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THE

CANADIAN NATURALIST AND GEOLOGIST.

VOL. VIII. JUNE, 1863. No. 3.

ART. XIII.—*The Air-Breathers of the Coal Period in Nova Scotia;* by J. W. DAWSON, LL.D., F.R.S., &c.

(*Continued from page* 92.)

V. DENDRERPETON OWENI.

Plate IV.

Among the reptilian remains found in erect trees at the South Joggins, there have occurred several portions of skeletons, which from their sculptured cranial bones, plicated teeth, and the forms of their scales and limb-bones, I have referred to the genus *Dendrerpeton*, but to individuals of much smaller size than the full-grown specimens of *D. Acadianum.* It did not occur to me to suppose that these were specifically distinct from the larger individuals, until I observed that bones of this kind, contained in the collections sent by me to the Geological Society, or represented in the figures drawn to illustrate one of my papers, were referred by Professor Owen, in his notes on these specimens and figures, in the Journal of the Geological Society, to the genus *Hylonomus*; which is quite distinct from *Dendrerpeton*, as will be explained in the sequel.

I was thus induced to re-examine all the specimens in my collection, and the result has been to establish a strong probability that there is in reality a second species of *Dendrerpeton*, smaller than *D. Acadianum*, and differing from it in several points. This species I propose to name *D. Oweni.* It differs from *D. Acadianum* in the following particulars:—(1) Its much smaller size: (2) Its long and hooked teeth; Pl. IV, Figs. 2 to 8; (it will be seen that these teeth differ very markedly in their proportions and form from those of the larger species represented in Pl. III): (3) The greater plication of the ivory in the intermaxillary teeth; Figs. 8, 9; (in *D. Acadianum* these teeth are, on the outside, simple almost to the base, and plicated on the inner side, while in this species they are plicated all around like the inner maxillary teeth): (4) The form of the skull, which has the orbits larger in proportion, and is also shorter and broader. On the other hand, when we have described the species of *Hylonomus*, it will be seen that this animal, except in size, differs from them quite as widely as does *D. Acadianum*.

The distinctness of *D. Oweni* is further confirmed by the fact that I possess small jaw bones of *Dendrerpeton*, about the size of those of this species, but having the teeth similar in form to those of the larger species; these I suppose to have belonged to young individuals.

On examining the figures, it will be seen that the bones of the skull were corrugated as in the large *Dendrerpeton*, but with a smaller pattern. The forms of the jaw-bones also, and of the vertebræ, ribs, scapular bone, bones of the limbs, and bony scales, are very similar, and indicate that in general form this creature was not far removed from its larger relative. The bones of the foot, represented in Fig. 14, especially deserve attention. This is the most perfect foot of *Dendrerpeton* hitherto found; and I have enlarged it in the figure, in order more distinctly to show its parts. It presents three long toes, with traces of a smaller one at each side, so that there were probably five in all. If these toes be compared with the footprints on the slab discovered by Dr. Harding, represented in Pl. I, Fig. 2, it will be seen that they very closely correspond, though the toes of the present species are much smaller. The footprints are precisely those which we may suppose an animal of the size of *Dendrerpeton Acadianum* would have made, if, as the bones found render in every way probable, this larger species had a foot similar to that of *D. Oweni*. I suppose, for this reason, that these footprints are really those of *Dendrerpeton Acadianum*; and that this species continued to exist from the time of the lower coal measures, to the period when those higher beds of the series, in which its bones are found at the Joggins, were deposited.

The present species must have lived in the same places with its larger relative; but may have differed somewhat in its habits.

Its longer and sharper teeth may have been better suited for devouring worms, larvæ or soft-skinned fishes, while those of the larger *Dendrerpeton* were better adapted to deal with the mailed ganoids of the period, or with those smaller reptiles which were more or less protected with bony or horny scales.

VI. Remains of Skin and Horny Scales.

Plate I, Fig. 5; Plate IV, Figs. 22 to 34, and Plate V, Figs. 22 to 29.

In one of my earliest explorations of the reptile-bearing stumps of the Joggins, I observed on some of the surfaces, patches of a shining black substance, which on minute examination proved to be the remains of cuticle, with horny scales and other appendages. The fragments were preserved; but I found it impossible to determine with certainty to which of the species whose bones occur with them they belonged, or even to ascertain the precise relations of the several fragments to each other. I therefore merely mentioned them in general terms, and stated my belief that they may have belonged to the species of *Hylonomus*.* More recently other specimens have been obtained, and I have undertaken the detailed examination of the whole. I shall now endeavour to describe the principal or most continuous fragments, and afterward to consider the probabilities of their having belonged to certain of the reptiles entombed with them. I do this here, rather than under the titles of these several animals, on account of the uncertainty which still rests on the assignment of certain portions of this cuticle to the species in question, and which renders it more convenient to consider these peculiar remains in one place, and to compare the different portions with each other.

(1) One of my specimens is a flattened portion of cuticle $2\frac{1}{4}$ inches in length. The greater part of the surface is smooth and shining to the naked eye, and under the microscope shows only a minute granulation. A limited portion of the upper, and I suppose, anterior part is covered with imbricated scales, which must have been membranous or horny, and generally have a small spot or pore near the outer margin, some having in addition smaller scales or points on their surfaces, (Pl. IV, Figs. 22 and 25). In contact with the upper part of this specimen there were many fragments of the skull of *Dendrerpeton Oweni*.

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* Journal of Geological Society, Vol. XVI.

(2) Another portion of cuticle, similarly marked, appears to preserve the form of the posterior part of the body and tail of the animal, and also a mark representing the point of attachment of the hind leg; near to which, and along the dorsal ridge, is a portion of the skin covered with much smaller scales. It is represented in Pl. I, fig. 5. This was found in close proximity to a mass of bones of *Dendrerpeton Oweni*, mingled with some of *Hylonomus Lyelli*.

(3) A third and still larger surface of integument with similar markings, has upon it a number of vertebræ and detached bones of the small reptile *Hylonomus Wymani*, to be described in the sequel; for which species however it would be much too large a covering.

(4) Another well preserved fragment, less than two inches in length, exhibits very different markings. It is nearly covered with very small imbricated scales, thicker than those on the specimens previously described. On either side of what seems to have been the middle line of the back, there is a series of pointed flat horny processes, which probably formed a double spinous crest. Without these there are tufts of strong bristles, and exteriorly to these last are rows of flat, thick, horny plates, transversely wrinkled. Near to these was a row of conical truncated tubercles. Sections of these appendages show them to have been horny and attached to the cuticle. None of them have bony structure. Figs. 23, 26, 27, 28, 29, 30, Pl. IV, represent this portion of cuticle, with magnified views of its markings, and of the structure of one of the thicker scales. Fig. 26 shows a portion of the ordinary scaly skin magnified and viewed by transmitted light. Fig. 27 exhibits a few of the bristle-like appendages from the point marked *a* in fig. 23. Fig. 28 shows four of the bluntly-conical points seen in a portion of skin a little beyond the margin of the fragment in fig. 23, but evidently belonging to it. Fig. 24 is an enlarged representation of one of the flat horny scales from the point *b* in fig. 23; and fig. 29 is a magnified section of a portion of the same scale, showing a compact translucent brown substance with round canals, and near the margin, a portion much more abundantly supplied with these apparently vascular canals, while without this part there is a thin layer of more dense material. Fig. 30 shows a portion of the surface of fig. 23, more highly magnified, and displaying at *a* ordinary scales, at *b* horny pointed organs, at *c* bristly appendages, and at *d* large

plates. The whole of these parts, though displaced by the flattening and wrinkling of the skin, are in good preservation, and show their characters in great perfection under the microscope. They are all black and shining as if carved in jet.

(5) Near this last portion of cuticle, and possibly belonging to it, are pointed and probably membranous appendages, marked on each side with rows of scales not overlapping, and each with a pore in its centre. The manner in which these appendages are bent and wrinkled, shows that they must have been soft, except at the tips, which seem to have been hard and horny, and they are arranged in series, as if originally placed along the sides of the neck or abdomen, or both. These appendages are represented in Pl. IV, figs. 31 and 32. A magnified representation of the point of one of them is given in fig. 33, and a small portion, still more highly magnified, in fig. 34. The use of these appendages it is not easy to conjecture. They remind us of the gular pouches of iguana, and of the lateral expansions of some geckos and of the *Draco volans*. Possibly they formed lateral parachutes, aiding the animal in moving over soft mud, or perhaps in leaping or swimming.

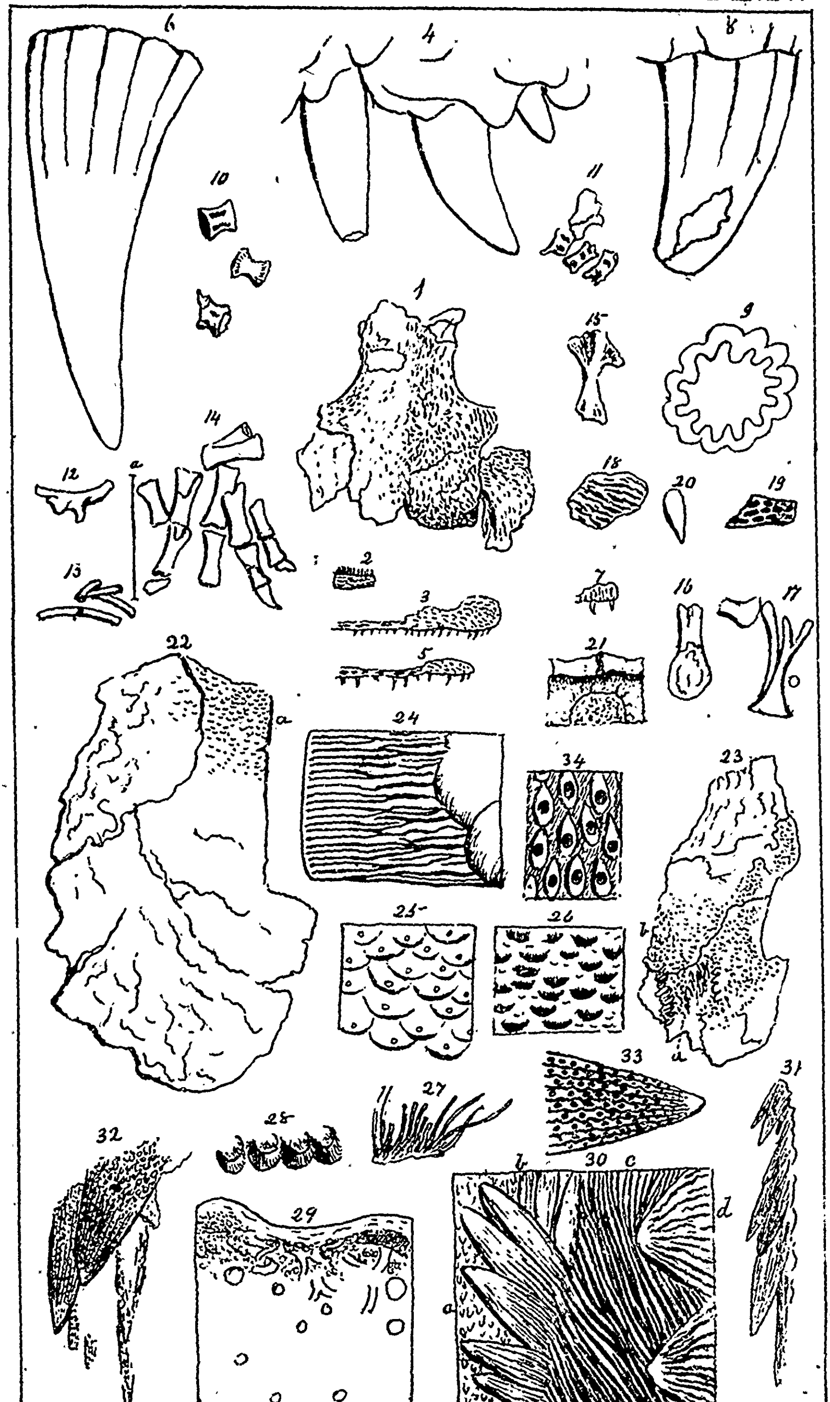
(6) Some other fragments appear to have belonged to a different species from either of the foregoing, and are represented in Pl. V. The best preserved specimen (Fig. 22), which is about one inch in length and half an inch in breadth, is covered with very small imbricated scales. It is crossed by six or seven obscure ridges, which both at the bottom and along a mesial line, projected into points covered with larger scales. A row of large scales with round pores, connects these along the lower side (Figs. 23 and 24.) If, as seems probable, this fragment belonged to the side of the trunk or tail, it would perhaps indicate a division of the sub-cutaneous muscles into an upper and lower band, as in the newts. A separate fragment, with transverse horny ridges (Figs. 26 and 27), and another with a longer lobe similar in structure to those above mentioned (Figs. 28 and 29), may perhaps be referred to the same animal. A larger patch of skin presents similar imbricated scales, but without a mesial line, and with an edging of larger scales (Fig. 25).

Six species of reptiles have left their bones in the repositories containing these remnants of cuticle. Of these, *Dendrerpeton Acadianum* was an animal of too great size to have been clothed with integument of this character and of such dimensions. *Hylo-*

nomus aciedentatus, described in Section VIII, and *Hylerpeton Dawsoni*, Section X, are each represented by only a single specimen, and these did not occur in proximity to any of the portions of cuticle, except that the appendages in Pl. IV, fig. 32, were found near a specimen of the former. Of the three remaining species, *Dendrerpeton Oweni*, from its size, the number of specimens found, and the juxtaposition of their bones to the fragments of cuticle, appears to have the best claim to the integument included under Nos. 1, 2, and 3; and in this case, while the creature had its throat, and perhaps its abdomen, armed with bony scales, its upper parts and tail, as well as its limbs, had a uniform covering of small thin imbricated horny scales, in the manner of many modern reptiles.

If the remaining portions of integument, Nos. 4 and 5, as would seem likely, belonged to two species, both of smaller dimensions, there would seem little reason to doubt that these were *Hylonomus Lyelli* (Section VII) and *H. Wymani* (Section IX). In this case, both of these species must have possessed a highly ornate covering of horny scales and appendages, comparable with that of any of the modern lizards, while there seems good reason to believe, as stated in a previous paper, that they were in part protected by bony scales somewhat like those of *Dendrerpeton*. These points, however, we shall consider more in detail under the sections which refer to the species of *Hylonomus*.

Before leaving these curious specimens of ancient skin, the most ancient I suppose known to exist, it is of interest to observe that the thicker portions, when broken across, have the aspect of jet, or of pure shining coal, and that thin slices, under the microscope, have the same rich brown colour with that material, though rather more translucent. When burned, fragments of the substance give a strong flame, and a bituminous and ammoniacal odour. We have thus an example of the production of coal from animal membrane, no doubt gelatinous and horny in the first instance, but which has proved itself capable of the same chemical changes that have been experienced by the vegetable matter buried with it. In order that this substance should be preserved in this way, it would be necessary that it should either be kept dry and hard, or that it should be immediately buried in matter impervious to air, and kept moist. The latter conditions are the more probable. The preservative qualities of the peaty vegetable matter imbedded with it must also be considered; and it is possible that these hol-



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DENDRERPETON OWENI *Dawson* (Figs. 1 to 21.)
Skin & Horny Scales (Figs. 22. &c.)

low stumps partly filled with fragments of Sigillaria bark, may have formed natural tan-pits, in which animal membranes would be preserved in a manner impossible in ordinary sediments. If this were the case, we may yet find an entire reptile, preserved as a flattened mummy, in one of these strange repositories.

Explanation of Plate IV.

Dendrerpeton Oweni, and Dermal Appendages.

Fig. 1.—Skull.
" 2.—Portion of mandible.
" 3.—Maxillary bone, with outer teeth.
" 4.—Teeth of same enlarged.
" 5.—Maxillary bone, with inner teeth.
" 6.—Tooth of same enlarged.
" 7.—Intermaxillary.
" 8.—Tooth of same enlarged.
" 9.—Section of same enlarged.
" 10 and 11.—Vertebræ.
" 12.—Portion of pelvis.
" 13.—Fragments of ribs.
" 14.—Bones of foot enlarged, (*a*) natural size.
" 15.—Scapular bone.
" 16.—Humerus.
" 17.—Bones of hind leg.
" 18 and 19.—Sculpturing of cranial bones, enlarged.
" 20.—Bony scale.
" 21.—Socket of inner tooth enlarged.
" 22 and 25.—Integument of *Dendrerpeton Oweni*, with imbricated scales.
" 23.—Integument of *Hylonomus Lyelli.*
" 24, 26, 27, 28, 30.—Scales and appendages of the same enlarged.
" 29.—Section of scale represented in Fig. 24.
" 31.—Angular pendants or processes of *H. Lyelli.*
" 32.—The same of *H. aciedentatus.*
" 33 and 34.—Portions of the same enlarged.

VII. Hylonomus Lyelli.

Plate V.

In the original reptiliferous tree, discovered by Sir C. Lyell and the writer, at the Joggins, in 1851, there were, beside the bones of *Dendrerpeton Acadianum*, some small elongated vertebræ, evidently of a different species. These were first detected by Prof. Wyman, in his examination of these specimens, and were figured, but not named, in the notice of the specimens in the Journal of the Geological Society, Vol. IX. In a subsequent visit to the Joggins, I obtained from another erect stump many additional remains of these smaller reptiles, and, on careful comparison of the specimens, was induced to refer them to three species, all apparently generically allied. I proposed for them the generic name *Hylonomus*, "forest-dweller." They were described in the proceedings of the Geological Society for 1859, with illustrations of the teeth and other characteristic parts.* The smaller species first described I named *H. Wymani*; the next in size, that to which this article refers, and which was represented by a larger number of specimens, I adopted as the type of the genus, and dedicated to Sir Charles Lyell. The third and largest, represented only by a few fragments of a single skeleton, was named *H. aciedentatus*.

Hylonomus Lyelli was an animal of small size. Its skull is about an inch in length, and its whole body, even if, as was likely, furnished with a tail, could not have been more than six or seven inches long. No complete example of its skull has been found. The bones appear to have been thin and easily separable; and even when they remain together, are so much crushed as to render the shape of the skull not easily discernible. They are smooth on the outer surface to the naked eye; and under a lens show only delicate uneven striæ and minute dots. They are more dense and hard than those of *Dendrerpeton*, and the bone-cells are more elongated in form. The bones of the snout would seem to have been somewhat elongated and narrow. A specimen in my possession shows the parietal and occipital bones, or the greater part of them, united and retaining their form. We learn from them that the brain-case was rounded, and that there was a parietal foramen. There would seem also to have been two occipital condyles; (see plate V, fig. 8.). Several well preserved specimens of the maxillary and mandibular bones have been obtained. They are smooth, or nearly so, like those of the skull, and are furnished with numerous sharp, conical, teeth, anchylosed to the jaw, in a partial groove formed by the outer ridge of the bone. In the anterior part of the lower jaw there is a group of teeth larger than the others. The intermaxillary bone has not been observed. (Figs. 1, 2, 3, 4, 5, 6.) The total number of teeth in each ramus

* Journal of Geological Society, Vol. XVI.

of the lower jaw was about forty, and the number in each maxillary bone about thirty. The teeth are perfectly simple, hollow within, and with very fine radiating tubes of ivory. (Fig. 7, *a* and *b*.) The vertebræ have the bodies cylindrical or hour-glass shaped, covered with a thin, hard, bony plate, and having within a cavity of the form of two cones, attached by the apices. This cavity was completely surrounded by bone, as it is filled with stained calc-spar in the same manner as the cavities of the limb bones. It was probably occupied by cartilage. The vertebræ were apparently bi-concave. The neural spines are short and broad, with zygapophyses, and are not separable from the bodies, the neural arches being perfectly anchylosed to the bodies of the vertebræ. There are, on the dorsal vertebræ, strong diapophyses or lateral spines, to which the ribs were articulated. (Figs. 15, 16, 17.) The ribs are long, curved, and at the proximal end have a shoulder and neck. (Figs. 1, 10, 18.) They are hollow, with thin hard bony walls. The anterior limb, judging from the fragments procured, seems to have been slender, with long toes, four or possibly five in number. A humerus is seen in fig. 1, and bones of the toes magnified in fig. 11. The posterior limb was longer and stronger, and attached to a pelvis so large and broad as to give the impression that the creature enlarged considerably in size toward the posterior extremity of the body, and that it may have been in the habit of sitting erect. The thigh bone is well formed, with a distinct head and trochanter, and the lower extremity flattened and moulded into two articulating surfaces for the tibia and fibula, the fragments of which show that they were much shorter. The toes of the hind feet have been seen only in detached joints. They seem to have been thicker than those of the fore foot. Detached vertebræ, which seem to be caudal, have been found, but the length of the tail is unknown. The limb bones are usually somewhat crushed and flattened, especially at their articular extremities, and this seems to have led to the error of supposing that this flattened form was their normal condition; there can be no doubt, however, that it is merely an effect of pressure. The limb bones present in cross section a wall of dense bone with elongated bone-cells, surrounding a cavity now filled with brown calc-spar, and originally occupied with cartilage or marrow. (Figs. 12, 13, 14.) Nothing is more remarkable in the skeleton of this creature than the contrast between the perfect and beautiful forms of its bones, and their imperfectly ossified condition, a circumstance which raises the question whether these specimens may not represent the young of some reptile of larger size.

