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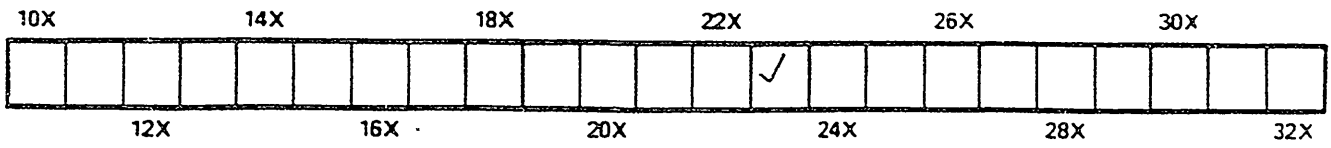

THE

CANADIAN NATURALIST

AND

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IMPRESSIONS AND FOOTPRINTS OF AQUATIC ANIMALS AND IMITATIVE MARKINGS, ON CARBONIFEROUS ROCKS.*

By J. W. Dawson, LL.D., F.R.S.

The footprints and other markings of aquatic invertebrate animals and of fishes, are necessarily for the most part, less distinctive and important than those of land animals, both because less characteristic in themselves, and because reproduced under similar forms in very different geological periods. The former peculiarity has caused them to be neglected as of little importance, or to be confounded with impressions of plants. With reference to the latter, I have myself shown that the impressions made by the modern King-crab faithfully represent the *Protichnites*, *Climactichnites*, and *Rusichnites* of the Primordial and Silurian, and similar comparisons have been made by Salter, Jones, Dana and others, between the tracks of modern Crustaceans and worms and some of those in the oldest rocks.

1. *Protichnites*, Owen.

The footprints from the Potsdam Sandstone in Canada, for which this name was proposed by Owen, and which were by him referred to Crustaceans probably resembling *Limulus*, were shown by me in 1862† to correspond precisely with those of

* *From Silliman's Journal.* † *Canadian Naturalist*, vol. vii.

the American Limulus (*Polyphemus occidentalis*). I proved by experiment with the modern animal that the recurring series of groups of markings were produced by the toes of the large posterior thoracic feet, the irregular scratches seen in *Protichnites lineatus* by the ordinary feet, and the central furrow by the tail. It was also shown that when the Limulus uses its swimming feet it produces impressions of the character of those named *Climactichnites*, from the same beds which afford *Protichnites*. The principal difference between *Protichnites* and their modern representatives is that the latter have two lateral furrows produced by the sides of the carapace, which are wanting in the former.

As Limuloid crustaceans are well known in the Carboniferous beds of Europe and America, their footprints might be expected to occur in rocks of this age, but the first I have met with were sent to me last summer by my friend Mr. Elder, of Harvard College, who found them quite abundantly in dark-colored flagstones belonging to the Millstone Grit formation at McKay's Head in Nova Scotia (fig. 1). The animal which produced these marks must have been of small size (about half an inch in breadth), in this agreeing with the usual size of the Coal-formation Limuloids; and like the ancient Protichnite makers, it left no trace of the edges of the carapace, but a very distinct impression of a sharp pointed tail. Its posterior feet had three or possibly four sharp toes. There were besides several pairs of sharp-pointed walking feet. On the same slabs there are some series of marks, evidently made by the same kind of animal, which have no tail-mark, and there are tail-marks with only traces of those of the toes. It is worthy of notice that, though these tracks indicate the presence of the animal, no crusts of Carboniferous Limuloid crustaceans have yet been found in Nova Scotia. The sand in which the tracks now referred to were made was probably too hard to permit the swimming feet to make any impression. With respect to the absence of the marks of the sides of the carapace, I may observe that the genus *Belinurus* of the Carboniferous had the sides of the carapace less deep than that of the modern Limulus, and this may also have been the case with the more ancient Limuloids of the Potsdam. See as to this a letter by Prof. Hall in the *Canadian Naturalist*, 1862.

To Protichnites may perhaps be referred a very singular

impression from Horton Bluff (fig. 2), which at first sight much resembles *P. Scoticus*, from the Primordial of Roxburghshire, though the Carboniferous specimen is larger and more complicated.* It seems to have been produced by the successive pressure of a pair of flat organs, crenated or toothed at the edges, rather than divided into separate toes. Its horizon is the Lower Carboniferous. It was collected by Prof. Hartt.

The first species of *Protichnites* referred to above may be appropriately named *P. Carbonarius*, and the second *P. Acadicus*. They are, I believe, the first impressions of this kind found in the Carboniferous.

2. *Rusichnites*, Dawson.

In a paper published in the *Canadian Naturalist*, 1864, I showed that the singular bilobate markings with transverse striæ named *Rusophycus* by Hall, and found in the Chazy of Canada and the Clinton group of New York, are really casts of burrows connected with footprints consisting of a double series of transverse markings, and that a comparison of them with the trails and burrows of Limulus justified the conclusion that they were produced by Trilobites. I proposed for these and for similar impressions of small size found in the Carboniferous, the name given above. The Carboniferous examples I supposed might have been produced by the species of *Phillipsia* found in these beds. A specimen recently obtained from Horton shows this kind of impression passing in places into a kind of Protichnites, as if the creature possessed walking feet as well as the lamellate swimming feet which it ordinarily used.

I can scarcely doubt that the *Cruziana semiplicata* of Salter, and *C. similis* of Billings from the Primordial of Newfoundland, must have been produced by crustaceans not dissimilar from those to which *Rusichnites* belongs.

To *Rusichnites* rather than to *Protichnites* ought perhaps to be referred certain transverse linear impressions with a broad central groove from the Lower Carboniferous of Horton, which occur at that place under different modifications, and sometimes seem to change into light scratches or touches of feet employed in swimming, or end abruptly as if the animal had suddenly risen from the bottom.

* Siluria, 4th edition, p. 153.

Arenicolites, Salter.

This genus may be held to include cylindrical burrows of worms with or without marks of minute setæ. They occur in rocks of all ages, and are especially abundant in the Lower Carboniferous series of Half-way River, Nova Scotia, and in the Upper Coal-formation at Tatamagouche in the same province; those at the latter place showing minute scratches produced by the setæ of the worms.* With the ordinary form at Horton there occur very long and slender, thread-like forms of the same nature with those to which the name *Nemertites* has been given.

I have long been of opinion that many of the cylindrical markings which have been described as plants under the names *Palæochorda*, *Buthotrephis*, *Palæophycus*, *Arthrophycus*, &c., are burrows of this kind, but the main difficulty seemed to be to account for their branching in a radiate or palmate manner. I have recently met with specimens from the Primordial and Carboniferous which seem to explain this. They show a central hole or burrow from which the animal seems to have stretched and withdrawn its body in different directions, so as to give an appearance of branching and radiation, possibly due merely to the excursions of the same worm from the mouth of its burrow.

No distinct examples of the Primordial and Silurian worm-trails known as *Nereites*, *Myrianites* and *Crossopodia*, have yet occurred to me in the Carboniferous.

Diplichnites, Dawson.

In the Journal of the Geological Society for 1861, I described a remarkable series of impressions found at the Joggins in the Coal-formation, on the surface of a sandstone holding footprints of reptiles. It consists of two rows of strongly marked depressions about one inch long and a quarter of an inch broad (fig. 3). These marks are placed close together in each row, and the rows are six inches apart, while the space between is somewhat smoothed as if by a flat body drawn over it. The general appearance is somewhat that which would be produced by a heavy-laden toy cart six inches wide, and with broad wheels, notched or cogged at the edges, if dragged over firm sand. I suggested, in the paper above mentioned, that these singular markings might have

* Journal of the Geological Society, vol. ii.

been produced by a large crustacean or by a gigantic worm, or by a serpentiform batrachian. I have since found a very perfect but smaller series on a sandstone of the Upper Coal-formation near Toney river, which in the varying distances of the impressions seems to show that they were made by prominent movable points, while the absence of any mark or smoothing between the rows shows that the body of the animal was borne above the sand. I have hence been induced to suppose that these imprints may have been produced by the pectoral or ventral fins of fishes armed with strong spines, on which the creatures may have executed a sort of walking movement when in shallow water. In my collection from the Joggins there is a spine which I have figured and described in my Acadian Geology under the name *Gyracanthus duplicatus*, which if we can suppose it to have been a pectoral or ventral spine, would produce precisely such impressions as those of the smaller series above mentioned. The impressions of the type of *Diplichnites* are known to me only in the Carboniferous. *Sœrichnites* of Billings, from the Anticosti group,* has some points of resemblance to it, but is essentially distinct. My species may be named *D. œnigma*.

Rabdichnites, Dawson.

Under this name I would designate the straight or slightly curved marks usually striated or grooved longitudinally, and either single or in pairs, which abound on some Carboniferous beds, and also in much older formations. At Horton Bluff, in beds holding remains of fishes, numerous footprints of crustaceans and reptiles, and scratches which were probably made by the fins of fishes, these marks abound. They were evidently furrows drawn by pointed objects trailed over the mud, and reproduced in relief on the under surfaces of the beds next deposited. Some have been produced by rounded points and are semi cylindrical. Others are the work of chisel-shaped, pointed, notched or fimbriated organs, giving a variety of more or less close subordinate grooves or striæ. In some cases they pass into or are associated with punctures or impressions made perpendicularly like those last noticed, and this is especially the case with some of the smaller varieties. The whole of these

* Report on Silurian Fossils of Anticosti, 1866.

impressions are probably marks of the spines and fins of fishes, striking the bottom or trailed over it. Some of the beds at Horton Bluff are as completely striated in this way as if glaciated, only that the striæ are individually more definite and are in all directions.

It is worthy of note that these markings strikingly resemble the so-called *Eophyton* described by Torell from the Primordial of Sweden, and by Billings from that of Newfoundland; and which also occurs abundantly in the Primordial of New Brunswick. After examining a series of these markings from Sweden shown to me by Mr. Carruthers in London, and also specimens from Newfoundland, and a large number *in situ* at St. John, I am convinced that they cannot be plants, but must be markings of the nature of Rabdichnites. This conclusion is based on the absence of Carbonaceous matter, the intimate union of the markings with the surface of the stone, their indefinite forms, their want of nodes or appendages, and their markings being always of such a nature as could be produced by scratches of a sharp instrument. Since, however, fishes are yet unknown in beds of this age, they may possibly be referred to the feet or spinous tails of swimming crustaceans. Salter has already suggested this origin for some scratches of somewhat different form found in the Primordial of Great Britain. He supposed them to have been the work of species of *Hymenocaris*. These marks may, however, indicate the existence of some free-swimming animals of the Primordial seas as yet unknown to us.

Three other suggestions merit consideration in this connection. One is that algæ and also land plants, drifting with tides or currents, often make the most remarkable and fantastic trails. A marking of this kind was observed by Mr. G. M. Dawson last summer to be produced by a Laminaria, and in complexity it resembled the extraordinary *Ænigmichnus multiformis* of Hitchcock from the Connecticut sandstones. Much more simple markings of this kind would suffice to give species of *Eophyton*. Another is furnished by a fact stated to the author by Prof. Morse, namely, that Lingulæ, when dislodged from their burrows, trail themselves over the bottom like worms, by means of their cirri. Colonies of these creatures, so abundant in the Primordial, may, when obliged to remove, have covered the surfaces of beds of mud with vermicular markings. The third is that the Rabdichnite-markings resemble some of the grooves in Silurian.

rocks which have been referred to trails of Gasteropods, as for instance, those from the Clinton group, described by Hall.

An might be expected, the markings above referred to, when in relief, occur on the under sides of the beds. A few instances may, however, be found where they exist on the upper surfaces. On careful consideration of these raised impressions, I have arrived at the conclusion that they have been left by denudation of the surrounding material, just as footprints on dry snow sometimes remain in relief after the surrounding loose snow has been drifted away by the wind; the portion consolidated by pressure being better able to resist the denuding agency. Such markings in relief on the upper surfaces of beds are, however, I believe, altogether exceptional.

It seems idle to give specific names to markings of this kind. They have evidently been made by many different species of animals, but they afford no certain characters. Fig. 4 *a* to *f*, represents some of the forms most common in the Carboniferous beds.

Imitative markings.

Rill-marks are often very beautifully developed on the Carboniferous shales and argillaceous sandstones, though not more elaborately than on the modern mud-banks of the Bay of Fundy,* and they occur as far back as the oldest Cambrian.† Some of these simulate leaves of ferns and fronds of Laminariæ, and others resemble roots, fucoids allied to Buthotrephis, or the radiating worm-burrows already referred to.

Shrinkage cracks are also abundant in some of the Carboniferous beds and are sometimes accompanied with impressions of rain-drops. When finely reticulated they might be mistaken for the venation of leaves, and when complicated with little rill-marks tributary to their sides, they precisely resemble the Dictuolites of Hall from the Medina Sandstone.

An entirely different kind of shrinkage-crack is that which occurs in certain carbonized and flattened plants, and which sometimes communicates to them a marvellous resemblance to the netted under-surface of an exogenous leaf (fig. 5). Flattened stems of plants and layers of cortical matter, when carbonized, shrink in such a manner as to produce minute

* Acadian Geology, 2nd edition, p. 26.

† Salter, Journal of Geol. Society, vol. 12, p. 251.

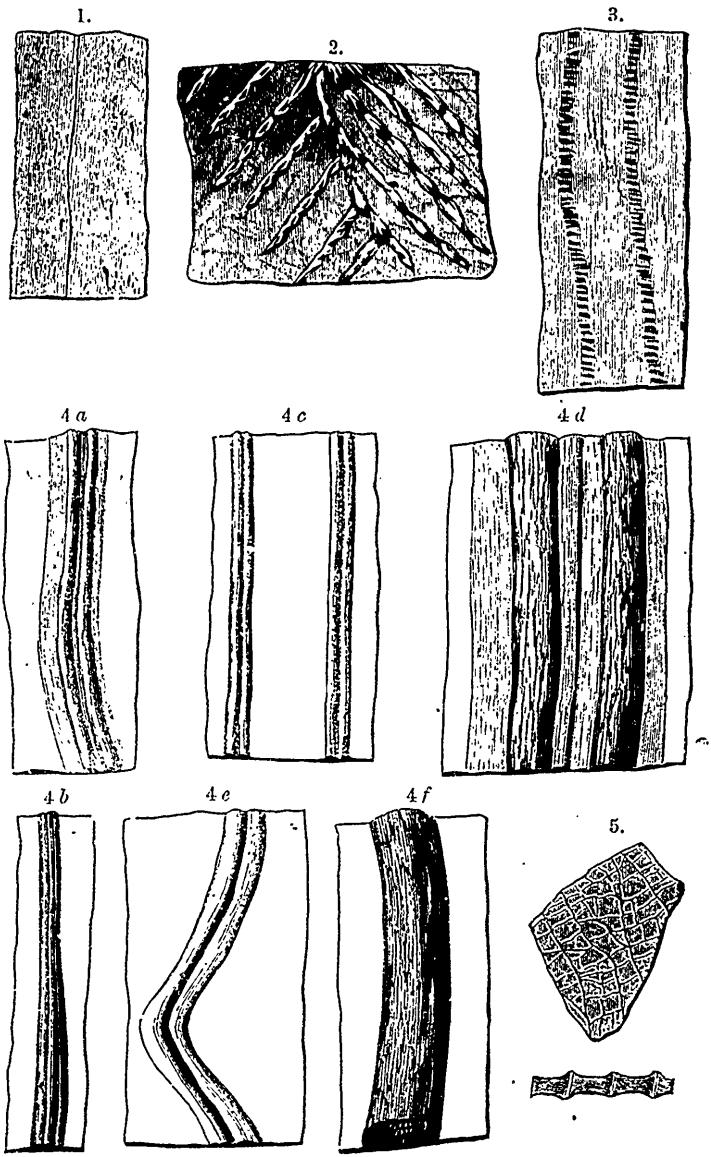

Fig. 1.—*Protichnites Carbonarius* (nat. size). Carboniferous, Nova Scotia.
Fig. 2.—*P. Acadicus*. " " "
Fig. 3.—*Diplichnites ænigma* (reduced). " "
Fig. 4.—*Rabdichnites*, different forms (nat. size). " "
Fig. 5.—Carbonized plant with reticulated markings (*nat. size*); *a*, enlarged section of part of the same. Carboniferous, Nova Scotia.

reticulated cracks. These become filled with mineral matter before the coaly substance has been completely consolidated. A further compression occurs, causing the coaly substance to collapse, leaving the little veins of harder mineral matter projecting. These impress their form upon the clay or shale above and below, and thus when the mass is broken open we have a carbonaceous film or thin layer covered with a network of raised lines, and corresponding minute depressed lines on the shale in contact with it. The reticulations are generally irregular, but sometimes they very closely resemble the veins of a reticulately veined leaf. One of the most curious specimens in my possession was collected by Mr. Elder in the Lower Carboniferous of Horton Bluff. The little veins which form the projecting network are in this case white calcite; but at the surface their projecting edges are blackened with a carbonaceous film.

