ERRATA.

Page 239—"Box No. 2"—Paragraph first should be transposed to the beginning of "Box No. 1." It refers to a specimen of the maxillary bone of *Hylonomus Lyelli*.

Page 241—The specimens referred to in paragraphs second and third were accidentally misplaced in Box No. 3. The first is a jaw of *Hylonomus Lyelli*. The second belongs to *Dendrerpeton*. The jaw of the *H. Wymani* is that figured in Pl. IX. Fig. 8, and not mentioned in the text.

Page 244—"Fig. 6," for "*Aciedentatus*" read "*Lyelli*."

"Fig. 8," after "*Hylonomus*" read "*Wymani*," and omit "a young or small kind of."

"Fig. 9," after "*Hylonomus*" read "*aciedentatus*."

"Fig. 15," for "*Hylonomus*" read "*Dendrerpeton*."

The above errors were caused by accidental intermixture of the specimens before they reached Prof. Owen, and were not detected until after the printing of these sheets.

Two years after this, in 1845, Baron de Ryckholt described ten new species from the same formation, in a paper that appeared in the 'Bulletins de l'Académie Royale de Bruxelles' (tome xii. no. 7). In 1847 the same author noticed another species, which he referred to *Chitonellus*, in the 'Bulletins de l'Académie Royale de Belgique' (tome xxiv. p. 63). Lastly, a species was described by Mr. W. H. Baily, of the Geological Survey, in 1859, from the Carboniferous Limestone of Ireland, in the 'Dublin Natural History Review,' vol. viii., and 'Journ. Geol. Soc. Dublin,' vol. viii. p. 167.

The latter author has also recently published an annotated translation of an old though interesting paper by Professor De Koninck, on two Silurian species of this genus, in which is given a short sketch of all that had been done in the palæontology of the *Chitonidæ* up to the date of publication of the paper; the sketch being accompanied by a list of fossil Chitons from the Lower Silurian to the Upper Tertiary, and Mr. Baily having increased its value by adding to it the results of recent discoveries. Both in this list, however, and in the one originally published by De Koninck, several of De Ryckholt's species are considered but varieties of those described by De Koninck, or altogether ignored; hence, instead of eleven, only three of De Ryckholt's species are allowed in these lists. It is quite possible that Professor De Koninck may be right, to some extent, in considering certain of De Ryckholt's species to be only varieties of his own, but, so far as may be judged from the descriptions and figures of the forms described by the latter author in his valuable paper in the 'Bulletins of the Royal Academy of Brussels,' I see no reason for adopting so sweeping a criticism as that which De Koninck has virtually passed upon De Ryckholt's species; for, though I have had but slight opportunities of examining specimens from Belgium, there seems evidence enough in the figures of De Ryckholt to show that other forms, besides the three allowed by De Koninck, possess peculiar characters of specific value. I include therefore, in the following list of the Carboniferous species of this family, all those described as such by Baron de Ryckholt; it being, in my opinion, only fair to that palæontologist to acknowledge his species until we have shown them to be unworthy of such distinction.

List of Chitones *from the Carboniferous Rocks.*

1. Chiton priscus, *Münster*.
2. —— gemmatus, *De Koninck*.
3. —— concentricus, *De Kon.*
4. —— Tornacicola, *De Ryckholt*.
5. —— Scaldianus, *De Ryck.*
6. —— Nervicanus, *De Ryck.*
7. —— Mempiscus, *De Ryck.*
8. —— Mosensis, *De Ryck.*
9. —— Viseticola, *De Ryck.*
10. —— Legiacus, *De Ryck.*
11. Chiton Eburonicus, *De Ryck.*
12. —— Sluceanus, *De Ryck.*
13. —— Turnacianus, *De Ryck.*
14. —— Thomondiensis, *Baily*.
15. —— Burrowianus, *Kirkby*.
16. —— coloratus, *Kirkby*.
17. ——?, spec. nov.
18. —— spec. nov. (?).
*19. Chitonellus Barrandeanus, *De Ryckholt*.

* The *Chitonellus cordifer*, which Professor De Koninck doubtfully referred to this family, has been shown by Baron De Ryckholt to belong to the *Crinoidea*.

2. *Description of Specimens of* Fossil Reptilia *discovered in the* Coal-measures *of the* South Joggins, Nova Scotia, *by* Dr. J. W. Dawson, F.G.S., &c. By Professor Owen, F.R.S., F.G.S.

[Plates IX. & X.]

The following specimens were transmitted to the Museum of the Geological Society by Dr. Dawson, in a series of boxes and parcels, most of which are numbered according to a list accompanying them, and have been submitted, by his desire, to my inspection. The descriptions will follow in the order of that list.

"Box No. 1.—*Hylonomus Lyelli*, Dawson."

This specimen is imbedded in a portion of a thin layer of carbonaceous matter, measuring six inches by four inches. It consists of scattered parts and impressions of vertebræ, ribs, limb-bones, and part of a cranium crushed, including part of a maxillary bone with teeth (Pl. IX. figs. 1–5). Not any of the bones are entire: all the long bones, even the ribs, are hollow; and the cavity is enclosed by a compact wall of almost uniform thinness throughout each bone, indicative that such cavity was not properly a medullary one, in the sense of having been excavated by absorption after complete consolidation of the bone by the ossifying process, but was posthumous, and due to the solution of the primitive cartilaginous mould of the bone, which had remained unchanged by ossification in the living species. I conclude, therefore, that these hollow long bones (and, indeed, the bodies of the vertebræ seem only to have received a partial and superficial crust of bone) were originally solid, and composed, like the bones in most *Batrachia*, especially the Perennibranchiates, of an external osseous crust, enclosing solid cartilage. The body of the vertebra (figs. 1 & 2) is chiefly represented by a downward growth of the base of the neural arch (*n*); and in the best-preserved specimen there seems to be a distinct inferior plate (*c*), with a median longitudinal channel on the lower surface,—such vertebræ belonging to the dorsal region: the cylindrical cavity of the centrum was doubtless occupied by the notochord. The neural arch developes a short, broad diapophysis (*d*), to which the rib articulates: it also has zygapophyses both before (*z*) and behind (*z'*), and a moderately long truncate spine (*n s*), slightly expanding in the fore-and-aft direction to its summit. The ribs are of various lengths, the shorter ones straight, the longer ones slightly bent; the best-preserved of these have an expanded end, slightly notched (fig. 3), but none show a distinctly bifurcate extremity. Those limb-bones, metapodials or phalanges, which have their articular end preserved, show it to be flattened (fig. 4),—not fashioned for a condyloid or trochlear joint with articular cartilage and synovial membrane, but adapted for a simple ligamentous union, as in the digits of the Salamanders, Turtles, *Amphiume*, and *Proteus*. One end of some of these bones shows a short longitudinal impression at the middle. The surface of some of the larger long bones shows longitudinal striation, indicative of a fibrous structure like that of the bones in some fishes. The maxillary fragment in the slab,

No. 1, which Dr. Dawson supposes to belong to another individual of *Hylonomus*, is figured of twice the natural size in Pl. IX. fig. 5. The bone, in respect to its proportions as to length and depth, to the number, size, and shape of the teeth it contains, and to the indications of sculpturing of the outer surface, resembles the maxillary and dentary bones of *Archegosaurus*. A series of twenty-four teeth occupies a part of the alveolar border, *a*, 6 millimeters (nearly 3 lines) in extent; but impressions and fragmentary traces of others beyond show that there were at least 40 teeth in a row on one side of the upper jaw. There is an indication of the lower border of the orbit *o*, above the hinder third of this series. The teeth increase gradually in length as they approach this part; their crowns are slender, subcompressed transversely, pointed, but not sharply, with evidence of alternate shedding. They are partially anchylosed to shallow alveolar depressions on the border, towards the inner side, of the jaw-bone. Their enamelled surface is smooth, and shows a whiter colour than the bone itself.