The dermal covering of this animal is represented in part by oval bony scales, which are so constantly associated with its bones that I can have no doubt that they belonged to it, being, perhaps, the clothing of its lower or abdominal parts; while above, it was probably clad in the beautiful scaly covering described in the last section. The bony scales are represented magnified in Plate V. figs. 19. 20, and 21. It will be seen that they differ in form from those of *Dendrerpeton;* they are also much thicker. On the inner side they are concave, with a curved ledge or thickened border at one edge. On the outer side they present concentric lines of growth.

The only specimens which afford much information as to the general form of *Hylonomus Lyelli* are those represented in Plate V, figs. 1 and 9. The first is the original specimen, from which I described the species in the paper already referred to. The bones, being small and of dark colour, are not very conspicuous, and many of them are broken, but many are beautifully perfect; and even those which are removed have left very distinct moulds of their form in the fine-grained matrix. In the figure I have carefully traced their outlines in their natural position, with the exception of the maxillary bone and mandible, which are removed from their place in the matrix, to bring the whole into a more compact form. The specimen also shows, in addition to the bones delineated, many fragments of the skull and scapular bones, crushed in such a manner that their forms cannot be distinguished. The specimen shows remains of thirty vertebræ, of which four appear to belong to the neck, and the rest are probably nearly all dorsal and lumbar. Three of the most perfect are represented enlarged, in figs. 15 and 16. Of about twenty ribs, more or less complete fragments remain. The fore limb is represented only by the impression of a humerus, (*e*), but other bones which may have belonged to it are scattered elsewhere on the stone. The pelvis, (*i*) is nearly entire, though crushed and flattened. One thigh bone remains tolerably perfect, and beside it lie the tibia and a part of the fibula, with several bones of the foot. The dimensions of these parts are as follows:—

Length of maxillary	0.7 inch.
" mandible	0.7 "
" longest rib, (chord)	0.6 "
" humerus	0.5 "

Length of femur	....	0.7 inch.
" tibia	....	0.45 "
" principal bone of pelvis	....	0.7 "

The other specimen above referred to, (Fig. 9.) shows the bones of the trunk, and part of those of the hind and fore limb of a small individual, nearly in their natural position. This specimen I have very recently obtained, in breaking open a mass of matrix in which I did not suspect its existence. It shows the humerus and radius and ulna in a tolerable state of preservation, with a fragment of the scapula. About thirteen dorsal and lumbar vertebræ can be made out, nearly in their natural position; and there are remains of five of the ribs. The hind limb is represented by fragments of the femur, tibia, and fibula. I believe that the maxillary represented in fig. 3, though now in a detached piece of stone, belonged to this skeleton.

While referring to these, my most perfect specimens, I think it proper to quote my original description of the species, based on the first of them, and published in 1859; as the subject has since been unfortunately obscured by inaccurate descriptions, consequent on the mixture of specimens and drawings, sent by me to London for further examination. I quote from the journal of the Geological Society, Vol. XVI.

"HYLONOMUS, gen. nov."

"The other reptilian remains represent three species belonging to a generic form, which, so far as I am aware, has not been previously observed, and for which, in allusion to its forest habitat, I propose the above name. As its typical species I shall describe that which I would name *Hylonomus Lyelli.* Its cranial bones are thin and smooth; the condyle I have not been able to observe, but there is a parietal foramen, and the parietal bones are arched in such a manner as to indicate a rounded rather than flattened skull, and a somewhat capacious brain-case. Its teeth are numerous (about twenty-six in each maxillary bone), elongated, conical, closely set in a single series, in a furrow, protected externally by an elevated alveolar ridge. In the intermaxillaries and extremities of the mandibles the teeth are larger than elsewhere. Fig. 14, (Fig. 5, Plate V. of this paper) represents a portion of the teeth of the maxillary bone as exposed by the fracture of the outer ridge. The vertebræ are imperfectly preserved, but appear to have been ossified, bi-concave, and with well-developed spinous processes. The ribs are long and curved; and there are traces of numerous accessory pieces which have been attached to their extremities. The pelvis is of large size and remarkable form; the ilium long and expanded below; the ischium greatly expanded; the pubis expanded and triangular where it joins the ischium, and round and arched toward the symphysis. The femur is thick and nearly straight, the tibia short and stout, the fibula slender, the phalanges broad. The hind limb thus largely developed must have been capable of supporting the whole weight of the body in standing or leaping. The anterior extremities appear to have been comparatively slender, with thin and long fingers. A few scattered vertebræ lying posteriorly to the pelvis, may perhaps be remains of a tail. There was a dermal covering of small ovate bony scales, of which, however, only a few scattered specimens remain. This species is evidently quite remote from the ganocephalous and labyrinthodont types of batrachians, and in many respects approaches to lacertians. It may perhaps be allied to the *Telerpeton* of Elgin, but does not appear to resemble any reptile hitherto found in the coal-formation."

It is evident, from the remains thus described, that we have in *Hylonomus Lyelli* an animal of lacertian form, with large and stout hind limbs, and somewhat smaller fore limbs, capable of walking and running on land; and though its vertebræ were imperfectly ossified externally, yet the outer walls were sufficiently strong, and their articulation sufficiently firm, to have enabled the creature to erect itself on its hind limbs, or to leap. They were certainly proportionally larger and much more firmly knit than those of *Dendrerpeton.* Further, the ribs were long and much curved, and imply a respiration of a higher character than that of modern batrachians, and consequently a more highly vitalized muscular system. If to these structural points we add the somewhat rounded skull, indicating a large brain, we have before us a creature which, however puzzling in its affinities when anatomically considered, is clearly not to be ranked as low in the scale of creation as modern tailed batrachians, or even as the frogs and toads. We must add to these also, as important points of difference, the bony scales with which it was armed below, and the ornate apparatus of horny appendages, with which it was clad above. These last, as described in the last section, and illustrated in Plate IV., shew that this little animal was not a squalid, slimy dweller in mud, like *Menobranchus* and its allies, but rather a beautiful and sprightly tenant of the coal-formation thickets, vying in brilliancy, and perhaps in colouring, with the insects which it pursued and devoured. Remains of as many as eight or ten individuals have been obtained from three erect sigillariæ, indicating that these creatures were quite abundant, as well as active and terrestrial in their mode of life.

With respect to the affinities of this species, I think it is abundantly manifest that it presents no close relationship with any reptile hitherto discovered in the Carboniferous system. The only indications of which I am aware of animals of this age, likely to be of similar type, are certain vertebræ discovered by Mr. Wheatley and Dr Newberry, in the coal formation of Ohio, and described, but not named, by Prof. Wyman, in Silliman's Journal, Vol. XXV, in connection with the singular bratrachian named by him *Raniceps Lyelli ;* which, in its broad frog-like head and want of ribs, differs materially from the creature now under examination. It is scarcely necessary to say that the characters above described, and illustrated by the figures in Plate V, entirely remove this animal from *Archegosaurus* and *Labyrinthodon*, as well as from all the other creatures associated with them in the orders *Ganocephala* and *Labyrinthodontia* of Owen. Equal difficulties attend the attempt to place it in any other group of recent or extinct batrachians or proper reptiles. The structures of the skull, and of some points in the vertebræ, certainly resemble those of batrachians; but on the other hand, the well-developed ribs, evidently adapted to enlarge the chest in respiration, the broad pelvis, and the cutaneous covering, are unexampled in modern batrachians, and assimilate the creature to the true lizards. I have already, in my original description above quoted, expressed my belief that *Hylonomus* may have had lacertian affinities, but I do not desire to speak positively in this matter; and shall content myself with stating the following alternatives as to the probable relations of these animals. (1) They may have been true reptiles of low type, and with batrachian tendencies. (2) They may have been representatives of a new family of batrachians, exhibiting in some points lacertian affinities. (3) They may have been the young of some larger reptile, too large and vigorous to be entrapped in the pit-falls presented by the hollow Sigillaria stumps, and in its adult state losing the batrachian peculiarities apparent in the young. Whichever of these views we may adopt, the fact remains, that in the structure of this curious little creature we have peculiarities both batrachian and lacertian, in so far as our experience of modern animals is concerned. It would however accord with observed facts in relation to other groups of extinct animals, that the primitive batrachians of the coal period should embrace in their structures, points in after times restricted to the true reptiles. On the other hand, it would equally accord with such facts that the first-born of laçertians should lean toward a lower type, by which they may have been preceded. My present impression is, that they may constitute a separate family or order, to which I would give the name of MICROSAURIA, and which may be regarded as allied, on the one hand, to certain of the humbler lizards, as the GECKO or AGAMA, and, on the other, to the tailed batrachians.

It is likely that *Hylonomus Lyelli* was less aquatic in its habits than *Dendrerpeton*. Its food consisted, apparently, of insects and similar creatures. The teeth would indicate this, and near its bones there are portions of coprolite, containing remains of insects and myriapods. It probably occasionally fell a prey to *Dendrerpeton*, as bones, which may have belonged either to young individuals of this species or to its smaller congener *H. Wymani*, are found in larger coprolites, which may be referred with probability to *Dendrerpeton Acadianum*.

EXPLANATION OF PLATE V.

Hylonomus Lyelli, and Dermal appendages.

Fig. 1.—Remains of a skeleton of a large individual of *Hylonomus Lyelli;* (*a*) Maxillary; (*b*) Mandible; (*c*) Ribs; (*d*) Vertebræ; (*e*) Humerus; (*f*) Femur; (*g*) Tibia; (*h*) Fibula, (*i*) Pelvis; (*k*) Foot.

" 2.—Right Mandible.

" 3.—Maxillary.

" 4, 5.—Portions of Maxillary, magnified.

" 6.—Extremity of Mandible, magnified.

" 7.—Sections of teeth; (*a*) magnified, (*b*) highly magnified.

" 8.—Portion of cranium, magnified; (*a*) natural size, (*b*) transverse section.

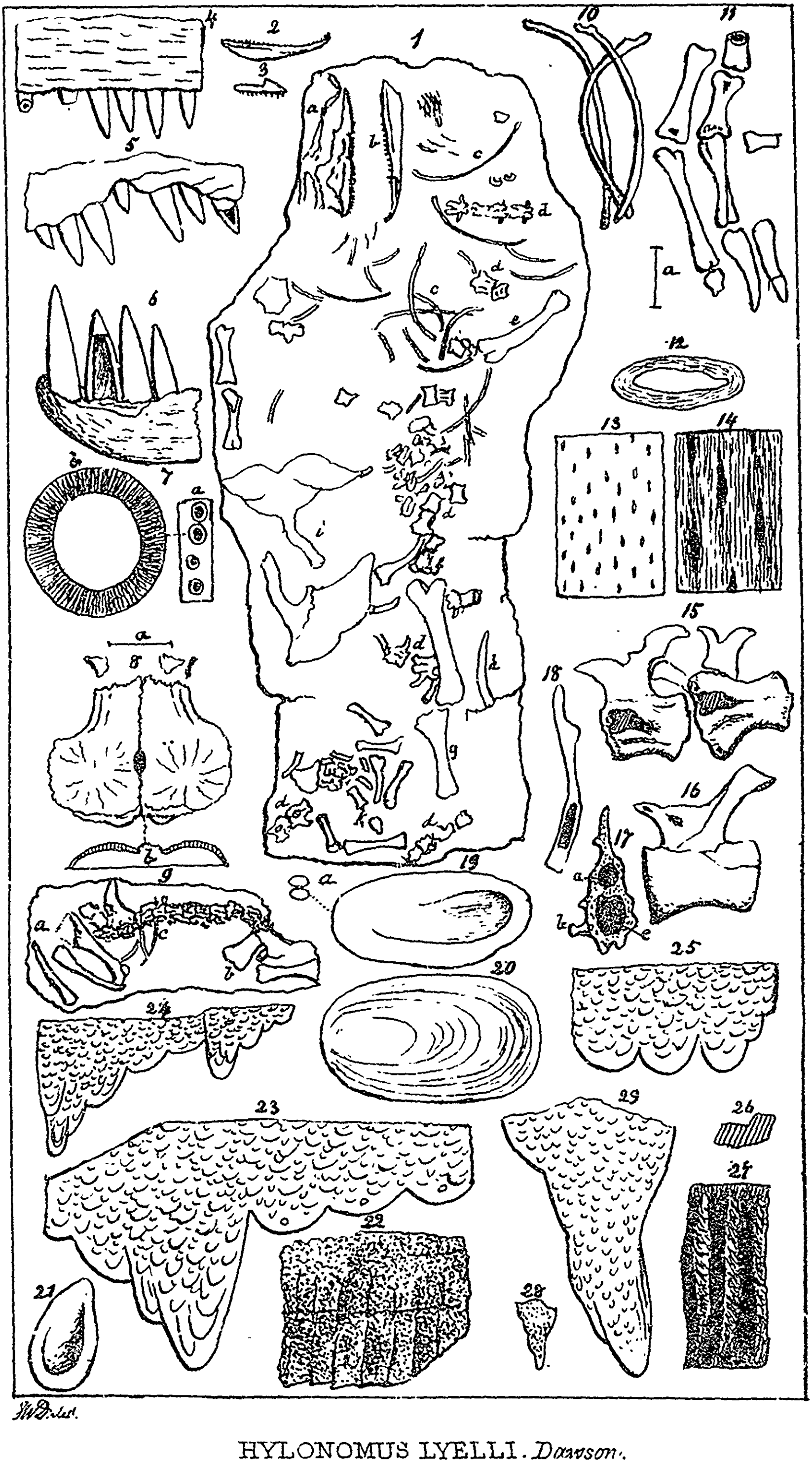
" 9.—Skeleton of the trunk of a small individual of *H. Lyelli;* (*a*) Fore limb, (*b*) Hind limb, (*c*) Ribs.

" 10.—Ribs from the slab, Fig. 1, magnified.

" 11.—Fore foot, magnified; (*a*) natural size.

" 12.—Cross section of flattened femur, magnified.

" 13, 14.—Portions of the bone of the same, more highly magnified.



H.W.D. del.

HYLONOMUS LYELLI. *Dawson*.

Fig. 15.—Pair of Vertebræ (dorsal), magnified.
" 16.—Vertebra magnified.
" 17.—Vertebra broken across and magnified, showing (*a*) neural arch, (*b*) diapophysis, and (*c*) central cavity.
" 18.—Head of a rib, magnified.
" 19, 20, 21.—Bony scales, magnified, (*a*) natural size.
" 22.—Portion of cuticle, probably of *Hylonomus Wymani.*
" 23, 24.—Parts of the same magnified.
" 25.—Lower margin of another portion of cuticle, magnified.
" 26, 27.—Ridged horny scale, natural size and magnified.
" 28, 29.—Cutaneous lobe, natural size and magnified.

(To be continued.)

ART. XIV.—*On the Superficial Geology of the Gaspé Peninsula;* by ROBERT BELL, C. E.; of the Geol. Survey of Canada.

(Read before the Natural History Society.)

The Gaspé peninsula embraces the region lying to the eastward of a line drawn across the country from the head of the Bay of Chaleur to about Matan on the St. Lawrence, and measures 140 miles in length by 70 in breadth.

The superficial accumulations of this district differ in their general character from those of the country to the west. One of the most remarkable points of difference is the absence of foreign boulders in Gaspé. On arriving in Gaspé Bay last spring, my attention was at once arrested by the contrast presented to many other parts of the country by the general scarcity of boulders of any kind in the fields, notwithstanding the hilly nature of the ground. On examination it was found that the loose masses were chiefly confined to the summits and more abrupt slopes of the hills, and farther, that they always belonged to rocks which existed *in situ* close by. During the whole summer, which was spent mostly in the interior of the County of Gaspé, my attention was directed to the inquiry; but I failed to discover a single stone which had not been derived from the rocks of the country, until I visited Cape Gaspé and Point Peter, where boulders of Laurentian gneiss were found in abundance on the sea beach. While the erratic masses of the interior are probably due to ancient glacial action, the presence of the Laurentian boulders on the beach, on the northern sides of Cape Gaspé and Point Peter, is no doubt owing to recent icebergs. The proof of this lies in the fact of their occurrence only on the beach, and that at points projecting into the open sea frequented by drifting ice, while they appear to be altogether absent from the shores of the bay between these points. Gaspé Bay remains covered with fixed ice till late in the spring, and thus icebergs from the north are prevented from entering it. This want of far-transported boulders over such a large area, is a fact of great importance; for when we find loose fragments of useful minerals in this region we may be sure their source is not far off.

In the Gaspé country the geologist is not aided by artificial excavations; but the superficial strata may be studied in the natural sections afforded by land slides, and by the wearing away of the banks along the rivers and coast. Excepting the patches close to the shore, there is an entire absence of the flat-lying clay and regularly bedded sand so widely spread in the St. Lawrence valley to the westward. Along the river valleys, great accumulations of loose gravel are spread over the unmodified drift, or boulder formation, and on the lower levels the gravel is covered with loam or silt. In passing through the intervals, the streams in many places eat away their banks, first on one side and then at the next bend below, on the opposite side, depositing the material on the banks alternately opposite, and in this way the minor courses of a river are changed in a few years. At one time a small portion of the York River, at high water, flowed through a narrow channel, north of the main one, for a distance of about two miles, just before reaching the head of tide water. About twenty years ago, some obstructions were removed from this channel to allow timber to pass down it; and since that time it has become gradually enlarged, until now the whole river passes through it, except during freshets, when a part is forced through the old channel.

A vast amount of material must be transported every year from the land into the sea by the action of these streams. The greater portion of it is carried out from the shore by the currents and deposited on the bottom of the sea. Alluvial islands and mud flats are formed at the mouths of some of the rivers which enter the sea in sheltered situations. The most conspicuous of these are found in Gaspé Bay, at the mouths of the Dartmouth and York Rivers, where the meadow islands, comprising hundreds of acres, furnish pasture and hay for the horses and cattle of the settlers in the neighbourhood. Natural dykes are thrown up along the borders of these islands, and upon them long rows of trees and bushes venture out beyond the outline of the woods upon the upper islands.

Along the rivers, the silt is from one to six feet and even more in thickness, and is frequently found to consist of very thin layers, separated by films of vegetable matter, probably marking the annual increase. Near the sea level, the silt is generally more than six feet in depth, and is much mixed with prostrate timber, often in such quantities as to suggest the idea that they are jammed accumulations of drift-wood which have been gradually buried beneath the soil.

Besides underlying the river intervals, the unmodified drift frequently occupies the smaller valleys and ravines, to a considerable depth. It consists generally of a stiff and sticky mixture of coarse sandy clay with gravel and boulders. The majority of the boulders are small, and many of them are longitudinally grooved and striated. It is impossible to say what thickness this boulder formation may attain, but it was seen exposed in many places to a depth of at least 100 feet. So far as the evidence afforded by the materials themselves is concerned, it would thus appear to be of local glacial origin. Some of the banks occur in such situations as to suggest the idea of their having been terminal moraines of the glaciers which once ran down the valleys. No ice grooves have hitherto been observed upon the solid rocks, probably because these are seldom or never uncovered in situations where their occurence might be looked for. Grooves were found on the rocks at the head of the fall on the Dartmouth, and a fall at the mouth of its first large tributary from the north. These were no doubt produced by stones borne by the ice and drift timber which are swept rapidly down with the freshets in spring. These current scratches are quite short, and made upon an uneven surface; while true glacial furrows are continuous, and always occur on a smoothed or planed base. Some years ago, the tributary just referred to, cut off a narrow neck of land which separated it from the river for several hundred yards, so that it now enters it in a direct course, at right angles to that of the river. At every spring freshet, since this change took place, it has precipitated a large quantity of shingle over the ledge at its mouth, into the bed of the river, and in this way a bank has been formed opposite to the fall which is already as wide as the former channel of the river, and is every year increasing in extent, and turning the main stream farther out of its original course.