Slicken-sided bodies, resembling the fossil fruits described by Geinitz as *Gulielmites*, and the objects believed by Fleming and Carruthers* to be casts of cavities filled with fluid, abound in the shales of the Carboniferous and Devonian. They are, no doubt, in most cases the results of the pressure and consolidation of the clay around small solid bodies, whether organic, fragmentary or concretionary. They are, in short, local slicken-sides precisely similar to those found so plentifully in the coal underclays, and which, as I have elsewhere† shown, resulted from the internal giving way and slipping of the mass as the roots of Stigmaria decayed within it. Most collectors of fossil plants in the older formations must, I presume, be familiar with appearances of this kind in connection with small stems, petioles, fragments of wood, and carpolites. I have in my collection petioles of ferns and fruits of the genus *Trigonocarpum* partially slicken-sided in this way, and which if wholly covered by this kind of marking could scarcely have been recognized. I have figured bodies of this kind in figs. 126 and 231 of my report on the Devonian and Upper Silurian plants, believing them, owing to their carbonaceous covering, to be probably slicken-sided fruits, though of uncertain nature. In every case I think these bodies must have had a solid nucleus of some sort, as the severe pressure implied in slicken-sliding is quite incompatible with a mere "fluid-cavity," even supposing this to have existed.

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* Journal of Geol. Society, June, 1871. † Ibid, vol. x, p. 14.

Prof. Marsh has well explained another phase of the influence of hard bodies in producing partial slicken-sides, in his paper on *Stylolites*, read before the American Association in 1867, and the application of the combined forces of concretionary action and slicken siding to the production of the cone-in-cone concretions, which occur in the Coal-formation and as low as the Primordial, was illustrated by the author in his Acadian Geology, p. 676.

Of course, as I have not seen the specimens referred by Prof. Geinitz to *Gulielmites*, but only the figures in his Memoir on the Permian plants of Saxony, I cannot offer any decided opinion as to their nature; but I have little doubt that the bodies mentioned by Mr. Carruthers are of the kind above referred to, and would be found to have had a solid nucleus either organic or of some other kind.

I may remark in conclusion that it would be well if collectors would give some attention to imitative markings and animal footprints of the kinds above referred to, as well as to their mode of occurrence with reference to the surfaces and material of the beds on which they are found. The labors of Duncan, Hitchcock, Jardine, Salter, and other careful observers, show how much interesting information may thus be obtained, and many mischievous errors might also be avoided. In my own studies in fossil botany, I have made it a point to collect and study all markings resembling plants, as well as the effects of crumpling, pressure, concretionary action, cyrstalization, shrinkage and slicken-siding upon actual vegetable remains; and by so doing I have avoided the trouble and expense of describing and figuring some dozens of imaginary species; while it would be easy to point out in works of some pretension costly figures and elaborate descriptions based on imitative forms or distorted and otherwise altered fossils.

IMPRESSIONS OF CUBA.

By G. F. Matthew.

(*Continued from page* 34.)

The plan of the houses in and about Cienfuegos is very different from that of our own, and a few words about their arrangement may be of interest. They are seldom more than one story high, and in the better class of houses the roofs are in almost all cases covered with tiles. I have already made allusion to the use made of the clay in the vicinity of Cienfuegos for the manufacture of tiles and bricks. The bricks are of a yellow color, and are much broader and flatter than those used in Canada: large quantities are used for the walls and floors of houses, for paving the sidewalks, &c.

The general arrangement of the apartment reminds one of the old Roman dwelling, modified to suit the requirements of the climate and the demands of modern civilization. In the centre is a paved court (*patio*) which corresponds to the *atrium* in being the heart of the structure. This court is usually adorned with flower-beds, a few ornamental trees and shrubs, and an aviary; and not unfrequently has beneath it a large cistern. In front of the court there is a closed veranda (*comodor*,) generally used as a dining and sitting room; and which is shut off from the court by latticed doors. On the sides of the court are bedrooms and store-rooms, while the back part of the building, which is shut off from the body of the house by a brick wall, is reserved for kitchen, laundry, &c. In the small court behind the main one are the apartments occupied by domestic slaves. In front of the veranda of which I have spoken, is the more substantial portion of the house, usually enclosed with brick walls, against which the veranda is built. In this part of the building there is on one side a very broad hall (*zaguan*), made so to accommodate the family carriage, which stands here when not in use. It is shut off from the street by a large, heavy door, in which is a wicket, the only entrance to the house under ordinary circumstances. On the other side of the main building is a large room (*sala*) devoted to the purpose of a parlour and drawingroom.

Both it and the hall are open to the roof, and it has usually two large windows opening to the street, secured by longitudinal iron bars and heavy wooden shutters. In a climate so warm as that of Cuba, one principal aim in the construction of houses is to make them as cool as possible. The windows and doors opening upon the court are accordingly closed only with Venetian shutters, and there are open spaces just beneath the eaves. The floors are of brick, stone-flagging, or marble, carefully laid, in order that no harbor may be afforded to the reptiles and vermin which abound in a warm climate.

In passing such a house in the day time, one finds the shutters closed, the great gate-like doorway fastened, and can see in it only the aspect of a prison. After nightfall, however, when the sea-breeze dies away, and the cool evening air settles around the town, Cienfuegos appears to wake up. The heavy shutters which hide the interior of the houses from view are thrown open, the rooms brilliantly lighted, and the passer-by is made acquainted with one phase in the social life of the Cubans. Within the parlour will be seen two rows of rocking-chairs arranged *vis-a-vis*. One row will be occupied by the ladies of the family, fan in hand, and in full dress; the other, reserved for any friends who may "drop in." These still, cool, balmy evenings are sure to find numbers of strollers and promenaders of both sexes in the streets. On Sundays and Thursdays there are gatherings of the townspeople in the evening on the *plaza*, or public square, to listen to operatic music from the band, and give opportunity for more general intercourse than is afforded by the more select meetings in private *salas*. On such occasions both ladies and gentlemen appear in full dress, the former with uncovered heads. Sunday is the gala-day of the week in this Island, and is chosen for public exhibitions and processions, theatrical entertainments and cock-fights, as well as for public and private balls.

While the evening hours bring into view the sociable and fashionable phase of Cuban life, a stroll through the streets in the early morning gives an insight into its devotional and domestic aspect. When the dew is scarcely off the ground, groups of females with their attendants may be observed wending their way toward the large double-gabled church on the side of the *plaza*. Such a group will consist of the *signora* and some of her daughters, accompanied by a black slave, who carries one or two stools for the ladies and a mat to kneel upon in church; for

such accommodation as pews, to encourage exclusiveness and somnolency, are not thought of in this land, and those who will be luxurious, must protect themselves against the chill communicated from the bare stone floor, by mats or carpets of their own. Another centre of attraction at this early hour is the market. Hither go the dark-skinned domestics with their long, sack-like baskets of palm-leaf, to gossip, or make purchases. A Babel of tongues—if not for variety, at least for volubility—salutes the ear of one entering the building where the market is held, and a great deal more chaffering accompanies the purchase of a dinner, than a stolid and reticent Northerner would think necessary. Sweet potatoes and their gigantic relative the yam, are presented for sale in large quantities. Eggs and poultry seem favourite articles of diet; the poultry are always offered for sale alive, as a prudent housewife in Cuba would hardly venture to buy plucked fowls, on account of the heat of the climate. As I did not visit Cienfuegos during the fruit season, I saw little in market; bananas, with a few oranges, mameys and limes seemed the staple varieties. The fish offered for sale appear to be all of the spiny-finned orders (*Acanthopteryges*): of these the *Rubia*, a beautiful rose-colored fish, not unlike a perch in its form, seemed an especial favorite. There were also prawns, crabs and small oysters. There is a large restaurant near the market where the countrymen (*guajiros*) may be seen sipping their coffee, chocolate, or wine, at small tables distributed through the rooms. All appeared temperate and orderly, and there was no "bar."

In the early morning hours, too, one may see these same *guajiros*, mounted on horse or mule, hawking their charcoal and *maloja* (green fodder) through the streets. As one of them appears in the early dawn approaching the city, mounted on his beast, with a great pannier or bundle on either side, the group looks not unlike an inverted pyramid, moving quietly yet swiftly towards you, and yet maintaining its equilibrium by some magical power.

Another class, which one frequently meets with at this time of day, is the huxters, who traverse the city on foot, bringing supplies to the doors of those who cannot visit the market. Among these are a number of Chinamen, who having served out their apprenticeship on the estates, and having a shrewd eye to business, obtain a little stock of vegetables and fruit, which they cry about town; carrying their wares in trays suspended from the ends of

a bamboo pole, resting on the shoulders—in true oriental fashion. They appear to be very thrifty and intelligent, but have other vices than opium-smoking, for they are avaricious and revengeful.

The Chinese very soon take a higher position on the estates than the negroes with whom they labor. They are generally to be found employed where delicate manipulation or higher intelligence is required. Thus they work in the sugar-houses, while the negroes are generally sent to the cane-fields. If there is any carpentry or masonry to be done on the estates, the Chinamen are the ones to do it; they are also frequently employed as landscape gardeners, and show much aptitude and originality in improving the surroundings of a planter's house. On a few estates some who have been long in the Island have risen to the responsible position of overseer of the sugar-house, receiving $2 to $3 per diem.

Negro field-hands are invaluable to the Cuban planters; for while the Chinamen have a bad trick of committing suicide when severely dealt with, the negro puts up with his hard lot, and works away, if not contentedly, at least with few attempts at open rebellion. Except for the tremendous labour exacted from them during the grinding-season, and the dependent position in which they are kept, the lot of the negro-bondsman in Cuba is one of considerable animal enjoyment, and is such as to subject him to few of the cares of life. He is well fed and housed, and his children well cared for. If he desires to acquire a few additional bodily comforts, a small patch of land is placed at his disposal for cultivation, and he is permitted to raise pigs and poultry on a small scale for sale—all this, however, during good behaviour. If he is restive, thievish, or lazy, he is deprived of the chance of attending to his little farm, and, from neglect, all his luxuries vanish. On the plantations, women, as well as men, are taken out to cut the cane, feed the crushers at the mill, and perform other work.

During the grinding season, which lasts four or five months, the slaves are required to work sixteen hours out of the twenty-four. After the canes are ground they are not usually required to work more than eight or ten hours a day. Planters often employ the farming population of the country in clearing new lands where cane is to be planted, thus saving their slaves from exhausting labor, and curtailing their chances for running away.

Oxen are extensively used as draft animals in Cuba. Large

numbers are required on an estate for ploughing the cane-fields, carrying the canes to mill when they are cut, and transporting the produce of the estates to market, or places of shipment. The Cuban oxen are about the size of our own: they are frequently dun-colored or brown, and trot with ease and rapidity. Seeing the swiftness with which they go over the estate roads, with a heavy cart behind them, one can appreciate better the value of the ox as a saddle animal in regions where horses cannot live, and can understand the luxury of riding "ox-back" in South Africa. Horses are reserved almost entirely for the saddle and the carriage. A Cuban farmer, let him be ever so poor, must have his horse to ride.

The view of a Cuban plantation with its fields of bright green cane extending for furlongs, sometimes miles, on every side of the single cluster of estate buildings, is a sight which, once seen, is not easily forgotten. As the dry season is not long enough to work up the whole crop of a plantation, the "grinding season" begins before the canes are ripe. The immature canes first cut are deficient in saccharine matter, and the juice obtained from them is seldom boiled down to sugar, but is generally converted into molasses: the article thus obtained is a rich heavy syrup, far superior to the common molasses obtained by drainage from the sugars. The process of sugar-making begins with the sending of one or more gangs of negroes to the cane-field, each accompanied by an overseer on horseback, whip in hand. Each field-hand is armed with a large knife, broad at the outer end and narrow near the handle; it is not much thicker than a saw-blade, and rings at every stroke. With these the canes are cut near the ground and the top removed; they are next stripped of the leaves by a dexterous movement and cast into heaps: these are gathered and thrown into the carts which convey them to the sugar mill. The machinery in the mills and the buildings connected with them involves the outlay of a large amount of capital: the works are driven by a steam-engine which moves the crushing rollers and the bands upon which the canes are carried to them: these moving bands extend out into the yard near the buildings, in which the canes brought from the fields are deposited. They run along the bottoms of two troughs, through one of which the canes are carried up to the crusher, and through another the crushed canes carried out in the opposite direction, and discharged in the yard, where they are spread out in the sun

to dry. The juice (*guarapo*) running from the crushers is caught in a trough, and carried down to a series of large cauldrons, heated beneath by means of furnaces. The fuel principally used to heat these furnaces is the dry, crushed cane, which has been spread out in the yard around the buildings of the estate; but wood and other kinds of fuel are also used. As the cane-juice is concentrated by boiling in the kettles, it is frequently skimmed to remove impurities, and is clarified with lime. As it continues to thicken it is passed onward from one kettle to another, till, in the last, it reaches the granulating point, and is then pumped out into the cooling pans. In these large shallow vats the syrup is left for a while to cool and solidify into moist sugar. When sufficiently cool to be handled, a gang of negroes, shovel in hand, step into the pan and throw it out into little wooden box-cars, which carry it along a tramway to the purging house. Here it is put into casks, in which several sticks are set upright to aid the molasses in its passage to the bottom of the cask. These casks rest on poles, beneath which is a sloping floor on which the molasses runs down to gutters leading into a general receptacle or tank. On some estates there is a distillery attached to the purging house, and the molasses, skimmings of the kettles, &c., are converted into rum (*agua ardiente*). Where there is no distillery, the waste products of the sugar houses are conducted by a drain to some point at a distance from the buildings. In the neighborhood of the little black pond at the discharge of such a drain, an odor pervades the air, which may be appreciated by opening the hatch of a sugar-laden vessel on her arrival from a long sea-voyage. When the sugars are sufficiently drained, they are packed in casks and sent to the port of shipment: here the merchant takes charge of them and packs them afresh at his warehouse, in the casks in which they are sent to Europe and North America, and are delivered for consumption.