"Box No. 2.—*Hylonomus aciedentatus*, Dawson."

This contains two portions of shaly carbonaceous matter. In one is imbedded the major part of a maxillary bone (Pl. IX. fig. 6), with the inner side exposed, which is smooth, and demonstrates the fixation of the teeth not to be as in the pleurodont lizard, but according to the acrodont type; the sockets, however, are shallow, and the simple bases of the teeth are partially anchylosed thereto, as in *Archegosaurus* and *Labyrinthodon*, and that of the largest tooth (being exposed by removal of the inner alveolar wall) shows the fossa due to the matrix of the successional tooth. The teeth are not so bent as to indicate which is the front or which the hind end of this maxillary bone. The teeth are the smallest at both ends, gradually increasing as they recede from one end, and rapidly from the other, near to which are four or five teeth, four times the length of the terminal ones of the series. I suspect this to be the fore part of the bone. The proportions and shape of the crown are much as in the *Hylonomus Lyelli*; but there seems to be a greater variety of length in the teeth of *Hylonomus aciedentatus*. In both species the dentition indicates a small insectivorous or vermivorous reptile.

A second portion of coal-shale, in box No. 2 (marked 5 *a*), contains the impression, with a small portion of one end, of a dentary bone of the lower jaw, which held a series of at least 40 teeth (Pl. IX. fig. 7*a*). These, in size and proportion, agree with those of *Hylonomus Lyelli*, in No. 1. The teeth very gradually decrease from the middle to the two ends, especially to the anterior one. In the number, proportions, and close arrangement of the teeth, this dentary bone agrees with that of the *Archegosaurus*. Lizards have not so many teeth.

A third portion of coal (5 *a*), in box No. 2, contained the slender-pointed end of a jaw-bone, with a close-set series of about 25 teeth in an extent of 13 millimeters, or 6½ lines (Pl. IX. fig. 9). These teeth

increase from the pointed end of the bone to about the tenth tooth, and thence continue with little difference of size: the crown expands slightly beyond the implanted base, before narrowing to the rather blunt-pointed end. The outer surface of the jaw-bone shows a striated or strio-punctate pattern of sculpture.

A fourth portion (5 *b*) included parts of the bones of a short natatory fore limb (Pl. IX. fig. 10). The humerus (*h*) has an expanded proximal end, with three ridges, two of them more extended than the other; the shaft of the bone is rather bent. This bone has been dislocated from the radius (*r*) and ulna (*n*), beyond which are evidences of three, if not four, digits; these progressively increase in length to the fourth (*iv*), of which, and of the third, impressions and parts of three successive phalanges are shown. These are slightly expanded at their flattened articular ends, at which the longitudinal impressions may be seen in two instances; but the joints were syndesmotic, as in *Archegosaurus* and modern aquatic batrachian reptiles; and the humerus and antebrachium are short in proportion to the manus, although not to such a degree as in *Archegosaurus*.

The group of dermal scutes includes some (Pl. IX. fig. 13 *b*, *c*) which are nearly perfect, of an oval form, smooth on the inner surface, with a low longitudinal ridge, half the length of the scute, on the outer surface; the external layer is of ganoid hardness; the internal structure is cellular. They indicate the nature of the covering of one of the species of *Hylonomus*.

"Box No. 3.—*Hylonomus Wymanni*, Dawson."

The remains of foot-bones (Pl. IX. fig. 11) in one of the portions of coal-shale in this box show a tridactyle structure, with more slender proportions than in the *Hylonomus aciedentatus*; but the phalanges have the same flat joints and incomplete ossification, a thin external crust of bone enclosing a cavity which had been occupied by cartilage: they much resemble the phalanges of the Axolotl.

A second portion contains a series of six or seven crushed neural arches of vertebræ (Pl. IX. fig. 12), of a length twice their breadth, with horizontal zygapophyses—the spines probably broken away. In the proportion of length to breadth, these vertebræ resemble those of *Proteus**. There is no evidence of an ossified centrum in any part of this series; but there are some elongated vacuities, which seem to represent the unossified parts of centrums, partially cased by thin bone. The impressions, with filmy remains of bones of a second series of six vertebræ, of similar slender proportions, are preserved in the same portion of coal.

Pl. IX. fig. 13 *a* represents one of the largest specimens of a rib, partly in bone, partly in impression, with an expanded, slightly notched head, as in the ribs of the Axolotl, but of greater length and more curved than in any modern naked Batrachian: it is hollow, as in the shorter specimens, with a thin outer crust.

* Cuvier, Ossemens Fossiles, v. pt. ii. pl. xxvii. fig. 14.

Near the specimen, and near the jaw of *Hylonomus* (fig. 7*a*), are specimens of the dermal scutes. They are oval, flattened, smooth and slightly concave on the inner side, with parallel curved striations on the outer surface.

Pl. IX fig. 14 is the dentary bone, with very small, equal, close-set teeth, eleven being in the extent of 2 millimeters; they best accord in character with those of the upper jaw of *Hylonomus Lyelli* (fig. 5), to which species I believe this lower jaw to belong.

Pl. IX fig. 15 is part of an upper jaw, with teeth less closely arranged, and very small in proportion to the breadth of the bone. It is of a *Hylonomus*, and exhibits on the outer surface of part of the bone the pits and radiating furrows which characterize the outer sculpturing of the skull-bones of *Archegosaurus*.

"Parcel No. 4.—Jaw of a Reptile, supposed to be new."
Hylerpeton Dawsoni, Ow. (Pl. IX. fig. 16).

This specimen consists of the left ramus of a lower jaw, which has been dislocated from the crushed head, of which the fore end of the left premaxillary (*p*) is preserved, terminating near the middle of the series of the teeth of the more advanced mandible. A fragment of the left maxillary (*m*), which has been separated from the premaxillary, overlaps the hinder mandibular teeth. The fore part of the mandible is wanting. The teeth in the remaining part are larger and fewer, in proportion to the jaw-bone, than in *Hylonomus* or *Dendrerpeton*. They have thicker and more obtusely terminated crowns; they are close-set where the series is complete at the fore part of the jaw, and their base appears to have been anchylosed to shallow depressions on the alveolar surface. The shape of what is preserved of the upper jaw affords the only evidence, and not very decisively, that the present fossil is not part of a fish. It inclines the balance, however, to the reptilian side; and, accepting such indication of the class-relations of the fossil, it must be referred to a genus of *Reptilia* distinct from those it is associated with in the Nova-Scotian coal, and for which genus I would suggest the term *Hylerpeton*.

