There seems now to be a general agreement that the biblical Hittites or Children of Heth, whom Abraham found in Palestine are identical with the Cheta of the Egyptian monuments and the Khita or Khatti of the Assyrians that they were a great and widely distributed people, powerful in war and advanced in civilization in very early times but waning even as early as the Hebrew occupation of Canaan. It seems further admitted that their language was of Akkadian or Turanian type rather than Semitic and that in physique & costume they bore some resemblance to ~~the~~ populations of Northern Asia while they possessed at a very early period the art of writing in a peculiar syllabic character. All these points, as well as the affinities of their language with those of eastern Asia and with certain American tongues have long been maintained by my friend Prof. J. Campbell of Montreal, for several years * but ~~are~~ my results ~~advanced~~ have been received with ~~some~~ confidence by ~~Sayce and others~~ scholars on independent testimony in Europe; these results remarkably confirm the

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* Proceedings Canadian Institute Toronto, & Presbyterian Review

early biblical notices and in all probability will eventually connect this ancient people on the one hand with the Hyksos invaders of Egypt and on the other with the old population of the latter Stone and early Bronze age in Europe. In so far as Egypt is concerned they render it probable that early settlers of this race had pene-trated into the Delta as early as the first settlements of the Egyptians proper, and that they were con-tinually as reinforced by their countrymen from the East and carrying on aggressive wars. In Palestine they are identified in the Bible with the children of Canaan as probably the most extensive branch of that stock who seem mainly to have been many Turanian, though probably mixed with Semitic blood in some at least of their tribes

The Canaanites

Hittites
Campbell

Zoan (margin)

Zoan

Now Hebron was built 7 years before
Zoan in Egypt Num 13. 22. Hyksos
age of Spies — Anakim in Hebron
Anakim allied to Hyksos. The latter
built Zoan, Tanitic Branch of Nile
City itself = Tanis. Commerce —
Government of Hyksos of later Kings.
Zoan capital of Rameses 2
"Field of Zoan" Psalm. 78. 12
Great Temple 14 obelisks — 2 lamps of Rameses granite
Statue of Rameses 90 ft
Petries Discoveries
Swamp or desert deserted Site.
Tablets up to Rameses great time.
Isaiah 19. 11. Ezek 30. 14.
City of Rameses
Inscription of old Egyptian.
Gen 13. 10. Land of Egypt as cometh unto
Zoan (Zoar or Zar) like garden of the
Lord — Compared with Jordan Valley
Modern Subsidence

Natural Size

Ch V

Plate I

From a Photo. by Henderson.

Vincent Brooks, Day & Son, Lith.

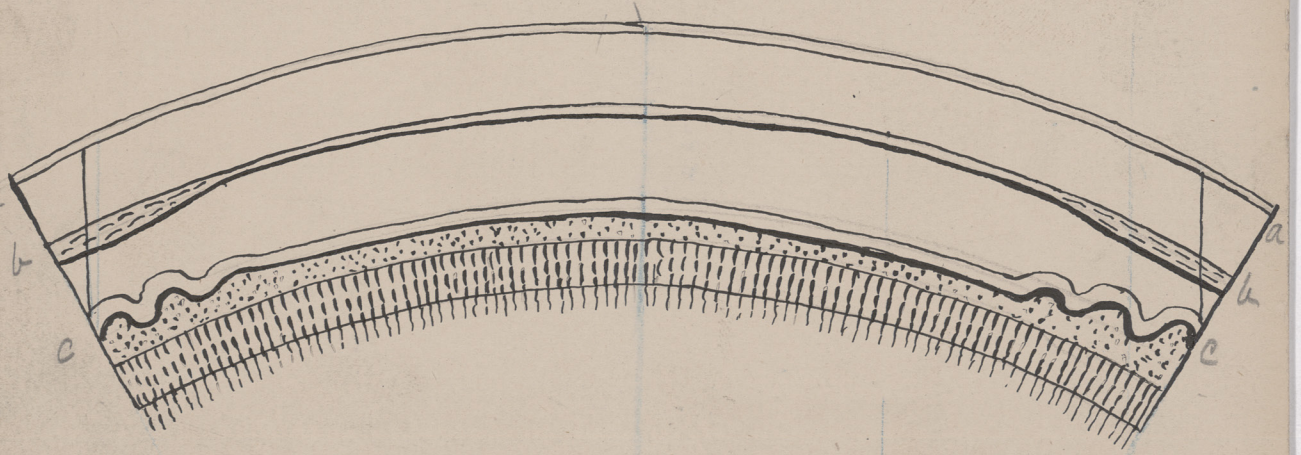
CAPE TRINITY ON THE SAGUENAY.
A CLIFF OF LAURENTIAN GNEISS.

Frontispiece

If this cannot be reproduced without re-drawing, leave it for the present

Ink in the Cells

1/2 Natural Size



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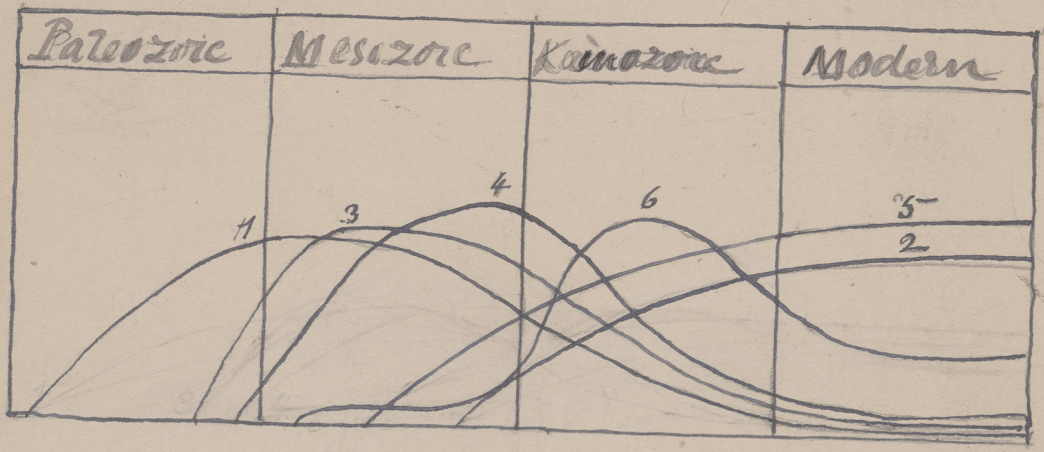

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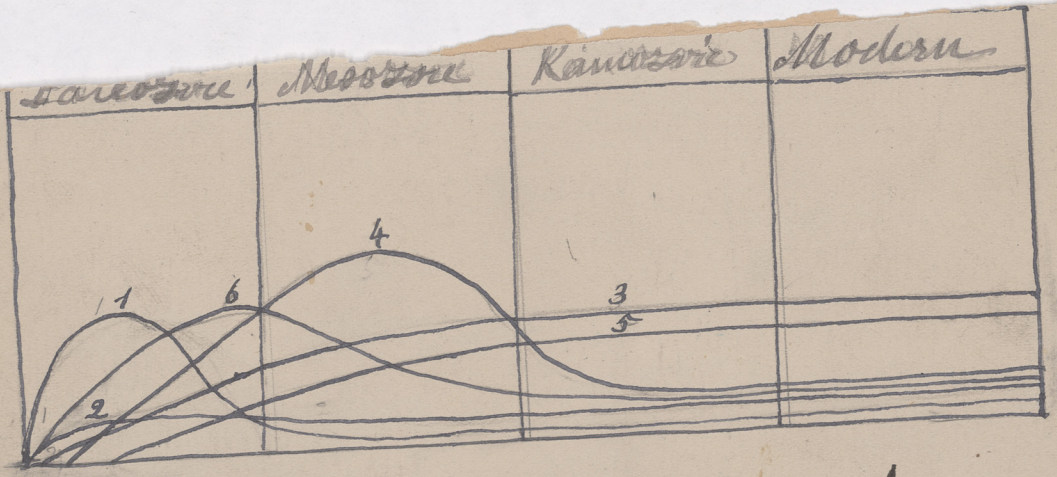
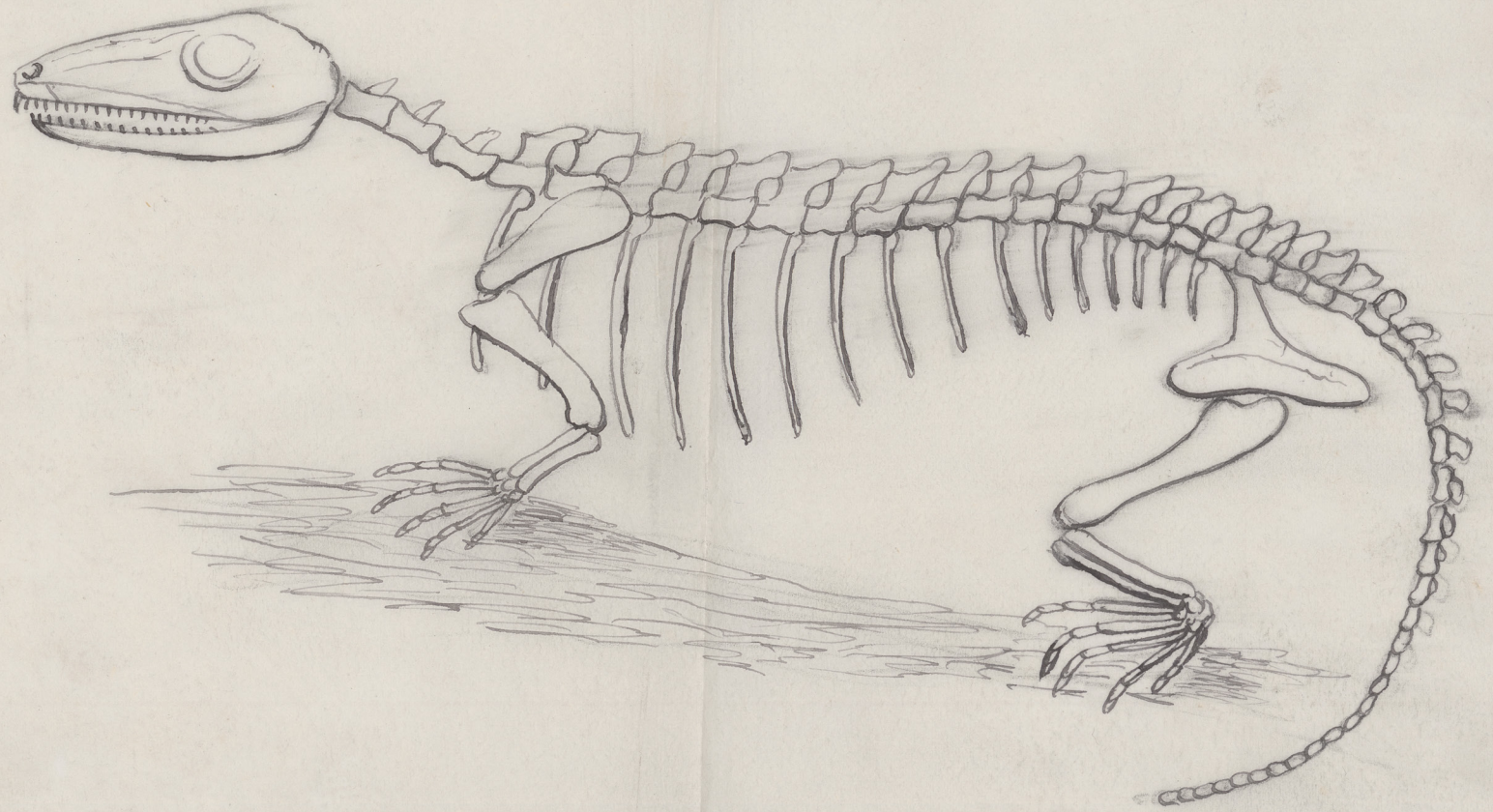