The small amount of debris usually found about the cliffs would seem to indicate that the country had existed in its present condition for a comparatively short period; but on the other hand, there are facts which shew that the present state of things has continued for a very great length of time. The principal of these are the accumulation of sand bars and points along the coast, and the wearing of the solid rocks in the channels of the rivers. About ten miles from its mouth, the Darmouth river crosses the Gaspé limestone in a gorge varying from 100 to 200 feet deep, cut through the whole formation, which is more than 2,000 feet thick, and tilted up at an angle of 45 degrees. At the Mountain Portage, on the Magdalen, the river flows in a deep and narrow ravine cut in the shale for a distance of a mile below the high fall. It is not asserted that these ravines have been excavated altogether by the rivers themselves, but they appear to have deepened them considerably. The second stretch of the York River cuts the Gaspé limestones and sandstones almost at right angles to their strike, and often flows for a considerable distance between perpendicular walls of sandstone, from twenty to eighty feet in height. The river itself appeared to have been the principal agent in wearing these channels. In some places large masses of the sandstone, which are known to have fallen from the cliffs within a recent period, are diminishing rapidly every year by the action of the ice and water, while the accumulations of the fragments, which are seen at every bend, when the water is low, afford striking evidence of the great wearing and transporting power of this rapid stream. Where the sandstone beds lie almost horizontally the river has in some cases cut for itself a very deep and narrow channel in the bottom of the main gorge. Two of these narrows, as they are termed, are only about one foot wide, and yet the whole volume of the river, at its ordinary height, passes through these confined spaces. It was necessary of course, to carry our canoes at these places, and although the extremely narrow portions were only a few yards in length, the channels leading into them were in both cases so crooked as scarcely to allow the canoes to turn between the walls. The sandstone beds in this part of the river are almost everywhere riddled with pot-holes. Many of them are very deep, and by their constant enlargement they sometimes meet and merge into one another. In this way one of the narrow places just described has been partly formed. One of the pot-holes measured thirteen feet in depth and eleven feet in diameter, and many others close by were nearly as large. The surface of the rock at the top of one of the cliffs, about twenty feet above the present river bed, was observed to be worn smooth by the action of water, and covered by several feet of gravel.

Behind St. John's Bay on the west coast of Newfoundland Mr. James Richardson observed a set of ancient sea margins, seven in number, rising above one another at intervals varying from 50 to 150 feet. The lowest is 500, and the highest 1225 feet, above the sea, and each is marked by a horizontal belt of boulders and pebbles of Potsdam sandstone, arranged by the waves of the sea when it stood at these levels. At Blanc-Sablon Bay, on the Labrador side of the Straits of Belleisle, as many as fourteen distinct terraces with beach gravel on each, occur between 47 and 357 feet above high-water mark. There is thus sufficient evidence of a great depression and subsequent elevation of the land in this region, while in Gaspé a bank of stratified sand and gravel, eighty feet high, which occurs on the Magdalen River at an elevation estimated at 1600 feet above the sea, and similar deposits at many intermediate levels, indicate that a gradual rise of equal amount has taken place in the peninsula, but possibly at a different period. I am not aware that far transported boulders have been noticed anywhere on the high lands between Gaspé and the meridian of Quebec, but must leave this uncertainty, and also the reason of their apparent absence in Gaspé, to be solved by future research, and proceed to describe the modified drift of the district.

The narrow border of clay land extending almost continuously from Quebec along the south side of the St. Lawrence, terminates a few miles below Matan; and to the east of this locality only a few small patches of clay occur on the north coast. The largest of these is at the mouth of the Magdalen River, and comprises about 1000 acres on the west side of Magdalen Bay. It is probably fit for the manufacture of bricks, and holds marine shells. No stratified clay whatever appears to exist on the eastern coast, but in the southern part, it occurs along the Bay of Chaleur for some distance on each side of the mouth of the Great Cascapedia River. In this clay, Sir William Logan found shells of *Mya* and *Saxicava* in a great number of beds lying above one another, to the height of seventeen feet over high-water mark, in the position which they occupied when in life. Each bed is separated from the one below it by a thin layer of sand, which also fills the tubular openings through which the inhabitants of the shells once communicated with the surface. At L'Anse au Gascon, near Port Daniel, *Mya arenaria*, *M. truncata*, *Cardium Grœnlandicum*, and

Tellina proxima were found in sand at about fifteen feet above high-water mark. The gravel beds which have been already mentioned as existing along the river valleys, are sometimes arranged in terraces. One of the most striking examples of this, is met with six miles up the York River. Here a regular terrace about thirty-five feet high comes to the north side, and runs almost straight for about three miles, cutting off the bends of the river. About twenty-five miles up the same stream, and more than 400 feet above the sea, the gravel is almost destitute of vegetation, and is worn into a number of terraces and mounds. Terraces were observed not far from the shore at Grand Pabos and on the west side of Mal Bay. Three of the most conspicuous at the last mentioned locality were estimated at eight, fifteen and fifty feet above the sea. On the south side, of the northwest arm of Gaspé Bay, an ancient beach, 154 feet above the water, is marked by a sudden step along a hill-side, and traces of other beaches are found at lower levels. On the north side of the peninsula a terrace is met with in many localities at an average height of fifty feet. At the mouth of the Matan River, the upper six feet of this terrace is of fine sand resting upon bluish clay; at their junction are found *Natica clausa*, *Mya arenaria*, *Tellina Grœnlandica*, *Mytilus edulis*, and *Mesodesma Jauresii*, together with *Balanus crenatus*. West of Matan a well marked terrace of the same height occurs one mile below the Metis River. Eight miles up this river, *Balanus Hameri*, *Natica clausa* and *Saxicava rugosa* are found at the height of 245 feet above the sea; and two miles west of the mouth of the same river, *Saxicava rugosa* and *Mya arenaria* occur in sand at the height of 130 feet.

An upheaval of the land appears to be going on, along the south side of the lower St. Lawrence. At Rivière du Loup, *Tellina Grœnlandica*, and a large variety of *Mya arenaria* are imbedded in great numbers, in the sand and disintegrated shale of raised beaches along both sides of a rocky ridge running eastward from the Government Quay, and varying from about five to about fifteen feet above the highest tides. To the east of Rivière du Loup, narrow terraces or raised beaches are met with in many localities, favorable to their preservation, along the coast as far as Cape Gaspé. They are found at numerous heights from the present sea level to fifteen feet above it. A terrace about five feet above the high-tide mark, and averaging 100 yards in breadth, extends from Rimouski to Whale Cape, with the exception of some interruptions caused by steep and rocky portions of the coast. It is composed of fragments of shells, and the ruins of the rocks which rise in the banks behind it, and forms an excellent road-bed, as well as a productive soil. The shells of these terraces belong to the same species as those now living on the shore, and among them the *Mesodesma*, which is not found in the post-pliocene deposits about Quebec or Montreal, is particularly abundant, immense numbers of these shells sometimes occurring in groups without any intermixture of sand or gravel. Large bones of whales were observed in several places between Metis and Matan, partially imbedded in the five-feet terrace. At Ste. Anne des Monts five or six distinct terraces of sand and gravel rise one above another to a height of about twenty-five feet over the sea. They all abound in shells, generally much broken and worn, belonging to the common littoral species. The formation of sand points, and of long sand beaches, closing up bays, and forming lagoons in numerous places on the east and south coasts, would also indicate that a gradual elevation of the land is now going on. The principal of these are, Peninsula Point and Sandy Beach, which, stretching from the opposite sides of Gaspé Bay, leave but a narrow channel between their extremities; the beach running across from Cape Haldimand to Douglastown, forming Douglastown Lagoon; the narrow beach nearly five miles long separating Mal Bay from the Barachois; the beaches of Grand Pabos and Port Daniel Lagoons, Pespebiac Point; and the beach forming the lagoon at the mouth of the Wagamet, or Bonaventure River. These beaches are above the influence of the tides, and, in places, support a growth of spruce trees. Peninsula Point is nearly covered by a spruce grove. In the northwest arm of Gaspé Bay several small partially wooded sand points have been formed at the foot of the high rocky banks; and these, like the two large points, are found by the settlers who live on the top of the cliffs, to be very convenient for landing places, and by the whalers for their sheds. Some of the points were observed to be thrown up into a series of small parallel ridges. Barriers of sand and gravel are thrown across several small coves or recesses between rocky points near Grand Pabos; and in this way a number of ponds are produced which being above the influence of the tide, are quite fresh, and to them, the sea-birds resort every day to drink. These facts appear to prove that the elevation of the country along the south side of the lower St. Lawrence, is still in progress. I might however add that I was informed by an old resident, that on some of the flats between Rivière du Loup and Rivière Ouelle large drifted logs lie rotting in places now rarely reached by the highest tides, and even then they are covered by only a few inches of water—quite insufficient to float such large timber. On the north coast of Gaspé I observed the remains of a very old wreck lying among spruce bushes above high-water mark, and at the time supposed it to be an evidence of elevation. I am inclined to regard it as doubtful, however since reading the accounts in the newspapers of the effects of the great gale and unprecedentedly high tide which recently visited these shores, sweeping away storehouses and boats supposed to be altogether beyond the influence of the sea.

The gradual subsidence of the Atlantic coast of the United States, appears to be proved beyond a doubt. In the Geological Journal for 1861, Dr. Gesner states that between New England and Newfoundland, the coast of the British provinces is rising in some places, while it is being submerged in others. Perhaps the most remarkable proof of subsidence is the sunken forests in Minas Bay, fully described by Dr. Dawson in his *Acadian Geology*. The elevation of Gaspé, now going on, is probably a continuation of the same movement which caused the whole peninsula to rise above the sea, and which appears to be connected with the other undulatory movements extending along the coast of the whole continent. It is worthy of remark, in connection with this subject that in Ohio and Upper Canada, a very gentle inclination appears to have been detected in some of the ancient water margins. On the Labrador coast, besides the evidence of recent upheaval afforded by the raised sand and limestone-gravel plains, and the worn pillars of Mingan, Sir Charles Lyell states that some of the rocks above the sea level at this locality are perforated by the burrows of the *Saxicava* in such a good state of preservation as to show that they have not been exposed to the weather for a very great length of time. In addition to these facts, the occurrence of whales' bones, covered by moss and lying among the bushes above the influence of the tide, in both Labrador and Newfoundland, affords geological evidence of elevation, while a gradual rise of that island above the sea appears to have been observed by the inhabitants, as is shewn by the following extract from the *Newfoundland Times* of October, 1847 :—

"It is a fact worthy of notice that the whole of the land in and about the neighbourhood of Conception Bay—very probably the whole island—is rising out of the ocean, at a rate which promises at no very distant day, materially to affect, if not to render useless, many of the best harbors we have on the coast. At Port de Grave a series of observations have been made, which undeniably prove the rapid displacement of the sea level in the vicinity. Several large flat rocks, over which schooners might pass some thirty or forty years ago with the greatest facility, are now approaching the surface, the water being scarcely navigable for a skiff."

Montreal, February 2nd, 1863.

ART. XV.—*On the Rocks of the Quebec Group at Point Lévis;* by SIR WILLIAM LOGAN, F.R.S.; Director of the Geological Survey of Canada; in a letter addressed to M. Barrande.

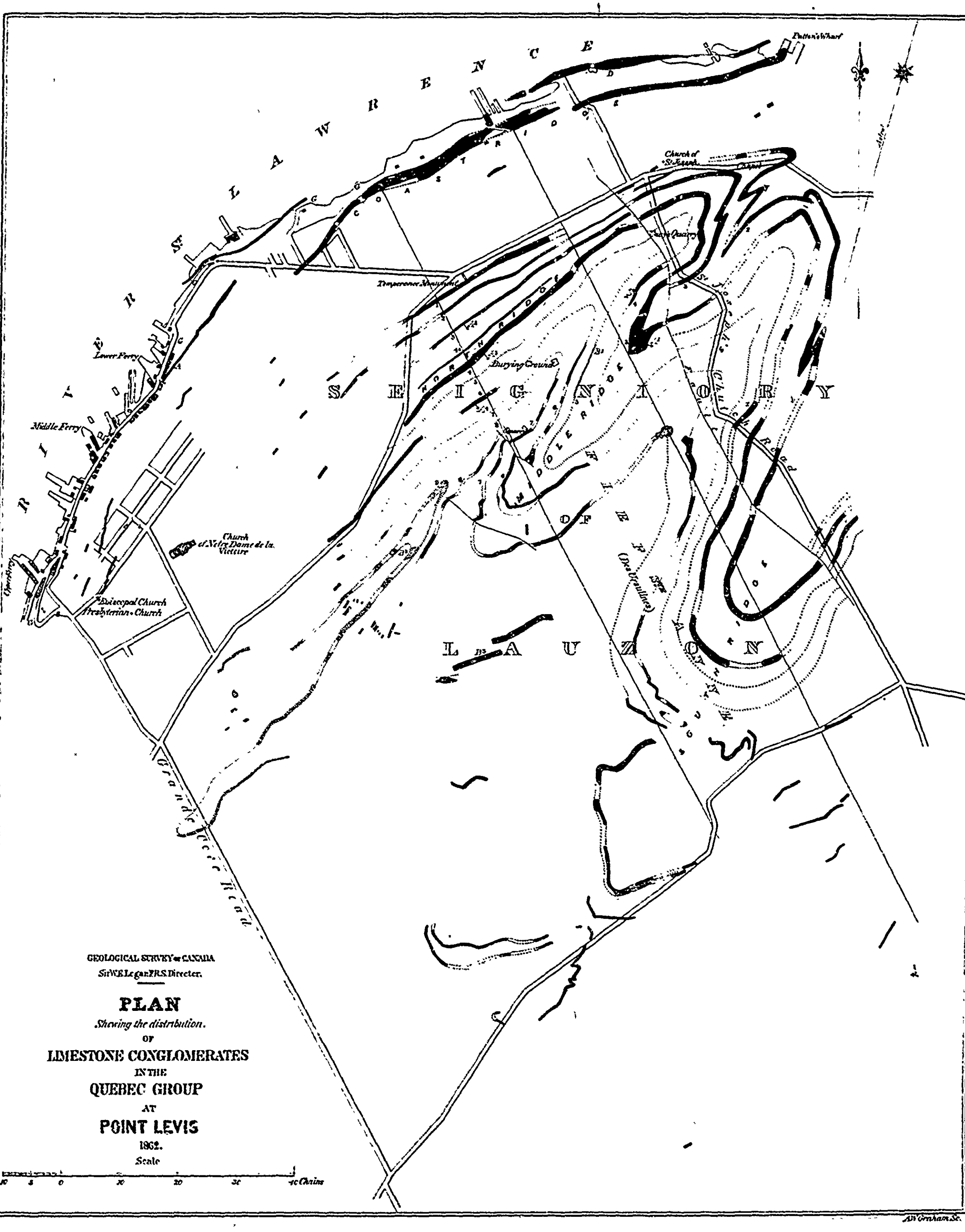
MONTREAL, 15th MARCH, 1863.

MY DEAR MR. BARRANDE,—Mr. Jules Marcou has addressed to you a letter dated the 2nd August last, on the Taconic rocks of Vermont and Canada, in which he says, on page 10, "I was able this "year to follow out and trace every bed and layer on the whole "contour of Point Lévis, from the Grand Trunk Terminus to In-"dian Cove; and as Point Lévis is a point of land surrounded "by high cliffs, I feel satisfied that there is no repetition of beds, "and no synclinal axis; and that the few foldings of the strata "at Ferry's cliff are mere accident, confined to a distance of a few "feet, and are without any effect upon the whole mass of strata "but are what we call in French *structure ployée* (contorted "strata)." On page 14 he says: "Fearing that my first unsuc-"cessful attempt last year to understand the explanation of Messrs. "Logan and Billings might be my own fault, I tried very hard "this year again, when at Point Lévis, but with no better success "and I left the Point fully convinced that the fossils described by "Mr. Billings, and the so-called outcrops, A^2, A^3, A^4, &c., of "Mr. Logan, were collected and observed in a very careless way, "without regard to stratigraphy, by irresponsible collectors, or "by unskilful practical geologists."

I have neither time nor inclination for controversial geology. I have never criticised any of Mr. Marcou's remarks on rocks in Canada, or out of it, nor have I suggested any such criticisms to others; but a charge of carelessness on the part of public officers in the discharge of their duties appears to me, on the present occasion, to require a few words of reply, lest you and others might suppose the accusation to have some foundation. It is due to Mr. Marcou to give him credit for the very great care he claims, as I am persuaded he would not have ventured so unreserved and condemnatory a contradiction of what has been stated on the part of the Survey, without having exhausted all his skill on his own investigation. The only critical remark therefore left for me to make, is that this distinguished stratigraphist has been very unfortunate; and that having missed the main feature of the conspicuously marked structure he so carefully searched for, it is not surprising that he should find a difficulty in understanding a statement connected with it.

In 1854 and 1856, a considerable time was expended by Mr. Richardson, one of my assistants, and myself, in ascertaining by measurement the position and extent of all the exposures of the limestone conglomerates which characterize Point Lévis. The result of this work was exhibited by me to Mr. Marcou, at the office of the Survey, in 1861, on an unpublished manuscript map, on a scale of six inches to one mile, showing nearly all the known exposures of rocks of the Quebec group for about twenty miles below, twenty miles above, and nearly twenty miles to the south-eastward of Quebec. This map represents an area of 800 square miles, on which all the exposures are laid down by admeasurements, comprising the work of one member of the Survey for two seasons, and of another for one season. The measurements at Point Lévis I have recently re-protracted on the same scale, with a view of completely separating what is exposed to view, from what is inferred; and a plan reduced from this to one half, by photography, accompanies the present communication. The topographical as well as the geological features are delineated from the measurements of the Survey.

On this plan, the heavy black bands represent the known exposures of the limestone conglomerates; the dotted lines between different exposures represent their supposed connection. Some of the geographical undulations are shown by what I have designated the Coast Ridge, and the North, Middle and South Ridges. The main feature of the Coast Ridge is a thick band of limestone conglomerate extending in a hill and precipice, which overlook the beach from Patton's wharf to the neighborhood of the Lower Ferry; beyond which it gives place to the cliff immediately behind the houses near the Lower, Middle and Upper Ferries. The



RIVER ST LAWRENCE
Patton's Wharf
Church of St Joseph
Chapel
Temperance Monument
Burying Ground
Lower Ferry
Middle Ferry
Church of Notre Dame de la Victoire
Episcopal Church
Presbyterian Church
SEIGNIORY
LAUZON
Church Road
Grande Allee Road
GEOLOGICAL SURVEY of CANADA
Sir W. E. Logan F.R.S. Director.
PLAN
Showing the distribution
OF
LIMESTONE CONGLOMERATES
IN THE
QUEBEC GROUP
AT
POINT LEVIS
1862.
Scale
10 5 0 10 20 30 40 Chains
A. W. Graham Sc.

North Ridge is a hill which rises up from and runs parallel with the road passing in front of the Temperance Monument or Cross; and attains its greatest height in a band of limestone conglomerate about 300 yards southeastward. The part of this ridge nearest the road probably constitutes Mr. Marcou's Cross Hill. The Middle Ridge is, I presume, Mr. Marcou's Parochial Hill. It includes Guay's quarry, or the Redoute, and crossing the St. Joseph Church road (Route de l'Eglise), extends for about a mile to the southwestward, with a somewhat broad depression southward from the Burying-ground. Where Mr. Marcou's Middle Hill may be situated, I am not quite sure, but suppose it to be the upper part of my North Ridge, as the extension of this seems to be the only hill between the Temperance Monument and Guay's quarry. The South Ridge crosses the St. Joseph Church road about half a mile to the southeastward of the Middle Ridge.

The limestone conglomerates, as you are probably aware, consist of beds of yellow-weathering magnesian limestone, in which, as a base, are imbedded masses of pure compact limestone, of colors varying from yellowish-white, through gray and brownish, to nearly black. These masses are generally of a sub-spherical or sub-elliptical form, looking like boulders, and many of them may probably be such; but beds of a limestone almost precisely similar to them in character appear occasionally to run in an irregular manner in the conglomerate bands, presenting the aspect of original sediments. The yellow-weathering matrix is often arenaceous, the white silicious grains sometimes attaining a quarter of an inch in diameter. The bands of conglomerate are separated rom one another by greenish and blackish slates, which in many places, are interstratified with strong yellow-weathering gray and black calcareo-magnesian slates, and occasionally with yellow-weathering sandstones. In a few places red slates are intermingled with the others.

South-eastward from the St. Lawrence, the limestone conglomerates of Point Lévis are distributed over a breadth of more than two miles. In the North Ridge there are four bands, numbered 1, 2, 3, 4, on the map; on which is represented, in addition, a long lenticular bed (4^a) subordinate to 4, but separated from it by slate. The lenticular bed is composed of brown-weathering magnesian limestone, but appears to contain few or no enclosed masses of the pure limestone. The bands 3 and 4 are, respectively, A^2 and A^3 of a former description. You will perceive that northeastwardly they converge a little; and at the time of that description, it was not determined whether they were to be considered two distinct beds, or one a repetition of the other. They are now taken to be two distinct beds. Followed northeastwardly, they appear to be dislocated by a fault near the St. Joseph Church road; but beyond this they are easily traceable around the extremty of a trough, with a deep channel worn between them in the slate. After passing the axis of the synclinal, the band 4 comes to the limestone of Guay's quarry, which is nothing more than a large lenticular mass of pure limestone, subordinate to the band. Southwestward of the quarry, both bands are seen again crossing the St. Joseph Church road, and again coming against the transverse fault. This fault appears to show an upthrow on its southwest side; since on that side the opposite outcrops of the trough are thrown towards the centre.