A small part of the external surface of the dentary bone shows a longitudinally wrinkled and striate or fibrous character. The outer bony wall, broken away from the hinder half of the dentary, shows a large cavity, now occupied by a fine greyish matrix (*x*), with a smooth surface, the bony wall of which cavity has been thin and compact. We have here the mark of incomplete ossification, like that in the skeleton of *Archegosaurus*. The crushed fore part of the right dentary bone, with remains of a few teeth, is below the left dentary, and exemplifies a similar structure. The teeth slightly diminish, though more in breadth than length, towards the fore part of the series: here there are nine teeth in an alveolar extent of 10 millimeters, or nearly 5 lines. The portion of jaw, figured of twice the natural size, in fig. 17, shows the anchylosis of the base of the teeth in a shallow groove or alveolus: the base of the teeth is

longitudinally fissured, but the fissures do not extend upon the exserted crown. In their general characters, the teeth manifest at least as close a resemblance to those of *Ganocephala* as of *Lacertia* or any higher group of *Reptilia*; whilst their mode of implantation, with the structure and sculpturing of the bone, weigh in favour of its relations to the lower and earlier order of the cold-blooded Vertebrates.

"No. 5.—Skin and dermal plates of *Hylonomus* (?), probably *H. Lyelli*."

The specimen so marked shows three oblong plates (Pl. X. *a*, *b*, *c*, fig. 2), with a slightly concave surface, finely striate transversely, and with one margin free, obtuse, and well defined. Continuous with this is a granulate surface, like shagreen, of small, close-set, subelliptic scales or tubercles (*d*).

Another portion of coal-shale shows a layer, and an impression of a continuous part of the same layer, of integument (Pl. X. fig. 1) which has been defended by similar small and subimbricate scales. From their state of preservation, these were probably bony or ganoid. I do not know the evidence in proof of their belonging to *Hylonomus*.

Pl. X. fig. 3 is a portion of the bones of the cranium, including the frontal and parts of the prefrontal, postfrontal, parietal, postorbital, and supertemporal bones of probably a *Hylonomus*. They show the skull to have been broad and much depressed: the superorbital border (*o*) is formed by the pre- and post-frontals. In most of the bones, and especially the supertemporal plate, *s*, the outer surface is sculptured according to the pattern shown in the skull of *Archegosaurus*.

Pl. X. fig. 4 is a portion of a jaw, with small equal teeth having the characters of those of *Hylonomus*, and with a sculptured external surface like that in Pl. X. fig. 3 and in Pl. IX. fig. 15.

Passing over the interesting examples of probably the food of the small reptiles, shown in No. 5 (*Pupa vetusta*, Dawson) and No. 7 (*Xylobius sigillarius*, Dawson), I come to

"No. 8. Loose specimens of *Dendrerpeton Acadianum*, Ow. (a nearly complete skeleton)."

The chief addition to the evidence already recorded of the characters of this reptile* are, 1st, the incompletely ossified conditions of the endoskeleton, manifested even in the slender ribs, which have their cavities filled with matrix, as formerly with the primitive cartilage; 2nd, the shape of the head (Pl. X. fig. 5 *a*); 3rd, the superficial markings of the cranial bones (fig. 6) and scutes; 4th, the batrachian type of the ilium, and probably of the pelvis, fig. 7.

The skull (Pl. X. fig. 5 *a*) is broad, depressed, obtusely rounded anteriorly, rather Labyrinthodontal than Archegosaural in shape; although, in the species of both these early types of batrachian air-

* Quart. Journ. Geol. Soc. vol. ix. p. 64, &c.

breathers, there is such a known range of variation as to detract from the value of the character of the degree of obtuseness of the muzzle. Unfortunately, the occipital part of the skull, which would have afforded the test of the mode of its articulation with the atlas, is wanting. The Labyrinthodonts have a pair of condyles, as in *Rana*: the *Ganocephala*, like *Lepidosiren*, show no bony joint between the basi-occipital and atlas.

The under surface of the bones forming the roof of the skull is exposed in this specimen. As in *Archegosaurus* and *Hylonomus*, the frontal (11) is separated from the orbital border (0, 0) by the union of the post- (12) and pre- (14) frontals. The temporal fossæ were roofed over with bone; and these cranial bones show their external surface, fig. 6, to be sculptured with the beautiful and characteristic pattern exhibited in the supertemporal plate of the specimen of *Hylonomus*, fig. 3. This pattern may be seen on the cranial bones of some ganoid fishes, and on those of *Archegosaurus* and *Labyrinthodon*. The orbits in *Dendrerpeton* are circular, divided by a bony tract of more than their own diameter: they seem to have been midway between the two ends of the skull; but the hinder part of this is not complete in the specimen. The small nostrils are not midway between the orbits and the muzzle, but nearer the latter. The few teeth preserved at this part of the skull show the plication of the base due to the entering folds of the cement, and yield, on a transverse section (fig. 5 *b*), the same approach to the labyrinthic character as in *Archegosaurus*. Their bases are confluent with the alveolar depressions: there are no tusks as in *Labyrinthodon*.

A short straight bone, uniting with two other divergent ones, appears to be the ilium; and I regard the specimen Pl. X. fig. 7 as part of the pelvis of *Dendrerpeton*: the ossified part of each of these bones is a thin outer crust. The ilium, by its shortness and straight subcylindrical rib-like form, agrees with that in *Archegosaurus* and in modern Perennibranchiate reptiles. In *Labyrinthodon* the ilium expands in some measure according to the Crocodilian type of the bone.

The short proportions and simplicity of shape and structure of the limb-bones combine, with the above-mentioned characters, to demonstrate the Ganocephalous nature of this Nova-Scotian reptile of the Coal-period.

Dendrerpeton, like *Hylonomus* and *Archegosaurus*, shows the affinity (shall we call it?) or analogy to the ganoid fishes, not only in the character of the cranial bones, but in the retention of a covering of the body by ganoid scales: these are elliptic, smooth on their inner surface, with a slight indication of a ridge, about half the length of the scale, on the external surface,—at least, in certain of the scales, and probably those along the back.

The genus *Hylonomus* also, although with more minute and simple teeth, had the skin defended by similar elliptic or suboval ganoid scales. Much remains to be determined as to the structure of the skull: nevertheless such cranial bones as have been obtained (Pl. X. figs. 3, & 5*a*, 6) exemplify the Ganocephalous sculpturing; while the arrested state of ossification of the endoskeleton and the characters

of the limb-bones sustain the reference of the genus to the order *Ganocephala*.

After careful scrutiny of all the specimens confided to my inspection by Dr. Dawson, I have not met with decisive evidence of a member of any of the orders of *Reptilia* represented by species of the Oolitic or later series of deposits. Some, as (*e.g.*) *Baphetes*, may be Labyrinthodont, but the rest are Ganocephalous; and *Baphetes* may possibly belong to this lower group of palæozoic air-breathing Vertebrates.

DESCRIPTION OF THE PLATES.

Plate IX.