The molasses also is pumped from the vats in the purging houses on the estates into casks, and forwarded to the consignees at the port of shipment. The best modern appliances for improving the qualities of the sugars produced are not universally applied in the district of Cienfuegos. Vacuum-pans are to be seen on some estates, but the process of sugar making in general use is the more primitive one which I have described.

The prosperity which for many years has attended sugar cultivation in Cuba has greatly increased the population and wealth

of the district of Cienfuegos, which is said to number more than thirty thousand inhabitants. Evidences of this may be seen, not only in the appearance of the thriving town where it centres, but in the trade carried on, on such an insignificant stream as the Damuji.

The Damuji, though of small size, is quite an attractive stream, and well worthy of a visit from any one who may be so near as Cienfuegos. I have already spoken of its aspect near the mouth, where the banks are bordered with mangrove swamps. This monotonous fringe disappears as one approaches the Ferry, and from this point onward, to the head of navigation, there is every variety of scenery which a somewhat flat, but rolling country, will admit of. A luxuriant growth of trees fringes the stream, except in places where the cane-fields of the estates, which line the banks, come down to the shore. Groves of elegant palm-trees, lordly ceibas, the silvery-leaved trumpet-tree, or the deep green glossy foliage of the Indian fig, appear at intervals along the slopes and swales descending to the stream. Elsewhere the banks of the river are covered with a dense forest, bristling with parasites, and matted with interlacing vines. The navigable part of the Damuji abounds in water fowls: at every bend of the stream we came in sight of flocks of cranes, herons and other aquatic birds, among which the white and scarlet ibis were conspicuous. Near the head of navigation, where the banks of the stream become somewhat rocky, and the grasses and undergrowth come down to the water's edge, a more timid water bird, the *gallinuela*, is common. Here the openings along the shore are less numerous, and the plantations further apart. It was along this river only that I saw anything like tropical luxuriance in the vegetation; the country, at the time of my visit, having been parched by many months of drought.

In sailing along the front of the bold mountain range at the eastern end of Cuba, the whole slope, from the summit almost to the water's edge, was clothed with what appeared in the distance to be a covering of little bushes, like the heaths of northern lands; but which, on a nearer approach, was resolved by a marine glass into a thick growth of trees, seemingly as devoid of leaves as any of our own hardwood trees in winter. During the dry season the greater part of the plants are taking their rest, and it is only in the case of the evergreen species, or of those growing along the sides of the streams, where perennial verdure reigns, that anything

approaching the luxuriant display of foliage which we are accustomed to associate with scenes in the Indies can be seen. On the hills about the mouth of Xagua Bay, I had an opportunity of seeing something of the brown leafless upland forests, such as cover at this season the slopes of the Cuban mountains. A noticeable feature in these woods is their low stature, and the great abundance of trees of the family *Leguminosæ*. *Cacti* are frequently seen, both trailing and arborescent species; and, here and there, that remarkable plant the American Aloe (*Agave Americana*.) It becomes an object of beauty, conspicuous for miles, when, at the close of its life, it exhausts all its energies in producing that magnificent tree-like flower-stalk (20–30 feet high), gilded with thousands of bright yellow blossoms, which, when vitality has quite departed, remains for years a withered monument of its fecundity. Perhaps no feature in the vegetation of the West Indies strikes a visitor from the higher latitudes of America more forcibly than the varied forms assumed by the plants of the Pea-tribe. Accustomed as we are only to the herbaceous clovers, vetches and peas, or, where intercourse with the South is more free, to the introduced locust tree, one can scarcely realize, without actually seeing them, the many forms in which this family meets us. Not only does it supply the Cubans with timber, but also with dyes, resins, flowering shrubs, hedge-plants, medicinal herbs, &c.

Another very striking feature in the Cuban woods is the presence of epiphytes, or air-plants, in abundance: they are chiefly of two natural orders, the Orchids and the Bromelians. The former have flowers of peculiar aspect and much beauty, and the latter are supplied with seeds fitted to float on the breeze and find lodgment in the crevices and clefts of trees. They are the birds of the vegetable kingdom, live in the air, are nourished in the trees, and renew their life without visiting mother earth.

On some of the rough-bark trees these parasites cluster in countless numbers, and form a conspicuous part of their foliage. The Jucaro (*Bucida Buceras*), for instance, seems literally oppressed with the swarms of Tillandsias bristling on every bough; but such trees as the majestic Ceiba and the Royal Palm rear their smooth grey trunks far above the ordinary forest growth, seeming quite regardless of the small seeds that float by them. A few effect a lodgement among the lofty branches of the Ceiba, but the Cuban Palm utterly repels them from its smooth stony

surface. Two plants of the family *Bromeliaceæ* are of great value to the Cuban husbandman, viz. the Rat-pine, used in hedging, and the well known Pine-apple. Creepers (*Ipomœa*) everywhere deck the hedges, and fill the air with their perfume. The Mallow family (*Malvaceæ*) and other allied groups, with mucilaginous foliage and flowers, are largely represented, and include the loftiest forms of forest growth, as well as plants notable for their economic worth. The immense order of composite plants, though only herbs with us, rise in Cuba to the dignity of shrubs, and present many curious forms. *Veroniaceæ* and *Eupatoriaceæ* prevail to a greater extent than in Eastern Canada; while the *Asteroideæ* are not nearly so abundant. Indeed I met no representatives whatever of the genera *Aster* and *Solidago*, of which so many forms and such countless numbers of individuals deck our fields and waste-lands in autumn. So also the thistle division (*Cynareæ*) of this order seems scarce or wanting. The order *Euphorbiaceæ*, insignificant herbs at the north, includes shrubs, as well as herbs, of great economical importance. In this group the Cubans find plants from which they obtain oil, medicine, farinaceous food and other products. Among the families of tropical plants known to us only by their fruits, may be mentioned the *Anonaceæ*, producing the Sweet-sop and Sour-sop; the Orange family (*Aurantiaceæ*), wherein are the Orange, Lime, Lemon and Shaddock; the Myrtle family (*Myrtaceæ*) which supplies to the Cuban his Guava and Pomgranate; other families giving him the Star-apple, the Avocado pear, and the curious melon-like Papaw. Two plants of the Chincona family, namely the Coffee Tree and Indian Mulberry, are not uncommon in waste places. Our beautiful but nauseous Lobelias are fitly personated by one species of terrible potency—if the anecdotes of the Creoles are to be relied upon—in the beautiful, but deadly *Isotoma*. The Bignonia family has trees which, when in bloom, are the glory of the Cuban forests and shrubberies, and, in fruit, bear arcuate pod-like seed vessels, sometimes of great length. The ornamental family to which the *Æanthus* belongs has several representatives in Cuba; and the allied group of Figwort (*Scrophulariaceæ*) is also present; but many of the genera in this large order, with which we are familiar, are wanting. Among the species of the useful and aromatic Mint family (*Labiatæ*), but few northern genera are to be met with; but the allied family of *Verbenaceæ* is represented in the Lantanas. In the several species of *Heliotropium*

we are reminded of the tropical affinities of our window-garden favourite, and note that, though colossal as compared with it, all have the circinate one sided racime of pale flowers, Another group, which, but for the interchanges of commerce, would be foreign to our shores, flourishes here as if at home; this is the potato family (*Solanaceæ*), species of which grow wild in all parts of the Island. Both the Pepper plant and the Tomato often arrest the attention by the display of their bright red fruit; the latter in its clusters of little cherry-like fruit, when compared with the large varieties grown in Canada, tells how much the plant has been modified by cultivation, in its progress northward. Two of our northern families with milky juice and pretty flowers are well represented in Cuba: they are the Dogbane (*Apocynaceæ*) and the Milk-weed (*Asclepiadaceæ*). A species of the latter is counted an efficacious medicine in fever. The maritime species of the Goosefoot family (*Chenopodiaceæ*), also have representatives on the Cuban shores, as the Globe Flowers and Amaranths have in the fields. As a counter part to the "Wait-a-bit" Thorn of Southern Africa, the *Una-de-gato* of the West Indies claims the attention of even the most careless traveller, by marking his face and his hands if he rides carelessly where it abounds. It has formidable recurved spines which will rend even the strongest leggings. Among the subdivisions of the Nettle family to be found in Cuba are the Indian Fig and the India-rubber tree. These, as well as the Mango, offer examples of dense and beautiful evergreen foliage at the driest season of the year, when the Ceibas, gummous trees and many others are almost stripped of leaves. Our well known family of Arums is scarcely to be recognized in the *Philodendron*, with its round, bright green stem, ascending the trunk of some lofty tree, and clinging to it by the roots which it emits from each joint of the stem in its upward progress. Nor would we easily recognize the Nettle family in the *Phoradendron*, which, in like manner, finds the forest trees a convenient resting-place, where it may display its little orange-colored blossoms. The Butter-cup family (*Ranunculaceæ*), representatives of which are met with on every hand in our own land, is scarcely to be recognized among the profusion of tropical forms in Cuba. The great family *Rosaceæ* as well as the Violet, Heath, Mustard, Pink and Parsley families, and many others which abound with us, are almost excluded from the West Indian Flora.

In the same category must be placed the four great arboreal groups which form the bulk of our forest growth; namely, the *Aceraceæ* (Maples), *Cupuliferæ* (Oaks, Butternuts, Beeches, &c.), *Amentaceæ* (Birches, Alders, Willows, Poplars, &c.), and the *Coniferæ* (Pines, Spruces, Firs, Larch, &c.) The last do not seem to have found a foot-hold even on the mountain tops, which, as already observed, exhibit in the dry season a uniform growth of trees, which, judging from their brown color, are quite divested of leaves, and have nothing in common with our evergreen forests.

As is the case with a number of orders already mentioned, so also the tropical grasses include some large and even gigantic forms; as for example *Plyra* and *Bambusa*. In the ferns, too, among the flowerless plants, there is the Golden Fork-fern (*Acrostichum*), growing to a height of nine or ten feet. The genus *Adiantum* (Maiden-hair), also includes some beautiful species with delicate leaves and hair-like stemlets.

But the greatest charm of a southern landscape, and that which marks it distinctively from views in northern lands, is the presence of the Palms (*Palmaceæ*). Nothing can be more attractive to the eye than the airy elegance of the Royal Palm, whether it be a few solitary individuals whose star-like clusters of green fronds stand out against the deep blue tropical sky, or the groves one meets with in rich swales and sheltered hollows. In these groves may be seen long vistas of straight round columns, very smooth, almost as hard as stone, and nearly as white as marble, loosing their tall shafts in a dense, feathery, waving canopy of foliage, high over head.

Possibly it was from such an ideal as these groves offered to his fancy, that the Greek drew his conceptions of architectural beauty; even as the Goth in later ages embodied the recollections of sylvan majesty which the sombre woods of Northern Europe, with their great rude trunks and lofty over-arching branches, left upon his memory, in the grand ecclesiastical buildings of mediæval times.

NOTES ON A DEEP-SEA DREDGING EXPEDITION ROUND THE ISLAND OF ANTICOSTI, IN THE GULF OF ST. LAWRENCE.

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

The following article is to a large extent a reproduction of one contributed to the "Annals of Natural History" for November, 1872. The results of nearly a year's additional study of the specimens collected are, however, incorporated into the present sketch.

No dredging operations have ever been conducted in the deepest parts of the River and Gulf of St. Lawrence, so far as I can learn, until the summer of 1871. In 1867 and 1869 I dredged in upwards of fifty different localities north of the Bay of Chaleurs, but never in deeper water than 50 fathoms. The researches of Dr. Packard and others on the coast of Labrador, those of Principal Dawson, Prof. Bell, &c. in the Gaspé district, together with those of Mr. Willis in the seas of Nova Scotia, were all carried on in comparatively shallow water. On several occasions I have called the attention of the Natural History Society of Montreal to the importance, from a scientific point of view, of a careful investigation into the nature of the animal and vegetable life of the greater depths of the Gulf, which seemed to me to promise a rich harvest of new facts.

A committee was appointed to petition the Dominion Government to allow qualified observers facilities for deep-sea dredging on board government vessels. Principal Dawson also, as President of the Society, represented to the Honourable the Minister of Marine and Fisheries the practical value of, and the useful results that might accrue from, such inquiries, and met with the most liberal response. The desired facilities on board government cruisers were at once promised, the necessary rope was provided, and no efforts were spared to make the cruises successful. I was deputed by the Natural-History Society to undertake the management of the expedition, and left Montreal early in July, 1871. My friend Mr. G. T. Kennedy, M.A., of Montreal, a skilfull zoologist, started with me, but returned after he had been a few days at sea.

The first cruise was on board the government schooner 'La Canadienne,' and lasted three weeks. The ground examined on this vessel was from Point des Monts (on the north shore of the St. Lawrence) to the Mingan Islands, then round the west point of Anticosti, and from there, in a diagonal line, to Gaspé Bay. Next, embarking on board the 'Stella Maris' at Gaspé Basin, we made an entire circuit of the island of Anticosti, sailing as far to the north-west as Sawhill Point, on the north shore, and to the south-east as the Magdalen Islands. We were driven to Byron Island, one of the Magdalen group, by a "nor'-wester," which of course prevented our dredging there. As these investigations were entirely subordinate to the special duties upon which the two schooners were engaged, dredging could only be carried on at intervals, and in several cases the same ground was gone over twice or more.

On 'La Canadienne' we had sixteen successful hauls of the dredge. Of these, four were in 50 fathoms of water or less, seven in between 50 and 100 fathoms, and five in from 100 to 200 fathoms.

On the 'Stella Maris' we had nine successful hauls. One of these was in less than 50 fathoms, two were between 50 and 100, and six between 100 and 250 fathoms.

The deep-sea mud, in the places examined, is dotted over with more or less water-worn masses of rock, usually of Laurentian gneiss, varying in size from that of a pea to considerably larger than a man's head. By a modification of the usual sieving process, every organism, piece of rock, &c., larger than one-sixteenth of an inch in diameter was first picked out from the mud. A large bagful of the residue, from each locality examined, was preserved for subsequent microscopic examination. Three fourths of this mud was found to be a silt so impalpable as, when wet, to pass readily through fine cambric; the remaining fourth consisted half of organic, and half of inorganic matter. The organic matter comprised a few diatoms, multitudes of Foraminifera, some Polycystina, many sponge spicules, and fragments of other organisms. The inorganic débris was a more or less coarse kind of sand, made up of fragments of quartz, bits of felspathic rock, and small flakes of mica.

Attempts were made to endeavour to ascertain the approximate temperature of the deep-sea mud. When the dredge was hauled up, its contents were emptied as quickly as possible into a large

shallow tub; and this was covered with a tarpaulin and placed in the shade. An ordinary thermometer, with a metal case and perforated base, was then plunged into the mud, and the whole was kept carefully shaded for a time. With one exception, the temperature of the mud was found to be from 37° to 38° Fahr., and this not alone in deep water; for sand brought up from 25 fathoms, on the north shore of the St. Lawrence, also made the mercury sink to 38° or 37° Fahr. In the centre of the river, between the island of Anticosti and the south shore of the St. Lawrence, mud brought up from 200 fathoms, only made the mercury sink to from 43° to 45° Fahr. Either a warm current affects the temperature of the bottom at this point, or else my observations were inaccurate or defective, which latter assumption is by no means unlikely.