Reduce to ½. Ink in the lettering



Reduce to this length

Natural Size or a little reduced. Say ¼ inch each way

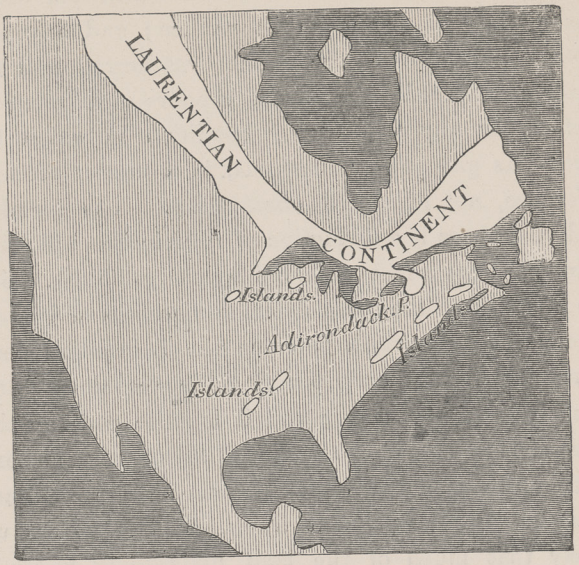
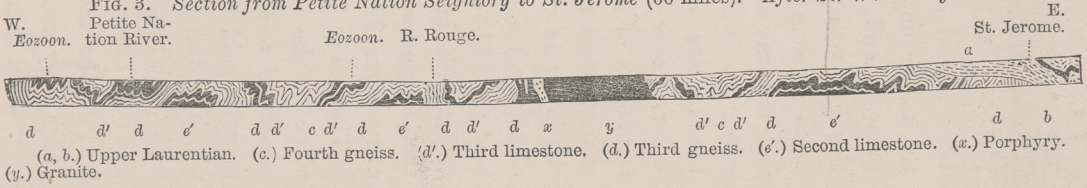
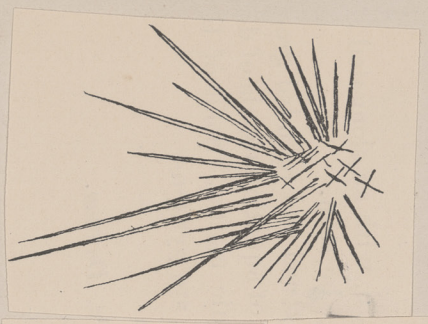
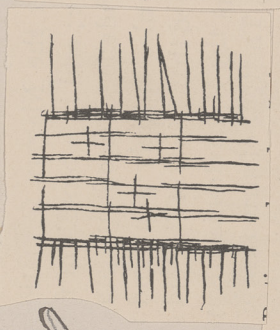


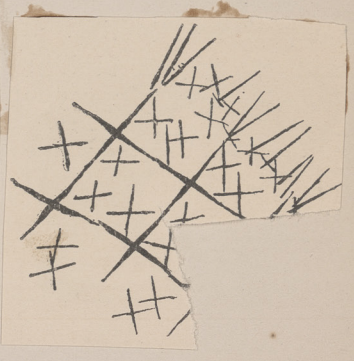
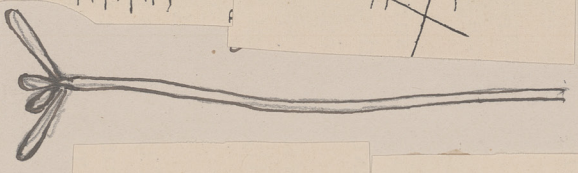
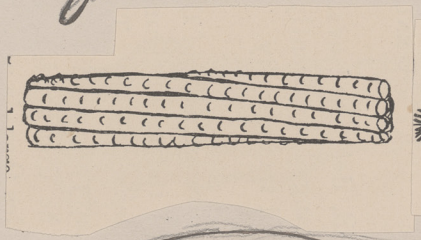
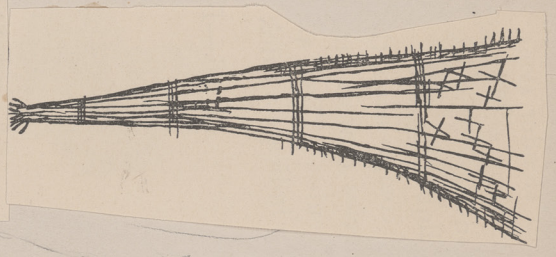
FIG. 4. *The Laurentian Nucleus of the American Continent.*

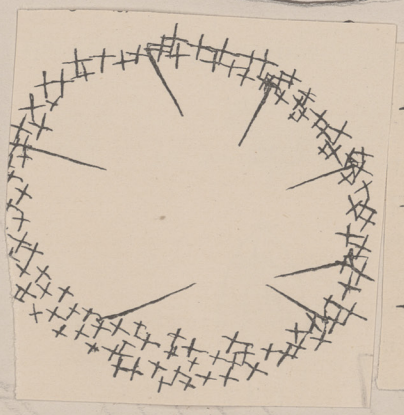
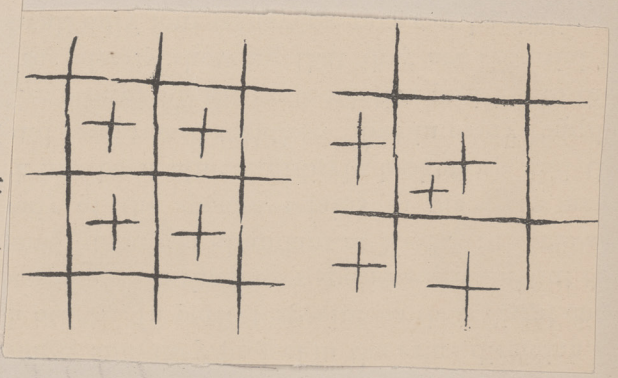
FIG. 3. *Section from Petite Nation Seigniory to St. Jerome* (60 miles). *After Sir W. E. Logan.*



(*a*, *b*.) Upper Laurentian. (*c*.) Fourth gneiss. (*d'*.) Third limestone. (*d*.) Third gneiss. (*e'*.) Second limestone. (*x*.) Porphyry. (*y*.) Granite.

Natural Size

Agnostus Fur
Matthew

FIG. 4.—*Hylonomus Lyelli.*[1]

[1] Reprinted from "Airbreathers of the Coal Period," 1868.

that it may have been in the habit of sitting erect. The thigh-bone is well formed, with a distinct head, 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, apparently 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, representing cartilage. 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 the clothing of its lower or abdominal parts; while above it was clad in the beautiful scaly covering above described. The scales are thicker than those of *Dendrerpeton*. 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 companion genera above named are not known so completely as *Hylonomus*, but all their characters so far as known would place them with it as members of the same group rather than with *Dendrerpeton* and its allies. Of other American forms it appears to me probable that *Sauropleura digitata* of Cope [1] may be very near to my genus *Fritschia*, and agrees with it in having rod-like abdominal scales, but its head is not yet known. *Brachydectes* of the same author is very near to *Hylerpeton*, especially as specimens of the latter recently obtained show some characters, as the ascending ramus of the lower jaw, on which Cope distinguishes this genus.