Fig. 1. *Hylonomus Lyelli*, dorsal vertebra, three times magnified: side view.
Fig. 2. ————————, dorsal vertebra, three times magnified: transverse section.
Fig. 3. ————————, one of the longer ribs, twice nat. size; the end showing the hollow.
Fig. 4. ————————, metapodial and phalangial bones, twice nat. size.
Fig. 5. ————————, upper maxillary and part of orbit, twice nat. size.
Fig. 6. Part of upper maxillary and teeth of *Hylonomus aciedentatus*.
Fig. 7*a*. Impression and remains of the dentary bone of the lower jaw of *Hylonomus aciedentatus*, and of a scute, three times magnified.
Fig. 8. Part of the dentary bone of a young, or small kind of *Hylonomus*, three times magnified.
Fig. 9. The anterior end of a jaw-bone of *Hylonomus*, twice nat. size.
Fig. 10. Bones of the fore limb of *Hylonomus*, three times magnified.
Fig. 11. Bones of a foot of *Hylonomus Wymanni*, twice nat. size.
Fig. 12. Series of (caudal?) vertebræ of *Hylonomus Wymanni*, twice nat. size
Fig. 13. Rib (*a*) and two scutes (*b* and *c*) of *Hylonomus*, twice nat. size.
Fig. 14. Right dentary part of lower jaw of *Hylonomus Lyelli*, twice nat. size.
Fig. 15. Part of the upper jaw and teeth of a *Hylonomus*, three times magnified.
Fig. 16. Parts of upper and lower jaws of *Hylerpeton Dawsoni*, nat. size.
Fig. 17. Small part of jaw of *Hylerpeton*, showing the mode of implantation of the teeth; twice nat. size.
Fig. 18. A group of the scutes of *Hylerpeton* (?); twice magnified.

Plate X.

Figs. 1 & 2. Dermal scutes and markings of the skin of *Hylonomus*?
Fig. 3. Portion of the frontal and contiguous cranial bones of a *Hylonomus*, twice nat. size.
Fig. 4. Part of the lower jaw of apparently the same species of *Hylonomus*.
Fig. 5 *a*. Inner surface of upper part of the skull of *Dendrerpeton Acadianum*, nat. size. 5 *b*, magnified section of base of tooth.
Fig. 6. Outer surface of supertemporal bone of *Dendrerpeton Acadianum*, twice nat. size.
Fig. 7. Ilium and parts of pubis and ischium of *Dendrerpeton Acadianum*.

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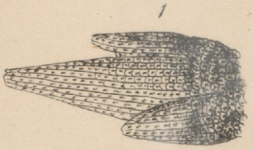
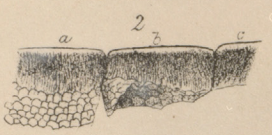
3. *On the* Occurrence *of* Mesozoic *and* Permian Faunæ *in* Eastern Australia. By the Rev. W. B. Clarke, F.G.S.

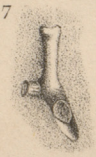
Since I forwarded my remarks on the "Relative Positions of certain Plants in the Coal-bearing Beds of Australia," which were published in the Quarterly Journal, vol. xvii. pp. 354–362, I have received, from a friend who is engaged, under my direction, in exploring the

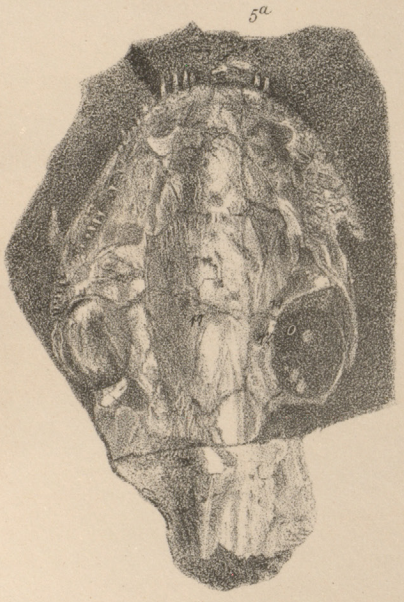
J. Dinkel lith. W. West. imp.

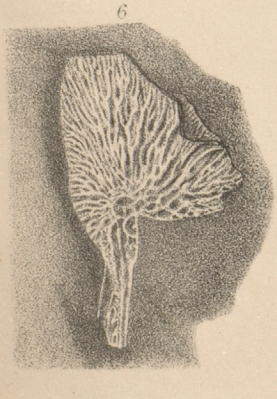
REPTILIAN REMAINS FROM NOVA SCOTIA.

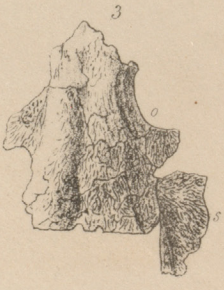












J. Dinkel lith.

W. West imp.

REPTILIAN REMAINS FROM NOVA SCOTIA.

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DESCRIPTION OF SPECIMENS

OF

FOSSIL REPTILIA

DISCOVERED IN THE COAL-MEASURES

OF THE

SOUTH JOGGINS, NOVA SCOTIA,

By Dr. J. W. DAWSON, F.G.S., &c.

By PROFESSOR OWEN, F.R.S., F.G.S.

Plates IX. & X.

[*From the* Quarterly Journal *of the* Geological Society *for August* 1862.]

LONDON:

PRINTED BY TAYLOR AND FRANCIS,

RED LION COURT, FLEET STREET.

1862.

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"Box No. 1.—*Hylonomus Lyelli*, Dawson."

This specimen is imbedded in a portion of a thin layer of carbonaceous matter, measuring six inches by four inches. It consists of scattered parts and impressions of vertebræ, ribs, limb-bones, and part of a cranium crushed, including part of a maxillary bone with teeth (Pl. IX. figs. 1–5). Not any of the bones are entire: all the long bones, even the ribs, are hollow; and the cavity is enclosed by a compact wall of almost uniform thinness throughout each bone, indicative that such cavity was not properly a medullary one, in the sense of having been excavated by absorption after complete consolidation of the bone by the ossifying process, but was posthumous, and due to the solution of the primitive cartilaginous mould of the bone, which had remained unchanged by ossification in the living species. I conclude, therefore, that these hollow long bones (and, indeed, the bodies of the vertebræ seem only to have received a partial and superficial crust of bone) were originally solid, and composed, like the bones in most *Batrachia*, especially the Perennibranchiates, of an external osseous crust, enclosing solid cartilage. The body of the vertebra (figs. 1 & 2) is chiefly represented by a downward growth of the base of the neural arch (*n*); and in the best-preserved specimen there seems to be a distinct inferior plate (*c*), with a median longitudinal channel on the lower surface,—such vertebræ belonging to the dorsal region: the cylindrical cavity of the centrum was doubtless occupied by the notochord. The neural arch developes a short, broad diapophys is (*d*), to which the rib articulates: it also has zygapophyses both before (*z*) and behind (*z'*), and a moderately long truncate spine (*n s*), slightly expanding in the fore-and-aft direction to its summit. The ribs are of various lengths, the shorter ones straight, the longer ones slightly bent; the best-preserved of these have an expanded end, slightly notched (fig. 3), but none show a distinctly bifurcate extremity. Those limb-bones, metapodials or phalanges, which have their articular end preserved, show it to be flattened (fig. 4),—not fashioned for a condyloid or trochlear joint with articular cartilage and synovial membrane, but adapted for a simple ligamentous union, as in the digits of the Salamanders, Turtles, *Amphiume*, and *Proteus*. One end of some of these bones shows a short longitudinal impression at the middle. The surface of some of the larger long bones shows longitudinal striation, indicative of a fibrous structure like that of the bones in some fishes. The maxillary fragment in the slab,

No. 1, which Dr. Dawson supposes to belong to another individual of *Hylonomus*, is figured of twice the natural size in Pl. IX. fig. 5. The bone, in respect to its proportions as to length and depth, to the number, size, and shape of the teeth it contains, and to the indications of sculpturing of the outer surface, resembles the maxillary and dentary bones of *Archegosaurus*. A series of twenty-four teeth occupies a part of the alveolar border, *a*, 6 millimeters (nearly 3 lines) in extent; but impressions and fragmentary traces of others beyond show that there were at least 40 teeth in a row on one side of the upper jaw. There is an indication of the lower border of the orbit *o*, above the hinder third of this series. The teeth increase gradually in length as they approach this part; their crowns are slender, subcompressed transversely, pointed, but not sharply, with evidence of alternate shedding. They are partially anchylosed to shallow alveolar depressions on the border, towards the inner side, of the jaw-bone. Their enamelled surface is smooth, and shows a whiter colour than the bone itself.