Continuing to trace the outcrops on the southern side of the trough, that of band 4 gradually thins, and disappears at P, in less than a furlong; while that of band 3 becomes more conspicuous, and shows a great development as it folds over an anticlinal axis just eastward of the eastern boundary of the fief St. Anne. From this it returns towards the Church road, but becomes concealed about fifty yards before reaching it, after again shewing the effect of the fault, in a much smaller horizontal displacement than before. On the northeast side of the anticlinal axis, on both sides of the fault, the dip is to the southeastward, and is therefore overturned; but from the character of the displacement it is evident that beneath the surface, on the northeast side of the fault, the inversion must be compensated for by a change to the northwest in the slope.

A little above the outcrop of band 4, at P, there occurs a layer of sandstone, which is traceable on the fief Ste. Anne over the anticlinal axis; and a sandstone approaches the outcrop of band 3 at A^1. In the description of 1860, this was supposed to show that possibly the stratigraphical place of the band 4 might gradually approach the band 3, and finally merge into it; but finding farther on, along the outcrops, an exposure of conglomerate at *z*, which will answer for band 4, it is now conceived that there may be two layers of sandstone, one above, and the other below the stratigraphical place of band 4; and though this band thins to nothing at P, it may commence again in its relative place farther on.

From the neighborhood of the Temperance Monument the outcrop of band 2 is traceable northeastward, running not quite parallel with 3, to the fault, and thence across the St. Joseph

Church road to the main road. It traverses this obliquely, a little beyond the church, and its turn upon the synclinal axis is seen on the north side of the road, about 400 yards beyond. In the limestone of Guay's quarry there is a small notch-like turn, which serves to augment somewhat its apparent volume; a corresponding twist is more conspicuous in the outcrop of band 3, and in band 2 it assumes a still further prominence at *y*. These successive forms indicate a plait in the stratification, commencing at the quarry, and rapidly augmenting northeastwardly in the space of 350 yards. The importance of its effect on the distribution of the strata would, at this rate of increase, soon become considerable, and it serves to show some of the complications of the neighborhood.

Without going into detail, it is evident from the map that the Middle Ridge is an anticlinal form, and that the South Ridge is another. On this, the exposures of the bands 2 and 3 conspicuously mark the turn on the axis, as they do in the synclinal between the ridges. It will be perceived that between the synclinal and anticlinal axes, the outcrop of band 2 is represented as showing a very sharp twist. The evidence of this is not quite satisfactory, and the apparent arrangement may possibly be due only to a swelling in the volume of the band, with parts obscured by drift.

The Temperance Monument stands on band 1, with which are associated some layers of sandstone. This band is easily traced to the northeastward, across the fief Ste. Anne; but between that and the fault, it becomes broken down and obscured, and it will require farther investigation. Nothing like it, nor indeed any conglomerate band has been yet observed following, in its relative place, the sinuosities of band 2, where the strata are affected by the synclinals and anticlinals that have been described. Eastward of the fault, and northward of band 2, there is an exposure of conglomerate close upon the southeast side of the main road, the bearing of which would carry it under the church of St. Joseph; and two years ago it was observed in an excavation for the foundation of a house on the northwest side of the road, close by the church. In the strike of these exposures, about 400 yards beyond the church, there is a band of conglomerate, which continues in the same strike for about a hundred yards. This strike would carry the band away from those of the North Ridge, and gradually bring it towards those of the Coast Ridge; and it appears probable that the bands of the Coast Ridge may be only a repetition of some of those of the North Ridge. The main band of the Coast Ridge is associated with several beds of sandstone; and from its great breadth it may possibly be capable of division into more than one mass of conglomerate. To the southwestward of the extreme point to which this band has been traced, there occurs in the cliff, to the southeast of the Lower Ferry, the band A; one of those referred to in the description of 1860. Its exact relation to the other bands has not yet been satisfactorily determined.

Southward of A^3 you will remark A^4, and you will perceive that these two bands somewhat converge to the southwest, in which direction they are not traceable for over a quarter of a mile. At the time of the previous description, it was left undecided whether these were to be considered distinct bands, or a repetition of one another. They are now assumed to be distinct. On the Middle Ridge, the band 4, at P, is followed by B^1; which is a band of slate with nodules of limestone. On the North Ridge its place would be between A^3 and A^4. It would therefore be band 5, and A^4 would be band 6. The bands 7, 8, and 9 succeed on the north side of the Middle Ridge, the band 9 being B^2 of the former description; like B^1, it is composed of slate studded with nodules of limestone. This band appears to have a considerable development southwestwardly, in a long shallow trough-like form, extending to the Grande Côte road. From this, its outcrop returns on the south side of the Middle Ridge anticlinal, and points to B^3; which however differs from it in character, having a base of magnesian limestone instead of slate. What is seen of the band B^3 is broken into three portions by transverse faults. It is evidently on the south side of the Middle Ridge anticlinal, and may correspond with band 8, but this has not yet been satisfactorily made out; nor has it yet been found possible to arrange the complicated exposures to the southeast of it, on the South Ridge.

On the southwest boundary of the fief Ste. Anne, near the quarry there indicated, the beds appear to be dislocated on the north side of the Middle Ridge anticlinal, by faults, which do not affect the outcrops on the south side. These faults may be small breaks accompanying twists in the strata, the connecting parts of which may be concealed by drift; but it would require additional facts to make their arrangements certain. Though the number of bands is assumed to be nine, some of them may be repetitions through the effect of plaits suddenly starting up, like that at *y*, or through undetected faults running with the stratification. The distribution of the outcrops in the southwest part of the South Ridge shows the very complicated character of the disturbances, and is a warning against over-confidence in respect to minute details. In regard to the main features of the structure however, there appears to be no doubt; namely that the Middle and South Ridges are two well marked anticlinals, and that a synclinal, not less so, runs between the Middle and North Ridges, repeating the whole mass of strata.

From the foregoing explanation you will be able to understand how the fossils enumerated in the description of 1860 are related to the conglomerate bands, as represented on the map. The whole of these fossils were collected by the officers of the Survey, who are all perfectly aware of the importance of observing the exact stratigraphical place of the organic remains, and always most carefully do so. The collectors were Messrs. Billings, Richardson, Bell, and myself; and from the statements made to me by my colleagues and assistants, I am quite prepared to assert that the specimens referred to B^3, B^2, B^1, A, A^1, and A^3, are from the bands marked on the map by those letters. With the exception of a single specimen of the pygidium of *Bathyurus Saffordi*, obtained by Mr. Sterry Hunt from the band 4 (A^3), where it crosses the more northern synclinal axis near the Redoute; the band A^2 afforded to my late regretted and talented young scientific friend, Mr. John Head, and myself, the first collection of fossils obtained by the Survey at Point Lévis. These were taken from the whitish limestone masses associated with the bed, where it crosses the fief Ste. Anne, and the opinion in regard to them expressed by Mr. Billings, induced me to instruct Mr. Bell to make a farther collection on the same band. In addition to the fossils collected by Mr. Head and myself from the band, there are some by Mr. Richardson, and others by Mr. Bell, all from the fixed rock; but in Mr. Bell's collection there are, in addition, those from the limestones designated by Mr. Billings as Nos. 1 and 3. These limestones were not, like the rest, firmly attached to the band, and as they have been by Mr. Marcou designated as two loose boulders, lying on the superficial soil, while he carries them away from their true site, and approximates their position to the lime-kiln of the Redoute, in order to affiliate them to that mass, it will be necessary for me to describe their mode of occurrence.

On the fief Ste. Anne, the band 3 (A^2) dips to the southeast at a high angle. It is from about twenty to twenty-five feet thick, and in its calcareo-magnesian base it holds a great many masses of yellowish-white limestone, in which fossils are apparent, and somewhat abundant. It is underlaid by slates; and in some parts a sudden step to the underlying slates occurs at its northern edge. At the foot of this step, Mr. Bell observed in one place a mass of gray-weathering yellowish-white limestone protruding for a few inches through the soil. This mass, when excavated from its position, proved to be about a foot in diameter, and very fossiliferous. Persuaded that it had fallen from the conglomerate band, he tried farther on in the strike, and found another; and finally, in the distance of about fifty feet along the strike, he obtained five masses, each as heavy as would require a strong man to lift; and twelve smaller masses, each of about twenty pounds weight and upwards. They were all rich in fossils. Some of these gave to Mr. Billings his limestone No. 1, and others that of No. 3. All of these masses, some of which were sharply angular, rested on the slate, just at the base of the conglomerate band; and with the exception of the small portion of the first one, were wholly covered by the soil, one of them to a thickness of a foot; requiring, before it could be extracted by aid of pick, shovel, and crow-bar, a hole to be made of two feet deep. It appears to me much more probable that these masses should have fallen from the conglomerate band which they touched, than that they should have been transported nearly half a mile from the Redoute, and all laid at the foot of the conglomerate band A^3, in a row in its strike. It is by no means supposed that the stock of these masses was exhausted by Mr. Bell; more may probably be obtained in the strike, and I am persuaded, that if the adjacent parts of the conglomerate band were laid bare, similar masses would be found imbedded in it.

Mr. Marcou states that the limestones Nos. 1 and 3, without doubt come from the Redoute; and that in respect to No. 1, so rich in trilobites, he could almost point out the exact spot from which it came. Soon after the first discovery of fossils at Point Lévis, I spent a good deal of time in endeavouring to obtain specimens from Guay's quarry, but with very indifferent success. Fragments of trilobites were observed, but the only recognizable species obtained was *Menocephalus globosus*. Perceiving that Mr. Marcou had been so fortunate as to meet with upwards of nine species of trilobites in the locality, I last season renewed my attempt; and with Mr. Billings, made a diligent search of the rock, but with no better luck than had attended my previous researches; *Menocephalus globosus* being again the only speeics procured. Mr. Marcou states that the stratification is indistinct, and that in consequence of the hardness of the stone, it is difficult to obtain specimens. This perfectly accords with what we observed; but not with the characters of the limestones Nos. 1 and 3; which are not very hard, and in which the fossils occur in layers, marking well the stratification. The limestones split with moderate facility in the direction of those layers, and give considerable planes of surface, with fossils starting prominently up from them. I presume therefore that the beds at the Redoute, with which Mr. Marcou compares the limestones No. 1 and 3, are some which he has not yet desribed, and with which we can make no comparison, as we have not been so fortunate as to find them.

Since 1860, Mr. Devine and Mr. Cayley, both of the Crown Lands Department, have obtained several species at Point Lévis. The latter gentleman discovered *Amphion Cayleyi*, (Billings) in band 3, (A^2) on the North Ridge; and Mr. Devine, on the same ridge, has procured *Bathyurus Saffordi* from band 2, *Menocephalus globosus*, and *Cheirurus Eryx* from band 3 (A^2); and from band 4 (A^3) *Bathyurus Saffordi*, *B. Cordai*, and *B. bituberculatus*. But from this band he has made a very important addition to the fauna of Point Lévis, in a perfect specimen of what Mr. Billings agrees with him in considering an *Olenus*, or a closely allied genus. This was obtained on the North Ridge, just east of the fief St. Anne, in a mass of drab-colored limestone; which Mr. Devine thinks is a part of the solid band, although he has not yet tested the matter sufficiently to be positive. The same part of this band here holds *Obolella*, *Orthis Evadne*, *Camerella calcifera*, *Pleurotomaria*, *Ecculiomphalus Canadensis*, *Orthoceras*, *Agnostus Americanus*, *A. Canadensis*, *A. Orion*, *Arionellus subclavatus*, *Bathyurus capax*, *B. quadratus*, *B. Saffordi*, *Cheirurus Eryx*, *C. Apollo*, *Dikelocephalus magnificus*, *D. megalops*, *D. planifrons*, *D. Oweni*, *Menocephalus Sedgwickii*, and *M. Salteri*. In this collection, the species of *Pleurotomaria*, *Ecculiomphalus*, and *Chierurus* do not occur in the same hand-specimens of rock with the others. *Bathyurus Saffordi* is in the same specimen with *Menocephalus Salteri*. On the Middle Ridge he has obtained *Menocephalus globosus* from band 4, at the Redoute. Mr Billings has obtained in band 2, on the North Ridge, *Bathyurus quadratus*; on the Middle Ridge, in band 6, on the north side of the anticlinal, *Leptæna decipiens*; and the same species in band 7, on the same side of the anticlinal; while band 7, on the south side of the anticlinal, has yielded him a *Pleurotomaria*, allied to *P. Laurentina*, *Orthoceras, n. s.*, *Illænus*———, and *Asaphus*———. In a band of conglomerate forming two successive mounds at the water's edge, northwest of the Coast

Ridge, and running parallel with it, he has met at D, with a new species of *Dikelocephalus*

To make the distribution of the fossils, which we in Canada (including Mr. Devine and Mr. Cayley) have obtained at Point Lévis, more clearly understood, a catalogue of them has been prepared, with the specific names of those which have been described, and a separate column for each of the bands, and made a part of the present communication. In this catalogue no certain stratigraphical place is assigned to the bands D, G, and A, in relation to the others; which, from 1 to 9, are supposed to be in ascending order. With the exception of those otherwise marked, all the determined species have been described by Mr. Billings.

Mr. Marcou, it appears to me, has gone somewhat out of his way to insinuate a discourtesy towards you on the part of the Canadian Survey, in that we have, as he says, distributed fossils of the Quebec group, in England, to more favoured geologists than yourself. Mr. Marcou could not have stated this from his own knowledge, as it is not consistent with fact. The truth of the matter is precisely the reverse of this. We long ago did ourselves the pleasure of transmitting to you a small collection of the principal species; while we have presented none to any other of our geological friends in Europe. On this side of the Atlantic we have exchanged a few specimens with Col. Jewett, of the New York State Museum, for New York species, of which we stood greatly in want; and we are just now about to make a small exchange with Mr. A. H. Worthen, State geologist of Illinois, for species from several of the Western States, of which we have long been anxious to possess authentic specimens. Mr. Marcou seems especially aggrieved that he did not obtain a pygidium of *Dikelocephalus magnificus*, asked for, as he states, in your name. This was during my absence in England, at the International Exhibition. Mr. Billings cannot call to his recollection that the application was made in your name. Such an application would have afforded him the opportunity of informing Mr. Marcou, that you were probably already supplied, in the collection sent; but it would not have altered the propriety of what, in conformity with his duty, he found himself under the necessity of replying; namely that he was not authorized to distribute the specimens of the Provincial Collection.

I am, my dear Mr. Barrande,

Yours very truly,

M. JOACHIM BARRANDE, W. E. LOGAN.

Rue Mézière No. 6, Paris,

CATALOGUE OF FOSSILS FROM THE QUEBEC GROUP, COLLECTED AT POINT LÉVIS.

	D	G	A	1	2	3	4	5	6	7	8	9
Tetradium ?		•										
Graptolithus, several sub-genera (Hall)		•					•					
Lingula Mantelli						•	•					
" Irene		•										
" Quebecensis			•									
Obolella Ida						•	•					
" desiderata			•									
Acrotreta n. s.						•						
Leptæna decipiens								•	•	•	•	•
" sordida								•				
" undescribed 1.								•				
" " 2.						•						
" " 3.							•					
Strophomena, undescribed			•									
Orthis gemmicula								•				
" Tritonia								•				
" orthambonites (Pander)								•				
" Euryone								•				
" Electra								•				
" Hippolyte								•				
" Evadne								•				
" Mycale								•				
" Eudocia								•				
" Quebecensis			•									
" undescribed 1.						•						
" " 2.							•					
" " 3.							•					
" " 4.												•
Camerella calcifera						•	•					
Stricklandia? Arachne								•				
" Arethusa								•				
Cyrtodonta? undescribed								•				
Ecculiomphalus Canadensis							•	•				
" intortus							•					
Pleurotomaria vagrans							•					
" Postumia							•					
" Quebecensis							•					
" undescribed 1.							•	•				
" " 2.							•					
" " 3.											•	
" " 4.											•	
Murchisonia, undescribed, 1.							•					
" " 2.							•					
" " 3.							•					
" " 4.											•	
Helicotoma perstriata							•					
Ophileta uniangulata (Hall)							•					
" undescribed, 1.							•					
" " 2.							•					
Maclurea Atlantica											•	
Holopea dilucula (Hall)							•					
" undescribed							•					
Metoptoma Melissa							•					
" Hyrie							•					
" Orphyne							•					
" Venillia						•	•					
" anomala							•					

	D	G	A	1	2	3	4	5	6	7	8	9
Metoptoma Augusta..................							*					
" superba..................							*					
Orthoceras Autolycus							*					
" undescribed 1.							*					
" " 2.							*					
" " 3.							*					
" " 4.							*					
" " 5.							*					
" " 6.												*
Cyrtoceras Metellus..................							*					
" Dictys..................							*					
" Alethes..................							*					
" Mercurius..................							*					*
" Syphax..................							*					
" undescribed..............							*					
Nautilus "												*
Agnostus Americanus..................						*	*					
" Orion..................						*	*					
Agnostus Canadensis..................						*	*					
Amphion Cayleyi..................						*	*					
Ampyx, undescribed..................							*					
Arionellus cylindricus..................						*						
" subclavatus..................						*						
Asaphus Illænoides..................						*						
" goniurus..................						*	*					
Bathyurus capax..................						*						
" dubius..................						*						
" bituberculatus..................						*						
" armatus..................						*	*					
" Saffordi..................							*					
" oblongus..................							*					
" Cordai..................							*					
" quadratus..................					*		*					
Cheirurus Apollo..................							*					
" Eryx..................							*					
Conocephalites Zenkeri..................						*	*					
Dikelocephalus magnificus..............						*	*					
" planifrons..............						*	*					
" Oweni..............						*						
" Belli..............						*	*					
" megalops..............						*						
" cristatus..............						*						
" undescribed..............	*											
" (Olenus) Logani (Devine)...							*					
Endymion Meeki..................											*	
Holometopus Angelini..................											*	
Illænus, undescribed..................											*	
Leperditia..................											*	
Menocephalus globosus..................						*	*					
" Sedgwicki..................						*	*					
" Salteri (Devine)..........							*					
Nileus, undescribed..................							*				*	
Shumardia granulosa..................				*								

ART. XVI.—*On the Chemical and Mineralogical Relations of Metamorphic Rocks;** by T. STERRY HUNT, M.A., F.R.S.; of the Geological Survey of Canada.

AT a time not very remote in the history of geology, when all crystalline stratified rocks were included under the common designation of primitive, and were supposed to belong to a period anterior to the fossiliferous formations, the lithologist confined his studies to descriptions of the various species of rocks, without reference to their stratigraphical or geological distribution. But with the progress of geological science, a new problem is presented to his investigation. While palæontology has shown that the fossils of each formation furnish a guide to its age and stratigraphical position, it has been found that sedimentary strata of all ages, up to the tertiary inclusive, may undergo such changes as to obliterate the direct evidences of organic life; and to give to the sediments the mineralogical characters once assigned to primitive rocks. The question here arises, whether in the absence of organic remains, or of stratigraphical evidence, there exists any means of determining, even approximately, the geological age of a given series of crystalline stratified rocks;—in other words, whether the chemical conditions which have presided over the formation of sedimentary rocks, have so far varied in the course of ages, as to impress upon these rocks marked chemical and mineralogical differences. In the case of unaltered sediments it would be difficult to arrive at any solution of this question without greatly multiplied analyses; but in the same rocks, when altered, the crystalline minerals which are formed, being definite in their composition, and varying with the chemical constitution of the sediments, may perhaps to a certain extent, become to the geologist what organic remains are in the unaltered rocks, a guide to the geological age and succession.

It was while engaged in the investigation of metamorphic rocks of various ages in North America, that this problem suggested itself; and I have endeavoured from chemical considerations, conjoined with multiplied observations, to attempt its solution. In the *American Journal of Science* for 1858, and in the *Quarterly Journal of the Geological Society of London* for 1859 (p. 488), will be found the germs of the ideas on this subject, which I shall endeavour to explain in the present paper. It cannot be doubted

* Read before the Dublin Geological Society April 10, and reprinted from advance sheets of the Dublin Quarterly Journal for July 1863.

that in the earlier periods of the world's history, chemical forces of certain kinds were much more active than at the present day. Thus the decomposition of earthy and alkaline silicates under the combined influences of water and carbonic acid, would be greater when this acid was more abundant in the atmosphere, and when the temperature was probably higher. The larger amounts of alkaline and earthy carbonates then carried to the sea from the decomposition of these silicates, would furnish a greater amount of calcareous matter to the sediments; and the chemical effects of vegetation, both on the soil and on the other atmosphere, must have been greater during the Carboniferous period, for example, than at present. In the spontaneous decomposition of feldspars, which may be described as silicates of alumina combined with silicates of potash, soda and lime, these latter bases are removed, together with a portion of silica; and there remains as the final result of the process, a hydrous silicate of alumina, which constitutes kaolin or clay. This change is favoured by mechanical division; and Daubrée has shown that by the prolonged attrition of fragments of granite under water, the softer and readily cleavable feldspar is in great part reduced to an impalpable powder, while the uncleavable grains of quartz are only rounded, and form a readily subsiding sand; the water at the same time dissolving from the feldspar a certain portion of silica, and of alkali. It has been repeatedly observed, where potash and soda-feldspars are associated, that the latter is much the more readily decomposed, becoming friable, and finally being reduced to clay, while the orthoclase is unaltered. The result of combined chemical and mechanical agencies acting upon rocks which contain quartz, with orthoclase, and a soda-feldspar such as albite or oligoclase, would thus be a sand, made up chiefly of quartz and potash-feldspar, and a finely divided and suspended clay, consisting for the most part of kaolin, and of partially decomposed soda-feldspar, mingled with some of the smaller particles of orthoclase and of quartz. With this sediment will also be included the oxide of iron, and the earthy carbonates set free by the sub-aërial decomposition of silicates like pyroxene and the anorthic feldspars, or formed by the action of the carbonate of soda derived from the latter upon the lime salts and magnesia salts of sea-water. The debris of hornblende and pyroxene will also be found in this finer sediment. This process is evidently the one which must go on in the wearing away of rocks by aqueous agency, and explains the fact that while quartz, or an excess of combined silica, is for the most part wanting in rocks which contain a large proportion of alumina, it is generally abundant in those rocks in which potash-feldspar predominates.