Of Fritsch's species several may come within the group of Microsauria. The genus *Hyloplesion* of this author has indeed been united by Credner with *Hylonomus*, a position to which it scarcely seems entitled, and *Petrobates* of Credner is nearly allied, while *Seelya* and *Dawsonia* of Fritsch also approach to the characters of this order. Still the whole of these animals seem very inferior in development of limb and form of body to *Hylonomus*.

I regret very much that, owing, as I believe, to imperfection of material, so many palæontologists have failed to appreciate fully the characters of *Hylonomus* as a type of the higher Carboniferous Amphibia approaching to Reptilia.

Fritsch, in the conclusion of his important work on the Stego-

[1] Ohio Reports, vol. ii. p. 388.

FIG. 4.—*Hylonomus Lyelli.* EXPLANATION TO PAGE 151.

a. Skeleton in matrix, showing jaws, ribs, vertebræ, pelvis, and bones of limbs.
b. Portion of skeleton in matrix, showing vertebræ and limb-bones.
c. Portion of maxilla with teeth ; enl.
d. Cross-sections of teeth ; enlarged.
e. Anterior end of mandible with teeth ; enlarged.
f. Bones of foot ; enlarged.
g. Parietal bones, showing foramen ; enl.
h. Vertebra ; enlarged.
j. Ribs ; enlarged.
k. Bony scale ; enlarged.
l. Portion of scaly cuticle.
m. to *s*. Horny scales, bristles, tubercles, and other appendages of the same ; magnified.

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. 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. 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. The total number of teeth in each ramus 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. 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 with cartilage. The vertebræ were biconcave. 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. The ribs are long, curved, and at the proximal end have a shoulder and neck. They are hollow, with thin, hard, bony walls. There are short ribs which may be cervical. The anterior limb, judging from the fragments procured, seems to have been slender, with long toes, four or possibly five in number. 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 towards the posterior extremity of the body, and

is *Hyloplesion* of Fritsch, and possibly not congeneric with *Hylonomus* proper, and certainly less reptilian in its characters.

"The question whether *Hylonomus*, and especially whether *Petrobates*, is to be classed with the Stegocephala or with the Rhynchocephala, is not one which can be at once decided. The long, bent, trunk ribs, the marking off of the cervical section by short differently-shaped ribs, the rhombic horned episternum, the bony pubica, the ossification of the carpus and tarsus taken together give both quadrupeds a reptilian habitus. In the case of *Petrobates* this becomes more pronounced by the occurrence of ventral ribs and of intercentral lower arches dovetailed in between the vertebral centres of the neck. On the other hand, *Hylonomus* and *Petrobates* have, like the Amphibians, only one sacral vertebra. A more primitive habitus is also presented in the persistence of the continuous chorda, in the insignificant superficial ossification of the elements of the skeleton, the absence of ossification in the heads of the hollow bones of the extremities,[1] and in the uniform shape of the small teeth.

"In *Hylonomus* this becomes strengthened by an apparently true stegocephalic skull-cover, as well as by the thick comb-like development of teeth in the roof of the mouth, and the presence of a ventral shield of bony scales.

"These several points of resemblance connect *Hylonomus* (*Hyloplesion*) rather with the Stegocephala, while *Petrobates*, on account of its ventral ribs and intercentral arches, comes nearer the *Rhynchocephala*. In other words, they both possess a general, as yet but slightly differentiated, common habitus, but in *Hylonomus* (*Hyloplesion*) the primitive type is more pronounced than in *Petrobates*, in which already a great specialization in the direction of the Rhynchocephala finds expression. If one, in considering *Petrobates*, disregards the skull, which is not accurately enough known, one might hold this quadruped to be a small Rhynchocephalian, of the family of the Proterosauridæ, if it were not that the presence of only a single sacral vertebra was opposed to this view. It appears as if *Hylonomus*, *Petrobates*, *Palæohatteria*, and *Kadaliosaurus* belong to a natural group of contemporaneous quadrupeds, representing however as many stages of specialization in the direction of Reptiles."

Bearing in mind that the typical species of *Hylonomus*, represented by *H. Lyelli*, are in some important respects nearer to *Palæohatteria* and *Kadaliosaurus* (which are regarded by all palæontologists as generalized reptilian genera tending to Amphibians) than either *Hyloplesion* or *Petrobates*, this conclusion of Credner becomes very significant as to the position of the Microsauria, and may be regarded as confirmatory of the conclusions which, though not a specialist in fossil reptilia, I have ventured to suggest in connexion with the species which I have been induced to study, in consequence of their connexion with my other work in Carboniferous geology.

It must be remembered that the repositories in which *Hylonomus* and its companions are contained are of an exceptional nature, and likely to have entrapped animals specially terrestrial in their habits.

[1] These characters do not apply in so great degree in *Hylonomus* proper.

cephala of the Gas-coal of Bohemia, has some valuable remarks on the affinities of these animals; and, though I can by no means agree with the manner in which he arranges them in families, or with the way in which he mixes up Labyrinthodontia and Microsauria with other creatures so different as the Branchiosauridæ and the Ophiderpeton group, I think his conclusions deserve mention, and may state them nearly in his own words as follows:—

After remarking on the fact that we know no clear links of derivation from any previous animals, he states that on any theory of derivation different origins must be supposed. He illustrates this by the characters of the vertebræ in different genera, as, for instance, the biconcave, the partly cartilaginous, and the diplovertebrate types.

Whatever view may be taken of their origin, the increased knowledge of their structures has not made clear as yet their precise relation to modern Amphibia and Reptilia; and only serves to make us doubt whether the distinctions recognized in the modern forms apply to these ancient creatures in the same degree. We seem indeed to have, both in the Labyrinthodonts and the Microsaurians, composite or generalized types having properties akin to those of both classes, and these in very different degrees. If we regard them all as agreeing in the general structure of the skull, with its free parasphenoid, and a similar set of bones in the shoulder-girdle, then we shall find that in other respects we have a heterogeneous assemblage, some agreeing in the formation of the vertebræ, ribs, and pelvis, with Amphibians, others with Reptiles; and there are corresponding differences in the dermal covering. If we attempt to group these creatures in orders and families, we are met with very great difficulties, owing to the variety and kinds of their differences, which, in connection with the imperfection of the material, almost defy the classifier.

So far Fritsch, and I may add that I consider that little is gained by grouping animals so diverse in organization under one head of Stegocephala in consequence of resemblances in certain cranial bones, and that a more general and large view should be taken of the *tout ensemble* of their structures.

With reference to that selection of these animals which has been preserved in the erect trees of Nova Scotia, the only ones which it has been necessary for me to study, I have no hesitation in placing in two orders or families, that of the Labyrinthodontia, to which *Dendrerpeton* belongs, and that of the Microsauria, including *Hylonomus*, *Hylerpeton*, *Fritschia*, and *Smilerpeton*, all of which have many important points in common. The other forms I leave to those who have to deal with them, but I feel convinced that some of them should be separated, probably ordinally, from the above.

The following extract from Credner on the systematic position of *Hylonomus* and *Petrobates*, shows that he to some extent shares in these views.[1] It should be understood, however, that his *Hylonomus*

[1] Zeitsch. Deutsch. geol. Gesellsch., Berlin, 1890, p. 257.

I have elsewhere[1] referred to the fact that even in the basal beds of the Carboniferous (Horton series) there are footprints of quadrupeds of larger size than *Hylonomus*, which were digitigrade, and had a length of stride comparable with that of modern carnivorous mammals. I therefore anticipate the discovery, in these Lower Carboniferous beds, of reptiles of as high or higher grade than those hitherto found in the Coal-formation or Lower Permian, throughout which periods the same or similar forms seem to have prevailed.

[1] Trans. Roy. Soc. part ii. 1882, p. 653.

STEPHEN AUSTIN AND SONS, PRINTERS, HERTFORD.

ON DENDRERPETON ACADIANUM.

[*Extracted from the* GEOLOGICAL MAGAZINE, April, 1891.]

London: KEGAN PAUL, TRENCH, TRÜBNER & Co., Ld., 57 and 59, Ludgate Hill.

[*Extracted from the* Geological Magazine, Decade III. Vol. VIII. No. 322, p. 145, April, 1891.]

On New Specimens of *Dendrerpeton Acadianum*, with Remarks on other Carboniferous Amphibians.

By Sir J. William Dawson, LL.D., F.R.S., etc.

THE genus *Dendrerpeton* was established by Owen on the evidence of remains found by Sir C. Lyell and the writer in an erect tree at the South Joggins in Nova Scotia in 1852.[1] Other specimens were afterwards obtained, and the most complete, presented by me to the Cabinet of the Geological Society, was found in 1861, and described in my "Airbreathers of the Coal Period."[2] These remains rendered it certain that the animal belongs to the order Labyrinthodontia,[3] and it is regarded by Lydekker as the type of a family in that group.[4]

As the characters of the type-species ascertained by Owen and by the writer have not as yet been stated in connected form, and the genus may in consequence be said to be still imperfectly known, it may be useful to sum them up before proceeding to notice some specimens recently obtained, and which have added somewhat to our knowledge of the type-species.