With a view of trying to get some information as to the nature of the food of some of the surface-feeding fishes, and especially of the herring and mackerel, towing nets were frequently used; but comparatively few specimens were taken in these. Hempen tangles, similar to those devised by Captain Calver, were also employed, and with much more success.

The following is a brief sketch of some of the most interesting forms of animal life obtained during the expedition. During the autumn of 1871, Mr. J. Gwyn Jeffreys, F.R.S., visited Montreal, and went over the whole of the testaceous Mollusca with me. I am also indebted to Professors A. Agassiz, A. E. Verrill, and S. I. Smith for the identification of several critical species.

Foraminifera.

Large quantities of these beautiful organisms were collected, especially from very deep water, but at present only a portion of these have been carefully examined. In Mr. G. M. Dawson's paper on the "Foraminifera of the River and Gulf of the St. Lawrence," published in Vol. 5 (New Series) of this Journal, a list is given of fifty-six subspecies or varietal forms. Among the individuals collected last year in deep water are a number of large specimens to which it is difficult to attach any name, but which form a series connecting the subgenera *Nodosaria*, *Dentalina*, *Marginulina* and *Cristellaria*. One of the most remarkable of these is a Marginulina with long spinous processes developed from the first chamber. It is probably *M. spinosa* of M. Sars. *Cristellaria crepidula* and *Trochammina incerta* were collected in

comparatively shallow water (30 to 40 fathoms); and *Bolivina punctata*, *Nonionina umbilicatula*, *Valvulina austriaca*, and gigantic examples of a *Triloculina* allied to *T. tricarinata*, (perhaps *T. cryptella*, D'Or,) reminding one of miniature beech-nut seed carved in ivory, were dredged in from 200 to 250 fathoms. By far the greater number of the St. Lawrence Foraminifera seem to have a wide range in depth. I have examined large bagfuls of dredgings from more than fifty localities in the northern part of the Gulf, and out of fifty or sixty species or varietal forms, only four or five seem peculiar to deep water. *Virgulina squamosa*, *Bolivina costata* and *squamosa*, *Nonionina umbilicatula*, and the *Triloculina* previously mentioned are apparently only met with in from 200 to 300 fathoms water. In the St. Lawrence, *Lagena distoma* (typical), *Bulimina pyrula* and *marginata*, and *Valvulina austriaca* are characteristic of deep water, but are very rarely met with in lesser depths. *Globigerina bulloides*, though small, is not unfrequent at all depths; but, curiously enough, *Orbulina universa* has not yet been found living in Canada. Although many of the Foraminifera from the deep water are small and delicate, by far the largest specimens yet collected were taken in from 200 to 250 fathoms. This agrees with the result of Dr. Carpenter's observations on board the 'Porcupine.' The *Rhabdopleura* figured by Mr. Dawson I believe to be an annelid tube, having examined the animal in a living state.

Polycystina.

Dictyocha aculeata and a species of *Ceratospyris* have been previously catalogued from the Gulf of St. Lawrence by Principal Dawson. Three additional species were dredged in upwards of 200 fathoms; but these are at present undetermined. In Canada, Polycystina are not peculiar to deep water; for I have taken fine specimens from the interior of a species of *Halichondria*, also from the stomach of *Echinus dröbachiensis*, both collected from a little below low-water mark.

Sponges.

Several examples of the *Grantia ciliata* of O. Fabricius were dredged from 96 fathoms in Trinity Bay, on the north shore of the St. Lawrence. It is the first sponge with calcareous spicules recorded from the Gulf. The straight spicules of the terminating cone and the triradiate ones of the body of the sponge, make

beautiful polariscope objects. Another species, which I at first thought referable to Bowerbanks genus *Polymastia*, occurred frequently in deep water. Since my paper in the 'Annals' was written, the inspection of a copy of Dr. Wyville Thompson's new volume "The Depths of the Sea," and the receipt by the Society of Prof. H. A. Pagenstecher's paper entitled 'Zur kenntniss der Schwämme,' have enabled me to rectify this error. The sponge in question is evidently *Thecophora semisuberites* of Dr. O. Schmidt. The diagnosis of the genus cited by Prof. Pagenstecher agrees well with St. Lawrence specimens. The character "Rinde aus homogen verdichteter Sarkode" (outer skin of a thickened and homogeneous sarcode) is a very conspicuous feature in the Canadian sponge, the spicules of which are uniformly spinulate fusiform. A massive *Halichondria*, allied to *panicea*, but differing from it in some respects, was taken in 38 fathoms off Cape Rosier village. The larger spicules are like those of *H. panicea*, but it has, in addition to these, numerous small retentive bihamate ones. The remainder of the deep-sea sponges have yet to be identified.

Hydrozoa.

The Hydroid polyps collected were tolerably numerous. The following species have been recognized, but only a portion of the series has been carefully examined.

(Athecata.)

Coryne pusilla, Gaertner.
Tubularia indivisa, Linn.

(Thecaphora.)

Campanularia verticillata, Linn.
Lafoea dumosa, Fl.
" *fruticosa*, Sars.
Salacia abietina, Sars.
Sertularella rugosa, Linn.
" *tricuspidata*, Alder.
Sertularia pumila, Linn.
" *filicula*, Ellis & Sol.
" *abietina*, Linn.
" *argentea*, Ellis & Sol.
Hydrallmania falcata, Linn.
Thuaria thuja, Linn.
" *articulata*, Pallas.

Actinozoa.

In the lowest order of this class, the Alcyonaria, the most interesting discovery was that of a fine series of Pennatulæ. About 50 or 60 living specimens were taken in the centre of the river between Anticosti and the south shore of the St. Lawrence, in depths ranging from 160 to 200 fathoms. In the largest specimens collected there are 40 pinnules on each side of the upper portion of the cœnosarc; but in average full-grown examples the number is less, and ranges from 30 to 35. On the back of the rachis there is a central groove, on each side of which are nu-

merous but unequal, spinose, undeveloped polyps. The average number of polyp-bearing cells on each pinnule seems to be about 11, but varies from 9 to 16. The polyp-bearing cells are entirely separate, and are margined with bundles of spines. The 8 mesenteries and somatic chambers, as well as the 8 tentacles of the polyps, can be well made out in the specimens collected. In one specimen examined by Mr. G. T. Kennedy the basal portion of the pinnules is filled with spheres of granular matter. The spicules of the lower half of the stem are elliptical or oblong, and decidedly constricted in the middle. The calcareous internal axis is somewhat longer than the cœnosarc itself, and is recurved at the base. Large examples measure about 8 inches; but some are only 6 inches long, or even less. These latter specimens have as few as 21 pinnules on each side of the stem.

My first impression, on examination of the Canadian Sea Pen, was that it differed materially from any described species, and that view was also taken by Prof. Verrill. But under the name *Pennatula phosphorea* Kolliker includes so many varieties and sub-varieties, and my specimens differ so much among themselves, that they may possibly rank as forms of that protean species. If P. *aculeata* of Danielssen be included among the synonyms of P. *phosphorea*, so I think must my P. *Canadensis*. But if, as Prof. Verrill claims, P *aculeata* is distinct from P. *phosphorea*, then the Sea Pen of the St. Lawrence must be called *Pennatula aculeata, var. Canadensis*. The species collected of the limited genus Alcyonium are three in number. One is probably A. *rubiforme*, Ehr., another comes near A. *carneum*, Ag., and there is a third species, found exclusively in very deep water, which has yet to be determined. This last, however, Prof. Verrill informs me, is not *Eunepthya glomerata*, as he at one time supposed. Besides these three there is another creeping Alcyonoid from deep water, apparently belonging to a genus near to Cornularia. Two species of Sea Anemone were dredged, attached to stones, in from 100 to 200 fathoms. One is *Urticina crassicornis*, and the other *Urticina digitata* of Muller. A creeping compound anemone, closely allied to *Zoanthus*, taken on stones at a depth of 212 fathoms, appear to be *Epizoanthus Americanus*.

Echinodermata.

In the deep sea mud, at depths of from 100 to 250 fathoms, the following species occurred more or less abundantly.

Schizaster fragilis. (*Brissus fragilis*, Duben and Koren).
Ctenodiscus crispatus, Duben and Koren.
Amphiura, near to A. *borealis*, Sars.
Ophiacantha spinulosa, Mull.
Ophioglypha Sarsii, Lutken, (large.)

In 69 fathoms, off Sawhill point, a curious Asterid was dredged, which is probably the *Korethraster hispidus* of Wyville Thompson. A few specimens of *Astrophyton Agassizii* were collected from 60 fathoms mud, off Thunder River; and *Asterias Greenlandicus*, Steenstrup, was occasionally met with at depths of from 30 to 60 fathoms.

Annelida.

The whole of the deep sea worms collected have been sent to Dr. W. C. McIntosh, F.L.S., (of Murthly, near Perth, Scotland) to whom I am indebted for the identification of the 12 species, of which a list is given below. In the deep sea mud, between 100 and 250 fathoms, the annelids determined so far, are as follows:

Ammotrypane auloyaster, Rathke.
Amphictene auricoma, Mull.
Amphiporus, sp.
Ephesia gracilis, Rathke.
Eunoa nodosa, Sars.
Goniada maculata, Œrsted.
Lineus, sp.
Lumbrinereis fragilis, Mull.
Nothria conchylega, Sars.
Praxilla gracilis, Sars.
Sabella pavonia, Savigny.
Terebellides Stroemii, Sars.
Thelepus circinatus, Fabr.
Trophonia plumosa, Mull.

In addition to these, Dr. McIntosh informs me, "there is a specimen of a small Balanoglossus, while a Lepidonotus, Nepthys, Maldane, Praxilla and Nothria, need determination." Of the 12 species at present identified, 11 are also found in the seas of the Shetlands.

Crustacea.

Although the Crustaceans collected are not very numerous in species, some of them are of considerable interest. The following is a list of those determined at present:

(Decapoda.)

Cancer irroratus, Say. Low water mark, Ellis Bay, Anticosti, and elsewhere.

Chionocœtes opilio, Fabr. Specimens of large size are not unfrequently met with, thrown ashore.

Hyas coarctata, Leach. Low water mark down to 60 or 70 fathoms.

Hyas aranea, Linn. With the preceding.
Eupagurus Kroyeri, Stimps.
Eupagurus pubescens, Stimps. Both common in shallow water.
Sabinœa septemcarinata, Sabine. Occasional.
Hippolyte Phippsii, Kroyer. 90 to 100 fathoms, scarce.
Hippolyte Fabricii, Kroyer. 125 fathoms, off Cape Rosier.
Hippolyte polaris, Kroyer. 38 fathoms, off Cape Rosier.
Hippolyte spina, White. 38 fathoms off Cape Rosier.
Pandalus annulicornis, Leach. Frequent at all depths.

(Amphipoda.)

Epimeria coniger? Fabr. Of large size in deep water.
Eusirus cuspidatus, Kroyer. Two examples.

(Isopoda.)

Munnopsis typica, M. Sars. 125 fathoms, off Cape Rosier lighthouse.

(Pycnogonoidea.)

Pycnogonum littorale, Ström. (=P. pelagicum, Stimpson.) Brought up by hempen tangles from 212 fathoms mud, between the East Point of Anticosti and the Bird Rocks.

Nymphon giganteum, Goodsir. 125 fathoms, off Cape Rosier lighthouse.

Polyzoa.

Good specimens of the following species have been determined, from depths of from 90 to 250 fathoms; but many interesting forms are at present unnamed:—

Crisia eburnea, Linn.
Idmonea atlantica, Forbes.
Defrancia lucernaria?, Sars.
Alcyonidium gelatinosum, Pallas.
Scrupocellaria scruposa, Linn.
Cellularia ternata, Ell. & Sol.
Gemellaria loricata, Linn.
Caberea Ellisii, Flem.
Bicellaria ciliata. Linn.
Acamarchis plumosa, Pallas.
Flustra Barleei, Busk.
Retepora cellulosa, var. elongata, Smitt.

Tunicata.

The following is a list of the few species of this order at present identified by Prof. A. E. Verrill:—

Ascidiopsis complanatus (=*Ascidia complanata*, Fabr.) In 212 fathoms to the south-east of the east point of Anticosti.

Eugyra pilularis, Verrill. In 50 fathoms off the St. John's River, Mingan.

Botryllus, a purple species, distinct from *B. Gouldii*, Verrill. Attached to *Flustra Barleei?*, Busk, from 96 fathoms in Trinity Bay.

Several examples of *Amouræcium glabrum*, Verrill, were collected in and just outside of Gaspé Bay, where I had previously dredged it in 1869.

Mollusca.

In the 'Canadian Naturalist' for 1869, I published a catalogue of 114 species of marine Mollusca inhabiting the Gulf of St. Lawrence, to the north of the Bay of Chaleurs. We now know localities for 150 species which inhabit the region in question. The shells collected last summer have been carefully studied; and the following is a list of some of the most interesting among them*.

Terebratula septentrionalis, Couth. In 112 fathoms, stones, off Charleton Point, Anticosti, and in 212 fathoms to the S.S.E. of the east end of that island.

Terebratella Spitzbergensis, Davidson. 38 fathoms, stones, off Cap-Rosier lighthouse, alive, adult, and frequent; 96 fathoms, in Trinity Bay, one young, but living example; 112 fathoms, off Charleton Point, Anticosti, one dead, adult. Most abundant in somewhat shallow water.

Pecten Grœnlandicus, Chemn. Take alive in several localities in from 160 to 250 fathoms, mud.

Lima sulculus, Leach. Fine specimens in 38 fathoms, off Cap-Rosier lighthouse.

Arca pectunculoides, Scacchi (=*A. raridentata*, Searles Wood.) Dredged on the north shore of the St. Lawrence, also between Anticosti and the south shore, in 160 to 170 fathoms. The specimens were often living, and of large size for the species. New to the western side of the Atlantic.

Arca glacialis, Gray (==*A. raridentata*, var. *major*, Sars). A few dead examples of this shell were taken with the preceding one.

Yoldia (? *Portlandia*) *thraciæformis*, Storer. One living specimen occurred in 212 fathoms, S.S.E. of the east point of Anticosti, and a dead, but perfect one, in 125 fathoms, off Cap Rosier.

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* I am indebted to Mr. J. Gwyn Jeffreys, F.R.S., for the determination of those species to which an asterisk is affixed.

Yoldia (Portlandia) lucida, Lovén. Living in seven of the localities examined, its range in depth being apparently from 150 to 250 fathoms.

**Yoldia (Portlandia) frigida* Torell. Frequent, living with the preceding. This and the preceding are new to America.

Dacrydium vitreum, Möll. In 212 fathoms, mud, to the S.S.E. of the east point of Anticosti, living.

Cryptodon Gouldii, Philippi. Common, living, at all depths; it ranges from 10 to 250 fathoms.

Astarte lactea, Brod & Sow. Fine in several localities. Off Sawhill Point in 30 fathoms; off Moisie village in 70 fathoms; mouth of St. John's River, Mingan, in 50 fathoms; Gaspé Bay. The young is *Astarte Richardsonii*, Reeve.