So long as this decomposition of alkaliferous silicates is sub-aërial, the silica and alkali are both removed in a soluble form. The process is often however submarine, or subterranean, taking place in buried sediments, which are mingled with carbonates of lime and magnesia. In such cases the silicate of soda set free, re-acts either with these earthy carbonates, or with the corresponding chlorids of sea-water, and forms in either event a soluble soda-salt, and insoluble silicates of lime and magnesia, which take the place of the removed silicate of soda. The evidence of such a continued reaction between alkaliferous silicates and earthy carbonates is seen in the large amounts of carbonate of soda, with but little silica, which infiltrating waters constantly remove from argillaceous strata; thus giving rise to alkaline springs, and to natron lakes. In these waters it will be found that soda greatly predominates, sometimes almost to the exclusion of potash. This is due not only to the fact that soda-feldspars are more readily decomposed than orthoclase, but to the well-known power of argillaceous sediments to abstract from water the potash salts which it already holds in solution. Thus when a solution of silicate, carbonate, sulphate, or chlorid of potassium is filtered through common earth, the potash is taken up, and replaced by lime, magnesia, or soda, by a double decomposition between the soluble potash salt and the insoluble silicates or carbonates of the latter bases. Soils in like manner remove from infiltrating waters, ammonia, and phosphoric and silicic acids, the bases which were in combination with these being converted into carbonates. The drainage-water of soils, like that of most mineral springs, contains only carbonates, chlorids, and sulphates of lime, magnesia, and soda; the ammonia, potash, phosphoric and silicic acids being retained by the soil.

The elements which the earth retains or extracts from waters are precisely those which are removed from it by growing plants. These, by their decomposition under ordinary conditions, yield their mineral matters again to the soil; but when decay takes place in water, these elements become dissolved, and hence the waters from peat bogs and marshes contain large amounts of potash and silica in solution, which are carried to the sea, there to be separated—the silica by protophytes, and the potash by algæ, which latter, decaying on the shore, or in the ooze at the bottom, restore the alkali to the earth. The conditions under which the vegetation of the coal formation grew, and was preserved, being similar to those of peat, the soils became exhausted of potash, and are seen in the fire-clays of that period.

Another effect of vegetation on sediments is due to the reducing or de-oxidizing agency of the organic matters from its decay. These, as is well known, reduce the peroxide of iron to a soluble protoxide, and remove it from the soil, to be afterwards deposited in the forms of iron ochre and iron ores, which by subsequent alteration become hard, crystalline and insoluble. Thus, through the agency of vegetation, is the iron oxide of the sediments withdrawn from the terrestrial circulation; and it is evident that the proportion of this element diffused in the more recent sediments must be much less than in those of ancient times. The reducing power of organic matter is farther shown in the formation of metallic sulphurets; the reduction of sulphates having precipitated in this insoluble form the heavy metals, copper, lead, and zinc; which, with iron, appear to have been in solution in the waters of early times, but are now by this means also abstracted from the circulation, and accumulated in beds and fahlbands, or by a subsequent process have been redissolved and deposited in veins. All analogies lead us to the conclusion that the primeval condition of the metals, and of sulphur, was, like that of carbon, one of oxidation, and that vegetable life has been the sole medium of their reduction.

The source of the carbonates of lime and magnesia in sedimentary strata is two-fold:—first, the decomposition of silicates containing these bases, such as anorthic feldspars and pyroxene; and second, the action of the alkaline carbonates formed by the decomposition of feldspars, upon the chlorids of calcium and magnesium, originally present in sea-water; which have thus, in the course of ages, been in great part replaced by chlorid of sodium. The clay, or aluminous silicate which has been deprived of its alkali, is thus a measure of the carbonic acid removed from the air, of the carbonates of lime and magnesia precipitated, and of the amount of chlorid of sodium added to the waters of the primeval ocean.

The coarser sediments, in which quartz and orthoclase prevail, are readily permeable to infiltrating waters, which gradually remove from them the soda, lime, and magnesia, which they contain; and if organic matters intervene, the oxide of iron; leaving at last little more than silica, alumina, and potash—the elements of granite, trachyte, gneiss, and mica-schist. On the other hand the finer marls and clays, resisting the penetration of water, will retain all their soda, lime, magnesia, and oxide of iron; and containing an excess of alumina, with a small amount of silica, will by their metamorphism, give rise to basic lime and soda-feldspars, and to pyroxene and hornblende—the elements of diorites and dolerites. In this way, the operation of the chemical and mechanical causes which we have traced, naturally divides all the crystalline silico-aluminous rocks of the earth's crust into two types. These correspond to the two classes of igneous rocks, distinguished first by Professor Phillips, and subsequently by Durocher, and by Bunsen, as derived from two distinct magmas; which these geologists imagine to exist beneath the solid crust, and which the latter denominates the trachytic and pyroxenic types. I have however elsewhere endeavoured to show that all intrusive or exotic rocks are probably nothing more than altered and displaced sediments, and have thus their source within the lower portions of the stratified crust, and not beneath it.

It may be well in this place to make a few observations on the chemical conditions of rock-metamorphism. I accept in its widest sense the view of Hutton and Boué, that all the crystalline stratified rocks have been produced by the alteration of mechanical and chemical sediments. The conversion of these into definite mineral species has been effected in two ways: first by molecular changes; that is to say, by crystallization, and a re-arrangement of particles; and, secondly by chemical reactions between the elements of the sediments. Pseudomorphism, which is the change of one mineral species into another, by the introduction, or the elimination of some element or elements, presupposes metamorphism; since only definite mineral species can be the subjects of this process. To confound metamorphism with pseudomorphism, as Bischoff, and others after him, have done, is therefore an error. It may be farther remarked, that although certain pseudomorphic changes may take in some mineral species, in veins, and near to the surface, the alteration of great masses of silicated rocks by such a process is as yet an unproved hypothesis.

The cases of local metamorphism in proximity to intrusive rocks go far to show, in opposition to the views of certain geologists, that heat has been one of the necessary conditions of the change. The source of this has been generally supposed to be from below;

but to the hypothesis of alteration by ascending heat, Naumann has objected that the inferior strata in some cases escape change, and that in descending, a certain plane limits the metamorphism, separating the altered strata above, from the unaltered ones beneath; there being no apparent transition between the two. This, taken in connexion with the well-known fact that in many cases the intrusion of igneous rocks causes no apparent change in the adjacent unaltered sediments, shows that heat and moisture are not the only conditions of metamorphism. In 1857, I showed by experiments, that in addition to these conditions, certain chemical reagents might be necessary; and that water impregnated with alkaline carbonates and silicates, would, at a temperature not above that of 212° F., produce chemical reactions among the elements of many sedimentary rocks, dissolving silica, and generating various silicates (1). Some months subsequently, Daubrée found that in the presence of solutions of alkaline solutions, at temperatures above 700° F., various silicious minerals, such as quartz, feldspar, and pyroxene, could be made to assume a crystalline form; and that alkaline silicates in solution at this temperature would combine with clay to form feldspar and mica (2). These observations were the complement of my own, and both together showed the agency of heated alkaline waters to be sufficient to effect the metamorphism of sediments by the two modes already mentioned,—namely, by molecular changes, and by chemical reactions. Following upon this, Daubrée observed that the thermal alkaline spring of Plombieres, with a temperature of 160° F., had in the course of centuries, given rise to the formation of zeolites, and other crystalline silicated minerals, among the bricks and cement of the old Roman baths. From this he was led to suppose that the metamorphism of great regions might have been effected by hot springs; which, rising along certain lines of dislocation, and thence spreading laterally, might produce alteration in strata near to the surface, while those beneath would in some cases escape change (3). This ingenious hypothesis may serve in

1. Proc. Royal Soc. of London, May 7, 1857; and Philos. Mag. (4) xv., 68; also Amer. Jour. Science (2), xxii., and xxv., 435.

2. Comptes Rendus de l'Acad., Nov. 16, 1857; also Bull. Soc. Geol. de France (2), xv., 103.

3. It should be remembered that normal or regional metamorphism is in no way dependent upon the proximity of unstratified or igneous rocks, which are rarely present in metamorphic districts. The ophiolites,

some cases to meet the difficulty pointed out by Naumann; but while it is undoubtedly true in certain instances of local metamorphism, it seems to be utterly inadequate to explain the complete and universal alteration of areas of sedimentary rocks, embracing many hundred thousands of square miles. On the other hand, the study of the origin and distribution of mineral springs, shows that alkaline waters (whose action in metamorphism I first pointed ou and whose efficient agency Daubrée has since so well shown), are confined to certain sedimentary deposits, and to definite stratigraphical horizons; above and below which saline waters wholly different in character are found impregnating the strata. This fact seems to offer a simple solution of the difficulty advanced by Naumann, and a complete explanation of the theory of metamorphism of deeply buried strata by the agency of ascending heat; which is operative in producing chemical changes only in those strata in which soluble alkaline salts are present. (4).

When the sedimentary strata have been rendered crystalline by metamorphism, their permeability to water, and their alterability, become greatly diminished; and it is only when again broken down by mechanical agencies to the condition of soils and sediments, that they once more become subject to the chemical changes which have just been described. Hence, the mean composition of the argillaceous sediments of any geological epoch, or

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amphibolites, euphotides, diorites, and granites of such regions, which it has been customary to regard as exotic or intrusive rocks, are in most cases indigenous, and are altered sediments. I have elsewhere shown that the great outbursts of intrusive dolerites, diorites, and trachytes in south-eastern Canada are found, not among the metamorphic rocks, but among the unaltered strata along their margin, or at some distance removed; and I have endeavoured to explain this by the consideration that the great volume of overlying sediments, which, by retaining the central heat, aided in the alteration of the strata now exposed by denudation, produced a depression of the earth's surface, and forced out the still lower and softened strata along the lines of fracture which took place in the regions beyond. See my paper "On some Points in American Geology," Amer. Jour. Science (2), xxxi. 414., and Can. Nat. vi. 81.

4. See Report of the Geological Survey of Canada, 1853–6, pp. 479, 480; also Canadian Naturalist, vol. vii., p. 262. For a consideration of the relations of mineral waters to geological formations, see "General Report on the Geology of Canada," p. 561; also chap. xix. on "Sedimentary and Metamorphic Rocks;" where most of the points touched in the present paper are discussed at greater length.

in other words, the proportion between the alkalies and the alumina, will depend not only upon the age of the formation, but upon the number of times which its materials have been broken up, and the periods during which they have remained unmetamorphosed, and exposed to the action of infiltrating waters. Thus for example, that portion of the Lower Silurian rocks in Canada which became metamorphosed before the close of the palæozoic period, will have lost less of its soluble bases than the portion of the same age which still remains in the form of unaltered shales and sandstones. Of these again, such parts as remain undisturbed by folds and dislocations, will retain a larger portion of bases than those strata in which such disturbances have favored the formation of mineral springs; which even now are active in removing soluble matters from these rocks. The crystalline Lower Silurian rocks in Canada may be compared with those of the older Laurentian series on the one hand, and with the Upper Silurian or Devonian on the other; but when these are to be compared with the crystalline strata of secondary or tertiary age in the Alps, it cannot be determined whether the sediments of which these were formed, (and which may be supposed, for illustration, to have been directly derived from palæozoic strata), existed up to the time of their translation, in a condition similar to that of the altered, or of the unaltered Lower Silurian rocks of Canada. The proportion between the alkalies and the alumina in the argillaceous sediments of any given formation is not therefore in direct relation to its age; but indicates the extent to which these sediments have been subjected to the influences of water, carbonic acid, and vegetation. If however it may be assumed that this action, other things being equal, has on the whole, been proportionate to the newness of the formation, it is evident that the chemical and mineralogical composition of different systems of rocks must vary with their antiquity; and it now remains to find in their comparative study a guide to their respective ages.

It will be evident that silicious deposits, and chemical precipitates, like the carbonates and silicates of lime and magnesia, may exist with similar characters in the geological formations of any age; not only forming beds apart, but mingled with the impermeable silico-aluminous sediments of mechanical origin. Inasmuch as the chemical agencies giving rise to these compounds were then most active, they may be expected in greatest abundance in the rocks of the earlier periods. In the case of the permeable and more highly silicious class of sediments already noticed, whose chief elements are silica, alumina, and alkalies, the deposits of different ages will be marked chiefly by a progressive diminution in the amount of potash, and the disappearance of the soda which they contain. In the oldest rocks the proportion of alkali will be nearly or quite sufficient to form orthoclase and albite with the whole of the alumina present; but as the alkali diminishes, a portion of the alumina will crystallize, on the metamorphism of the sediments, in the form of a potash-mica, such as muscovite or margarodite. While the oxygen ratio between the alumina and the alkali in the feldspars just named is 3 : 1, it becomes 6 : 1 in margarodite, and 12 : 1 in muscovite. The appearance of these micas in a rock denotes then a diminution in the amount of alkali, until in some strata the feldspar almost entirely disappears, and the rock becomes a quartzose mica-schist In sediments still farther deprived of alkali, metamorphism gives rise to schists filled with crystals of kyanite, or of andalusite; which are simple silicates of alumina, into whose composition alkalies do not enter; or in case the sediment still retains oxide of iron, staurotide and iron-alumina garnet take their place. The matrix of all these minerals is generally a quartzose mica-schist. The last term in this exhaustive process appears to be represented by the disthene and pyrophyllite rocks, which occur in some regions of crystalline schists.

In the second class of sediments we have alumina in excess, with a small proportion of silica, and a deficiency of alkalies, besides a variable proportion of silicates or carbonates of lime, magnesia, and oxide of iron. The result of the processes already described will produce a gradual diminution in the amount of alkali, which is chiefly soda. So long as this predominates, the metamorphism of these sediments will give rise to feldspars like oligoclase, labradorite, or scapolite (a dimetric feldspar); but in sediments where lime replaces a great proportion of the soda, there appears a tendency to the production of denser silicates, like lime-alumina garnet, and epidote, or zoisite, which replace the soda-lime feldspars. Minerals like the chlorites, and chloritoid, are formed when magnesia and iron replace lime. In all these cases the excess of the silicates of earthy protoxides over the silicate of alumina is represented in the altered strata by hornblende, pyroxene, olivine, and similar species; which give rise by their admixture with the double aluminous silicates, to diorite, diabase, euphotide, eklogite, and similar compound rocks.

In eastern North America, the crystalline strata, so far as yet studied, may be conveniently classed in five groups, corresponding to as many different geological series, four of which will be considered in the present paper.

I. The Laurentian system represents the oldest known rocks of the globe, and is supposed to be the equivalent of the Primitive Gneiss formation of Scandinavia, and that of the Western Islands of Scotland, to which also the name of Laurentian is now applied. It has been investigated in Canada along a continuous outcrop from the coast of Labrador to Lake Superior, and also over a considerable area in northern New York.

II. Associated with this system is a series of strata characterized by a great development of anorthosites, of which the hypersthenite, or opalescent feldspar-rock of Labrador, may be taken as a type. These strata overlie the Laurentian gneiss, and are regarded as constituting a second and more recent group of crystalline rocks, to which the name of the Labrador series may be provisionally given. From evidence recently obtained, Sir William Logan conceives it probable that this series is unconformable with the older Laurentian system, and is separated from it by a long interval of time.

III. In the third place is a great series of crystalline schists, which are in Canada referred to the Quebec group, an inferior part of the Lower Silurian system. They appear to correspond both lithologically and stratigraphically with the Schistose group of the Primitive Slate formation of Norway, as recognized by Naumann and Keilhau, and to be there represented by the strata in the vicinity of Drontheim, and those of the Dofrefeld. The Huronian series of Canada in like manner appears to correspond to the Quartzose group of the same Primitive Slate formation (5). It consists of sandstones, imperfect varieties of gneiss, diorites, silicious and feldspathic schists passing into argillites, with limestones, and great beds of hematite. Though more recent than the Laurentian and Labrador series, these strata are older than the Quebec group; yet from their position to the westward of the greatest accumulation of sediments, they have been subjected to a less complete metamorphism than the palæozoic strata of the East. The Huronian series is as yet but imperfectly studied, and for the present will not be further considered.

(5) See Macfarlane—Primitive Formations of Norway and Canada compared—Canadian Naturalist, vii., 113, 162.

IV. In the fourth place are to be noticed the metamorphosed strata of Upper Silurian and Devonian age, with which may also be included those of the Carboniferous system in eastern New England. This group has as yet been imperfectly studied, but presents interesting peculiarities.

In the oldest of these, the Laurentian system, the first class of aluminous rocks takes the form of granitoid gneiss, which is often coarse grained and porphyritic. Its feldspar is frequently a nearly pure potash orthoclase, but sometimes contains a considerable proportion of soda. Mica is often almost entirely wanting, and is never abundant in any large mass of this gneiss, although small bands of mica-schist are occasionally met with. Argillites, which from their general predominance of potash and of silica, are related to the first class of sediments, are, so far as known, wanting throughout the Laurentian series; nor is any rock here met with, which can be regarded as derived from the metamorphism of sediments like the argillites of more modern series. Chloritic and chiastolite schists, and kyanite are, if not altogether wanting, extremely rare in the Laurentian system. The aluminous sediments of the second class are however represented in this system by a diabase made up of dark green pyroxene and bluish labradorite, often associated with a red alumino-ferrous garnet. This latter mineral also sometimes constitutes small beds, often with quartz, and occasionally with a little pyroxene. These basic aluminous minerals form however but an insignificant part of the mass of strata. This system is farther remarkable by the small amount of ferruginous matter diffused through the strata; from which the greater part of the iron seems to have been removed, and accumulated in the form of immense beds of hematite and magnetic iron. Beds of pure crystalline plumbago also characterize this series, and are generally found with the limestones. These are here developed to an extent unknown in more recent formations; and are associated with beds of crystalline apatite, which sometimes attain a thickness of several feet. The serpentines of this series, so far as yet studied in Canada, are generally pale colored, and contain an unusual amount of water, a small proportion of oxide of iron, and neither chrome nor nickel; both of which are almost always present in the serpentines of the third series.

The second or Labrador series is characterized, as already remarked, by the predominance of great beds of anorthosite, composed chiefly of triclinic feldspars, which vary in composition from anorthite to andesine. These feldspars sometimes form mountain masses, almost without any admixture, but at other times include portions of pyroxene, which passes into hypersthene. Beds of nearly pure pyroxenite are met with in this series, and others which would be called hyperite and diabase. These anorthosite rocks are frequently compact, but are more often granitoid in structure. They are generally greyish, greenish, or bluish in colour, and become white on the weathered surfaces. The opalescent labradorite-rock of Labrador is a characteristic variety of these anorthosites; which often contain small portions of red garnet and brown mica, and more rarely, epidote, and a little quartz. They are sometimes slightly calcareous. Magnetic iron and ilmenite are often disseminated in these rocks, and occasionally form masses or beds of considerable size. These anorthosites constitute the predominant part of the Labrador series, so far as yet examined. They are however associated with beds of quartzose orthoclase gneiss, which represent the first class of aluminous sediments, and with crystalline limestones; and they will probably be found, when further studied, to offer a complete lithological series. These rocks have been observed in several areas among the Laurentide Mountains, from the coast of Labrador to Lake Huron, and are also met with among the Laurentian rocks of the Adirondack Mountains; of which according to Emmons, they form the highest summits.