Dendrerpeton Acadianum, Owen, Journ. Geol. Soc. Lond. vol. ix. 1853.

Skull of moderate size and rounded broadly in front. Nostrils small and near the muzzle. Orbits nearly in the middle of the length. Occipital condyle double. Parietal foramen small. Surface of cranial bones sculptured with relatively deep pits. Teeth conical, smooth above, grooved at base, especially on the inner side; enamel simply plicated at base. Outer series of teeth somewhat unequal and larger anteriorly in the intermaxillary bones. A few large teeth within on the inner surface of the maxillaries. A group of small simple teeth on the vomerine bones. Mandibles sculptured like the skull, but much more feebly. Teeth similar to those in the upper jaw, but not larger in front. For the arrangement of the central cranial bones see diagram in Memoirs on Animal Remains in Erect Trees, Phil. Trans. Royal Society, 1882, pl. 44.

[1] Journ. Geol. Soc. of London, vol. ix. p. 66. A preliminary examination of the specimens had been made by the late Prof. J. Wyman, of Cambridge, U.S., and was quoted by Prof. Owen.

[2] Montreal, 1863. See also Journ. Geol. Soc. vol. xvi. p. 273; vol. xviii. p. 5; and vol. xix. p. 470.

[3] Journ. Geol. Soc. vol. xv. p. 274; also "Airbreathers of the Coal Period."

[4] Brit. Museum Catalogue, Reptiles and Amphibia, vol. iv. p. 170; also Nicholson and Lydekker, Manual of Palæontology, vol. ii. p. 1032.

Not having visited the Joggins for some years, and the gentleman on whom I had relied to give me intimation of new exposures of reptiliferous trees having left the locality, I made a short excursion to the place last summer, and found two trees partially exposed in the reef. These were extracted with the kindly aid of Mr. McNaughton, Superintendent of the Joggins Mine, but unfortunately proved unproductive. A large tree had fallen from the cliff in the previous winter and had possessed a layer of very productive material in its lower part, much of which had however been removed by the waves. I succeeded in obtaining a portion of this material, which on examination proved to contain parts of the skeletons of two specimens of *Dendrerpeton Acadianum* and one of *D. Oweni*. No other reptilian bones nor remains of millipedes or of land shells were observed.

The specimens of *D. Acadianum* were the largest yet found, and some of the bones were in a more perfect state. As examples of these I figure (Fig. 1) the two mandibles of the largest specimen. These seem to have separated on the decay of the body and to have fallen across one another, so that they lie side by side and reversed. They are 8·6 centimetres in length, and one of them shows very well the corrugated sculpture of the bone and a number of the teeth. On the same slab, represented in Fig. 1, is a well-preserved humerus. It has been exposed by cleaning away some of the stone, which probably contains other bones of the fore-leg; but they cannot be worked out without destroying those in sight.

Fig. 1.—Humerus and Mandibles of *Dendrerpeton Acadianum*. Natural size.

I would call attention to the humerus as indicating the development of the fore-limb in this species. The bone in this probably mature specimen is better ossified than in smaller and probably younger specimens. In length it is 4·3 centimetres, or half that of

Vertebræ imperfectly ossified, very slightly biconcave, with large and broad neural processes in dorsal region. Those of the tail have spines above and below. Ribs of moderate length, with expanded head and slight shoulder; solid towards the head, but hollow and thin-walled at distal end, the longest barely equal to the breadth of the skull, curved, the anterior ones very much so, scapular and pelvic bones large and well ossified. Ilium? broad.

Limbs well developed, especially the anterior pair. Limb-bones ossified and cancellated at the extremities, and with bony walls of considerable thickness. Humerus equal to more than half of the length of the mandible. Femur smaller than humerus, the tibia flattened at the extremity. Toes five in each foot, somewhat broad and short.

Chest covered with bony scales, which are thin, unequally ovate and about half as wide as long, and marked with obscure concentric lines. They have a thickened edge or margin interiorly. They are arranged in chevron and close together, forming a compact armour. There appears to have been a rhombic breast-plate in front, with obscure radiating lines, but this has only been found detached.

Skin of upper surface of body minutely granular or scaly, with a semicircular patch of horny tubercles in front, which I have referred to the snout, but it may have belonged to the back of the head. On the throat or sides were flat, pointed, and apparently flexible lappets marked with elongated areoles and pores. Nearly the whole skin of some specimens has been preserved in the erect trees apparently by a sort of tanning process, but it is so flattened and crumpled that its form is scarcely discernible.

The following are the dimensions of two specimens, one of them (No. 2), that of 1890, and the largest yet obtained:—

	No. 1.	No. 2.
Length of Skull *	7 centimetres.	9 centimetres.
Breadth of Skull *	5 ,, ...	6 ,,
Length of Mandible	6·6 ,, ...	8·6 ,,
,, Humerus	3·5 ,, ...	4·3 ,,
,, Ulna	2·5 ,, ...	— ,,
,, Femur	2·6 ,, ...	— ,,
,, Rib	2· ,, ...	2·8 ,,
,, Eleven vertebræ ...	5·6 ,, ...	— ,,

* The skulls being flattened and crushed, these measurements are not certain.

In form, *Dendrerpeton Acadianum* was probably elongated and lizard-like; with a broad flat head, short stout limbs, and an elongated tail; and having the skin of the belly protected by small bony plates closely overlapping one another, while the upper part of the body was covered with a tough skin more or less scaly and ornamented in parts with lappets or pendants. As in the case of other small Reptilians of the Coal, its enemies were found rather below than above. Its armour therefore was beneath.

The bone-cells are broad and with much-branched canaliculi, those of the bony scales being similar to those of the other bones. The hollow bones are occupied with calcite stained brown and probably representing cartilage.

the mandible, thus exceeding in relative size the humerus of the American Alligator, while its form indicates a limb of much muscular power. Other specimens show that the hind-limb was not larger than the fore-limb; on the whole it was perhaps feebler, so that in this animal there was no approach to that exaggerated size of the hind-limb seen in some of the larger Labyrinthodonts.

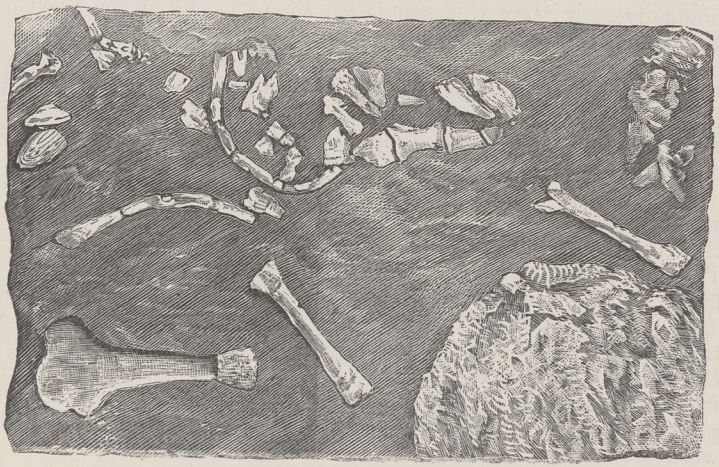


Fig. 2.—Ribs, Phalanx, Scales, Scapular bones, and part of Skull of *Dendrerpeton Acadianum*. Natural size.

The slab represented in Fig. 2 shows the anterior part of the crushed skull, giving its broadly rounded form in front, and the sculpturing of the bone. After the photograph from which the cut is copied was taken, a portion of the matrix was removed, so as to expose the outer teeth on one side and one of the large inner teeth. One of the former with the sculpturing of the edge of the maxillary bone is represented enlarged in Fig. 3.

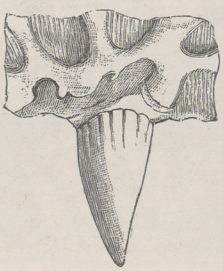


Fig. 3.—Outer tooth and portion of Maxillary bone of *Dendrerpeton Acadianum*.—Enlarged.

On the slab Fig. 2 are two slender bones and a larger bone which I suppose to be parts of the shoulder-girdle. There are also two of the anterior ribs and some bones of the foot (among them a phalanx)

showing portions of four of the bones in position, and giving for one of the toes of the fore-foot a length of about 2·3 centimetres; also a few of the anterior abdominal scutes. All the bones represented belong to the anterior parts of the animal; the portion of the tree containing its posterior parts had unfortunately been destroyed or removed by the sea.

I have remarked in previous memoirs that possibly the animals found in the erect trees, while they must all have been of terrestrial rather than aquatic habits, may in some cases have been young individuals of the species to which they belonged. This supposition is to a certain extent borne out by the present specimens, which are considerably larger than the corresponding parts of individuals previously found, and have the bones more ossified and more strongly sculptured. Possibly, however, we may not yet know the species in its full magnitude.

This suggests the question whether *D. Oweni* may be founded on still younger individuals of the same species. The likelihood of this is not, however, increased by the new discoveries. The specimen of *D. Oweni* found in the tree of 1890 is quite as distinct as those previously found. It has longer, more curved and pointed teeth, thinner and less sculptured cranial bones. The mandibles are only very feebly sculptured. The limbs and feet seem to have been similar to those of *D. Acadianum*, but the abdominal bony scales were narrower and more pointed or "oat-shaped," and the skin of the upper surface more distinctly scaly. On the whole, therefore, the evidence is in favour of *D. Oweni* having been a smaller species allied to, but presenting so far as known no connecting links with, its larger congener.