ASTARTE. Two species of *Astarte*, both of the *A. sulcata* group, were collected in deep water. One, of which two specimens only were dredged (off Bear Point, Anticosti, in 112 fathoms), I at first thought to be *A. crebricostata*; the other is by far the most abundant mollusk of the greater depths of the northern part of the river and gulf of the St. Lawrence. Mr. Jeffreys says that this latter shell is *Astarte sulcata*, var. *minor*. No specimens that I have seen, from American or European localities, exactly resemble either of these shells; and in my judgement, both are new and good species.

Tellina (Macoma) inflata, Stimpson, MSS. Perhaps *M. fragilis* of Leach. Fine living specimens of a shell which the late lamented Dr. Stimpson gave to the writer some years ago, with the label "*Macoma inflata*, St. MSS.," were dredged in 70 fathoms, sand, off Moisie village, and at various depths in other localities.

**Neæra arctica*, Sars. Several living specimens of this species (the largest of which measures upwards of an inch and a quarter in its greatest breadth) were taken in 125 fathoms, off Cap-Rosier lighthouse; also in 200 fathoms, mud, Ellis Bay, Anticosti, bearing S.S.W., 27 miles distant.

Neæra obesa, Lovén (=*N. pellucida*, Stimpson). Off Caribou Island, on the north shore of the St. Lawrence, nearly opposite Cape Chattè, living, in 170 fathoms, mud. I regard both *N. arctica* and *N. obesa* as varieties of the European *N. cuspidata*, *N. arctica* being adults of unusual size, and *N. obesa* the young of the same species. In deference to Mr. Jeffreys's greater experience, however, I keep the two forms separate. *N. arctica* has not previously been found on the American coast.

Utriculus pertenuis, Mighels. In 25 fathoms, sand off Trinity River, also in Gaspé Bay; abundant at both localities. (Probably =*U. turritus*, Möller.)

**Utriculus hyalinus?*, Turton (=*Diaphana debilis*, Gould). With the preceding, but rare in both places.

**Philine quadrata*, Wood. Alive, from 212 fathoms, mud, to the S.S.W. of the east point of Anticosti.

Philine lineolata, Couth. Gaspé Bay, and off the St. John's River, Mingan, in 50 fathoms.

Dentalium abyssorum, Sars. Dead but good specimens of this species were dredged in three localities:—in 184 fathoms, mud, off Seven Island Bay; also in 150 and 200 fathoms to the S.W. and S.S.W. of Ellis Bay, Anticosti. New to America.

Siphonodentalium vitreum, Sars. Deep water, in several localities, fine and living. Most frequent in 200 to 250 fathoms; also new to the American side of the Atlantic.

Margarita argentata, Gould (=*M. glauca*, Möll.) Off the mouth of the St. John's River, Mingan, in 50 fathoms, and sparingly in other localities. Gaspé Bay.

Margarita striata?, Brod. & Sow. A remarkable variety of this species, with three unusually prominent revolving ribs (so much so as to remind one of some of the Australian Trochocochleas), occured in 70 fathoms, sand, off Moisie village. The type is abundant and large everywhere in the St. Lawrence in shallow water.

Rissoa carinata, Mighels. Frequent, alive, from 96 fathoms in Trinity Bay.

Rissoa castanea, Möll. With the above and elsewhere not unfrequent.

Rissoa scrobiculata, Möll. Collected in three localities, in from 125 to 250 fathoms, where it is large and fine. It occurs living, but of small size, in Gaspé Bay, at depths of from 20 to 30 fathoms.

Rissoella eburnea, Stimpson. One living and adult example, in 70 fathoms, off Mosie village.

Lacuna glacialis, Möller. A living adult specimen of this species was dredged from 96 fathoms in Trinity Bay.

Aporrhais occidentalis, Beck. A remarkable thin and inflated variety of this species was taken in 120 fathoms off Bear Head, Anticosti. The type is not uncommon throughout the Gulf, in from 20 to 50 fathoms.

Eulima stenostoma, Jeffreys. A single living adult was taken from 160 fathoms, to the south-west of Ellis Bay, Anticosti. New to America.

Astyris Holböllii, Möll. (= *Columbella rosacea*, Gld.). Trinity Bay, 96 fathoms, also other localities. Ranges from 20 to 100 fathoms.

Buccinum ciliatum, O. Fabr. Alive, in 112 fathoms off Charleton Point, Anticosti.

Buccinum cyaneum?, Brug. From 250 fathoms, mud, between the east point of Anticosti and the Bird-rocks.

Sipho islandicus, Chemn. Only one living example of this mollusk was collected, from 112 fathoms, off Charleton Point, Anticosti.

Sipho Sarsii, Jeffreys. With the above but much more frequent; also off Egg Island, in 70 to 80 fathoms. The epidermis is very different in these two species; but it is difficult to separate them when the specimens are water worn.

Trophon craticulatus, O. Fabr. Off Cap-Rosier lighthouse, in 38 fathoms, stones, fine and living; also near the mouth of the St. John's River, Mingan, and in 50 fathoms, sand, but dead.

Fasciolaria ligata, Mighels. Two living examples were taken in Gaspé Bay, near Cape Gaspé, on a stony bottom, in 20 or 30 fathoms.

Twenty-five species of shells not previously known to inhabit the seas of the Province of Quebec were collected during the two cruises; of these, twelve are new to the American side of the Atlantic.

Fishes.

The only fishes brought up in the dredge were a young specimen of each of the following species:—

Sebastes Norvegicus. The Norway haddock. 96 fathoms, Trinity Bay.

Anarrhichas lupus. The wolf fish. 112 fathoms, off Charleton Point, Anticosti.

Agonus decagonus?, Schneid. With the preceding.

It is estimated that, when the whole of the material collected has been examined with care and all the specimens are determined, upwards of 100 species of marine invertebrates new to the Gulf of the St. Lawrence can be added to its previously recorded fauna. Of these, from 30 to 40 species are new to the western side of the

Atlantic, and a few are undescribed. When it is considered that only five weeks were spent at sea, that during that time the ordinary duties upon which the schooners were engaged (and some times unfavourable weather) often made dredging quite impracticable, also that I was alone (so far as scientific help was concerned) nearly the whole time, I may be pardoned for thinking that the results of these investigations, so far as they go, are very encouraging and such as should stimulate to renewed exertions in so promising a field of inquiry.

I have previously shown (in the 'Canadian Naturalist' for 1869) that a large proportion of the Greenland invertebrates, probably three fourths of the whole, range as far south as the northern part of the Gulf of St. Lawrence down to Gaspé Bay. In Canada many marine animals (such as, for example, the oyster and the two species of *Crepidula* which are found attached to it) occur a little to the south of the Bay of Chaleurs, but not in the Bay itself. A number of characteristic New-England species inhabit the coasts of Nova Scotia and New Brunswick, most of which do not apparently range further north than the Bay of Chaleurs.

On the Admiralty Charts of the Gulf of St. Lawrence, an irregular line of 60 fathoms soundings may be seen to extend from a little above the northern extremity of the Island of Cape Breton, round the Magdalen group, and thence, in a westerly direction, to Bonaventure Island. To the south and south-west of this line the water is uniformly somewhat shallow, while to the north, north-west, and north-east the water deepens rapidly, and in some places precipitously. Principal Dawson suggests that the Subcarboniferous rocks of which the Magdalen Islands are composed, and which appear again on the mainland, in Bonaventure County, may possibly crop up under the sea in the area between the north-west side of Cape Breton and the mainland of New Brunswick, as well as that of the counties of Bonaventure and Gaspé, in the Province of Quebec. This may account, for the shallowness of the water in the area in question. Whether this is the case or not, it seems not improbable that the submarine plateau inside of this line of shallow soundings, may form a natural barrier to those arctic currents which sweep down the Straits of Belle Isle in a south-westerly direction, and may tend to deflect their course in a bold curve into and up the river St. Lawrence.

In the centre of this river, opposite Murray Bay, about 80

miles below Quebec, Principal Dawson has dredged quite a large series of Labrador marine invertebrates; but how much further up the stream these salt-water denizens extend, we have yet to learn.

North of the Bay of Chaleurs the fauna of the Gulf of St. Lawrence has a purely arctic character. The species of which it is composed are remarkable alike for their geological antiquity and for their wide range of geographical distribution. In time, a few of them date back to as ancient periods as the Coralline and Red Crags, and a much larger number occur in the Postpliocene deposits of both Europe and North America. It is curious to observe that species which are found both living on the American coast to-day and fossil in the European Pliocene and Postpliocene, had a different geographical range in former times from that which they are known to have now. Many of these arctic marine invertebrates are circumpolar in their distribution and not only inhabit both sides of the Atlantic, but are also found in the Northern Pacific. The preceding generalizations refer almost exclusively to the assemblage of marine animals characteristic of comparatively shallow water, the members of which range in depth from low-water mark up to about 50 fathoms.

The deep-water fauna, at least that of the localities examined, is also decidedly arctic, but it has at the same time a much more Scandinavian aspect. Nearly all of the species which are now for the first time recorded as inhabitants of the Atlantic coast of America occur also in the seas of the north of Scotland, of Norway, and Spitzbergen. There is a striking similarity between the series of fossils from the Quaternary deposits of Norway (as catalogued by Sars) and the marine invertebrates of the deepest parts of the St. Lawrence. *Pennatulæ*, *Ctenodiscus*, *Tripylus* (*Schizaster*) *fragilis*, *Ophioglypha Sarsii*, together with many species of mollusks, are common to both. Still it must be borne in mind that in the Quaternary deposits of Norway a number of characteristic European invertebrates occur, which, so far as we know, do not live on the western side of the Atlantic.

In the River and Gulf of St. Lawrence, generally speaking, the number of species of marine animals which may be collected at or above low-water mark is very small; few specimens, apparently, are washed ashore by storms. But there is a constant tendency in the opposite direction; littoral and shallow-water forms are constantly being drifted down to lower levels, particularly shells

(which are usually dead and empty) and the larger calcareous Polyzoa, such as *Celleporaria incrassata* and *Myriozoum subgracile*. Sometimes the Mollusca are living: on one occasion I dredged an example of *Littorina rudis*, apparently alive, but certainly with the operculum fitting tightly into the aperture, from upwards of 100 fathoms water. When such is the case, it is often difficult to separate the true denizens of the deep sea from those which are washed down from shallower water.

Since the above was written, I have re-examined the Canadian Thecaphoræ, and find among them two examples of what seem to be *T. ibla* of Wyville Thompson. It is the spicules of what I take to be this latter species that are spinulate fusiform; those of *T. semisuberites* have yet to be studied.

NATURAL HISTORY SOCIETY.

PROCEEDINGS FOR THE SESSION 1872-73.

ANNUAL MEETING.

The Annual Meeting was held on May 18th, 1872, the President, Principal Dawson, in the chair.

After the minutes of the last annual meeting were read, the President delivered the Annual Address. This will be found on pages 1 to 15 of the present volume.

The Report of the Chairman of Council was next read by Mr. G. L. Marler, of which the following is an abstract. The number of new members elected during the past session is eight, while nineteen names have, from various causes, been taken off the list. This decrease was attributed partly to the inaction of the membership committee and partly to the circumstance that the operations of the Society are not as widely known as could be wished. A suggestion was offered as to the desirability of amalgamation with kindred societies, such as the Mercantile Library and the Fraser Institutes, and the advantages of such a plan were pointed out. The Annual Conversazione and the Field Day held during the past session have each resulted in some pecuniary loss, but it was thought that such meetings have a beneficial tendency, and that they should be continued. About 500 persons have visited the museum during the year, but as there was no officer residing on the premises during the first three months, an accurate record was not kept. One thousand dollars of the mortgage on the Society's buildings have been paid off, but there

are still one thousand dollars due, and it was recommended that immediate exertions be made to raise this sum in order to free the Society from debt. During the current year an unusual outlay (of $337) has been necessitated for repairs, painting and cleaning.

The Report concluded with an expression of thanks to the other office holders.

The Reports of the Scientific Curator, Recording Secretary and of the Editing Committee of the 'Canadian Naturalist' were then read by Mr. J. F. Whiteaves, of which a brief and condensed account is submitted.

A deep sea dredging expedition to the Gulf of St. Lawrence, under the auspices of the Hon. the Minister of Marine and Fisheries was successfully carried out on behalf of the Society. More than 100 species of marine animals, new to Canada, were collected. These have been for the most part studied, identified and labelled, and a report on the general results of the expedition has been prepared for and published by the Department of Marine and Fisheries. Eight new specimens of Canadian birds have been added during the year. Fourteen species of birds and twenty-four of mollusca, collected by Mr. Richardson in British Columbia, have been presented by Mr. A. R. C. Selwyn. These have been mounted, labelled and incorporated into the general collection. Sir J. Duncan Gibb has kindly forwarded a large collection of British and exotic fossils. Mr. Peter Redpath has contributed a series of W. Indian sponges and alcyonoids. No cases being available to exhibit these, they have been carefully stored away, until a proper provision can be made for them. About three hundred species of recent shells have been mounted on tablets and labelled, and about 1000 more have been roughly grouped in drawers preparatory to mounting. The want of additional cases for the museum was strongly urged, especially of one for the preservation and exhibition of alcoholic preparations. The publishers of the 'Naturalist' having decided that the first No. of Vol. 6 should bear date, September 1871, three numbers have been issued, and it was hoped that the fourth would be ready in July. As soon as the volume is finished new arrangements will be entered into between the publishers and the Society.

The Treasurer, Mr. James Ferrier, jr., then submitted a statement of the financial position of the Society, of which the following is an abstract:

DR. THE NATURAL HISTORY SOCIETY *in Account with* JAMES FERRIER, JR., *Treasurer.* CR.

1871-72.	
To Cash paid J. F. Whiteaves, salary	$400.00
" " S. W. Passmore, "	200.00
" " Pell, commission	29 35
" " Interest	100.00
" " for Coal	159.20
" " " Gas	25.92
" " " Water	34.70
" " " City Taxes	49.50
" " " Insurance	39.00
" " Repairs, and petty expenses	350.99
" " Books, printing and advertising	173.95
" " Loss on Field Day	5.25
" " Dredging expenses	94.28
" " Royal Institution	1000.00
	$2662.14

LIABILITIES.

Royal Institution, Balance on Mortgage	$1000.00
Dawson Bros. acc't	653.92
	$1653.92

1871-72.	
By Cash rec'd. Government Grant	$750.00
" Balance in Treasurer's hands May 1, 1871	917.33
" Cash, Members' Yearly Subscriptions	435.00
" " Life " (D. A. P. Watt)	50 00
" " Subscriptions to 'Naturalist,'	164.00
" " Museum Entrance Fees	63.46
" " Rent of Lecture Room	227.00
" " Interest from Treasurer	21.78
" Balance due the Treasurer	33.57
	$2662.14

Errors and omissions excepted.

(Signed) JAMES FERRIER, JR.

Montreal, May 14th, 1872.

The various reports were adopted and ordered to be printed in this Journal.

On motion of Rev. Dr. De Sola, seconded by Mr. J. H. Joseph, a vote of thanks to the President for the address, and for his continued and valuable services to the Society, was passed unanimously.

The following gentlemen were then duly elected officers for the Session 1872–73:

President.—G. Barnston.

Vice-Presidents.—Principal Dawson, E. Billings, Dr. Smallwood, Rev. Dr. De Sola, A. R. C. Selwyn, His Lordship the Metropolitan, Dr. T. Sterry Hunt, Sir W. E. Logan, and Dr. P. P. Carpenter.