In the third series, which we have referred to the Lower Silurian age, the gneiss is sometimes granitoid, but less markedly so than in the first; and it is much more frequently micaceous, often passing into micaceous schist, a common variety of which contains disseminated a large quantity of chloritoid. Argillites abound, and under the influence of metamorphism sometimes develop crystalline orthoclase. At other times they are converted into a soft micaceous mineral, and form a kind of mica-schist. Chiastolite and staurotide are never met with in the schists of this series, at least in its northern portions, throughout Canada and New England. The anorthosites of the Labrador series are represented by fine grained diorites, in which the feldspar varies from albite to very basic varieties, which are sometimes associated with an aluminous mineral allied to chlorite in composition. Chloritic schists, freqently accompanied by epidote, abound in this series. The great predominance of magnesia in the forms of dolomite, magnesite, steatite and serpentine, is also characteristic of portions of this series. The latter, which forms great beds (ophiolites), is marked by the almost constant presence of small portions of the oxides of chrome and nickel. These metals are also common in the other magnesian rocks of the series; green chrome-garnets, and chrome-mica occur; and beds of chrome iron ore are found in the ophiolites of the series. It is also the gold-bearing formation of eastern North America, and contains large quantities of copper ores in interstratified beds resembling those of the Permian schists of Mansfeld and Hesse. In some parts of this series pure limestones occur, which contain various crystalline minerals common also to the Laurentian limestones, and to those of the fourth series. The only graphite which has been found in the third series, is in the form of impure plumbaginous shales.

The metamorphic rocks of the fourth series, as seen in south-eastern Canada, are for the greater part quartzose and micaceous schists, more or less feldspathic; which in the neighboring States become remarkable for a great development of crystals of staurotide and of red garnet. A large amount of argillite occurs in this series; and when altered, whether locally by the proximity of intrusive rock, or by normal metamorphism, exhibits a micaceous mineral, and crystals of andalusite; so that it becomes known as chiastolite slate in its southern extension. Granitoid gneiss is still associated with these crystalline schists. Gold is not confined to the third series, but is also met with in veins cutting the argilites of Upper Silurian age. The crystalline limestones and ophiolites of eastern Massachusetts, which are probably of this series, resemble those of the Laurentian system; and the coal beds in that region are in some parts, changed into graphite. It is to be remarked that the metamorphic strata of the third and fourth series are contiguous throughout their extent, so far as examined, but are everywhere separated from the Laurentian and Labrador series by a zone of unaltered palæzoic rocks.

Large masses of intrusive granite occur among the crystalline strata of the fourth series, but are rare or unknown among the older metamorphic rocks in Canada. The so-called granites of the Laurentian and Lower Silurian appear to be in every case indigenous rocks; that is to say, strata altered *in situ*, and still retaining evidences of stratification. The same thing is true with regard to the ophiolites and the anorthosites of both series; in all of which the general absence of great masses of unstratified rock is especially noticeable. No evidences of the hypothetical granitic substratum are met with in the Laurentian system, although this is in one district penetrated by great masses of syenite, orthophyre, and dolerite. Granitic veins, with minerals containing the rarer elements, such as boron, fluorine, lithium, zirconium, and glucinum, are met with alike in the oldest and the newest gneiss in North America. These however, I regard as having been formed, like metalliferous veins, by aqueous deposition in fissures in the strata.

The above observations upon the metamorphic strata of a wide region seem to be in conformity with the chemical princiciples already laid down in this paper; which it remains for geologists to apply to the rocks of other regions, and thus determine whether they are susceptible of a general application. I have found that the blue crystalline labradorite of the Labrador series of Canada is exactly represented by specimens from Scarvig, in Skye; and the ophiolites of Iona resemble those of the Laurentian series in Canada. Many of the rocks of Donegal appear to me lithologically identical with those of the Laurentian period; while the serpentines of Aghadoey, containing chrome and nickel, and the andalusite and kyanite-schists of other parts of Donegal, cannot be distinguished from those which characterize the altered palæozoic strata of Canada. It is to be remarked that chrome and nickel-bearing serpentines are met with in the same geological horizon in Canada and Norway; and that those of the Scottish Highlands, which contain the same elements, belong to the newer gneiss formation; which, according to Sir Roderick Murchison, would be of similar age. The serpentines of Cornwall, the Vosges, Mount Rosa, and many other regions, agree in containing chrome and nickel; which on the other hand, seem to be absent from the serpentines of the Primitive Gneiss formation of Scandinavia. It remains to be determined how far chemical and mineralogical differences, such as those which have been here indicated, are geological constants. Meanwhile it is greatly to be desired that future chemical and mineralogical investigations of crystalline rocks should be made with this question in view; and that the metamorphic strata of the British Isles, and the more modern ones of Southern and Central Europe, be studied with reference to the important problem which it has been my endeavour, in the present paper, to lay before the Society.

MONTREAL, January, 25, 1863.

ART. XVII.—*Description of a new species of* PHILLIPSIA, *from the lower Carboniferous rocks of Nova Scotia;* by E. BILLINGS, F.G.S.

PHILLIPSIA HOWI. (N. SP.)

P. HOWI. Pygidium. The tubercles on the side lobes were overlooked in the drawing, the specimen being nearly smooth.

Description.—Pygidium semi-elliptical, strongly convex, width at the anterior margin a little less than the ength, seventeen or eighteen articulations in the axis, side lobes with ten or twelve ribs and a smooth border. The axis is very prominent, about one-third the width, gradually and uniformly tapering and terminating abruptly at five-sixths of the whole length in an obtusely rounded apex. The ribs on the axis are depressed convex, becoming smaller and more crowded towards the apex, each with eight or nine small tubercles, which are confined to the middle third of the width of the axis, and are situated near the posterior margin of the ribs. The side lobes have ten or twelve depressed convex ribs, the last three indistinct, the first three or four with a very obscure fine groove near the posterior edge, in the outer third of the length. The smooth border is about one-fourth the width of the side lobes at the anterior angles, but a little wider behind; all the space behind the apex of the axis is smooth. Each rib has nine or ten small tubercles near its posterior margin. On the posterior third of the pygidium there is an obscure shallow groove along the inner edge of the smooth border.

Length of the specimen six lines; width at the anterior margin, nearly the same, about one-sixth of a line less.

This species resembles *P. Meramecensis* (Shumard), but has a greater number of ribs in the axis of the pygidium.

P. insigens (Winchell) is a very closely allied species. The pygidium is thus described by Prof. Winchell in the Proc. Acad. Nat. Sci., Phi. January 1863, p. 24.

"Pygidium very convex, semi-elliptic, the axis very prominent and forming about one third the width at the anterior margin; consisting of twelve to fourteen rings each bearing six small tubercles, the whole of which are arranged in six longitudinal rows; the tubercles often worn down on the exterior of the test, but always well defined in the cast; lateral lobes bent rather abruptly downwards, having ten ribs, which become indistinct and disappear toward the margin, and are entirely wanting over the narrow space behind the axis; the anterior ribs shewing a faint median groove toward their vanishing extremities, and a few of the posterior ones bearing feeble tuberculations toward their axial extremities".

The only difference of any importance between the two species appears to be the greater number of rings in the axis of our species. This however will most probably turn out to be correlated with differences in the glabella.

Dedicated to Prof. H. How, King's College, Windsor, Nova Scotia.

Locality and Formation.—Kennetcook, Nova Scotia; lower carboniferous.

ART. XVIII.—*Description of a new Trilobite from the Quebec Group.* By T. DEVINE, F. R. G. S., C. L. Department, Quebec.

MENOCEPHALUS SALTERI, (N. S.P.)

(Enlarged two diameters.)

DESCRIPTION.—form oblong—oval.—Entire length three lines and width at posterior margin of the head one and one fifth line—front of head and posterior margin of the tail broadly rounded—sides parallel.

HEAD—Semicircular, two fifths of the entire length, strongly convex, posterior margin marked by a well defined furrow which curves round the lateral angles anteriorly.

GLABELLA—Ovate, narrow at the base, and broadly rounded in front, extending anteriorly beyond the fixed cheeks, prominently convex with a very narrow flat rim forming an arch round the front.

THORACIC SEGMENTS—Six or seven, flat lying close to each other with a broad, deep groove extending outwards to the tips which are bent down.

AXIS—Tapering regularly from the front of the head to the posterior margin of the tail, convex, as wide as the pleuræ in front and less posteriorily, the rings of the axis run into the groves of the pleuræ—marked by a deep grove.

TAIL—Semicircular, the lateral lobes marked by two or three ribs with a deep grove as in the pleuræ, owing to which and the smallness of the specimen, it is difficult to perceive the line of separation between the body and tail.

The eyes and free cheeks are absent in all the specimens.

AFFINITIES—In form and number of pleuræ it resembles *Cyphoniscus Socialis* (Salter) but differs from it in details of structure —the pleuræ are of a different type, having the groove running along the middle, straight outwards, and not obliquely outwards and downwards, as in Salter's figure. The pygidium is entire but is as deep grooved as the pleuræ, the whole form is not so convex, and the pleuræ are not facetted.

It appears from the outward edge of the fixed cheeks that the facial suture cuts the margin in front and posterior margin far outward, The head of *Menocephalus Salteri* resembles closely that of *Bathyurus Saffordi* in the flat arched border in front of the Glabella, and in the three convex lobes into which the head is divided.

Dedicated to J. W. Salter, Esq, Palæontologist of the Geological Survey of Great Britain.

This beautiful little crustacean was found at Point Levis in the Quebec Group of Rocks, in the same band of Limestone as *Olenus Logani.*

BOTANICAL SOCIETY OF CANADA.

The usual monthly meeting was held in the University Hall, Kingston C. W. on Friday evening, March 13, Rev. Prof. Williamson, LL.D., presiding.

The following papers were read ;—

1. Remarks on the Flora of Brockville, C.W., and vicinity. By Robert Jardine, B.A.

2. Communication from Dr. Francis W. Bird, with fresh specimens of broad-leaved evergreens from the woods of Virginia, including "Live Oak," from within the walls of Fortress Munroe, Hollies, &c. Read by Prof. Dickson, M.D.

3. List of ferns collected in the neighbourhood of Hamilton, C.W. By Judge Logie.

4. On the Flora of Beckwith, with remarks on the physical geography and industrial products of the locality. By Josiah Jones Bell.

5. Remarks on the cultivation of flax in Canada. By. Rev. Prof. Williamson.

The following were exhibited :—

A Fairy Rose in bloom, from Mrs. Prof. Lawson; specimens of an Algia, apparently identical with a long lost plant, the *Lemania variegata* of Bishop Agardh, from Mr. Marcoun, Belleville; specimens of Brockville Plants, from Mr. Jardine; a flower of very large size, of the Night Flowering Cereus, preserved in alcohol, which had been presented to the college museum by Mrs. McLeod.

Letters were read by Prof. Lawson, from Thomas Briggs, jr.; Dr. Muller, Government Botanist, Melbourne, advising the transmission to the Society of a large collection of Australian plants; Dr. Grant, Ottawa, accepting of membership, &c.

The Secretary laid on the table the first number of a new monthly periodical, the Journal of Botany, British and Foreign, edited by Dr. B. Seemann, London.

The librarian presented donations to the library from the American Philosophical Society: Dr. Muller, Melbourne; and Prof. Asa Gray, Harvard.

ENTOMOLOGICAL SOCIETY OF CANADA.

A meeting of Canadian Entomologists was held in Toronto, in the rooms of the Canadian Institute on Thursday, the 16th of April, for the purpose of taking into consideration the propriety of forming a Society for the advancement of Entomological pursuits.

The following gentlemen were present:—Rev. Prof. W. Hincks F.L.S., Prof. H. Croft, D.C.L., Beverley R. Morris, M.D., J. H. Sangster, A.M., and J. Hubbert, of Toronto; Thomas Cowdry, M.D., and H. Cowdry, York Mills; Rev. C. J. S. Bethune, M.A., Cobourg, and W. Saunders, London.

Prof. Hincks was appointed chairman, and Mr. Bethune, secretary *pro tem.*

Letters of apology for non-attendance were read from E. Billings, F.G.S., Montreal; R. V. Rogers, Kingston; T. Reynolds, Hamilton; B. Billings, Prescott; Rev. V. Clementi, B.A., Peterborough, and E. Baynes Reed, London. These gentlemen expressed regret at their inability to attend, and pledged themselves to do all in their power to further the interests of the society.

The following resolutions were then unanimously adopted :

1st. That a Society be formed to be called the Entomological Society of Canada, consisting of all students and lovers of Entomology, who shall express their desire to join it and conform to its regulations.

2nd. That its officers shall consist of a President, a Secretary-Treasurer, and a Curator, to be elected annually at the first general meeting in each year, whose duty it shall be to manage the affairs of the Society.

3rd. That the annual contribution of members shall be two dollars, to be paid in advance.

4th. That application be made to the Canadian Institute for the use of a room in their building for the purposes of the Society.

5th. That two separate collections be formed, a general one to be the property of the Canadian Institute, and a duplicate one to be the property of the Society, and to consist of all surplus specimens contributed to the Society by members; and that all members be at liberty to exchange species for species under the supervision of the Curator.

6th. That meetings be held at 3 P. M., on the first Tuesday in each month, and that special meetings may be called when necessary by the Officers.

7th. That Prof. Croft be President for the present year; that Wm. Saunders be the Secretary-Treasurer, and J. Hubbert the Curator.

8th. That the President be authorized to bring the subject before the Council of the Canadian Institute at its next meeting.

The following papers were then read to the Society :—" Insect Life in Canada, March and April;" by the Rev. C. J. S. Bethune, and " A Synopsis of Canadian ARCTIIDÆ ;" by W. Saunders, the latter illustrated by a complete series of specimens.

A number of interesting insects were brought to the meeting for inspection, chiefly from the collections of Dr. Morris and W. Saunders. Among others, Canadian specimens of the following were much admired. *Limenitis ursula*, *Vanessa cœnia*, *Mellitœa nycteis*, *M. phœton*, *Thecla niphon*, *T. mopsus*, *T. laeta*, *Lycœna neglecta*, *Polyommatus dorcas*, *Hesperia mystic*, *H. wamsutta* and *Pamphila numitor*. A specimen of *Colias eurytheme* though not itself Canadian, was regarded with great interest from the fact that a specimen had been captured last fall near St. Catherines by D. W. Beadle.

The pretty little moths *Glaucopis semidiaphana* and *Melanippe propriaria* were duly represented; also beautiful specimens of *Arctia dione* and *Sphinx drupiferarum.*

Magnificent specimens of *Ceratocampa regalis* and *Dryocampa imperialis* wero exhibited, and although not natives, the probability of their being yet found with us gave them an additional interest.

Among the coleoptera we observed some rarities, for example: *Xyloryctes satyrus*, *Canthon chalcites*, *Chlœnius lithophilus*, *Calosoma frigidum*, *Geotrupes splendidus*, *Bolbocerus Lazarus*, *Aphonus frater*, and *Leptura nitens*, all natives of Canada.

After a careful examination of all that was interesting, the meeting adjourned, each one highly pleased with the results of the gathering.

The application for the use of a room in the building of the Canadian Institute, for the purposes of the Society, was brought before the Council, by the President, at their meeting on Saturday the 18th, when they very liberally granted it free of expense.

The Society thus formed will we trust be a prosperous one. The number of Entomologists in this country is not large, but they are amply sufficient to sustain an organization of this sort. The advantages the Society offers to its members are not by any means small. The general collection will be open to all for purposes of roference and comparison, and will thus afford valuable opportunities to those who wish to name their specimens; while the cabinet of duplicates will offer means of exchange with al- parts of Canada. It is intended that duplicate copies of Entomological papers, published by those connected with the Society, shall be left with the curator for distribution among members. It is probable also that as soon as the funds will permit, an Entomological library will be added to the other attractions in the Society's room; and that a stock of pins will be purchased from which members may obtain supplies at cost price.

That the meetings of the Society may be made as interesting and attractive as possible, it is desired that members at a distance should furnish short monthly records of interesting captures in their localities, always accompanied when convenient with specimens of the insects.

All lovers of Entomology may become members of the Society by remitting the amount of the yearly subscription to the secretary-treasurer. W. SAUNDERS, *London.*

NATURAL HISTORY SOCIETY.

ORDINARY MEETING, FEBRUARY 23.

Principal Dawson, one of the Presidents, in the Chair.

After some routine business a Committee was named to "take steps in connection with the Horticultural Society for the establishment of a Botanical Garden."

Several names were proposed for membership, after which the following papers were read and presented:

On a new method of preparing Chlorine, Carbonate of Soda, Sulphuric Acid, and Hydrochloric Acid; by Thomas MacFarlane. Read by Dr. Hunt.

On the Superficial Geology of the Gaspé Peninsula; by Robt. Bell.

On the parallelism of the Quebec Group with the Llandeilo of England and Australia, and with the Chazy and Calciferous formations; by E. Billings, F.G.S.

On the Birds of North America; by B. R. Ross. Read by Dr. Hingston.

Notes on the Diatomaceæ from the St. John River; by Prof. L. W. Bailey, of the University of New Brunswick. Presented by Dr. Dawson.

ORDINARY MEETING, MARCH 30.

Rev. Dr. De Sola, Chairman of Council, in the Chair.—About forty members were present.

The following gentlemen were elected corresponding members:—

Hugh E. Montgomerie, of London; Charles Waterton, near Wakefield, England; Professor Bailey, of Fredericton, N. B.; N. W. Bethune, of Ottawa.

The following gentlemen were elected ordinary members:—

Alexander Urquhart, Thos. Leeming, Francis Scholes, Alfred Brown, Prof. Small, late of Lincoln College, Oxford; J. F. Whiteaves, F.G.S., &c., &c.

The following donations were presented:—

From N. W. Bethune, a Canada Bank Note of the year 1792.

From T. Devine, Quebec, sixteen specimens of Electrotype casts of Fossils from Point Levi.

From Mr. Charlton, Laprairie, fish for the Aquaria.

For the Library.—From Principal Dawson: A pamphlet on the Devonian Flora of Eastern America; a vol., Rhopalocera Afriæ Australis, from W. S. M. D'Urban; and the usual magazines and papers.

After other routine business the following papers were read:—

1. *On Amendments of the Game Laws of Canada*, by A. Rimmer. The author explained and advocated a number of amendments which have been proposed by the Game Preservation Society, and which it was believed would materially tend to the preservation of game birds, as well as of those smaller birds, the wanton slaughter of which is so injurious to agriculture and horticulture.

2. *On a New Trilobite from the Quebec Group*, by T. Devine. This paper was read by Sir W. E. Logan, who noticed, in introducing it, the successful labours of Mr. Devine in collecting in these ancient rocks, the fossils of which are of so great interest in connection both with the questions as to the age of the group and with general geology. The fossil now described was of special interest, as giving the complete characters of a genus previously known only by parts of the body.

3. *On the Geology of the County of St. John, New Brunswick*, by G. F. Matthew.

This paper was read by Principal Dawson. It contained a minute stratigraphical description of the Devonian rocks of the vicinity of St. John, and of the overlying carboniferous and new red sandstone deposits. A very interesting fact was the occurrence, in these beds, of successive floras of the Devonian, lower carboniferous, coal-formation, and mesozoic periods, all more or less distinct from each other.

Mr. Leeming stated that Mr. Whiteaves would enter on his duties as scientific Curator to the Society on Wednesday, 1st April, and after that date would be found at the rooms.

Proceedings of the Annual Meeting.

The annual meeting of this Society was held in their rooms on the evening of May 18th, Principal Dawson, one of the Vice-Presidents, in the chair. A large number of the members were present. Mr. J. F. Whiteaves, the Scientific Curator, on behalf of the recording secretary, Mr. John Leeming, read the minutes of the last annual meeting; after which the usual annual address of the presiding officer was read, as follows:—

THE PRESIDENT'S ADDRESS.

GENTLEMEN—I could have wished that the duty of preparing the annual address of the President had, on the present occasion, fallen on some other person, as I fear that the pressure of various official duties has scarcely left me time to do justice either to myself, or to the work of the Society—still less to enter on that wider survey of the progress of Natural Science to which we are invited on an occasion of this kind.

I find that, in the past winter, twenty-six original papers have been read at the meetings of the Society, in addition to a number of articles and reviews contributed by our members, and published in the *Naturalist*, without being formally read here. I shall not give a list of these papers, but shall endeavour to group them according to the subjects to which they relate, and to give in this way a general sketch, first of the amount of original scientific research represented by these papers; and secondly, of their bearing on the arts of life, and on the material improvement of this country.

To begin with Geology, which in our day sits justly enthroned as queen of all the natural history sciences, and with Canadian Geology which most nearly concerns us, we have had several elaborate papers on those ancient, disturbed, disputed, and until lately problematical rocks on which the oldest capital of Canada stands, and which are consequently known to our survey as the "Quebec group." To the common eye, the ancient citadel of Quebec has been standing impregnable and secure, but in the minds of geologists it has been floating like a mirage, now here and now there, until many men have been at a loss in what terms to express their idea of its geological place. The officers of our survey have addressed themselves with much zeal and success to this formation, and deserve great credit, first for frankly giving up incorrect views previously maintained; and secondly, for establishing the true geological position of these difficult rocks on a sure basis. Mr. Billings has in the past year furnished us with an interesting view of the parallelism of these beds with the Llandeilo of England. Sir Wm. E. Logan has introduced to us a new and useful laborer on these fossils, Mr. Devine, of Quebec, and will himself publish in next number of our proceedings an elaborate survey of the stratigraphical arrangements of the beds at Point Lévi. In the geology and mineralogy of the metalliferous deposits of this group, as they exist at the celebrated copper mine of Acton, Mr. MacFarlane's paper is a great step in advance, more especially in the large number of facts which he chronicles, and which, but for his careful collection of them in the progress of the workings, would have been forever lost.