Hylonomus Lyelli, Dawson, Journ. Geol. Soc. Lond. vol. xv. 1859, p. 274.

Though the newly-found specimens throw no farther light on the amphibians of the group *Microsauria* found in the same repositories with *Dendrerpeton*, they have invited comparison and fresh study of the material previously obtained, and I desire in this connexion to state the reasons which have induced me from the first to maintain that *Hylonomus*, *Hylerpeton*,[1] *Smilerpeton*, and *Fritschia*[2] are not Labyrinthodonts properly so called, and belong to a quite distinct group, making in some respects nearer approach to the reptilian order to which the *Proterosaurus* of the Permian belongs.

We may take *Hylonomus Lyelli*, the best known of these animals, as a type, and I would state the following points of comparison with *Dendrerpeton*, and most if not all other typical Labyrinthodonts.

1. As to the skull, this is large behind and pointed in front, and its bones are smooth, while the teeth are perfectly simple, without any trace of fluting or plication of the enamel, and there are no interior large teeth. The nasal and maxillary bones are smooth, thin, and elongated. The parietal bones larger and more convex

[1] Owen, J.G.S. vol. xviii. 1862, p. 241.

[2] Dawson, Phil. Trans. Royal Society, 1882, pt. ii. pp. 638, 641.

than in most other amphibians. The bone which I suppose to be the parasphenoid has a long axial process, and the posterior end moderately broad. On the other hand, it is certain that the skull has an open parietal foramen, has a group of small palatal teeth, and has two occipital condyles.

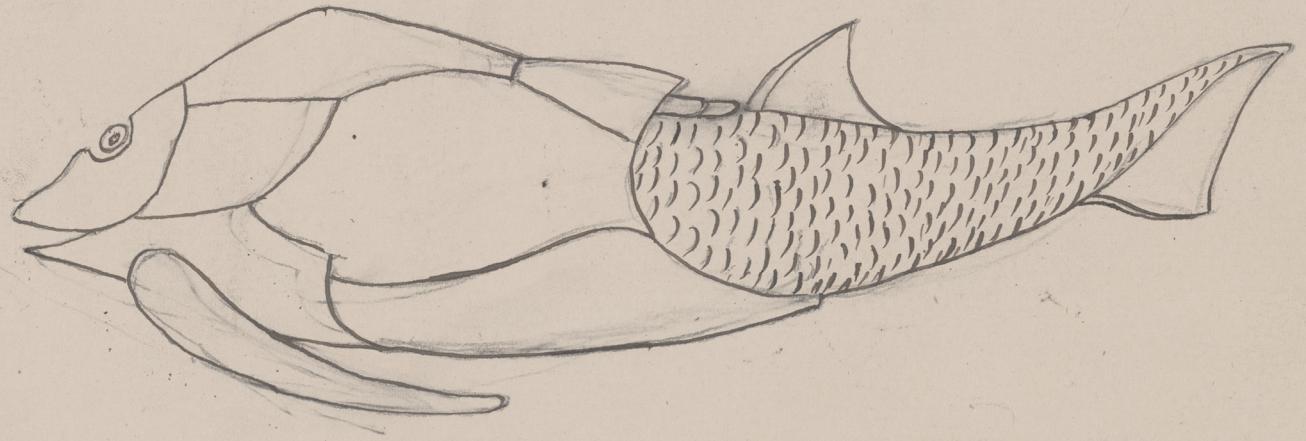
2. As to the trunk. The vertebræ are long, hour-glass-shaped, biconcave, and ossified exteriorly, with large and broad neural and lateral processes. The ribs are well developed, curved, and with a double head. The scapular and pelvic bones are large, especially the latter, which has a very broad well-ossified principal bone, perhaps the ilium. The pelvic bones thus resemble those of *Diplovertebron*[1] of Fritsch, which is, however, an animal very different in other respects. I regret that I have had no means of ascertaining whether the pelvis of *H. Lyelli* was attached to one sacral vertebra or more. The large size of the pelvis would, however, render its attachment to a single vertebra improbable, and in the skeletons on the slabs (*a*) and (*b*), Fig. 4, there are in the vicinity of the pelvis pairs of vertebræ attached to each other in such a manner as to suggest that they were permanently united.

3. The limb-bones and ribs have a thin and hard outer bony coat, the interior being usually filled with calcite darkened by organic matter, probably remains of cartilage. The bones of the limbs and feet are long and slender, with well-ossified extremities, and their forms indicate slender limbs and active habits. The hind-limb in particular is somewhat larger than the anterior; and this with the size of the pelvis indicates a form of body broader behind, narrower in front. In farther connexion with this I have remarked in former papers that the skeletons of this animal always lie *on the side*, indicating that the body was flattened, not vertically, but laterally, as in some Lizards. This I regard as an important diagnostic character for *Hylonomus*, and it does not seem to apply to the genus *Hyloplesion* of Fritsch, which is flattened vertically, as well as much inferior in development of pelvis and limbs.

4. As to dermal covering, *Hylonomus* has the abdomen protected by bony scales, but differing in form and probably in arrangement from those of *Dendrerpeton*. The covering of its upper part was however peculiar to itself, presenting a perfectly scaly surface of true corneous scales and with ornamental tubercles and spiny epaulettes on the shoulders, of which there is no trace in any other known amphibian, recent or fossil. It also possessed pendant fringes of cuticle like those of *Dendrerpeton*.

In connexion with this statement, I copy here (Fig. 4) from my "Airbreathers of the Coal Period" an illustration of the scattered bones of a skeleton of *Hylonomus Lyelli*, and some of the parts enlarged, which will serve with the accompanying description to illustrate some of the structures. I have given in the paper above referred to, in the "Transactions of the Royal Society," a copy of a portion of the scaly armour from a micro-photograph.

[1] Plate 52, Fauna der Gaskohle. As interpreted by Fritsch, the flat bone is called the pubis.



This length

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1/2 size

(Reduce to 1/2 Size)

snow and ice on the latter. But if the pressure of such snow and ice was sufficient to depress the hills, it must necessarily at the same time elevate the plains, and this change, by diminishing evaporation and by increasing continental warmth, would at once cause the ice-caps to melt away. Thus subsidence produced by accumulations of ice would at once accomplish the destruction of such accumulations, while it would remove the high lands necessary to account for any extensive movement of glacial ice. In other words, as elsewhere urged in this volume, the facts of dynamical geology and physical geography are fatal to hypotheses of polar ice-caps and continental ice-sheets, and if one were to admit all that has been alleged in reference to depression of land by pressure of ice, these difficulties would not be removed in the slightest degree.

II.—Causes of Glaciation and Distribution of Erratics.

We now come to consider the probable causes of glaciation and boulder-deposits, and first the agency of "continental" and local glaciers.

1.—GLACIER ACTION, ETC.

1. With respect to the agency of land ice, I have no hesitation in saying that, as I have maintained for thirty years, a sheet of ice covering the wide surface of the American continent, and piling up a "moraine" such as that which extends from the northern end of the Missouri coteau and south of the great lakes to the Atlantic coast, is a physical impossibility. It is so, first, because the only possible gathering-ground of sufficient snow to form glaciers is on high lands sufficiently cold and sufficiently

the equatorial current between North and South America, all of which suppositions are substantiated by known geological facts, more especially the occurrence of Pleistocene fossils at high levels, and of the same species of modern shells on the Atlantic and Pacific shores. Following the example of those geologists of the United States who are in the habit of giving a factitious reality to their palæogeographical views, by attaching names to extinct lakes, etc., we may name some of the more prominent features of our map after eminent living advocates of extreme glacial views, whose personal merit and ability, I am prepared to admit, are in the inverse proportion to the probability of their theoretical views. The great southern bay, at the bottom of which lies the "terminal moraine," may bear the name of Dana. The strait leading to the north-east, where the St. Lawrence now flows, may be Upham strait. The great western opening may well be called Chamberlain sound, and the northern bay, filled with ice in the region now occupied by Hudson's bay, may be the gulf of Wright. The greater islands will be respectively Cordilleran and Laurentide lands, fit companions of Greenland; and the smaller eastern island, Appalachia Infelix. Thus will be completed the rough general outline of one map of America in the age of the boulder-clay. Respecting Dana bay and Wright bay on the map, it is evident that the heavy ice-fields borne down by the arctic current and north-west gales, and the bergs derived from the mountain glaciers, would choke them with continuous masses of ice of enormous width, the pressure of which would pile up heaps of broken ice full of stones and earth on their shores, and would exert a mechanical force much greater than that of ordinary glaciers, so that morainic accumula-

tions of great magnitude would be produced of the same general nature with those of the Missouri coteau. These, of course, now constitute the great "terminal moraine" * which has been so carefully traced by the geologists of the United States.

Comparing a map of America in the Pleistocene with that of the same region in the later Cretaceous and early Eocene, it will be at once seen how, in the one case, the arctic conditions must have been transferred to temperate regions, and how, in the other, temperate conditions must have been carried north to Greenland.