"Box No. 2.—*Hylonomus aciedentatus*, Dawson."

This contains two portions of shaly carbonaceous matter. In one is imbedded the major part of a maxillary bone (Pl. IX. fig. 6), with the inner side exposed, which is smooth, and demonstrates the fixation of the teeth not to be as in the pleurodont lizard, but according to the acrodont type; the sockets, however, are shallow, and the simple bases of the teeth are partially anchylosed thereto, as in *Archegosaurus* and *Labyrinthodon*, and that of the largest tooth (being exposed by removal of the inner alveolar wall) shows the fossa due to the matrix of the successional tooth. The teeth are not so bent as to indicate which is the front or which the hind end of this maxillary bone. The teeth are the smallest at both ends, gradually increasing as they recede from one end, and rapidly from the other, near to which are four or five teeth, four times the length of the terminal ones of the series. I suspect this to be the fore part of the bone. The proportions and shape of the crown are much as in the *Hylonomus Lyelli*; but there seems to be a greater variety of length in the teeth of *Hylonomus aciedentatus*. In both species the dentition indicates a small insectivorous or vermivorous reptile.

A second portion of coal-shale, in box No. 2 (marked 5 *a*), contains the impression, with a small portion of one end, of a dentary bone of the lower jaw, which held a series of at least 40 teeth [illegible] fig. 7*a*). These, in size and proportion, agree with those of the scale[illegible]*us Lyelli*, in No. 1. The teeth very gradually decrease [illegible] middle to the two ends, especially to the anterior one. In [illegible] teeth, had the proportions, and close arrangement of the teeth, this [illegible] scales. Much [illegible] grees with that of the *Archegosaurus*. Lizards have [illegible] skull: neverthe[illegible]th.

[illegible] figs. 3, & 5*a*, 6) [illegible] of coal (5 *a*), in box No. 2, contained the slender- [illegible] arrested state of [illegible]aw-bone, with a close-set series of about 25 teeth [illegible]illimeters, or 6½ lines (Pl. IX. fig. 9). These teeth

increase from the pointed end of the bone to about the tenth tooth, and thence continue with little difference of size: the crown expands slightly beyond the implanted base, before narrowing to the rather blunt-pointed end. The outer surface of the jaw-bone shows a striated or strio-punctate pattern of sculpture.

A fourth portion (5 *b*) included parts of the bones of a short natatory fore limb (Pl. IX. fig. 10). The humerus (*h*) has an expanded proximal end, with three ridges, two of them more extended than the other; the shaft of the bone is rather bent. This bone has been dislocated from the radius (*r*) and ulna (*n*), beyond which are evidences of three, if not four, digits; these progressively increase in length to the fourth (*iv*), of which, and of the third, impressions and parts of three successive phalanges are shown. These are slightly expanded at their flattened articular ends, at which the longitudinal impressions may be seen in two instances; but the joints were syndesmotic, as in *Archegosaurus* and modern aquatic batrachian reptiles; and the humerus and antebrachium are short in proportion to the manus, although not to such a degree as in *Archegosaurus*.

The group of dermal scutes includes some (Pl. IX. fig. 13 *b*,*c*) which are nearly perfect, of an oval form, smooth on the inner surface, with a low longitudinal ridge, half the length of the scute, on the outer surface; the external layer is of ganoid hardness; the internal structure is cellular. They indicate the nature of the covering of one of the species of *Hylonomus*.

"Box No. 3.—*Hylonomus Wymanni*, Dawson."

The remains of foot-bones (Pl. IX. fig. 11) in one of the portions of coal-shale in this box show a tridactyle structure, with more slender proportions than in the *Hylonomus aciedentatus*; but the phalanges have the same flat joints and incomplete ossification, a thin external crust of bone enclosing a cavity which had been occupied by cartilage: they much resemble the phalanges of the Axolotl.

A second portion contains a series of six or seven crushed neural arches of vertebræ (Pl. IX. fig. 12), of a length twice their breadth, with horizontal zygapophyses—the spines probably broken away. In the proportion of length to breadth, these vertebræ resemble those of *Proteus**. There is no evidence of an ossified centrum in any part of this series; but there are some elongated vacuities, which seem to represent the unossified parts of centrums, partially cased by thin bone. The impressions, with filmy remains of bones of a [illegible] series of six vertebræ, of similar slender proportions, are [illegible] in the same portion of coal.

Pl. IX. fig. 13 *a* represents one of the largest specim[illegible]nion, as in partly in bone, partly in impression, with an expa[illegible] *Proteus*. One notched head, as in the ribs of the Axolotl, but of gr[illegible] impression at more curved than in any modern naked Batrachian[illegible]ng bones shows in the shorter specimens, with a thin outer crust. [illegible]ture like that of [illegible]ment in the slab,

* Cuvier, Ossemens Fossiles, v. pt. ii. pl. xx[illegible]

breathers, there is such a known range of variation as to detract from the value of the character of the degree of obtuseness of the muzzle. Unfortunately, the occipital part of the skull, which would have afforded the test of the mode of its articulation with the atlas, is wanting. The Labyrinthodonts have a pair of condyles, as in *Rana*: the *Ganocephala*, like *Lepidosiren*, show no bony joint between the basi-occipital and atlas.

The under surface of the bones forming the roof of the skull is exposed in this specimen. As in *Archegosaurus* and *Hylonomus*, the frontal (11) is separated from the orbital border (0, 0) by the union of the post- (12) and pre- (14) frontals. The temporal fossæ were roofed over with bone; and these cranial bones show their external surface, fig. 6, to be sculptured with the beautiful and characteristic pattern exhibited in the supertemporal plate of the specimen of *Hylonomus*, fig. 3. This pattern may be seen on the cranial bones of some ganoid fishes, and on those of *Archegosaurus* and *Labyrinthodon*. The orbits in *Dendrerpeton* are circular, divided by a bony tract of more than their own diameter: they seem to have been midway between the two ends of the skull; but the hinder part of this is not complete in the specimen. The small nostrils are not midway between the orbits and the muzzle, but nearer the latter. The few teeth preserved at this part of the skull show the plication of the base due to the entering folds of the cement, and yield, on a transverse section (fig. 5 *b*), the same approach to the labyrinthic character as in *Archegosaurus*. Their bases are confluent with the alveolar depressions: there are no tusks as in *Labyrinthodon*.