Treasurer.—Mr. J. Ferrier, jun.

Cor. Secretary.—Prof. P. J. Darey.

Scientific Curator and Rec. Secretary.—Mr. J. F. Whiteaves.

Council.—G. L. Marler, D. R. McCord, Prof. R. Bell, D. A. P. Watt, J. H. Joseph, E. E. Shelton, Dr. J. Baker Edwards, A. T. Drummond, and C. Robb.

Library and Membership Committee.—A. T. Drummond, Dr. John Bell, D. R. McCord, N. Mercer and Dr. B. J. Harrington.

FIELD DAY.

A field day was held at Isle Perrot on the first of June, 1872, which was numerously attended.

On the spot, Dr. T. Sterry Hunt gave an account of the history of the Island, as well as a popular description of the Geology of the District. Mr. Whiteaves explained the nature of some of the fossils to be met with in the adjacent Potsdam sandstone and calciferous Sand-rock, and Dr. J. Baker Edwards made some remarks on the topography of the surrounding country.

Prizes having been offered for the best Zoological or Botanical collections made during the day, the awards were made as follows:

1. For the largest named collection of animals, plants, or fossils.—open to all. Mr. J. B. McConnell, 70 species of flowering plants.

2. Ladies Prize, for the best named collection of wild flowers. Miss Morgan, twenty species.

3. Children's Prize.—Master Selwyn, for 37 un-named species of flowers.

MONTHLY MEETINGS.

1st Monthly Meeting, held Oct. 28th, 1873.

A paper on the Ferns of Ceylon, by the President, G. Barnston, was read by the Rec. Secretary.

Principal Dawson made a communication on Fossil Footprints.

A portion of a paper on the Island of Cuba, by G. F. Matthew, was read by the Recording Secretary.

2nd Monthly Meeting, held Nov. 25th, 1872.

Major H. Mills and Alexander Robertson were elected members of the Society.

D. McEachran, V.S., then read a paper on the prevailing Disease among Horses.

After some remarks upon this topic by Principal Dawson and Dr. J. Baker Edwards,

Dr. P. P. Carpenter gave a verbal account of the life and labors of the late Dr. W. Stimpson, as a malacologist.

Some concluding observations by Principal Dawson, on this last subject, terminated the proceedings.

3rd Monthly meeting, held Dec. 30th, 1872.

A small collection of fresh water shells, made by Prof. Bell, at Fort Garry, was exhibited, and some remarks upon the species were made by Mr. Whiteaves.

Rev. Canon Baldwin, Dr. Wolfred Nelson, G. M. Dawson and John Taylor were elected resident members.

Rev. C. H. Paisley's paper on Post Pliocene Beds at Bathurst, N. B., was read by the Rec. Secretary.

Some comments and remarks on this essay having been made by Principal Dawson, and C. Robb,

The second paper on the list, "on the Geology of Huron Co., Ont.," by John Gibson, B.A., was also read by the Secretary.

Some discussion ensued, in which Principal Dawson, Prof. Bell and C. Robb took part.

4th monthly meeting, held Jan. 27th, 1873.

Rev. John Empson, and A. H. Foord, F. G. S, were elected ordinary members.

Mr. A. R. C. Selwyn, F.G.S., made a communication "on some points in the Geology of Vancouver and Queen Charlotte Islands."

Principal Dawson followed with a description of the Fossil Plants collected by Mr. Richardson.

Mr. E. Billings made some remarks on the animal fossils of the two islands.

Mr. Whiteaves also commented on the fossils exhibited, and also pointed out the salient features of interest in a small collection of recent shells from the same localities.

The President, (Mr. G. Barnston), gave an interesting account of the uses to which the Coast Indians put various marine mollusca. He congratulated Mr. Richardson on the fine series of fossils collected during the past summer, and moved a vote of thanks to Mr. Selwyn for bringing the subject before the meeting, which was carried by acclamation.

5th Monthly Meeting, held Feb. 24th, 1873.

Mr. Christian Hoffman was elected an ordinary member.

A paper "On the Huronian and Mineral-Bearing Rocks of Lake Superior," was read by Prof. R. Bell.

Some discussion followed after the reading of this communication, in which Principal Dawson, Messrs. Selwyn, Robb and the author took part.

Mr. Selwyn brought a series of rock specimens from Australia to compare with examples of the rocks and minerals from Lake Superior exhibited by Prof. Bell in illustration of his paper.

6th Monthly Meeting, held March 31st, 1873.

Dr. C. F. Davies, Messrs. C. Gibb and E. Sawtell were elected resident members, and John Gibson, B.A. (of Almonte, Ont.) a non-resident member.

Mr. J. F. Whiteaves read a paper "On recent Deep-Sea Dredging operations between Cape Rosier and the Magdalen Islands, with some notes on the marine fisheries of the Province of Quebec."

After some remarks by Principal Dawson and other members, the proceedings were brought to a close.

7th Monthly Meeting, held May 5th, 1873 (adjourned from April 28th, 1873.)

Mr. J. Fraser Torrance was elected an ordinary member.

A paper "On the Races of Northern Europe," was read by the Rev. Canon Baldwin.

The Acting President (Principal Dawson) in moving a vote of thanks to the lecturer, took occasion to point out the close connection existing between ethnological and anthropological researches and recent investigations into the newest stratified rocks

He claimed that the facts collected up to the present date in each of these fields of inquiry, and especially late discoveries at Mentone, all tend to throw doubts upon the great antiquity which some had assigned to the human family.

ADDRESS TO H. E. THE GOVERNOR-GENERAL.

On the occasion of His Excellency's first visit to Montreal, in October, 1872, the President and Rec. Secretary were deputed to call on His Excellency to request him to become the Patron of the Society, and to honour the Society with a visit. His Excellency, through his Private Secretary, kindly consented to become Patron of the Society, but regretted that in consequence of numerous engagements he would be unable to visit the Museum on this occasion, but hoped to do so at some future time.

At a subsequent visit to the city, the same deputation waited on His Excellency to invite him to inspect the Society's collection. His Excellency was again compelled to postpone his visit, but kindly consented to receive an address of welcome from the officers and members.

SESSION 1873-74.

ANNUAL MEETING.

The Annual Meeting was held on Monday evening, May 19th, 1873, the Rev. A. De Sola, LL.D., in the chair.

The minutes of the last Annual Meeting having been read, the address of the Acting President, Principal Dawson, LL.D., F.R.S., &c., was read by the Recording Secretary, as follows:

ADDRESS OF THE ACTING PRESIDENT.

GENTLEMEN,—Our present meeting closes the fortieth year of the existence of this Society, and it becomes us to consider to what extent the hopes of its founders, expressed in the motto, "*Tandem fit surculus arbor*," have been realized. A tree that can boast of forty annual rings of growth, in the soil and climate of Canada, should have attained to a goodly stature, should extend a wide and grateful shade, and should have borne some good fruit. Looking back upon the origin of the Society, we must confess that our growth has been slow, and has not kept pace with that of the great business community of Montreal, nor with that of similar institutions in the larger cities of the United

States, where, in many cases liberal and public and private endowments have given a magnitude and stability to the operations of kindred societies, which we have not been able to attain to; and while we have many favors to acknowledge, it is my decided impression that the commercial and professional community of Montreal has not appreciated as it should the efforts of this Society, nor treated it with the liberality which it deserves. In a city such as this scientific workers are necessarily few; and the great majority of the people have little leisure even to give a passing attention to the objects of a society like this. Still those who do give to scientific pursuits either the intervals of leisure snatched from daily work, or the time which they may have earned for themselves or have inherited as a precious gift of fortune, are from their exertions in this way doubly valuable as members of society; and the professing and teaching naturalists whom we can number, are in their place indispensable both to our material and educational welfare. Further it is of great importance that the taste and intellect of all classes of the community should be cultivated by an acquaintance with natural objects; and the existence of a society of this kind is at once one of the sure marks of high taste and culture, to which the city can point with pride, and has a useful function in providing a rational means of employing leisure as a counteraction to low and degrading places of amusement which too often spring up with a vigor and luxuriance of growth disproportionate to that of literary and scientific institutions.

I consider it a matter of no small importance that our Museum represents to some extent the popular study of nature in this community. In the Zoology of Canada it is undoubtedly the most important collection in this country, and in other departments it has much of value and interest. It provides the means of preserving, determining and exhibiting remarkable and interesting specimens which would otherwise be lost. Its doors are ever open to all who wish to know anything of our natural productions, and to strangers who desire to obtain some acquaintance with the aspects of nature in this country. Our Museum has now reached a somewhat critical point in its history. When the Society removed into its present building, we seemed to have ample space for our then comparatively small collections. But the objects in our possession have grown until we are in need of much more room, and our collection is again beginning to be crowded, while

we lack means to extend our accomodation or even to utilize by new and improved cases the space that we have. With some changes of arrangement and additional cases, our present building might contain and exhibit the collections of the Society for several years to come; but it would require an annual sum of at least $1,000 at the disposal of our curator, to provide for the necessary repairs, additions and extensions. Were the public sufficiently alive to the importance of the object, it should not be difficult to realize this amount either by annual subscriptions or by a permanent endowment. In any case we should be prepared to consider within a few years the necessity of enlarging our Museum.

Our Library has not kept pace with our Museum, and as it cannot in the nature of the case become a popular or general library, but must be mainly one for scientific reference and consultation, we are here again in a position which requires extraneous aid and endowments, or the contributions of a large number of members.

It seems evident, therefore, that if we are to emerge from the present slow and languid condition of our progress, we shall be obliged in the course of not many years to appeal to the liberality of the friends of science on a still larger scale than that which was necessary in the erection of our present building.

Our journal, the *Canadian Naturalist*, begins with this year the seventh volume of the new series—fourteen volumes in all having been issued. Its present volume is under the able editorship of Dr. Harrington; and our new arrangement with the publisher enables us to give the journal gratuitously to each of our members, a change which it is hoped will greatly increase their interest in the work of the Society. It is not saying too much to affirm that the *Naturalist* should be in every Canadian library. It is the only work that affords a complete view of what has been done in the Geology and Natural History of the Dominion during the past fifteen years; and in the case of all who wish to have means of reference with regard to the natural resources of our country, it must occupy a place side by side with the reports of the Geological Survey. That its list of subscribers is so small beyond the limits of the Society, is not creditable to the practical good sense of our people; since independently of other considerations there can be no question that the information which it annually contains would, in a practical point of view, many

times repay its cost. Its present limited issue will in no great number of years, render it a scarce work, and I have no doubt that the time is not far distant when it will be difficult, if not impossible, to procure complete sets.

The work of our last session may be summed up in the course of Sommerville lectures, and in the papers read at our monthly meetings. The former course—as usual largely attended— embraced subjects of great interest, and we are much indebted to the lecturers for their gratuitous services in this matter to the Society. The list is as follows:—

SOMMERVILLE LECTURES.

1. The Natural History of Ore Deposits, by Dr. T. Sterry Hunt.
2. The Life of an Oyster from a Man's standpoint, by Dr. P. P. Carpenter.
3. The Aborigines of New Brunswick, by C. Robb.
4. Man's Life in Montreal from an Oyster's standpoint, by Dr. P. P. Carpenter.
5. The Furs and Fur-bearing Animals of Canada, by Prof. Bell.
6. On the Chemical characters of the water available for the supply of Montreal, by Dr. J. Baker Edwards.

For next year I would suggest that possibly in addition to the Sommerville Course, we might provide a course or courses of evening lectures, not gratuitous, and by means of which the finances of the Society might be recruited.

The papers read at our monthly meetings number twelve in all. Four of these, that on the Ferns of Ceylon, by the President, Mr. Barnston; that on the Island of Cuba, by Mr. Matthew; the account of the Life and Labours of the late lamented Dr. Stimpson, by Dr. Philip Carpenter, and that on the Races of Northern Europe, by Rev. Canon Baldwin, relate to subjects beyond our immediate field. The others were more or less Canadian in their scope. Dr. McEachran gave us the result of his observations on the remarkable and mysterious disease which, with such marvellous rapidity, attacked the horses over nearly all Eastern North America, and the facts relating to the transmission and symptoms of which throw no little light on epidemics which afflict our own species. Mr. Paisley contributed some notes on the Post pliocene of New Brunswick, and Mr. Gibson on the Geology of Huron County, Ontario. Mr. Selwyn kindly laid before us a valuable summary of the Explorations of Mr. Richard-

son in Vancouver and Queen Charlotte Islands, so rich in new fossils and geological facts; Prof. Bell gave us a similar resumé of the recent discoveries in the metalliferous rocks of the North and West of Lake Superior. To these great Western regions the eyes of all men are now turned; and the wonderful scientific and economic discoveries made in the western territories of the United States, with the first fruits already realized in our own western territories, stimulate our hopes and expectations. I have had occasion lately, in connection with the departure of my own son into these regions as one of the pioneers of scientific exploration, to look over the literature of western geology; and in doing so, I have been struck with the amount of good work achieved under difficult circumstances, in times previous to the annexation of these regions to Canada. I would mention in connection with this the names of Dr. Bigsby, one of the earliest, and Dr. Hector, one of the latest explorers of the west, as well as those of Richardson, Hind and others who come between. With reference to the first mentioned, who is still living and working ably and usefully, I may mention his admirable summary of the post-pliocene deposits in the west, published in the journal of the Geological Society many years ago, and I do so the more readily, as with reference to the theory of drift deposits, he anticipated much of what I have myself been endeavouring to illustrate in our journal in the investigation of this difficult subject. Dr. Bigsby's paper of 1851 is still well worthy of perusal in connection with what has been done subsequently by geologists in the United States and in this country.

My own contribution on fossil foot-prints I may pass over without remark; and in conclusion of this part of the subject would direct attention to the fact that Mr. Whiteaves has again represented Canadian science as a dredger in the deeper parts of the Gulf of St. Lawrence, reaching in this last expedition the deepest known part of the Gulf, and adding very considerably to our knowledge of its fauna and many new facts bearing on the distribution and habits of useful fishes. The work was prosecuted under some difficulties, the double task of watching poachers on forbidden fisheries and of dredging in deep water, being evidently too much for any one cruiser. In future if this work is to be prosecuted as it undoubtedly should be, a suitable craft should be put at the exclusive disposal of the dredging party for the summer months. If we are obliged to leave the wide ocean to the

Governments of Great Britain and the United States, Canada should at least have the credit of thoroughly exploring the Gulf of St. Lawrence, one of the most interesting inland seas in the world; and it is to be hoped that the Honorable the Minister of Marine and Fisheries will follow up in this matter the work he has so well begun.

I have considered it my duty, in this address, prepared, as you know, merely as the substitute of my aged friend, Mr. Barnston, one of the veterans in the study of natural history in this country, to dwell almost entirely on the special interests of the Society, and I would, in conclusion, earnestly bespeak in its behalf your warm and zealous countenance and aid, in order that it may enter on a new and vigorous career, and may in the year to come advance with accelerated rapidity and make itself more and more worthy of being the central and most important Society devoted to Natural Science in this Dominion.

I trust that those who have been the old and tried friends of the Society will still cling to its interests, and that the young naturalists who are rising up around us will add their fresh vigour and enthusiasm, so that the next year may be signalized by greater things than any which has preceded it. For my own part I am disposed to give more time and effort than heretofore, rather than less, to the interests of the Society, whether aiding in its management or in contributing to its scientific success.