It may be well here to notice shortly the contention often made that the weight of the ice upon the parts of the continents loaded with it must have been itself a cause of the Pleistocene depression. No one has, I believe, contended more strenuously than the writer, in connection both with the carboniferous deposits and those of the deltas of great rivers,† in favour of the instability of the crust of the earth when loaded with great weights or when these are removed; but it must be observed that such weights are usually due to the deposition of sediment in the sea. The effect of accumulations of ice on high lands is less certainly known. If, however, we imagine that the continental period of the later Pliocene was closed by a differential depression, submerging the plains and leaving the mountains elevated, the resulting geographical conditions would be favourable to accumulation of

* I need scarcely say that the reference of this terminal moraine to a land glacier is absurd on physical grounds; and there is no modern example of such a thing, as even the Greenland nevé discharges by local glaciers.

† "Acadian Geology," "Modern Science in Bible Lands," Presidential Address to Brit. Association, 1886.

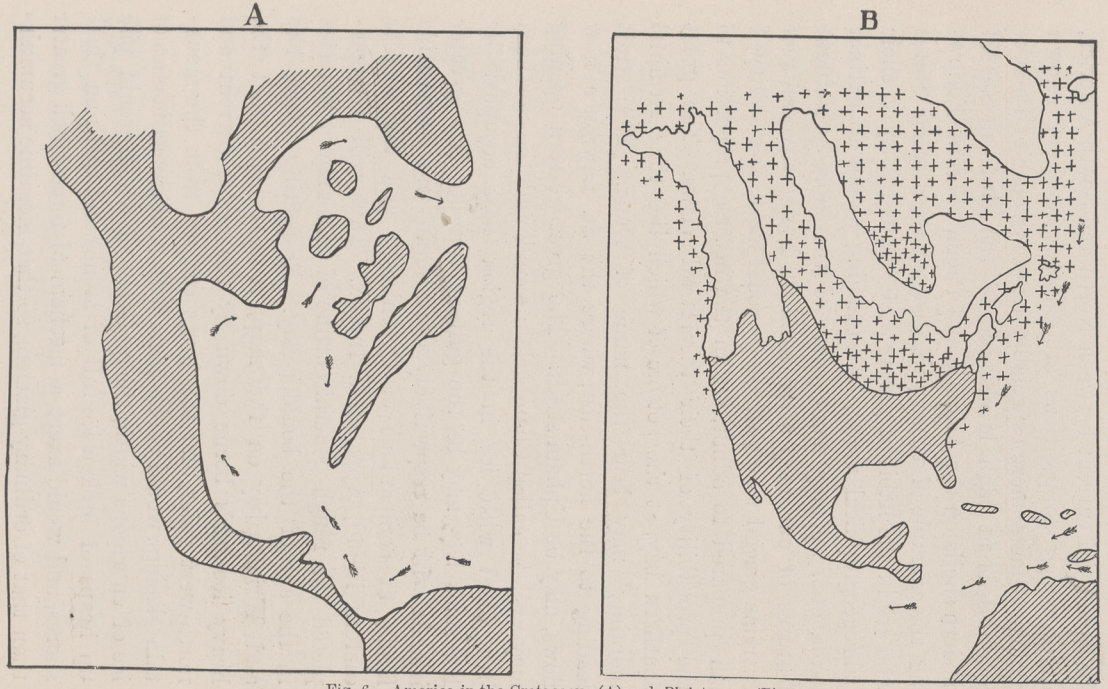


Fig. 6.—America in the Cretaceous (A) and Pleistocene (B).
Shaded portions, land; crosses, ice-laden sea; unshaded bands, glaciated mountains.

FIG. 2. *Laurentian Hills opposite Kamouraska, Lower St. Lawrence.*
The islands in front are Primordial.

Chap III

Atlantic Mail

Chap IV

Nature Print

Canals

Mallard Queens

Chap V

tendency to form a supplemental or intermediate skeleton with canals, though the canals themselves in their arrangement more nearly resemble Calcarina, which

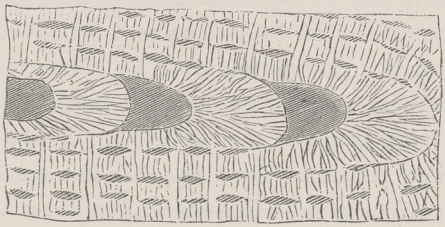


FIG. 19. *Section of a Nummulite, from Eocene Limestone of Syria.*

Showing chambers, tubuli, and canals. Compare this and fig. 20 with figs. 10 and 11.

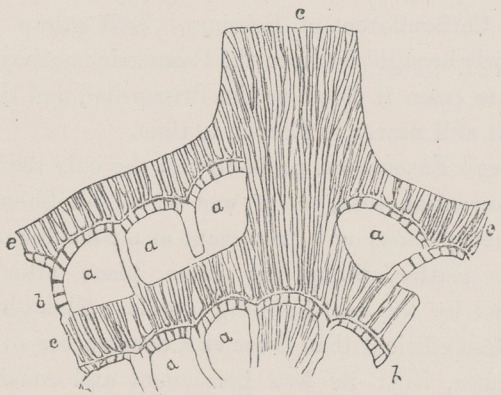


FIG. 20. *Portion of shell of Calcarina.*

Magnified, after Carpenter. (*a.*) Cells. (*b.*) Original cell-wall with tubuli. (*c.*) Supplementary skeleton with canals.

is represented in fig. 20. In its superposition of many layers, and in its tendency to a heaped up or acervuline irregular growth it resembles *Polytrema* and *Tinoporus*,

forms of a different group in so far as shell-structure is concerned. It may thus be regarded as a composite type, combining peculiarities now observed in two groups, or it may be regarded as a representative in the Nummuline series of Polytrema and Tinoporus in the Rotaline series. At the time when Dr. Carpenter stated these affinities, it might be objected that Foraminifera of these families are in the main found in the Modern and Tertiary periods. Dr. Carpenter has since shown that the curious oval Foraminifer called *Fusulina*, found in the coal formation, is in like manner allied to both Nummulites and Rotalines; and still more recently Mr. Brady has discovered a true Nummulite in the Lower Carboniferous of Belgium. This group being now fairly brought down to the Palæozoic, we may hope finally to trace it back to the Primordial, and thus to bring it still nearer to Eozoon in time.

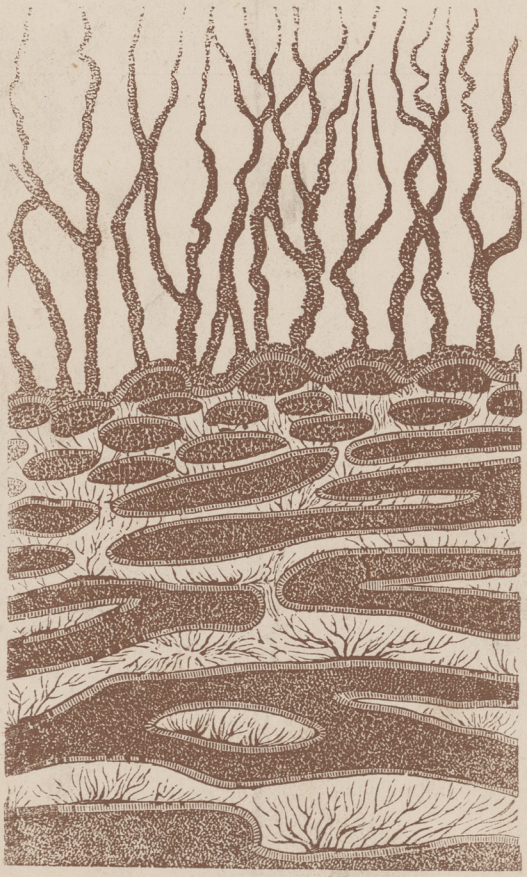
Though Eozoon was probably not the only animal of the Laurentian seas, yet it was in all likelihood the most conspicuous and important as a collector of calcareous matter, filling the same place afterwards occupied by the reef-building corals. Though probably less efficient than these as a constructor of solid limestones, from its less permanent and continuous growth, it formed wide floors and patches on the sea-bottom, and when these were broken up vast quantities of limestone were formed from their debris. It must also be borne in mind that Eozoon was not everywhere infiltrated with serpentine or other silicious minerals; quantities of its substance were merely filled with car-

Print these as delicately as possible they are two bold and dark.

Magnified and Restored Section of a portion of Eozoon Canadense.

The pictures in brown show the animal matter of the Chambers, Tubuli, Canals and Pseudopodia — the pictures uncolored the Calcareous skeleton.

PLATE IV.



Magnified and Restored Section of a portion of Eozoon Canadense.

The Chambers, Canals, Tubuli and Pseudopodia in brown — the Calcareous Skeleton uncoloured.

Print in Brown from new block sent by this mail

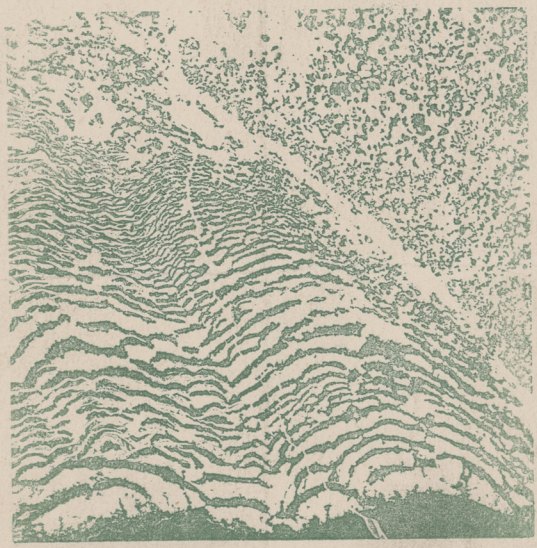
PLATE IV.