A short straight bone, uniting with two other divergent ones, appears to be the ilium; and I regard the specimen Pl. X. fig. 7 as part of the pelvis of *Dendrerpeton*: the ossified part of each of these bones is a thin outer crust. The ilium, by its shortness and straight subcylindrical rib-like form, agrees with that in *Archegosaurus* and in modern Perennibranchiate reptiles. In *Labyrinthodon* the ilium expands in some measure according to the Crocodilian type of the bone.

The short proportions and simplicity of shape and structure of the limb-bones combine, with the above-mentioned characters, to demonstrate the Ganocephalous nature of this Nova-Scotian reptile of the Coal-period.

Dendrerpeton, like *Hylonomus* and *Archegosaurus*, shows the affinity (shall we call it?) or analogy to the ganoid fishes, not only in the character of the cranial bones, but in the retention of a covering of the body by ganoid scales: these are elliptic, smooth on their inner surface, with a slight indication of a ridge, about half the length of the scale, on the external surface,—at least, in certain of the scales, and probably those along the back.

The genus *Hylonomus* also, although with more minute and simple teeth, had the skin defended by similar elliptic or suboval ganoid scales. Much remains to be determined as to the structure of the skull: nevertheless such cranial bones as have been obtained (Pl. X. figs. 3, & 5*a*, 6) exemplify the Ganocephalous sculpturing; while the arrested state of ossification of the endoskeleton and the characters

of the limb-bones sustain the reference of the genus to the order *Ganocephala*.

After careful scrutiny of all the specimens confided to my inspection by Dr. Dawson, I have not met with decisive evidence of a member of any of the orders of *Reptilia* represented by species of the Oolitic or later series of deposits. Some, as (*e. g.*) *Baphetes*, may be Labyrinthodont, but the rest are Ganocephalous; and *Baphetes* may possibly belong to this lower group of palæozoic air-breathing Vertebrates.

DESCRIPTION OF THE PLATES.

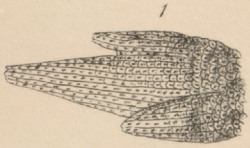
Plate IX.

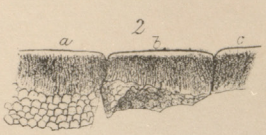
Fig. 1. *Hylonomus Lyelli*, dorsal vertebra, three times magnified: side view.
Fig. 2. ————————, dorsal vertebra, three times magnified: transverse section.
Fig. 3. ————————, one of the longer ribs, twice nat. size; the end showing the hollow.
Fig. 4. ————————, metapodial and phalangial bones, twice nat. size.
Fig. 5. ————————, upper maxillary and part of orbit, twice nat. size.
Fig. 6. Part of upper maxillary and teeth of *Hylonomus aciedentatus*.
Fig. 7*a*. Impression and remains of the dentary bone of the lower jaw of *Hylonomus aciedentatus*, and of a scute, three times magnified.
Fig. 8. Part of the dentary bone of a young, or small kind of *Hylonomus*, three times magnified.
Fig. 9. The anterior end of a jaw-bone of *Hylonomus*, twice nat. size.
Fig. 10. Bones of the fore limb of *Hylonomus*, three times magnified.
Fig. 11. Bones of a foot of *Hylonomus Wymanni*, twice nat. size.
Fig. 12. Series of (caudal?) vertebræ of *Hylonomus Wymanni*, twice nat. size.
Fig. 13. Rib (*a*) and two scutes (*b* and *c*) of *Hylonomus*, twice nat. size.
Fig. 14. Right dentary part of lower jaw of *Hylonomus Lyelli*, twice nat. size.
Fig. 15. Part of the upper jaw and teeth of a *Hylonomus*, three times magnified.
Fig. 16. Parts of upper and lower jaws of *Hylerpeton Dawsoni*, nat. size.
Fig. 17. Small part of jaw of *Hylerpeton*, showing the mode of implantation of the teeth; twice nat. size.
Fig. 18. A group of the scutes of *Hylerpeton* (?); twice magnified.

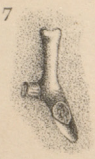
Plate X.

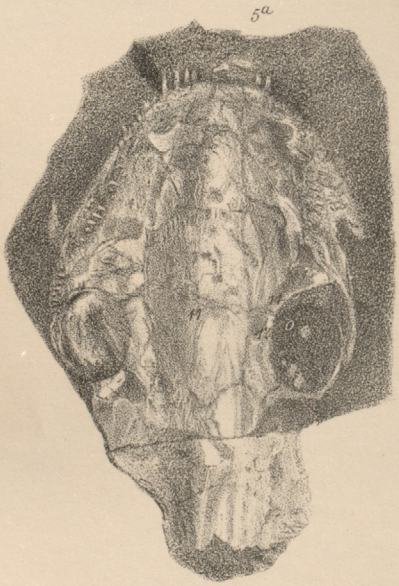
Figs. 1 & 2. Dermal scutes and markings of the skin of *Hylonomus*?
Fig. 3. Portion of the frontal and contiguous cranial bones of a *Hylonomus*, twice nat. size.
Fig. 4. Part of the lower jaw of apparently the same species of *Hylonomus*.
Fig. 5 *a*. Inner surface of upper part of the skull of *Dendrerpeton Acadianum*, nat. size. 5 *b*, magnified section of base of tooth.
Fig. 6. Outer surface of supertemporal bone of *Dendrerpeton Acadianum*, twice nat. size.
Fig. 7. Ilium and parts of pubis and ischium of *Dendrerpeton Acadianum*.

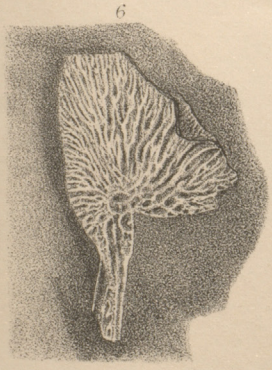
REPTILIAN REMAINS FROM NOVA SCOTIA.

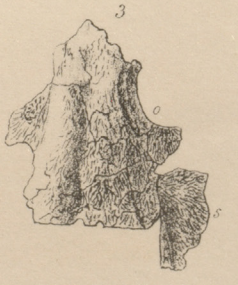












J. Dinkel lith. W. West imp.

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DESCRIPTION OF SPECIMENS

OF

FOSSIL REPTILIA

DISCOVERED IN THE COAL-MEASURES

OF THE

SOUTH JOGGINS, NOVA SCOTIA,

By Dr. J. W. DAWSON, F.G.S., &c.

By PROFESSOR OWEN, F.R.S., F.G.S.

Plates IX. & X.

[*From the* Quarterly Journal *of the* Geological Society *for August* 1862.]

LONDON:

PRINTED BY TAYLOR AND FRANCIS,

RED LION COURT, FLEET STREET.

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A second portion of coal-shale, in box No. 2 (marked 5 *a*), contains the impression, with a small portion of one end, of a dentary bone of the lower jaw, which held a series of at least 40 teeth (Pl. IX. fig. 7*a*). These, in size and proportion, agree with those of *Hylonomus Lyelli*, in No. 1. The teeth very gradually decrease from the middle to the two ends, especially to the anterior one. In the number, proportions, and close arrangement of the teeth, this dentary bone agrees with that of the *Archegosaurus*. Lizards have not so many teeth.