The Chairman of Council, Mr. G. L. Marler, then read the following report of the proceedings of that body:

REPORT OF THE CHAIRMAN OF COUNCIL.

Your Council at the end of their year of office respectfully report as follows:

That the monthly meetings of the Society have not been very numerously attended—a fact greatly to be regretted and due perhaps to their having been called by postal cards, issued at the beginning of the year and containing a list of the meetings, with their dates. Your Council had hoped that this system would have attained its object, but it has apparently been unsuccessful.

Your Council suggest that for the ensuing year, arrangements be made as early in the season as possible for the papers to be read at the monthly meetings and for the Sommerville course of Lectures: in this way contributors would have ample time to prepare their subjects and there could be some system adopted as to the order of the papers, &c.

Several necessary improvements have been affected, a new furnace having been put in, double windows obtained for the Lecture room, and the drainage attended to—But there are others equally needed to which your Council beg to draw your attention. Foremost among these are the thorough cleaning which the staircase and the museum flat require and new additional cases for the Museum.

The rooms of the Society have been let for eighty days during the past year to the Ladies' Educational Association for which the Society have received $120 exclusive of attendance. A special tariff has lately been adopted by your Council for the hire of the rooms, it being so arranged that the rate shall vary according to the season and according to whether light or fuel is supplied or not. The Recording Secretary has been authorized to have cards printed explaining this tariff, and to have these put up in various parts of the building.

It is with much regret your Council has to report that during the past year only 14 new members have been elected. Special efforts should be made to increase the list of members during the coming session. The Library and Membership Committee, appointed some years ago, have so far apparently taken no action in the matter.

There have been about one thousand or more visitors to the Museum during the past year, a circumstance which it is thought is very encouraging.

The debt on the building has been reduced by $1000, as was stated to be the intention of the Treasurer at the last annual meeting. The donations to the Library and Museum have not been as liberal as heretofore.

This Spring, on the occasion of the Governor-General's visit to this city, an address was presented, to which a reply was forwarded by His Excellency, who has kindly consented to be its Patron.

Arrangements have been made with Messrs. Dawson Brothers, and approved by the Society, whereby Dr. Harrington undertakes to edit the 'Canadian Naturalist.' Under the new arrangement a copy will be supplied to each member gratuitously.

Your Council report that Messrs. Dawson Bros.' account of $653.92 is in a fair way of being reduced by special donations and by the collection of outstanding subscriptions to the journal.

That extra exertions should be used to get more Lady Asso-

ciates, and that efforts should be made to collect their outstanding subscriptions.

The Council in retiring, desire to convey their thanks to the officers who have so efficiently carried on the business of the Society during the past year.

Montreal, 19th May, 1873.

The subjoined report of the Scientific Curator and Recording Secretary, was next read by Mr. Whiteaves.

REPORT OF THE SCIENTIFIC CURATOR AND RECORDING SECRETARY.

During the greater part of the past Session, the work done has been of an almost purely scientific character. After the last annual meeting, active preparations were set on foot towards carrying out a second deep-sea dredging expedition to the Gulf of St. Lawrence. Before leaving the city, as the Society had pledged itself to give the fullest publicity to the results already obtained in a previous expedition, two papers embodying the latest studies of myself and others on the specimens collected were written. One of these was kindly read by Dr. Nicholson of Toronto, at the last meeting of the British Association, and the other was published in the 'Annals of Natural History' for November, 1872. The months of July and August were spent in the prosecution of deep-sea dredging operations in the Gulf. The task was beset with many unforeseen difficulties, and the time wasted, so far as I was concerned, was considerable. Still, the number of new and rare specimens collected was very large, and many new facts bearing directly on the sea fisheries of that region, were amassed. Such books as were not accessible here, but which were essential to the correct identification of these marine invertebrates, were ordered from England, and most of the remainder of the session was devoted to the careful examination of these specimens. A somewhat elaborate report on the results of the second series of investigations, was written for the Minister of Marine and Fisheries, and submitted on behalf of the Society. The document (of which copies are lying on the table) makes a pamphlet of 22 pages roval octavo. Besides some introductory matter, it contains, 1st, a diary kept during my absence, shewing how the time was spent; 2ndly, as careful an account as possible of the many specimens collected; and

lastly, a series of observations on the sea fisheries of this Province, and on other practical subjects. Although doubtless very imperfect, it is yet hoped that on the whole this report will reflect no discredit either upon the Society which I have the honour to represent, or on the Minister under whose auspices these investigations were conducted.

In order to shew that during the past session important additions have been made to our knowledge of the marine zoology of this Province, the following details may not be out of place.

FORAMINIFERA.—These microscopic organisms have been partially studied. The novelties detected are not very numerous so far. About ten new species or varietal forms can now be added to the latest list published.

POLYCYSTINA.—The few species collected in 1872 are precisely the same as those dredged in 1871.

SPONGES.—There are about ten species new to our fauna in the series collected last year. These are unusually curious and interesting. An attempt has been made to work up the whole group, and portions of many have been boiled in nitric acid, and the spicules carefully examined. The subject is one of great difficulty, however, and the trouble may be referred partly to the want of a series of accurately named British species for comparison, and partly to the fact that most of the sponges of the lower St. Lawrence are in all probability new to science. The appearance of Dr. Wyville Thompson's new book, 'The Depths of the Sea,' has thrown some light on several of these sponges. It is clear that some of the genera and species described in this volume are identical with specimens dredged in deep water in the St. Lawrence last year.

HYDROZOA.—These simple corallines have been carefully examined and studied. Twenty-three species have been recognised in last year's collection, and it is estimated that about ten more have yet to be identified.

ACTINOZOA.—The eight or ten additional species in this group have been studied by Prof. Verrill and myself. The three kinds of *Alcyonium* collected are not yet determined with any great degree of certainty; one is apparently undescribed, as is also a sea anemone of the limited genus *Actinopsis*.

ECHINODERMATA.—The sea urchins and star fishes of the Gulf have also been critically re-examined, and a list of them published. The number at present known to inhabit the Gulf north of the Bay des Chaleurs, is about twenty-eight, nearly half of which are now for the first time recorded as denizens of our waters. Three critical species require further elucidation.

ANNELIDA.—All the marine worms collected in 1871 and 1872, have been sent to Dr. W. C. McIntosh (of Murthly, near Perth) a well-known authority in this little studied group of animals. About twenty-four species have been already named, and in a short time it is hoped that the whole series will be identified. The collection made in 1872 is larger, and contains more species than that obtained in 1871.

CRUSTACEA.—Thirty species of Crustacea, collected last summer, have been named. Mr. S. J. Smith (of Yale College, Newhaven, Conn.) has kindly identified those which I had no opportunities of determining here. Most of the species are new to the seas of the Province of Quebec.

TUNICATES.—The Tunicates collected, with two exceptions, were sent to Prof. Verrill, who has made a special study of these animals. So far ten species have been identified.

POLYZOA.—This group has been partially studied and worked up by myself. About forty species have been made out with tolerable precision, but there is little doubt that the list will be greatly increased by a closer and more rigorous examination.

MOLLUSCA.—All the sea shells obtained last year have been critically examined and determined. About 150 species of marine testacea are now known to inhabit the seas of this Province.

FISHES.—In conformity with a request from the Minister of Marine and Fisheries to that effect, special attention was paid to the collection of facts bearing directly or indirectly upon the sea fisheries of the Dominion. With what success this part of my mission has been attended, those who have taken the trouble to peruse my report to the Government must decide.

To sum up this portion of my report, about ninety species of marine animals, new to the Canadian fauna, have been collected, studied and determined during the past year. These have either

been mounted on tablets, if dry preparations, or put into separate bottles with alcohol, if the nature of the specimens required that mode of treatment. The strain upon the eyes caused by prolonged use of towing nets at sea, and in protracted microscopic work at the office, has been considerable. The correspondence involved, in order to attain successful results, has also taken up much time.

It is much to be regretted, that in consequence of lack of funds, the Society has not been able to provide suitable cases, in which these and other alcoholic preparations can be exhibited to the public. At present the collections made in 1871 and 1872, as well as many other objects of great scientific interest and value, are almost unavailable to the student, and are wholly so to the general run of visitors, for want of proper accommodation.

At intervals, when my eyes required rest, after close application to the microscope, some progress has been made in mounting my own collection of shells for the use of those who wish to consult it. About 300 species have been mounted on tablets and labelled.

During the past year the donations to the Museum have been unusually small. So far as birds and mammals are concerned, this may have arisen from the state of the law on the subject. During the last session of the Quebec Legislature, efforts were made to induce the Government to permit the granting of licenses to enable naturalists to procure specimens of birds or their eggs for bonâ fide scientific purposes. Through the kindness of the Hon. James Ferrier, one of the most generous benefactors to this Society, the requisite clause was inserted in the Act for the protection of insectivorous birds. It is hoped that the effect of this measure will ultimately be to largely increase the Society's collection of native birds and mammals.

An interesting series of the *Muridæ* (mice, meadow-mice, rats, &c.) of this Continent has been received from the Smithsonian Institute, carefully named by Dr. Elliot Coues. The collection contains many species new to our Museum, and would have been a most valuable addition to the few North American mammals in our cases, but unfortunately the skins are so badly preserved that it was found to be impossible to mount them for public exhibition.

As a cheering omen for the session just about to commence, it may be mentioned that advices have just been received of a

donation of sixty specimens of East Indian birds from Major G. E. Bulger, who has previously given many valuable and interesting donations of objects of various kinds from that part of the world. The consignment has been shipped by the Scandinavian, and may be expected at an early date.

The additions to the library are about equal to the average of other years. The most important of them are illustrated monographs on the sponges, hydrozoa, zoophytes, and sessile eyed crustaceans, purchased with a special view to working up the St. Lawrence species. Every year the Society becomes better known and appreciated by kindred associations in Europe and the United States. Did our finances permit, there are few scientific bodies in either of these countries with whom we should not exchange periodicals, reports, &c. For this and for other reasons an amount of correspondence is involved which occupies more and more of my time every year.

Gentlemen,—the session which is now brought to a close terminates the first decade of my association with this Society. I am free to admit that, reviewing the past ten years, the hopes that I once entertained as to the future of this Institution have not been realized. The success or failure of this Society in particular affords, as it seems to me, a fair criterion of the value which the inhabitants of the city set upon higher education generally. Yet how lamentably small has been the support or aid accorded to the Society by our wealthy citizens. For the last three years it has laboured under such a pressure of pecuniary difficulties that during that time literally nothing has been spent on either the Museum or Library. The Hall, the Gallery and Museum have never been properly cleaned since the building was erected, and improvements which are most urgently needed have been found impracticable, and abandoned for want of funds. That some interest is taken in the work which we are engaged in attempting to further, is manifest from the fact that upwards of 1000 persons have visited the Museum during the past twelve months. Were our collections made more worthy of this commercial and wealthy metropolis, and the building thrown open freely to the public, it is reasonable to suppose that the number of visitors to the Institution would be very largely increased. I should not have ventured to offer these remarks, especially as similar ones have been dwelt upon in the able address of the Acting President, but that I had a special object in so doing.

My desire has been to shew how many difficulties and obstacles I have had to contend with in the proper carrying out of the trust which for ten consecutive years you have reposed in me. Due allowance being made for many shortcomings and deficiencies in the past, it is yet confidently hoped that if the work done during so long a time has been less than it ought to have been, the fault is largely attributable to that want of liberal patronage which might well have been accorded to a Society so deserving of the sympathy and practical assistance of all classes in the community.

J. F. WHITEAVES, F.G.S., &c.

The Treasurer, Mr. James Ferrier, jr., submitted the following financial statement, and gave some verbal explanations of various details connected with it.

Dr. THE NATURAL HISTORY SOCIETY *in Account with* JAMES FERRIER, Jr., *Treasurer.* Cr.

1872-73.	RECAPITULATION.	
To Balance due the Treasurer, May 1, 1872		$33 57
To Cash paid J. F. Whiteaves, salary		400.00
" " S. W. Passmore, "		200.00
" " Mr. Pell, commission		31 65
" " Interest		60.00
" " for Coal and Wood		220.61
" " " Gas		29.04
" " " Water		38.50
" " " City Taxes		49.25
" " " Insurance		62.00
" " Repairs, and petty expenses		282.32
" " Books, printing and advertising		256.44
" " Loss on Field Day		0.30
" " Dredging expenses		488.94
" " for New Furnace		132.50
1873. May 1.—To balance in Treasurer's hands		0.60
		$2285.72

LIABILITIES—May 1st, 1873.

Royal Institution	$1000.00
Dawson Bros.	536.00
Petty Accounts	28.69
	$1564.69

1872-73	RECAPITULATION.	
By Cash rec'd. annual Government Grant		$750.00
" " " Government Grant on Dredging account		500.00
" " " Collected by Messrs. Barnston and Watt for Dredging expenses of 1871		100.00
" " " Members' Yearly Subscriptions		645.00
" " " Subscriptions to 'Naturalist,'		12.00
" " " Museum Entrance Fees		51 97
" " " Rent of Lecture Room		226.75
		$2285.72

Errors and omissions excepted.

(Signed) JAMES FERRIER, Jr.

Montreal, May 16th, 1873.

Rev. Dr. De Sola made some remarks on the reports submitted, and urged the necessity of trying to popularize the papers read at the monthly meetings and the Somerville lectures.

Dr. J. Baker Edwards asked if any arrangements had been made for holding a field day shortly, and pointed out the importance of continuing these pleasant social gatherings, as well as the desirability of trying to interest ladies in the work of the Society.

It was moved by L. A. H. Latour, seconded by H. Rose, and resolved:

"That the reports just read be adopted, printed and distributed to the members."

On motion of Dr. De Sola, seconded by Dr. J. Baker Edwards, it was unanimously resolved:

"That Dr. T. Sterry Hunt, F.R.S., be elected an honorary member of the Society."

It was moved by His Lordship the Metropolitan, seconded by James Ferrier, jun., and resolved:

"That the thanks of the Society be voted to Principal Dawson for the preparation of the annual address."

The following resolution, having been moved by G. L. Marler, and seconded by R. McLachlan, was adopted unanimously.

"That the Rule relating to the election of officers be suspended, and that Principal Dawson be elected President."

Similar resolutions having been duly moved, seconded and adopted, the following officers were re-elected by acclamation:

Treasurer—James Ferrier, jun.

Cor. Secretary—Prof. P. J. Darcy, M.A., B.C.L.

Scientific Curator and Rec. Secretary—J. F. Whiteaves, F.G.S., &c.

Messrs. G. L. Marler and Prof. P. J. Darcy having been appointed scrutineers, the balloting for the remaining officers was then proceeded with, and the following results were announced:

Vice-Presidents—Rev. A. De Sola, LL.D.; Sir W. E. Logan, LL.D., F.R.S.; G. Barnston; C. Smallwood, M.D., LL.D., D.C.L.; A. R. C. Selwyn, F.G.S.; E. Billings, F.G.S.; His Lordship the Bishop of Montreal and Metropolitan.; C. Robb.

Council—G. L. Marler, D. A. P. Watt, J. H. Joseph, Prof. R. Bell, E. E. Shelton, D. R. McCord, Dr. B. J. Harrington, and the Rev. Canon Baldwin.