Magnified and Restored Section of a portion of Eozoon Canadense.

The Chambers, Canals, Tubuli and Pseudopodia in brown. The Calcareous Skeleton uncoloured.

Pl V
Correct

PLATE V.



Nature-print of Eozoon, showing laminated, acervuline, and fragmental portions.

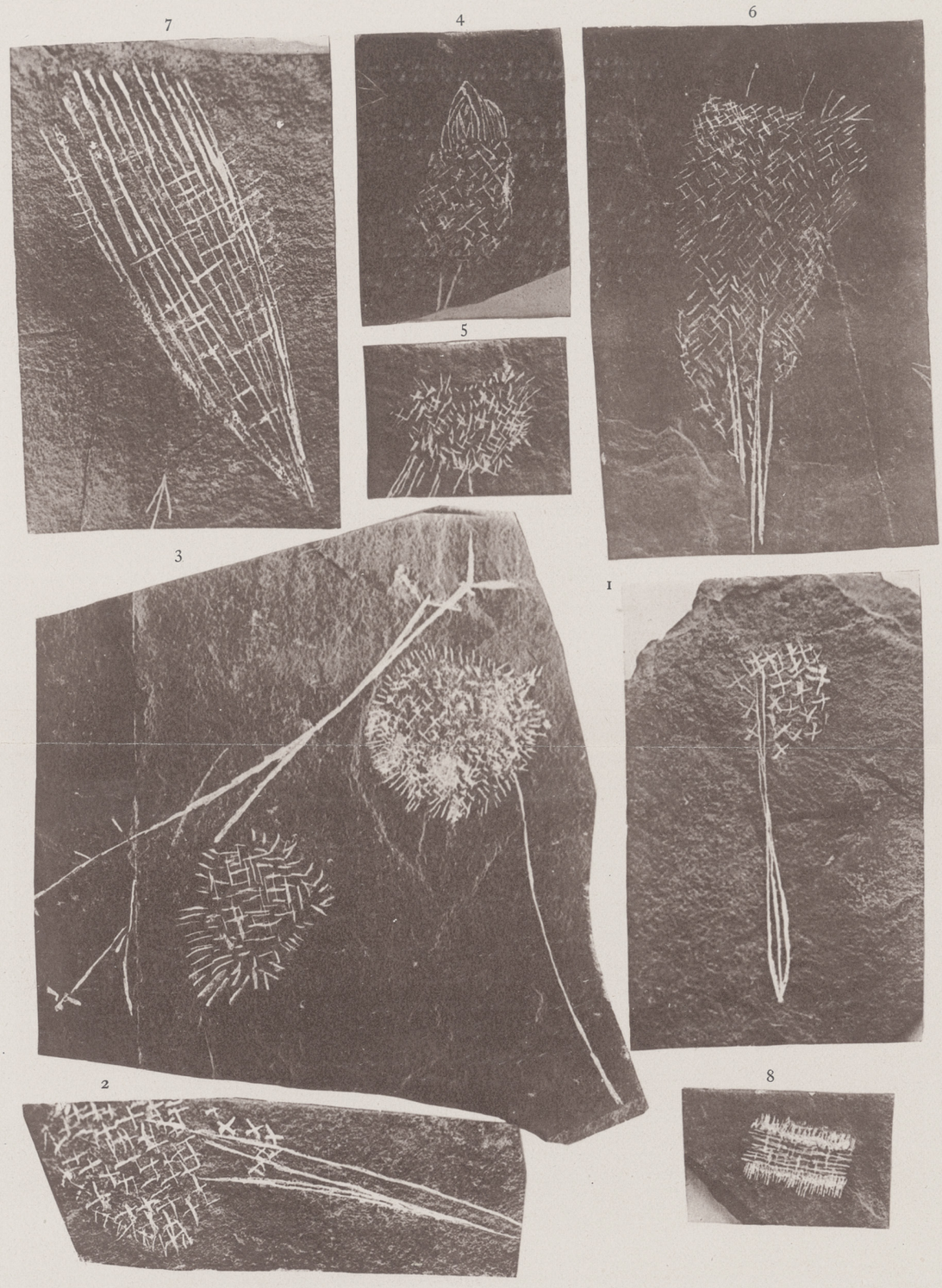
This is printed from an electrotype taken from an etched slab of Eozoon, and not touched with a graver except to remedy some accidental flaws in the plate. The diagonal white line marks the course of a calcite vein.

From a Photo. by Weston. Vincent Brooks, Day & Son, Lith.

WEATHERED SPECIMEN OF EOZOON CANADENSE.

(ONE-HALF NATURAL SIZE.)

To face Chap. 3.



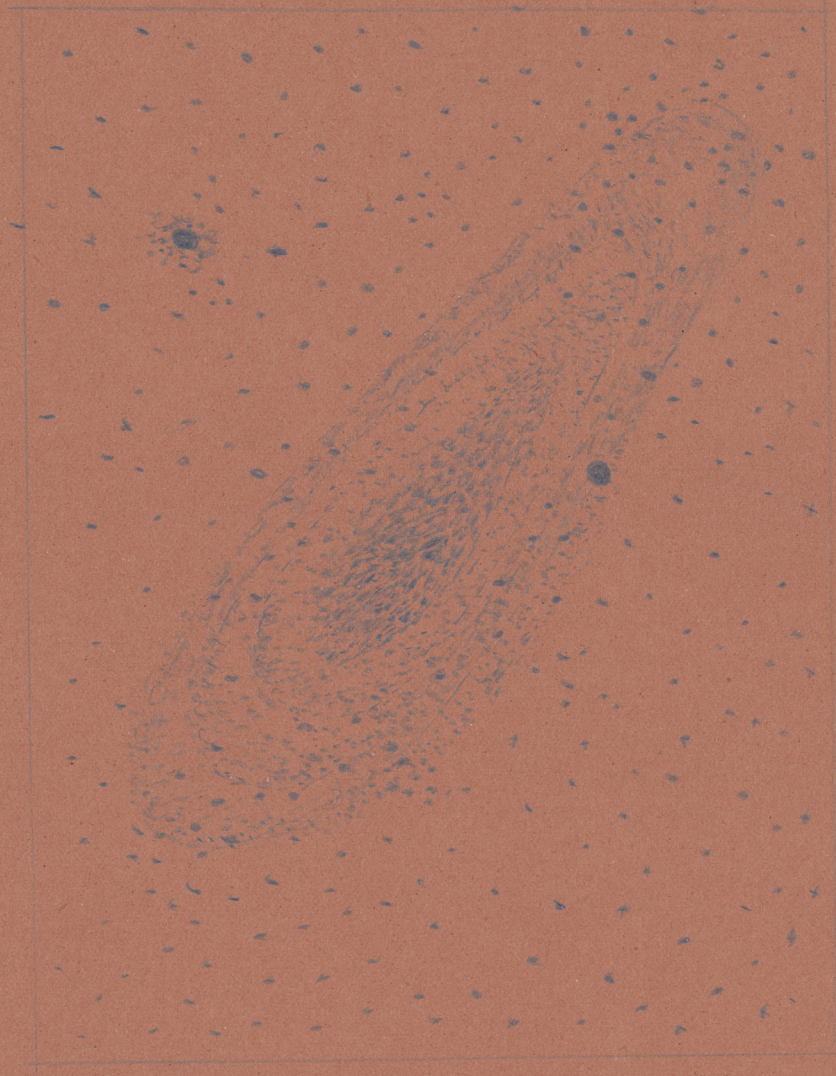
(From Photographs.)

Figs. 1 and 2. Protospongia tetranema, 3. P. mononema, 4. P. coronata, 5. P. polynema, 6. P. cyathiformis, 7. Cyathospongia Quebecensis, 8. Acanthodictya hispida.

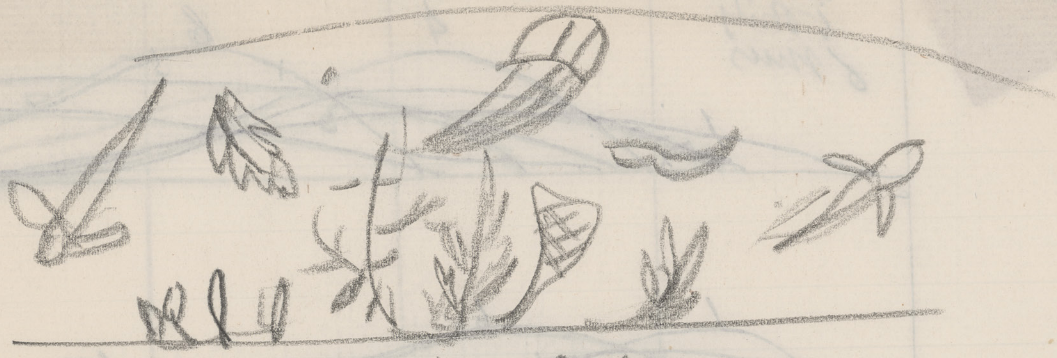
TO ILLUSTRATE SIR WILLIAM DAWSON'S PAPER ON FOSSIL SPONGES.

