects is concerned. Of its value in bringing out fine lines and markings on the scales of *Podura angulatum* and various other test objects a single inspection would be sufficient for the most obdurate disbeliever in its efficacy. The principle is a modification of semi-circular illumination,—or illumination from one side only, as artists adopt in their pictures. An ordinary achromatic condenser throws the light all round the object, and, consequently, as each half of the circle of illumination throws shadows from any prominences or thicknesses of the object in opposite directions, so there are also illuminations of the shadows from both sides of the circle of light, and the definition of the object, which is only brought out by the *depth* of the shadows, must be weakened. Mr. Reade invented his condenser, as many other things have been invented, by an accident. He placed a lamp directly in front of his object, and another lamp at right angles to it at the side. The shadows were consequently *artistically* thrown upon the object, and he found the definition of it wonderfully increased. From this it occurred to him that by using a hemisphere of glass and covering the top or flat surface with two oversliding diaphragms, pierced with certain orifices, he could throw one ray of light longitudinally and another at right angles horizontally over his object; and that by means of the overcrossing of the intermediate slits of the diaphragms he could throw an intermediate ray at any angle he desired. This in principle, is a semi-circular illumination, but improved by shutting out all but necessary light, and consequently intensifying the shadows; so much so that, with one of the admirable half-inch object-glasses now manufactured by Mr. Andrew Ross, results are conspicuously obtained, which before were but obscurely or were quite unattainable by quarter-inch and even one-eighth-inch glasses. Mr. Mackie has suggested that the principle should be applied to the illumination of opaque objects, the reflected light from the Lieberkuhns being now likewise dispersed over the shadows of the object by the circular radiation from their brightly polished surfaces and no artistic effects are produced, as would be the case if the light were thrown down from one side of the Lieberkuhn only.

THE "NATURALISTE CANADIEN."—We have received the first number of this periodical, and hail with no small pleasure its advent. It is under the direction of the Abbé Provencher, Curé of Portneuf; and is printed in our sister city of Quebec. It contains twenty-four pages of printed matter; and we fully endorse the views of the author's prospectus, "that while furnishing to the amateur the medium of the study of Natural History, it will, at the same time, be the means of disseminating all new discoveries, and form the means by which the public will participate in these investigations."

There is also a page devoted to the Meteorology of Portneuf, which forms a new and important point of observation. We hope that investigations will ere long be extended to other points on the Lower St. Lawrence, and we sincerely wish the author that success which his energy and devotion to the science so richly deserves. C. S.

SOCIAL AND SANITARY SCIENCE.—One of the greatest social problems in all civilized nations is, how to return to the earth what is taken from it; or, how to collect and return to the soil, in a way profitable for cultivation, the refuse of man and animals which now, under favorable circumstances, runs to waste, and, under ordinary circumstances, remains to breed disease.

The simplest of the modes yet adopted is now coming into extensive use in England, viz., "Moule's Earth Closets." It is simply a convenient application of the old principle, that earth is the best absorbent of fœtid matter. The patent consists in an easy mode of dropping dry earth on excreta and carrying it off, charged with plant-food, in pans. It is now being tried, with excellent results, in the Kingston Penitentiary and other public institutions. How far it can be adapted to the ordinary requirementsof city or of country life, during our severe winters, remains to be seen. All who have the opportunity will do well to try experiments in it, and communicate their results to the editor of this department, who is also the Honorary Secretary of the Montreal Sanitary Association. The experiment in the English camp during the last unusually hot summer was marvellously satisfactory; all previous experiments, even with good closets and drains, having more or less failed.

The evils of the old system, even with a fair amount of sewering, and a large average of closets, are terribly apparent in the continued, and even increased, mortality of Montreal, in spite of increased vigilance on the part of the sanitary police. The death-rate for 1868 amounts to within a fraction of forty per thousand, or one in every twenty-five. The details will be discussed in the ensuing number.

P. P. C.

PHYSIOLOGICAL.—At a recent meeting of the Royal Society a paper was read by Mr. W. S. Savory, "On the Structure of the Red Blood Corpuscle of Oviparous Vertebrata," which goes far to overturn the conclusions accepted and held by many physiologists. They have maintained that between the red blood corpuscle of mammalia and that of other vertebrate classes a fundamental distinction existed; the distinction being a nucleus in the red corpuscle of the oviparous vertebrata. Mr. Savory shows, according to the *Athenæum*, that this nucleus has no existence, that the appearance which has been mistaken for a nucleus is merely a change which the blood undergoes after death, and by being kept too long before it is put under the microscope for examination. And he describes a method by which the formation of the so-called nuclei can be observed and their fictitious character detected. Assuming that this view is well founded, it follows, to quote Mr. Savory's words, "that the red corpuscle of all vetrebrata is in its natural state structureless."