A third portion of coal (5 *a*), in box No. 2, contained the slender-pointed end of a jaw-bone, with a close-set series of about 25 teeth in an extent of 13 millimeters, or 6½ lines (Pl. IX. fig. 9). These teeth

longitudinally fissured, but the fissures do not extend upon the exserted crown. In their general characters, the teeth manifest at least as close a resemblance to those of *Ganocephala* as of *Lacertia* or any higher group of *Reptilia*; whilst their mode of implantation, with the structure and sculpturing of the bone, weigh in favour of its relations to the lower and earlier order of the cold-blooded Vertebrates.

"No. 5.—Skin and dermal plates of *Hylonomus* (?), probably *H. Lyelli*."

The specimen so marked shows three oblong plates (Pl. X. *a*, *b*, *c*, fig. 2), with a slightly concave surface, finely striate transversely, and with one margin free, obtuse, and well defined. Continuous with this is a granulate surface, like shagreen, of small, close-set, subelliptic scales or tubercles (*d*).

Another portion of coal-shale shows a layer, and an impression of a continuous part of the same layer, of integument (Pl. X. fig. 1) which has been defended by similar small and subimbricate scales. From their state of preservation, these were probably bony or ganoid. I do not know the evidence in proof of their belonging to *Hylonomus*.

Pl. X. fig. 3 is a portion of the bones of the cranium, including the frontal and parts of the prefrontal, postfrontal, parietal, postorbital, and supertemporal bones of probably a *Hylonomus*. They show the skull to have been broad and much depressed: the superorbital border (*o*) is formed by the pre- and post-frontals. In most of the bones, and especially the supertemporal plate, *s*, the outer surface is sculptured according to the pattern shown in the skull of *Archegosaurus*.

Pl. X. fig. 4 is a portion of a jaw, with small equal teeth having the characters of those of *Hylonomus*, and with a sculptured external surface like that in Pl. X. fig. 3 and in Pl. IX. fig. 15.

Passing over the interesting examples of probably the food of the small reptiles, shown in No. 5 (*Pupa vetusta*, Dawson) and No. 7 (*Xylobius sigillarius*, Dawson), I come to

"No. 8. Loose specimens of *Dendrerpeton Acadianum*, Ow. (a nearly complete skeleton)."

The chief addition to the evidence already recorded of the characters of this reptile* are, 1st, the incompletely ossified conditions of the endoskeleton, manifested even in the slender ribs, which have their cavities filled with matrix, as formerly with the primitive cartilage; 2nd, the shape of the head (Pl. X. fig. 5 *a*); 3rd, the superficial markings of the cranial bones (fig. 6) and scutes; 4th, the batrachian type of the ilium, and probably of the pelvis, fig. 7.

The skull (Pl. X. fig. 5 *a*) is broad, depressed, obtusely rounded anteriorly, rather Labyrinthodontal than Archegosaural in shape; although, in the species of both these early types of batrachian air-

* Quart. Journ. Geol. Soc. vol. ix. p. 64, &c.

breathers, there is such a known range of variation as to detract from the value of the character of the degree of obtuseness of the muzzle. Unfortunately, the occipital part of the skull, which would have afforded the test of the mode of its articulation with the atlas, is wanting. The Labyrinthodonts have a pair of condyles, as in *Rana*: the *Ganocephala*, like *Lepidosiren*, show no bony joint between the basi-occipital and atlas.

The under surface of the bones forming the roof of the skull is exposed in this specimen. As in *Archegosaurus* and *Hylonomus*, the frontal (11) is separated from the orbital border (0, 0) by the union of the post- (12) and pre- (14) frontals. The temporal fossæ were roofed over with bone; and these cranial bones show their external surface, fig. 6, to be sculptured with the beautiful and characteristic pattern exhibited in the supertemporal plate of the specimen of *Hylonomus*, fig. 3. This pattern may be seen on the cranial bones of some ganoid fishes, and on those of *Archegosaurus* and *Labyrinthodon*. The orbits in *Dendrerpeton* are circular, divided by a bony tract of more than their own diameter: they seem to have been midway between the two ends of the skull; but the hinder part of this is not complete in the specimen. The small nostrils are not midway between the orbits and the muzzle, but nearer the latter. The few teeth preserved at this part of the skull show the plication of the base due to the entering folds of the cement, and yield, on a transverse section (fig. 5 *b*), the same approach to the labyrinthic character as in *Archegosaurus*. Their bases are confluent with the alveolar depressions: there are no tusks as in *Labyrinthodon*.

A short straight bone, uniting with two other divergent ones, appears to be the ilium; and I regard the specimen Pl. X. fig. 7 as part of the pelvis of *Dendrerpeton*: the ossified part of each of these bones is a thin outer crust. The ilium, by its shortness and straight subcylindrical rib-like form, agrees with that in *Archegosaurus* and in modern Perennibranchiate reptiles. In *Labyrinthodon* the ilium expands in some measure according to the Crocodilian type of the bone.

The short proportions and simplicity of shape and structure of the limb-bones combine, with the above-mentioned characters, to demonstrate the Ganocephalous nature of this Nova-Scotian reptile of the Coal-period.

Dendrerpeton, like *Hylonomus* and *Archegosaurus*, shows the affinity (shall we call it?) or analogy to the ganoid fishes, not only in the character of the cranial bones, but in the retention of a covering of the body by ganoid scales: these are elliptic, smooth on their inner surface, with a slight indication of a ridge, about half the length of the scale, on the external surface,—at least, in certain of the scales, and probably those along the back.

The genus *Hylonomus* also, although with more minute and simple teeth, had the skin defended by similar elliptic or suboval ganoid scales. Much remains to be determined as to the structure of the skull: nevertheless such cranial bones as have been obtained (Pl. X. figs. 3, & 5*a*, 6) exemplify the Ganocephalous sculpturing; while the arrested state of ossification of the endoskeleton and the characters

of the limb-bones sustain the reference of the genus to the order *Ganocephala*.

After careful scrutiny of all the specimens confided to my inspection by Dr. Dawson, I have not met with decisive evidence of a member of any of the orders of *Reptilia* represented by species of the Oolitic or later series of deposits. Some, as (*e. g.*) *Baphetes*, may be Labyrinthodont, but the rest are Ganocephalous; and *Baphetes* may possibly belong to this lower group of palæozoic air-breathing Vertebrates.

DESCRIPTION OF THE PLATES.

Plate IX.

Fig. 1. *Hylonomus Lyelli*, dorsal vertebra, three times magnified: side view.
Fig. 2. ————————, dorsal vertebra, three times magnified: transverse section.
Fig. 3. ————————, one of the longer ribs, twice nat. size; the end showing the hollow.
Fig. 4. ————————, metapodial and phalangial bones, twice nat. size.
Fig. 5. ————————, upper maxillary and part of orbit, twice nat. size.
Fig. 6. Part of upper maxillary and teeth of *Hylonomus aciedentatus*.
Fig. 7*a*. Impression and remains of the dentary bone of the lower jaw of *Hylonomus aciedentatus*, and of a scute, three times magnified.
Fig. 8. Part of the dentary bone of a young, or small kind of *Hylonomus*, three times magnified.
Fig. 9. The anterior end of a jaw-bone of *Hylonomus*, twice nat. size.
Fig. 10. Bones of the fore limb of *Hylonomus*, three times magnified.
Fig. 11. Bones of a foot of *Hylonomus Wymanni*, twice nat. size.
Fig. 12. Series of (caudal?) vertebræ of *Hylonomus Wymanni*, twice nat. size
Fig. 13. Rib (*a*) and two scutes (*b* and *c*) of *Hylonomus*, twice nat. size.
Fig. 14. Right dentary part of lower jaw of *Hylonomus Lyelli*, twice nat. size.
Fig. 15. Part of the upper jaw and teeth of a *Hylonomus*, three times magnified.
Fig. 16. Parts of upper and lower jaws of *Hylerpeton Dawsoni*, nat. size.
Fig. 17. Small part of jaw of *Hylerpeton*, showing the mode of implantation of the teeth; twice nat. size.
Fig. 18. A group of the scutes of *Hylerpeton* (?); twice magnified.