ARTOTYPE, PATENTED; CANADA BANK NOTE CO., LIMITED, MONTREAL.

Ch II



Chap VI

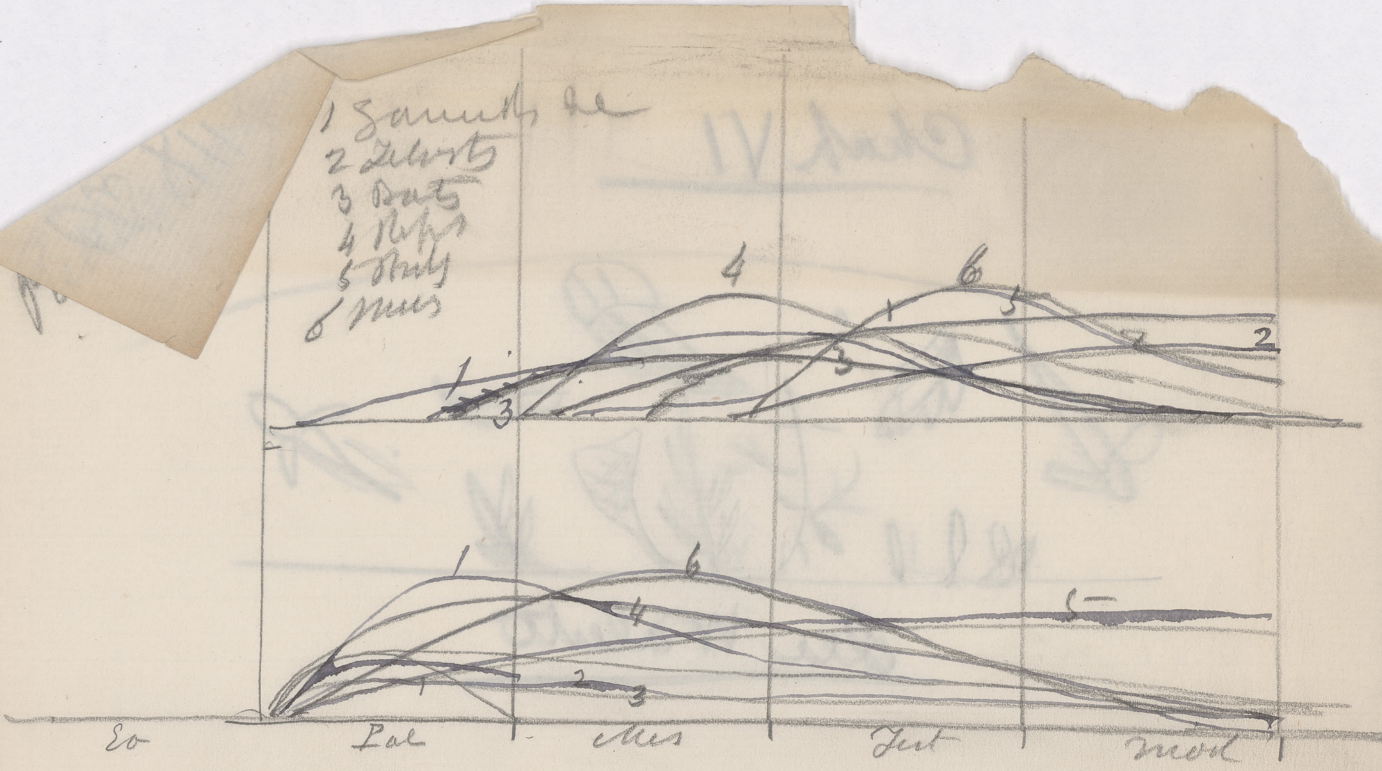


Sea Walnuts

Chap VIII

Sweeping of Hidden Nonsuch Return

Sweeping of Brachiopods Bermuda



1 Trilob 2 Phyllop 3 Mus 4 Brachiol 5 Gast & Lam
6 Tetra Cephalop

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~~3 Brachiop~~
~~4 Cephalop~~
~~5 Dibranch~~

1 Trilob
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3 Gast & Lam
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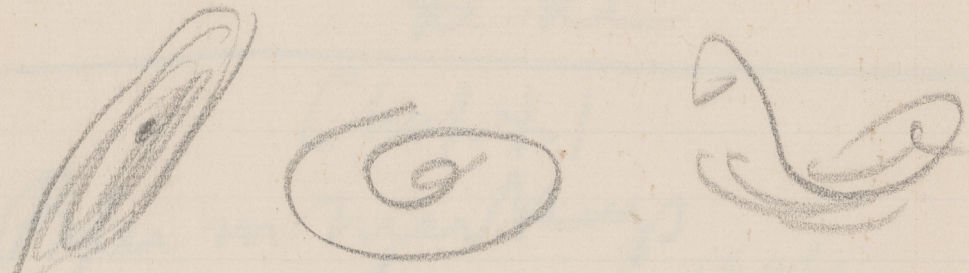
5 Dibran
6 Brachiop

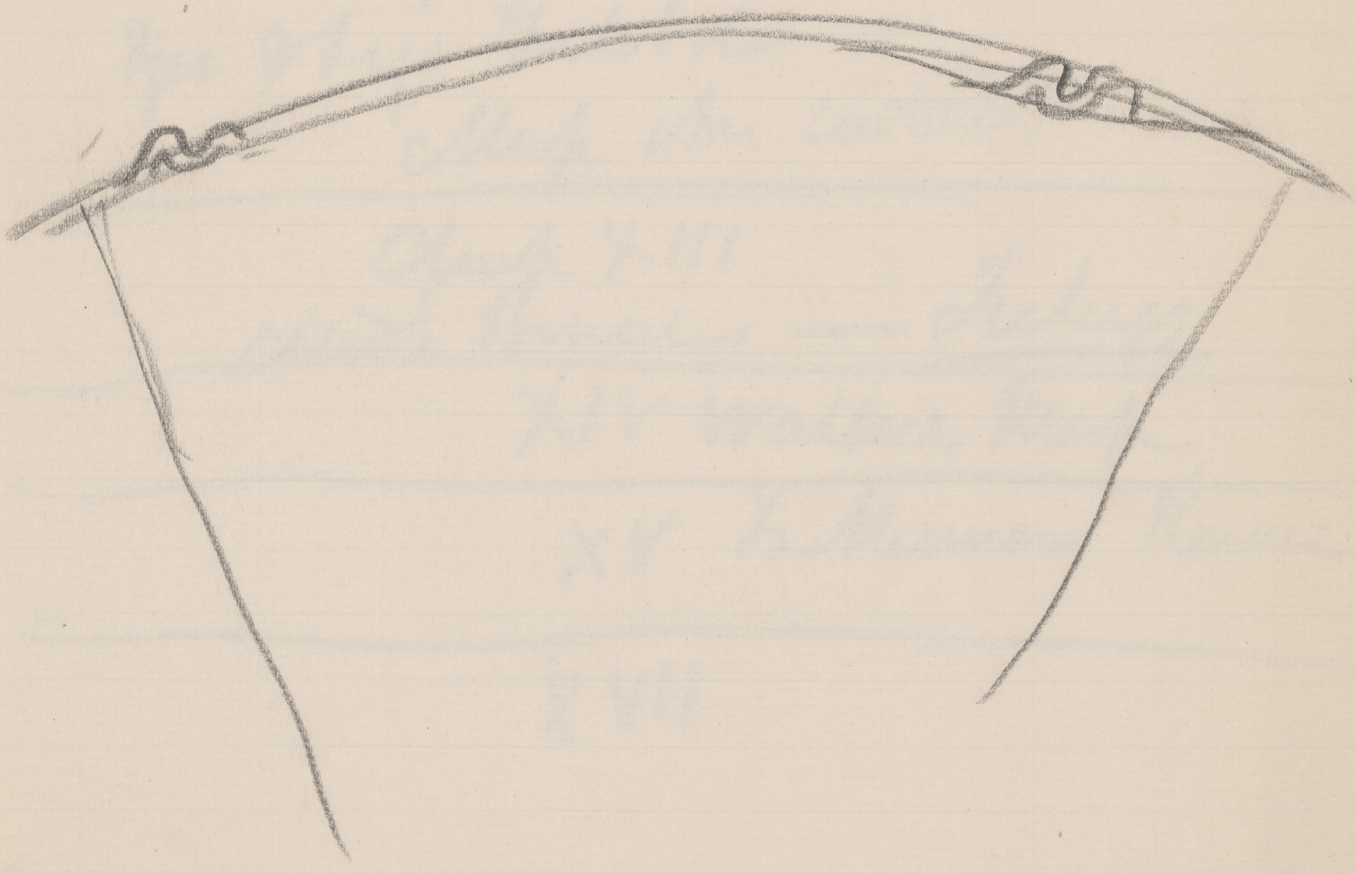
Indep

Illustrations & Salient Points

Chap II



Nebulæ



Chap X

N Eskdale Reppley Laund Snaily
the sea

Chap XI

Paper on markings
Summers portfolio
Paper Geol Soc

Chap XII

Sponge Roots &c

Eyes & legs Trilobite

Map the contours

Chap XIII

~~Nature Bowling~~ — Ireleth

XIV Wallace Map

XV Luckenman Rumme

XVII