Making a sudden leap from these ancient rocks to the most modern formations, our proceedings show several valuable contributions to the geology of the post-pliocene deposits. In this field, Mr. Billings' paper on the remains of fossil elephants found in Canada is of especial value, as for the first time giving accurate descriptions and figures of these remains, and identifying our species with that known to American naturalists as *Elephas Jacksoni*. In this paper, Mr. Billings has worthily followed up, with reference to the extinct elephantine animals of Canada, the able investigations of Dr. Falconer on the general distribution of these animals. The society has also received valuable contributions in the field of Canadian post-tertiary geology from Mr. Robb, Mr. Bell, and Mr. Whiteaves. We have not yet succeeded in Canada in tracing man back to the post-pliocene period, as is claimed to have been done in Europe; but, as I have pointed out in papers on this subject, read before the society on former occasions, the researches in the superficial geology of Canada, will have important bearings on many disputed questions as to the distribution and supposed changes of plants and animals which have survived from the post-pliocene to the modern period.

On points of the geology of the United States connected with Canadian geology, we have had important contributions from Prof. Hall and Col. Jewett. The paper of the late lamented Moses Perley on Newfoundland, presents a valuable picture of the geology and topography of that island; and the paper of Mr. Matthews on the geology of St. Johns, New Brunswick, is an excellent piece of stratigraphical geology, bearing on the solution of some most important and difficult questions. In this connection I shall take the liberty to apologise for the great length to which my own papers on the Reptiles of the coal period have extended, and to mention the ray of light which the footprints of the modern King-crab have enabled me to throw on the *Protichnites* of the Potsdam sandstone.

In chemical and economical geology, I need merely mention the profound generalisations of Dr. Hunt in his paper on the chemistry of the earth; the practical information contained in the same author's paper on the gold-fields of Canada, and in that by Mr. MacFarlane on the extraction of cobalt from Canadian ores.

In zoology and botany, our work has perhaps been less extensive and important than in geology. In these fields, however, we may mention Dr. Lawson's paper on *Aphis avenæ;* Mr. Cooper's on *Saperda Candida;* Mr. Scudder's on the *Orthoptera* of the northwest territory; Dr. Cobbold on a Canadian *Tœnia;* Mr. Billings on *Monohammus;* Mr. Whiteaves on the land and fresh-water shells of Canada; Prof. Bailey on the *Diatoms* of the St. John River; Mr. Barnston on the Otters of America; and the completion of Dr. Hall's elaborate paper on the mammalia and birds of Montreal.

All of these papers contain important new facts in natural history. One of them, that of Mr. Whiteaves, nearly exhausts the subject to which it refers, in so far as present material is concerned; others add new species of the Canadian fauna; and several are of great practical value.

In their purely scientific aspect, the pursuits of the *Naturalist* should be highly esteemed, as widening our views of nature, enlarging our minds, and elevating the reputation of our country. They are, however, also of utility to the country in their economical applications. To this I would especially advert, in connection with our proceedings, as establishing a valid claim to consideration on the part of the public, independently of our merely scientific discoveries, or of the pleasure to be derived from our collections and lectures.

In 1862, Mr. Macfarlane of Acton gave us the results of experiments on certain varieties of iron pyrites occurring near Brockville, from which he showed that cobalt and sulphuric acid could be obtained in remunerative quantities. These experiments seem to have led him to further studies of the reactions of sulphuret of iron and common salt; and the result has been another paper, detailing a new mode of obtaining chlorine and soda, which has been patented in England, and promises to effect a revolution in the manufacture of these important substances, and to cheapen and render more accessible some of the most useful agents in the promotion of comfort, cleanliness and health.

A little striped beetle, *Saperda Candida*, burrows when in its larval condition in our apple trees, and soon blasts the results of much expenditure, and of years of labour. Mr. Cooper of Quebec has shown us how the entomologist, by careful study of this creature's habits, can counteract its operations, and enable us to enjoy some degree of immunity from its ravages. Mr. Billings has explained to us the habits of another insect destroyer, of the genus *Monohammus*, which it seems can devour in a single season and on a single property, pine timber to the value of £10,000. Dr. Lawson has laid before us the habits of the curious little *Aphis*, which sometimes swarms in our grain fields; and has to some extent vindicated it from the charges brought against it, and which more properly lie at the door of the wheat midge. I have myself only been prevented by lack of time from bringing under your notice some sketches of the habits of the Army-worm, and of some other of the more common insect pests, and may commend the subject to other observers as a most promising and valuable field of labor.

A committee of our society has been engaged in promoting measures for the more effectual protection of the smaller insectivorous birds, to which has been assigned by Providence the function of protecting us against insect ravages, and which, as a part of the unpaid police of nature, as well as for their beauty and their song, should be cherished and guarded from harm in every country truly civilized.

Another Committee has been engaged in the investigation of the causes of the decay of the apple orchards, for which the island of Montreal was once celebrated. Among the principal results of this inquiry, in addition to points well known to gardeners, may be mentioned the following:—(1) That old varieties of trees necessarily become delicate and unproductive, and should be replaced by new and hardy seedling varieties. (2.) That efforts should be made to supply to the soil the mineral matters required to constitute the ashes of healthy wood, and which in the process of culture become exhausted. (3.) That the habits of injurious insects, fungi, &c., should be carefully studied, and that the birds frequenting orchards should be more effectually protected.

Other kinds of trees have also attracted our attention, and among these the vine, which, notwithstanding the great success of its culture in vineries, and the zealous efforts of M. DeCourtenay, is not yet extensively cultivated in the open air. Observation and experience have convinced me that wherever, even in Lower

Canada, there are gravelly or light soils, or stony hill-sides, with good exposure, some of the varieties of our native grapes could be ripened abundantly. Independently altogether of the manufacture of wine, the introduction of the grape as an article of food of a peculiarly agreeable and healthful quality, is well deserving of effort.

At some of our meetings discussions have arisen respecting the use of Canadian fibres in the manufacture of fabrics and of paper. It would seem that the fibres of the stem and the silky coma of the seed of our common milk-weed, might be made available in this way, and that the culture of the plant might be profitably undertaken. A more important subject, perhaps, is the culture of silk. Efforts are now being made by the Botanical Society of Kingston, to introduce into this country from China, a species of silk-worm, *Bombyx Cynthia*, said to be hardy, and which feeds on the leaves of *Ailanthus glandulosa*, a well-known ornamental plant, rather tender for this climate, but still capable of cultivation here. Dr. Lawson has kindly sent me a few of the cocoons, from which it is hoped that a small colony of the animals may be reared, as Mr. Sheppard of this city possesses a little plantation of the *Ailanthus*. Dr. Lawson has also furnished for publication a valuable paper on the subject, by Mr. Patterson of Leith. It appears to me, however, that the silk of some of our native moths might be rendered more available than that of any foreign species. The ubiquitous moths of the genus *Clisio campa*, which devastate our forests and orchards, produce delicate silken cocoons, tons of which go to waste annually, and the amount could no doubt be greatly increased by the artificial culture of the animal. A still more abundant source of silk would be the cocoons of the great emperor moths of the genus *Attacus*, some of which, and especially the *A. cecropia*, yield cocoons superior to those of many of the species cultivated in China and India. Harris, in his "Insects of Massachusetts," states that the silk of this moth is very strong and quite available for manufacture. The writer of an excellent article on this subject in the Journal of the Board of Arts and Manufactures for Upper Canada, adduces additional facts as to the easy breeding and culture of the moth. An esteemed correspondent and good entomologist, Dr. Morris of Baltimore, has naturalized there the *Ailanthus* moth, and is now engaged in experiments on the culture of the American species. There seems no reason why these creatures, instead of reducing our forests and orchards to nakedness, might not be employed in clothing the daughters of Canada with fabrics equal to those of China and India, and in adding silk to our articles of export. In effecting this result, the naturalists must, in the first instance at least, take the lead.

An important part of the work of this society is that of popularizing natural science, in such a way that its results may be extensively known, and that new votaries may be attracted to its study. This end we seek to attain by our popular course of Somerville lectures, free to the public, and by throwing our museum open on easy terms. I should especially mention in this connection, the engagement of our scientific Curator, Mr. Whiteaves, under whose care large portions of our collections are being arranged in such a manner as to give education in natural history to any ordinary observer, and to aid the labours of the scientific student.

We are also reminded, in glancing at the proceedings of the past year, that we do not now labour alone. On one side, the Canadian Institute of Toronto, and on the other the Literary and Historical Society of Quebec are pursuing similar paths. The young but vigorous Botanical Society of Canada, established at Kingston, has availed itself of our journal for the publication of some of its papers and proceedings. The Natural History Society of New Brunswick has in like manner contributed some important memoirs for publication. The Literary and Scientific Society of Nova Scotia has sent us its constitution and regulations. Our proceedings have been enriched by valuable contributions from Rupert's Land, and there is now a natural history society in that region. Mr. Bethune has given us a catalogue of Canadian entomologists, and this has been followed by the organization in Toronto of an Entomological society. We have also to express our thanks to many individual contributors and correspondents in various parts of British America, and to many scientific institutions and associations abroad, which have in various ways recognized our humble labors. More especially in this regard should we state our obligations to the Smithsonian Institution of Washington for its frequent kindly offices. The society has further to congratulate itself that its relations with its two nearest neighbors—the Geological Survey of Canada and the McGill University—are at once intimate and mutually advantageous. The officers of the survey are among our most valued members, while through us they are sometimes enabled more readily to bring under the public notice important facts or discoveries. The prosperity of this society is an important stimulus to the study of natural science in the university; and, on the other hand, the graduates who are constantly going forth with a knowledge of the elements of natural science, and some degree of taste for its cultivation, must materially strengthen the society.

The Council will report to the Society a regulation for the disposal annually of a silver or bronze medal to some gentleman distinguished for important services to science, and especially to science in Canada. I have further very much pleasure in stating that it is proposed that the first silver medal granted under this regulation shall be bestowed on Daniel Wilson, LL.D., of University College, Toronto. Dr. Wilson came to Canada with a high reputation, earned in the study of British archæology; and in this country he has pursued with much energy and success researches in the ethnology and antiquities of America, the results of which have appeared in many papers, published here and abroad, and more recently in his valuable work "Pre-historic Man." It is one of the most pleasant features connected with the institution of these medals, that they will thus enable us to testify our appreciation of the services of labourers in science not of our own body, nor resident here, but who are nevertheless fellow-workers with us in the objects which we have in view.

I have reached the limits to which an address of this kind should be restricted, without exhausting the topics suggested by our annual meeting, and perhaps without having noticed some important parts of our work; but I must now conclude, with the expression of the hope that the coming year may be still more prosperous than the last, and more fruitful of great results.

Report of the Council.

The Council of the Natural History Society of Montreal, on the occasion of the 35th Annual Meeting of the Society, find it their duty to submit to the members generally a review of the proceedings and condition of the Society during the past year. And if their predecessors have had cause on former occasions to congratulate themselves on the steady progress of the Society, your Council have now the pleasure of announcing that no other year has excelled, or perhaps equalled, the one just closing in its history, either for the amount of scientific work done, or for the successful introduction of new valuable features, which it is believed will be sources of permanent benefit to the Society. Among these, two may be especially mentioned: first, the commencement of a series of annual social meetings open to the public; and secondly, the appointment of a scientific curator, a want which had grown into a reproach to the Society. It is deemed proper to exhibit the operations and progress of the Society under appropriate heads. And first of

The Museum.

During the past year the donations to the Museum have been more than ordinarily numerous and valuable. Without desiring to be invidious, your Council cannot but acknowledge the extreme liberality of some members of the Society who have very handsomely added to departments hitherto scarcely represented in the Museum. Through the kindness of Sir William Logan, the curator has been enabled to add to our collection some seventy-two specimens of marine shells, eighty-one of land and fresh water shells, ten echinodermata (sea urchins, and star-fishes), four crustaceans, four cirripides, six annelidæ, in all 177 species, besides a number of bryozoa and sponges, nearly all new to science. Dr. Dawson, among many other valuable gifts, presented the Society several species of marine shells, echinodermata, &c., from the gulf of St. Lawrence, Labrador, Nova Scotia, and the United States. James Ferrier, jun., Esq., has presented a most extensive and valuable series of foreign shells, in which the Society's collection was formerly very deficient. The number of species is about 410, and contains many rare genera. R. J. Fowler, Esq., has kindly enabled the Society to complete its collection of land and fresh water shells of Lower Canada, by contributing the missing species. Your Council invite an inspection of these valuable additions to the Museum, and trust that the considerate liberality of the donors may be imitated by others. Your Council regret that the number of quadrupeds is still so very small. They have, however, issued a circular inviting contributions to their mammalia, and adding a list of the specimens wanted. Of this circular one thousand copies were printed, distributed to each member, and extensively sent to kindred societies in Europe and the United States; so that your Council are sanguine the Society will soon be enabled to see some improvement in this department. Some interesting specimens have been added to the collection of birds. Mainly through the zeal of Mr. Whiteaves, the curator of the

Society, a commencement has been made for a collection of the eggs of North American birds, and several donations have already been received. Your Council having authorized Mr. Hunter the janitor of the Society, to collect specimens of the fish of this country not in the Museum, a very creditable progress has been made in the work, which it is earnestly hoped will be further promoted by the members. In the miscellaneous department various contributions have been received; and your Council have had the pleasure of welcoming among the donors a new and promising organization—the Numismatic Society of Montreal. Your Council would offer as a suggestion to their successors the consideration of the expediency of uniting the Society's collection of coins with that of the new Society.

The Library.

The additions to the library have consisted of donations from members and scientific societies, or exchanges of "the Naturalist," the financial state of the Society still forbidding the purchase of scientific works much wanted.

Appointment of a Scientific Curator.

One of the greatest difficulties with which the student of Natural History in Montreal has had to contend, was the impossibility of finding a trustworthy classified collection, especially in zoology. It were needless to remind the members, of the chaotic state in which the collection of this Society has been permitted to remain. And although a former sub-curator and some members had bestowed much time on the task of classification, still, all must be aware that the work required to be done could not possibly be effected by a few spasmodic efforts of individuals, having but little leisure to spare. Your Council therefore esteem it matter of much congratulation that they have been enabled to secure the valuable and zealous services of one so well and so favourably known as Mr. J. F. Whiteaves. It cannot be expected that all his labours should be specified within the limits of this portion of the Report; but your Council would beg leave to refer to the statements already made public, to Mr. Whiteaves' Report delivered last month, and finally to the Museum itself, where the members can judge for themselves, as to the expediency and necessity of the appointment.

Original Papers Read.

In the past session, twenty-six original papers in the departments of zoology, geology, botany, and ethnology have been read, the value and importance of which may be estimated by reference to "the Canadian Naturalist," in which they have nearly all been published. Many of them have been noticed in terms of the highest eulogy in the scientific periodicals of Europe and the United States.

The Publication of the Naturalist.

This Journal has been continued as heretofore; and the former liberality of its publishers, Messrs. Dawson Bros., has been exceeded during the past year, they having furnished its columns with an unlimited number of engravings at a considerable pecuniary loss. The volume for 1862 (the 7th) has been duly completed. Two numbers for 1863 have been issued, and the third is in progress. It is intended to commence a new series after the present volume is completed, with Scotch paper, expressly made for the Journal, and new type. Its circulation however is still much smaller than it should be, and it is hoped members will use due efforts to extend it.

Public Lectures.

The annual Somerville course of public lectures was delivered, as usual, and was well attended. The following is an enumeration of the lecturers and subjects discussed:

12th February, 1863.—First lecture, Dr. Dawson, On some novelties in Natural History.

19th February.—Second lecture, Mr. Rimmer, On the Fishes of the St. Lawrence.

26th February.—Third lecture, Mr. Robb, On the Rocks, Woods, and Waters of Western Canada.

5th March.—Fourth lecture, Mr. Gilbert, On the Climate and Products of Australia, and the Customs of the Inhabitants thereof.

12th March.—Fifth lecture, Professor Small, On the Natural History of the Old World compared with that of the New.

19th March.—Last lecture, Mr. Leeming, A Glance at Science as a Recreation.

Conversazione.

On the evening of the 3rd of February the first Annual Conversazione of the Society was held. The rooms had been provided with a large collection of works of art, microscopes, &c., by the friends of the Society, and addresses were delivered by Principal Dawson, the Rev. A. F. Kemp, and the Rev. Dr. De Sola. The audience was the largest that had ever assembled in the city of Montreal for such a purpose; and your Council have great pleasure in believing that the experiment proved a decided success. The tendency of such social reunions must necessarily be beneficial to the Society; opportunity being afforded for general participation in the discussion of subjects connected with natural science.

Botanic Garden.

Your Council deemed it proper to appoint a committee* to co-operate with the Montreal Agri-Horticultural Society for the purpose of establishing a Botanic Garden in this city, if possible in the grounds of the McGill College. Your Council are happy to state that the project has been most favourably received by the public; and the governors of McGill University having, in the same spirit of liberality which led them to present gratuitously the site of the Society's present building, offered their grounds at a nominal rent for the purposes of the garden, your Council trust that so important an auxiliary to this Society may soon be established.

Miscellaneous.

Your Council are happy to announce a continued increase in the number of members. During the month of July his Excellency the Governor General visited the Museum, when an address was presented to him requesting him to become a patron of the Society. His Excellency was pleased to assent and to express great gratification with the appearance of the Museum. The number of additional ordinary members has been forty-eight, corresponding members nine, and life members two, in all fifty-nine. Your Council believe fully one half of these resulted from the favourable impression made by the Society's Conversazione, and they know that one other result was that a member liberally offered to commence a list with the sum of $200, to pay off the remaining indebtedness of the Society. In this connection also your council deem it fitting to refer to the liberality of the Society's treasurer, James Ferrier, jun., Esq., who to save the payment of a high rate of interest, has advanced a considerable sum of money for the purpose of liquidating the Society's indebtedness. The usual government grant was received—an earnest, your Council trust, that the legislature will continue to appreciate the efforts of the Society and enable them to bring together the means by which scientific attainments can be acquired. As evincing their own desire and that of the Society's to extend as widely as possible

* The committee consisted of Rev. Dr. De Sola (Convener), Rev. A F. Kemp, Messrs. S. C. Bagg, C. Robb, and John Leeming.

the knowledge of natural science, your Council granted the use of their rooms to Mr. Denton during the month of October for the delivery of a course of five lectures on geology, being desirous more particularly that the younger and non-scientific portion of the community should benefit by them, and devote more attention to such subjects than they have been accustomed to give. Among other proceedings of the year, your Council would further report that a committee was appointed to prepare for a field day under the direction of the Society, but that it was found necessary to postpone it for a future occasion; that the services of an assistant secretary have been dispensed with; that the building and portico have been repainted, and the sign which has been placed thereon, has had the effect of increasing the number of visitors; that the Society's amended act has been printed, and that the election o additional members of Council under its provisions has been found to promote the efficiency of its operations; that correspondence has been opened with kindred societies occupying a very high place in European estimation, among them the "Société d'Histoire Naturelle et de Physique" of Geneva; and that these societies have come to look upon the organ of the N. H. Society, "the Canadian Naturalist," as one of the most valuable exponents of the scientific progress of this continent. The sympathy of societies and individuals with the aims of the Natural History Society of Montreal, has been shown by many generous donations both of books and specimens; but your Council would offer as a suggestion that many desirable objects, the products of foreign countries, might be obtained by enlisting in behalf of the Society the assistance of the masters of the various vessels trading to this port, who have so many opportunities of procuring valuable specimens, and who have so extensively benefitted the various collections in the United States. The senior members of the Society will gratefully remember the liberal and numerous contributions of their zealous friend Captain Stoddard, whilom of the ship "Thames."

Your Council would especially record its gratification at the very efficient manner in which Mr. Wm. Hunter has discharged the duties of his office, combined as it has been with an obliging demeanor on all occasions.

A committee, appointed by the Council of the Natural History Society, at their meeting of the 23rd inst., to consider what disposition should be made of the medals of the Society, reported that after due consideration they would recommend that at least one bronze medal should be voted annually by the Society to some resident in the British provinces distinguished for attainments in natural science, or for special discoveries or active engagement in the same; and that the *silver* medals of the Society be presented *occasionally* to the same class of persons, whether resident in the British provinces or not.

The Council would now propose to the Society that the silver medal of the Society for the present year be given to Professor Daniel Wilson, LL.D., of Toronto, in acknowledgment of his services in American ethnology.

And now your Council would divest themselves of the trust with which they have been honoured, with the fervent hope that the onward steps taken during the past year may be continued and extended in the future, and that each succeeding anniversary meeting may witness an increase of prosperity and usefulness in the Natural History Society of Montreal.

ABRAHAM DE SOLA, LL.D.,
Chairman of Council.

Montreal, May 18th, 1863.

REPORT OF THE SCIENTIFIC CURATOR.