On motion of G. L. Marler, seconded by J. H. Joseph, the following gentlemen were elected to serve as a library and membership Committee: Dr. J. Baker Edwards, Dr. John Bell, D. McEachran, G. T. Kennedy, and L. A. H. Latour.

GEOLOGY, PALÆONTOLOGY AND MINERALOGY.

REPORT OF THE GEOLOGICAL SURVEY OF CANADA FOR 1871–72. A. R. C. SELWYN, F.G.S., Director.—This volume is one of special interest, as it contains accounts of explorations by the Geological Survey in the regions beyond the "Mountains of the Setting Sun,"—regions rocky and grand, but as yet little studied by the geologist.

Besides a summary Report by Mr. Selwyn, indicating the general progress of the Survey, the volume contains the following:

1. Journal and Report of preliminary Explorations in British Columbia, by Mr. Alfred R. C. Selwyn.
2. Report on the Coal-fields of the East Coast of Vancouver Island, with a map of their distribution, by Mr. James Richardson.
3. Report of progress in Exploration and Surveys of country between Lake Superior and the Albany River, by Mr. Robert Bell.
4. Preliminary Report of Exploration and Surveys in the country between Lake St. John and Lake Mistassini, by Mr. Walter McOuat.
5. Progress Report of Exploration and Surveys in the Counties of Leeds, Frontenac and Lanark, in the Province of Ontario, with a plan of the Township of Marmora, showing the position of the worked Gold Mines, and the course of the Auriferous Zone, by Mr. H. G. Vennor.
6. Report of progress in Geological Investigation in New Brunswick, by Professor L. W. Bailey.
7. Summary of Statistics of Mines and Mineral Produce of the Dominion, prepared from Official Returns and other sources, by Mr. Charles Robb.

From Mr. Selwyn's Journal we learn the more than ordinary difficulties with which the geologist has to contend among the rugged hills and rushing streams of British Columbia.

In his report upon the geological structure of the country, Mr. Selwyn gives the following as a provisional classification of the rocks:

I. *Superficial Deposits.*
II. *Volcanic Series and Coal and Lignite Group of the Man-land; and the Coal-rocks of Vancouver Island.*
III. *Jackass Mountain Conglomerate Group.*
IV. *Upper Cache Creek Group (Marble Canon Limestones).*
V. *Lower Cache Creek Group.*
VI. *Anderson River and Boston Bar Group, and Upper Rocks of Leather Pass and Moose Lake.*
VII. *Cascade Mountain and Vancouver Island Crystalline Series.*
VIII. *Granite, Gneiss and Mica-schist Series* of North Thompson, Albreda Lake and Tête Jaune Cache, including the micaceous schists of the Cariboo district.

Each group is then described in detail, and amongst other points it is interesting to note the highly crystalline character of many of the rocks which are shewn from their fossils to be of comparatively recent date. Mr. Selwyn's report contains a number of valuable facts with reference to the soil, forests, game, &c., of British Columbia, and concludes with the following remarks:

"Though British Columbia possesses considerable tracts of fine "agricultural and pastoral land, amply sufficient to produce all the "food her own population is ever likely to require, yet it is not "probable that she will ever hold a prominent position as an exporting "agricultural country. Her chief resourses are her forests, her fisheries "and her mines; and these are capable of almost unlimited develop- "ment. Her gold-fields, her silver veins and her coal-mines are yet "in their infancy; her timber trade is in a similar condition, and her "fisheries, which may fairly be expected to rival those of the Atlantic "Provinces, have not yet extended beyond the supply of local reqire- "ments.

"There can scarcely be a doubt in the mind of any one who has "visited the country, that a bright and prosperous future is in store "for the Alpine Province of the great Dominion; only to be realised, "however, when the iron road shall have brought her into closer com- "munion with her elder sisters in the east."

Mr. Richardson's report contains much useful information about the coal-fields, as well as about the crystalline rocks, superficial deposits, crops, &c., of Vancouver Island. It is followed by a note by Dr. Dawson on the fossil plants collected by Mr. Richardson, and by analyses and notes, by Dr. Hunt, upon samples of coal and crystalline rocks from Vancouver Island.

We have not space to say much of the remaining reports, though they are all valuable and interesting. Those interested in the economic geology of Ontario will do well to consult Mr. Vennor's report, which contains notes on the iron ores of Frontenac, Leeds and Lanark; on the phosphate of lime in North Burgess, Bedford, and South Crosby; and on the gold of Marmora.

The mining statistics form a new feature in the Reports of the Survey, the importance of which cannot be over-estimated. Some of the figures given in the tables are undoubtedly too low; but this is explained by the difficulty experienced in obtaining complete returns from persons engaged in mining.

A MANUAL OF PALÆONTOLOGY. By Henry Alleyne Nicholson, M.D., &c., &c., Professor of Natural History, University College, Toronto.*

This is a well executed and well illustrated octavo of 600 pages, presenting to the student a comprehensive, and, on the whole, accurate view of the subject of fossil organic remains, whether animal or vegetable. The introductory chapters contain some valuable general views on the subject of geology in its relations to palæontology, after which the author proceeds to take up his main subject, that of fossil animals, arranged in zoological order. The classification is that of the modern English school of zoology, for whose shortcomings Dr. Nicholson is not to be held responsible, as no writer of an educational work on natural history for use in Great Britain can hope for success unless he conforms to the prevalent London fashion. Prof. Nicholson, however, rises altogether superior to this school in the wide view which he takes of his subject, giving importance not only to European but also to American fossils, and thus rendering his work of far more value to the student in this country than any other English manual. Every group of animals to which we have had occasion to refer in this part of the Manual, is clearly and well represented.

The part devoted to fossil botany is less copious; but students of that important but neglected subject may be thankful to find it represented at all, and on the whole a good general view is given of the successive floras, which are treated not in botanical

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* Blackwood & Sons, Edinburgh.

but in geological order, an arrangement which has important advantages, and might be applied to zoological palæontology as well.

The concluding part of the work gives a good summary of historical palæontology, and there is a useful glossary and a copious index. On the whole the work can be strongly commended to Canadian teachers and students, and to all those who are endeavouring with such aid as they can obtain from books, to form collections of fossils. D.

THE SUPPOSED DIAMONDS IN XANTHOPHYLLITE.—Considerable interest was excited a short time back by M. Jeremejew's announcement that he had discovered diamonds imbedded in a rare Russian mineral known as Xanthophyllite. Wishing to verify Jeremiejew's observations, Dr. Knop, of Carlsruhe, has been quietly working at the subject, and has recently come to to the conclusion that the so called crystals of diamond are merely angular cavities, suggesting, it is true, the well-known forms in which the diamond is wont to crystallize, but nevertheless destitute of the veriest trace of diamond, or of any other mineral substance. It might, however, be fairly supposed that the cavities, though now empty, originally contained certain crystalline materials which impressed their angular form upon these hollows. Some curious experiments by Knop lead, however, to an opposite conclusion. He obtained thin sections of xanthophyllite, which, when magnified 1500 diameters, appeared to be absolutely destitute of any of these angular cavities; nevertheless, after treating the preparation with sulphuric acid, numerous cavities were recognized exactly similar to those referred in other cases to the presence of diamonds. In other experiments, fine lamellæ of xanthophyllite were carefully examined in all directions under the microscope, and the entire absence of any crystalline impressions then determined; the object was then touched with a few drops of concentrated sulphuric acid, and heated until white fumes appeared. The preparation, when cooled, was protected with a cover glass, and placed under the microscope, when it exhibited swarms of beautiful tetrahedral cavities, sharply defined, regularly formed, and arranged in parallel rows. From these and other observations, the author feels justified in concluding that the angular cavities in the Russian xanthophyllite have nothing to do with the presence of diamonds, but owe their origin merely to the corrosive action of acids.—*Quarterly Journal of Science.*

A Maryland Oil Well.—A few years ago an oil well was started near Cumberland, Maryland; but instead of striking oil, the pioneers came upon a gas chamber, and penetrated it. The gas was ignited, and continued burning. About a year ago, Mr. Haworth, of Boston, purchased the well, and obtained a patent for the manufacture of carbon. The gas is allowed to burn against soapstone plates, on which the carbon is deposited in the form of soot. Six hundred and sixty burners are now in operation, each burner consuming eight cubic feet per hour. By a mechanical arrangement, the soot is scraped and deposited in large tin boxes about 3 feet long, 1½ feet wide, and 1½ feet deep; scrapers are passed along the soapstone plates every twenty minutes, and the boxes are filled on their fourth passage. A building twice the size of the present one is now in course of construction. It will have in use 1328 gas burners. The present consumption of gas amounts to about one-twelfth the whole quantity escaping from the well. The total consumption of gas by the burners of both buildings will be one-fourth of the whole. The carbon is generally used for the manufacture of ink.—*Quarterly Journal of Science.*

BOTANY.

Home Botany.—It is to be regretted that although every year a considerable amount of botanical research is made in the neighbourhood of Montreal, few results are chronicled. In this way much local botanical knowledge is lost, and much time is expended by new enthusiasts in finding out what had already been known to former workers in the same department. Inasmuch as the natural productions of one's own vicinity are of much greater interest than those of parts more remote, so it is allowable for Montreal botanists to study with peculiar enthusiasm the flora of the mountain and regions lying within reach of a day's excursion. If the interesting discoveries that are made from year to year by new and older investigators in this limited and well-searched area, were regularly published in our local scientific magazine, the accumulated facts would gradually give us a thorough knowledge of the flora of the district, which would serve as an exploring shaft into the vegetable products of the country, to shew their nature from the highest to the lowest forms. The thorough study of such a district is of higher scientific value than the superficial investigation of a whole province. The im-

provements taking place in this vicinity are producing great changes in the flora, causing the disappearance of many rare and beautiful species, and the introduction of hardy and noxious weeds. As time goes on, the houses, creeping out block by block from the narrow area enclosed by the walls in olden times, fill up the vacant lots and fields. By degrees new drains and tunnels are drying up the pools where the pondweeds grew, and duckweed mantled the surface o'er with green, and the swamps and ravines no longer afford the moist and shady home for the orchids and moccasin flowers of former years. Further away from the din of busy industry, the farms and market gardens are rapidly encroaching on the woods and copses, while these again are being robbed of their pristine character by the constant incursions of men and cattle, and thus, soon, the lover of flowers may look in vain for our sweet-scented pyrolas and slipper-plants, and be forced to say in the words of the old Scottish song,

"The flowers of the forest are a' wede awa'."

So rapidly is this process of encroachment on rural parts going on, that sometimes plants essentially of the country and fen, are surrounded and imprisoned by the advancing lines and forming squares of houses. Thus, specimens of the marsh five-finger, and buckbean or swamp gentian, and other swamp plants, could be seen only a year ago growing in a boggy lot between Richmond square and the R.R. track. The following are some examples which occur at the moment, of particular localities where somewhat uncommon species of plants may be found: *Orchis spectabilis*, ravine head of University street; *Viola Selkirkii*, amongst loose rocks at the base of the east end of the Mountain; *Viola sagittata*, rising ground back of Hochelaga village; *Viola lanceolata*, near Mde. Bruneau's, Montarville; *Atragene Americana*, brow of mountain above Ravenscraig, and summit of Belœil mountain; *Uvularia sessilifolia*, top of the Mountain, above Terrace Bank; *Cratægus oxycantha*, the English hawthorn, St. Helen's Island; *Claytonia Virginica*, woodland at the base of the east end of the Mountain, near the cemetery fence; *Aralia trifolia*, swamp in the cemetery; *Aspidium fragrans*, exposed rocks near the lake, Belœil Mountain.

These may furnish some localities new to many collectors in this neighbourhood, and other localities of somewhat rare species will be furnished in future numbers. Any one making known

the occurrence of uncommon species in particular localities will contribute much to the common knowledge of the flora of the district, and add greatly to the pleasure and profit of excursions and rambles in the neighbourhood of Montreal. J. B.

CHEMISTRY.

WATERS OF PRINCE EDWARD ISLAND.—In Dr. Dawson's Report on the Geological Structure and Mineral Resources of Prince Edward Island, published in 1871, attention was called to the deficient supply of water to Charlottetown, and suggestions offered with regard to obtaining a supply by means of boring. The question is one of much importance and has been too long neglected, for much of the water at present used there is totally unfit for drinking purposes. The 'American Chemist' for May, 1873, contains the following note by S. D. Hayes, of Boston:

"There is probably no city of ten thousand inhabitants on this continent, that is suffering more for want of pure water than Charlottetown, the capital of Prince Edward Island. The public and private wells of this city are unfit for use from the presence in them of animal matters in uncommonly large proportions, and they undoubtedly constitute the primary cause for some of the diseases prevailing among the people there. The inhabitants of this city are literally dependent upon a water cart or two and a spring just outside of the city limits for every drop of water fit to use for cooking or drink; and this water, which is itself not by any means of the best, is sold from the carts for nearly one cent per gallon. For more than two years the City Council have had this matter under consideration, and the first complete analyses of their waters were made in November, the sources of the different specimens being unknown at the time. In recording only partial results of these analyses, it should be understood that the constituents called *organic matter*, consist of the volatile matters after correction and deduction of carbonic and nitric acids, water of composition, etc., belonging to the mineral and saline constituents determined by full analyses.

One United States gallon (231 cubic inches) of these waters contained in grains:

Source of waters analysed.	*Inorganic matter.*	*Organic matter.*	*Total weight of residue.*
City pump well	50.61	5.95	56.56
Park spring	5.05	3.17	8.22
Winter river, six miles from the city.	4.21	2.46	6.67

The well water contained nitrate of potash in sufficient quantity to admit of its separation by crystallization; and the predominant constituent in the other specimens was sulphate of lime.

There is now every reason to suppose that the water of Winter River will be brought into Charlottetown before long, through a proper system of supply pipes, although the same partisan feeling on the 'water question' finds expression there as elsewhere.

ESTIMATION OF PHOSPHORIC ACID.—As our deposits of apatite continue to be opened up, a rapid method for the determination of the percentage of phosphoric acid will become more and more a desideratum. Several articles have recently appeared on this subject in scientific journals, and the following abstract of one of them is given in the Journal of the Chemical Society for March*:

"Two grams of the phosphate to be examined are treated at the ordinary temperature with 50 c.c. of dilute hydrochloric or nitric acid, the solution is filtered, and the filtrate treated with citric acid, and then with excess of ammonia; the phosphoric acid is then precipitated with solution of magnesium chloride in excess, whereby the precipitated ammonio-magnesium phosphate is made to subside more rapidly than it would otherwise do The supernatant liquid is now separated from the precipitate by means of an aspiration-filter, and the precipitate is washed with ammoniacal water, which is afterwards removed by the same means. The precipitate is next dissolved by means of a few drops of nitric acid and the phosphoric acid estimated with uranium acetate solution, according to a modification of Leconte's method.

Boussingault has stated that an excess of ammonium citrate holds in solution a considerable portion of the ammonio-magnesium phosphate; but the author finds that by using not more than 80 to 100 parts of citric acid to one of phosphoric acid contained in the substance, no loss is experienced.

He also finds that by adding excess of magnesium chloride, keeping the proportion of citric acid within proper limits, adding the right quantity of ammonia in excess, and not allowing the total volume of the solution to exceed a certain amount, accurate results can be readily obtained in presence of lime, iron and alumina."

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* Any one interested in this matter should consult Joulin's paper in the 'Chemical News' for May 9th.