It should be observed that this report refers to a period of time little exceeding six weeks, from the 1st of April, 1863, to the 18th of May in the same year. On entering upon my duties one of the first things that struck me was the want of arrangement of the specimens in the side cases in the gallery. These contained a confused assemblage of marine shells, Echinodermata (sea urchins, star fishes, etc.), Crustaceans (crabs, lobsters, etc.), Sponges and other marine organisms from the Gulf of the St. Lawrence, and a large series of the land and fresh water shells of Upper and Lower Canada. These were the property of the Geological Survey of Canada, and were collected principally by Messrs. J. Richardson and R. Bell. The cases containing the same, also belonged to the Geological Survey. After several interviews with Sir W. E. Logan, I was requested to go over the whole of this rather large collection and pick out as complete a series as possible, for the Natural History Society. Since that time I have carefully mounted, classified and named the collection thus formed, which will now be available for reference and study.

The sponges, corallines, and other undetermined and, for the most part, minute objects have been temporarily grouped together in one case by themselves. The following is a rough estimate of this collection:

	No. of Species.
Marine Shells, (from the lower St. Lawrence)	72
Land and Fresh Water Shells	81
Bryozoa, (Sea mats, etc.)	undetermined.
Echinodermata, (Sea urchins, star fishes etc)	10
Crustacea	4
Cirripedes, (barnacles, etc.)	4
Annelida, (marine worms, inhabiting, in this case, shelly tubes.)	6
Sponges, (mostly species new to science.)	undetermined.

It should be stated that the tablets upon which these specimens are affixed were presented by the Geological Survey.

Among the marine shells are three species: Crenella nigra, Gray; Trochus occidentalis, Mighels; and Margarita obscura, Gould; which had previously been omitted in the lists of shells inhabiting the Gulf of St. Lawrence as published in the "Canadian Naturalist."

Dr. Dawson has presented to the Society several species of marine shells, echinodermata etc., from Gaspé, Labrador, Nova Scotia, and the United States. Among them is the common edible periwinkle of Europe (Littorina littorea) discovered by Dr. Dawson at Pictou, Nova Scotia, where it is believed to have been for the first time detected on the North American continent.

Mr. R. J. Fowler has presented a series of specimens of eighteen species of those Lower Canadian land and fresh-water shells which were wanting to complete the Society's local collection. Some of these are rare species, for the first time described as inhabiting Lower Canada, in the April Number of the "Canadian Naturalist" for 1863. The specimens of the above mentioned series have been carefully arranged and named, with the donor's name attached to each species.

Mr. James Ferrier, Jun., has presented to the Society a most extensive and valuable series of foreign shells, including several rare and interesting genera. The number of species is as follows:

From the Bay of Mazatlan, Mexico:

Bivalves, 30 species. Univalves, 57.

Exclusive of these

Bivalves, 87 species. Univalves, 228.

These have been mounted, named, and classified. The general collection of shells belonging to the Society has also been partly classified and arranged. The following is an estimate of the Society's collection of shells, previous to the above mentioned donations:

Bivalves,	74	species.
Univalves,	340	"

As far as possible the names of the donors have been given with the name of each species, but in some cases this could not be ascertained.

To add to the interest of the Society's collection of birds, an attempt has been made to get up a collection of the eggs of North American birds. A few gentlemen have been seen, and the following donations received:

From J. Ferrier, Jun., Esq.,

15 species of eggs from Canada and the United States.

From G. Barnston Esq.,

6 species of eggs from the Hon. Hudson Bay Company.

1 " egg from Lake Superior.

The eggs thus obtained have been named and carefully put away, until a proper cabinet be voted by the Society for their reception.

Prof. Baird, of the Smithsonian Institute at Washington, has been written to by me soliciting donations to this branch of our natural history.

As Recording Secretary to the Society, I have endeavoured to make the newspaper reports of our ordinary and annual meetings more accurate and satisfactory. In my spare time I have attempted to call some attention, through the press, to what the Society is endeavouring to effect, by reviewing its journal and by popular articles on local natural history. It has been my duty too, assisted by other members of the Society, to prepare the annual report for the year ending May 17th, 1863. Finally, it is hoped that reasonable courtesy and attention has been paid to visitors who have wished for any special information, and to strangers.

J. Whiteaves F. G. S.,
Honorary Member of the Ashmolean
Society, Oxford, England, etc.,
Scientific Curator and Recording Secretary.

It was moved by Dr. David, seconded by Professor Cornish :—That the various reports now presented be accepted, and with the annual address printed as usual.

After which a vote of thanks to the officers of the past year was proposed by Mr. Mackay, seconded by Major Latour, and unanimously carried.

The Society then proceeded to ballot for officers for the ensuing year, when the following were duly elected.

OFFICERS FOR 1863-64.

President.—Principal Dawson, LL.D., F.R.S., &c., &c.

Vice-Presidents.—The Lord Bishop of Montreal; Rev. A. De Sola, LL.D.; Sir W. E. Logan, LL.D., F.R.S., &c.; T. Sterry Hunt, M.A., F.R.S., &c.,; Rev. A. F. Kemp, M.A.,; E. Billings, Esq., F.G.S.,; J. Leeming, Esq., and W. H. A. Davies, Esq.

Treasurer.—J. Ferrier, jun., Esq.

Cor. Secretary.—Prof. P. J. Darey.

Rec. Secretary and Scientific Curator.—J. F. White- -es, Esq., F.G.S., &c.

Librarian.—Mr. H. Rose.

Council.—Dr. Smallwood; Stanley C. Bagg, Esq.; A. Rimmer, Esq.; C. Robb, Esq., C.E.; E. Murphy, Esq.; D. A. P. Watt, Esq.; -. Hingston; J. H. Joseph, Esq., and J. Swanston, Esq.

Library Committee.—Messrs. J. C. Becket; Prof. Cornish; Dr. Fenwick; Dr. David, and Dr. Mackay.

Editing Committee of the "Canadian Naturalist."—D. A. Poe Watt, Esq., Acting Editor; Dr. Dawson; Dr. Hunt; E. Billings, Esq.; Rev. A. F. Kemp, M.A.; Prof. Robins, and the Corresponding and Recording Secretaries.

The Canadian Naturalist.

The *Canadian Naturalist* is sent to the following Institutions and Societies:—

CANADA, ETC,

University College,....................Toronto.
Trinity College,.......................Toronto.
Canadian Institute,....................Toronto.
Knox's College,........................Toronto.
Victoria College,......................Cobourg.
Queen's College,.......................Kingston.
Botanical Society,.....................Kingston.
McGill College,........................Montreal.
Bishop's College,......................Lennoxville.
Laval University,......................Quebec.
Literary and Historical Society,.........Quebec.
Natural History Society,...............St. John, N. B.

UNITED STATES.

Harvard College,.......................Cambridge, Mass.
Amherst College,.......................Amherst, Mass.
Yale College,..........................New Haven, Conn.
Natural History Society,...............Boston, Mass.
State Library,.........................Albany, New York.
Albany Institute,......................Albany, New York.
Essex Institute,.......................Salem, Mass.
Lyceum of Natural History,.............New York.
Astor Library,.........................New York.
Academy of Natural Sciences,...........Philadelphia.
Franklin Institute,....................Philadelphia.
Smithsonian Institute,.................Washington.
Academy of Science,....................St. Louis, Missouri.
University of Nashville,...............Tennessee.

GREAT BRITAIN.

Geological Society,....................London.
Linnæan Society,.......................London.
Royal Society,.........................London.
Royal Geographical Society,............London.
British Museum Library,................London.
University College,....................London.

Society of Arts,......................London.
Geological Survey of Great Britain,.....London.
Geological Society,..................Dublin.
Royal Dublin Society,................Dublin.
Literary and Philosophical Society,.....Manchester.
Natural History Society,..............Newcastle upon Tyne.
Bodleian Library,....................Oxford.
University Library,..................Cambridge.
University Library,..................Edinburgh, Scotland.
University Library,..................Glasgow, Scotland.
University Library,..................St. Andrew's Scotland.
College Library,.....................Maynooth, Ireland.
Queen's College,.....................Cork, Ireland.
Queen's College,.....................Belfast, Ireland.

CONTINENT OF EUROPE.

Société Géologique de France,........Paris, France.
Académie des Sciences,...............Paris, France.
Academia Car. Leop.,.................Jena, Saxe Weimar.
Imper. Geological Institute,...........Vienna, Austria.
Deutsches Geolog. Gesellschafft,........Berlin, Prussia.
Société Hollandaise des Sciences,......Haarlem, Holland.
Konigl. Sachs. Gesellschaft der Wissenschaften,....................Leipzig, Saxony.
Société Impériale des Naturalistes,......Moscow, Russia.
Konigl. Bayerischen Akademie der Wissenschaften,..................Munich, Bavaria.
Stockholm Biksbibliolekket,...........Stockholm, Sweden.
Upsala University,..................Upsala, Sweden.
Academy of Sciences,...............Stockholm, Sweden.
Christiania University,...............Christiania, Norway.
Royal Library,.....................Copenhagen, Denmark.
St. Petersburg, Bibliothèque Impériale,..St. Petersburg, Russia.
Dorpat University,..................Dorpat, Russia.
Kasan University,...................Kasan, Russia.
Helsingfors University,...............Helsingfors, Russia.
Amsterdam Stadsch Bibliotheek,........Amsterdam, Holland.
Leyden Batavian Academy,............Leyden, Holland.
Gröningen University,................Gröningen, Holland.
Bonn University.....................Bonn, Prussia.
Breslau University,..................Breslau, Prussia,
Freiberg Royal Acad.,................Freiberg, Saxony.

And to the following Periodicals :—

CANADA.

Journal of the Board of Arts,.........Toronto.

UNITED STATES.

Silliman's Journal,...................New Haven.

GREAT BRITAIN.

Annals and Magazine of Natural History,..London.
The Geologist,........................London.
The Phytologist,......................London.
The Zoologist,........................London.
Journal of Botany,....................London.
The Technologist,.....................London.
London, E. and D. Philosophical Magazine, London.
Edinburgh New Philosophical Journal,...Edinburgh.

CONTINENT OF EUROPE.

Annales des Sciences Naturelles,........Paris, France.
Allgemeine Deutsches Naturh. Zeitung,..Dresden, Saxony.
Archiv. fur Naturgeschichte by Weigman,.Berlin, Prussia.
Leopoldoia,...........................Jena, Saxe Weimar.
Leonhard und Brohn Jahrbuch,........Stutgardt, Wurtemburg.

List of Donations to the Museum.

Donors' Names.	Donations.
	May 26th, 1862.
— Lambe, Esq.........	English silver two-penny piece.
Dr. A. H. Hall,.........	Skin of Star nosed mole, (*Condylura cristata, Linnæus.*)
Miss Wright, ...	Hen's egg within another.
B. Hall, Esq., ...	Two eggs joined together.
N. Macintosh. Esq.,.....	Lop eared Rabbit.
Mr. W. Hunter, ...	Little Sandpiper, female,(*Tringa pusilla, Wilson*)
J. Ferrier, Jr., Esq......	Number of small Fish and water plants for the Aquaria.
Mrs. A. Miller, ...	Specimen of Copper Ore from Lake Superior
Mr. R. P. Isaacson,.....	Antler from the Cape of Good Hope.
Mr. W. Hunter, ...	Muscicapa—? (*Flycatcher, species undetermined.*)
	June 30th, 1862.
— Ramsay, Esq., ...	4 Eggs of the spotted Sandpiper, (*Tringoides macularius, Gray.*)
Mr. W. Hunter, ...	Geothylypis Philadelphia, Baird, male. (*Mourning warbler.*)
	Dendroica Striata, Baird, female. (*Blackpoll warbler.*)
	Helminthophaga ruficapilla, Baird, male. (*Nashville swamp warbler.*)
	Mniotilta varia, Viellot, male. (*Black and white creeper.*)
	Vireosylvia —? species undetermined.
J. Ferrier, Jr., Esq......	Fish and aquatic insects for the Aquaria.
	August 25th, 1862.
— Ross, Esq...........	Double hen's egg, grown together.
Mrs. McIntosh,.........	Lop-eared rabbit in spirits.
G. Barnston, Esq.,......	Pelicanus erythrorynchus, Gmelin, (*American Pelican.*)
	Accipenser carbonaria, Agassiz, (*Long nosed Sturgeon.*)
	Salmo fontinalis, Linnæus, (*Brook Trout.*)
	Coregonus Artedi, (*Fresh water "Herring."*)
	Coregonus sapidissimus, (*White-fish.*)
	Lota maculosa, Lesuer, (*Loche.*)
Dr. Dawson,...........	4 Limulus Polyphemus, Latreille, (*King Crab.*)
Mrs. Hamilton,.........	An antique pair of stays, 100 years old.
Mr. Higgins, Côte S. Paul	Petrifaction, (*Incrustation of carbonate of lime and oxide of iron around leaves and branches.*)

List of Donations to the Museum.

DONORS' NAME.	DONATIONS.
	September 29th.
Mrs. Peter Redpath, ...	4 young Limulus Polyphemus, Latreille. (*King Crab.*)
J. Ferrier, Jr., Esq., ...	9 Gold fish and several Eels for the Aquaria.
H. G. Vennor, Esq., ...	Salmo "namycush" Pennant. The Longe. Lake Magog, Georgeville.
C. F. Hill, Esq..........	Hen's egg of unusual size.
D. McKay, Esq.,........	3 Flint arrow-heads from Burlington heights.
A. Rimmer, Esq.,.......	2 specimens of Gorgonia —? (*Sea fan.*)
Mr. W. Hunter, ...	W. Cowper, Esq., specimens of Saperda candida. Perisoreus Canadensis Bonaparte. (*Canada jay.*) Eggs of Emys picta. (*The painted turtle.*) Case containing 18 species of Fish from the St. Lawrence at Montreal, as follows: 1 Perca flavescens, Mitchell. (*Common yellow Perch.*) 1 Labrax lineatus, Bloch. (*Striped Bass.*) 2 Lucioperca Americana, Cuvier and Valenciennes. (*American Pike Perch.*) 1 Centrarchus œneus, Lesuer. (*Rock Bass.*) 2 " fasciatus, Lesuer. (*Black Bass.*) 1 Pomotis vulgaris, Richardson. (*Sun fish*). 2 Gasterosteus —? (*Stickleback, species undetermined.*) 1 Pimelodus catus? Linnæus. (*Common Cat fish.*) 1 Catastomus —? (*Sucker, species uncertain.*) 1 Leuciscus pulchellus, Storer. (*The "Roach Dace"*). Esox estor, Lesuer. (*Common Pike or Maskinonge.*) 1 Coregonus albus, Lesuer. (*White fish.*) 1 Hyodon clodalis, Lesuer. (*Winter shad.*) 2 Lepidosteus oxyurus. (*Gar pike.*) 1 Lota maculosa, Lesuer. (*Common ling.*) 1 Anguilla tennirostris, DeKay. (*Common Eel.*) 1 Accipenser oxyrynchus, Mitchell. (*Sharp nosed Sturgeon.*) 1 Pteromyzon nigricans? Lesuer. (*Blue Lamprey.*) Also Amia ocellicauda, Richardson. (*The Mud or Beaver fish, from Lake St. Peter.*
	October 27th, 1862.
J. Ferrier, Jr, Esq.,.....	Fishes for the Aquaria.
G. Barnston, Esq.,......	2 Salmo "siscowet," Agassiz. 1 Salmo ursinus, Barnston, nov. sp. 1 Salmo amethystinus? Mitchell. 1 Salmo Hoodii, or nov. sp. (*S. Bairdii, Barnston, M. S. S.*) 1 Young beaver, (*Castor fiber.*) From Lake Superior.

List of Donations to the Museum.

Donors' Name.	Donations.
	October 27th, 1862. (*Continued.*)
Dr. Van Courtlandt,....	Specimens of Gasterosteus gymnetes? and Leuciscus, new species.
Mr. W. Hunter,........	Picoides hirsutus, Gray. (*Banded 3 toed Woodpecker.*)
	November 24th, 1862.
P. Macfarlane, Esq.,.....	Minerals from the Giants Causeway.
J. Ferrier, Jr., Esq.,.....	Pair of Bucephala albeola, Baird. (*Buffel headed duck.*)
	Fishes for the Aquaria.
Mr. Gaven,.............	2 Eutainia sirtalis, Baird, and Girard. (*Garter Snake.*)
Mr. Miller, ...	Specimens of Copper Ore from the Bruce mine.
J. S. Thompson, Esq., ..	1 Cygnus Buccinator, Richards. (*Trumpeter Swan.*)
G. Barnston, Esq.,......	8 Percopsis —? nov sp. 3 Coltus —? 2 Rana —? 1 Salamandra —? } From Lake Superior.
E. C. David, Esq.,......	Specimen of wild rice from the prairies.
B. Gibb, Esq., ...	Horn of African Rhinoceros.
J. O'Brien, Esq., ...	Bubo Virginianus, Bonaparte. (*Great Horned Owl.*)
Mr. W. Hunter,.........	32 Specimens of the sternum (*Breast bone*) of Canadian birds.
	February 23rd.
R. Thompson, Esq.,.....	A silver, and copper coin of Napoleon III.
	2 busts of Daniel O'Connell.
	Model of the Great Eastern Steamship.
— Leslie, Esq.,........	Part of the stem of an Indian pipe found near Lake Ontario.
	Receptaculites occidentalis.
Mrs. Rollo, ...	English blackbird, (*Turdus merula, Linnæus,*) female.
— Boa, Esq.,..........	Columnaria alveolata.
	Scops Asio, Bonaparte. *Mottled Ow*.
Mr. W. Hunter,.........	Troglodytes Parkmanni, Audubon. (female) *Parkman's Wren.*
	March 20th, 1863.
N. W. Bethune Esq.,....	A Canada bank note of the year 1792.
T. Devine, Esq., Quebec.	16 specimens of electrotype casts of fossils from Point Levis.
Mr. Charlton, Laprairie,.	Fish for the Aquaria.

List of Donations to the Museum.

Donors' Names.	Donations.
	April 27th, 1863.
Geological Survey of Canada,.............	A large series of marine shells, echinodermata crustacea, sponges, &c., from the Gulf of the St. Lawrence, and a collection of the land and fresh water shells of Upper and Lower Canada, of which the following is a rough estimate:
	No. of Species.
	Marine shells........................ 72
	Land and Fresh water shells............ 81
	Bryozoa, (*Sea Mats, &c.*) not yet determined.
	Echinodermata, (*Sea Urchins, Starfishes, &c*) 10
	Crustaceans........................... 4
	Cirripedes (*barnacles, &c.*)............... 4
	Annelida.............................. 6
	Corallines, not yet determined.
	Sponges, (*nearly all new to science*) undetermined.
Dr. Dawson,...........	12 Species of marine shells and 3 of Echinodermata from Gaspé, Labrador, Nova Scotia, and the United States.
R. J. Fowler, Esq.,.....	15 Species of such Lower Canadian land and fresh water shells, as were wanting to complete the Society's local collection.
J. Ferrier, Jr., Esq......	A valuable and extensive series of foreign shells, corals, &c., of which the following is an estimate.
	Shells from Mazatlan, Mexico, about 80 species.
	Exclusive of these:
	Bivalves 87 species.
	Univalves 228 "
	Cirripedes.
	(*barnacles.*)
	Acasta Montagui, Leach. Britain.
	Corals.
	5 species.
	Foraminifera.
	Nummulites nummularia? (Fossil from the Pyramids of Egypt.)
G. Barnston. Esq.......	6 species of birds' eggs (*named*) from the Hudson's Bay Territory, and 1 from Lake Superior.
J. Ferrier, Jr.., Esq.....	15 species of birds' eggs from Canada and the United States.

THE NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAMES FERRIER, JUN., TREASURER.

Dr. | Cr.

Dr.			Cr.		
1863. May 1.	RECAPITULATION.		1863. May 1.	RECAPITULATION.	
To Cash paid,	Mr. Hunter's salary and note	$250 00	By Cash received from	Government grant	$1000 00
" "	Mr. McCormick's acct. commission	30 00	" "	Life Members	130 00
" "	Interest	251 48	" "	Admission fees to the Museum.	45 00
" "	City Assessment	40 00	" "	Proceeds of conversazione	27 05
" "	Fuel	107 50	" "	Members' subscriptions	1357 00
" "	Water Rent	42 75	By Balance in Treasurer's hands May, 1862		16 26
" "	Gas Rent	29 08			
" "	Insurance	40 00			
" "	Books and Binding	179 96			
" "	Advertising and Printing	18 70			
" "	Repairs and Fixtures	119 90			
" "	McNab, arranging Herbarium	40 00			
" "	Legal Expenses	26 40			
" "	The Society's note	1000 00			
" "	Post Office account	5 73			
" "	Incidental Expenses	40 71			
Balance in Treasurer's hands		353 10			
		$2575 31			$2575 31

Montreal, 1st May, 1863.

JAMES FERRIER, JUN.,
Treasurer, N. H. S.