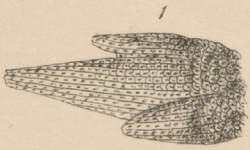
Plate X.

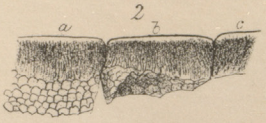
Figs. 1 & 2. Dermal scutes and markings of the skin of *Hylonomus*?
Fig. 3. Portion of the frontal and contiguous cranial bones of a *Hylonomus*, twice nat. size.
Fig. 4. Part of the lower jaw of apparently the same species of *Hylonomus*.
Fig. 5 *a*. Inner surface of upper part of the skull of *Dendrerpeton Acadianum*, nat. size. 5 *b*, magnified section of base of tooth.
Fig. 6. Outer surface of supertemporal bone of *Dendrerpeton Acadianum*, twice nat. size.
Fig. 7. Ilium and parts of pubis and ischium of *Dendrerpeton Acadianum*.

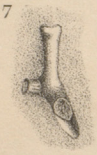
J. Dinkel lith.

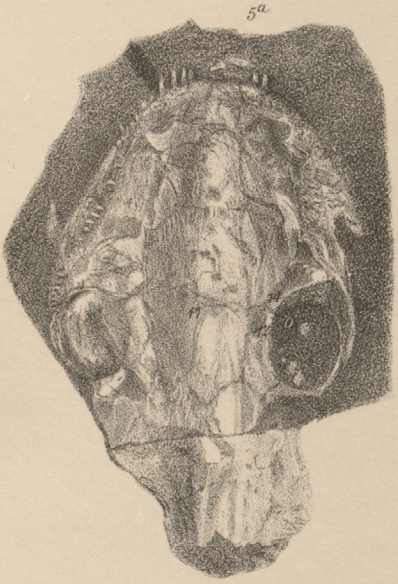
W. West imp.

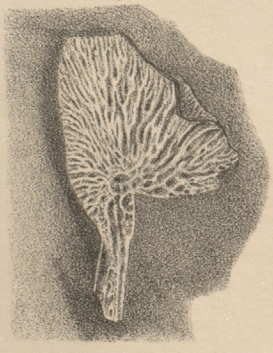
REPTILIAN REMAINS FROM NOVA SCOTIA.

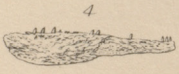


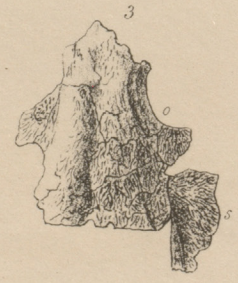












J. Dinkel lith. W. West imp.

REPTILIAN REMAINS FROM NOVA SCOTIA.

"Fossil Reptilia ... S. Joggins ..."

1862

ERRATA.

Page 239—"Box No. 2"—Paragraph first should be transposed to the beginning of "Box No. 1." It refers to a specimen of the maxillary bone of *Hylonomus Lyelli*.

Page 241—The specimens referred to in paragraphs second and third were accidentally misplaced in Box No. 3. The first is a jaw of *Hylonomus Lyelli*. The second belongs to *Dendrerpeton*. The jaw of the *H. Wymani* is that figured in Pl. IX. Fig. 8, and not mentioned in the text.

Page 244—"Fig. 6," for "*Aciedentatus*" read "*Lyelli*."

"Fig. 8," after "*Hylonomus*" read "*Wymani*," and omit "a young or small kind of."

"Fig. 9," after "*Hylonomus*" read "*aciedentatus*."

"Fig. 15," for "*Hylonomus*" read "*Dendrerpeton*."

The above errors were caused by accidental intermixture of the specimens before they reached Prof. Owen, and were not detected until after the printing of these sheets.

DESCRIPTION OF SPECIMENS

OF

FOSSIL REPTILIA

DISCOVERED IN THE COAL-MEASURES

OF THE

SOUTH JOGGINS, NOVA SCOTIA,

By Dr. J. W. DAWSON, F.G.S., &c.

By PROFESSOR OWEN, F.R.S., F.G.S.

Plates IX. & X.

[*From the* Quarterly Journal *of the* Geological Society *for August* 1862.]

LONDON:

PRINTED BY TAYLOR AND FRANCIS,

RED LION COURT, FLEET STREET.

1862.

The following specimens were transmitted to the Museum of the Geological Society by Dr. Dawson, in a series of boxes and parcels, most of which are numbered according to a list accompanying them, and have been submitted, by his desire, to my inspection. The descriptions will follow in the order of that list.

"Box No. 1.—*Hylonomus Lyelli*, Dawson."

This specimen is imbedded in a portion of a thin layer of carbonaceous matter, measuring six inches by four inches. It consists of scattered parts and impressions of vertebræ, ribs, limb-bones, and part of a cranium crushed, including part of a maxillary bone with teeth (Pl. IX. figs. 1–5). Not any of the bones are entire: all the long bones, even the ribs, are hollow; and the cavity is enclosed by a compact wall of almost uniform thinness throughout each bone, indicative that such cavity was not properly a medullary one, in the sense of having been excavated by absorption after complete consolidation of the bone by the ossifying process, but was posthumous, and due to the solution of the primitive cartilaginous mould of the bone, which had remained unchanged by ossification in the living species. I conclude, therefore, that these hollow long bones (and, indeed, the bodies of the vertebræ seem only to have received a partial and superficial crust of bone) were originally solid, and composed, like the bones in most *Batrachia*, especially the Perennibranchiates, of an external osseous crust, enclosing solid cartilage. The body of the vertebra (figs. 1 & 2) is chiefly represented by a downward growth of the base of the neural arch (*n*); and in the best-preserved specimen there seems to be a distinct inferior plate (*c*), with a median longitudinal channel on the lower surface,—such vertebræ belonging to the dorsal region: the cylindrical cavity of the centrum was doubtless occupied by the notochord. The neural arch developes a short, broad diapophys is (*d*), to which the rib articulates: it also has zygapophyses both before (*z*) and behind (*z'*), and a moderately long truncate spine (*n s*), slightly expanding in the fore-and-aft direction to its summit. The ribs are of various lengths, the shorter ones straight, the longer ones slightly bent; the best-preserved of these have an expanded end, slightly notched (fig. 3), but none show a distinctly bifurcate extremity. Those limb-bones, metapodials or phalanges, which have their articular end preserved, show it to be flattened (fig. 4),—not fashioned for a condyloid or trochlear joint with articular cartilage and synovial membrane, but adapted for a simple ligamentous union, as in the digits of the Salamanders, Turtles, *Amphiume*, and *Proteus*. One end of some of these bones shows a short longitudinal impression at the middle. The surface of some of the larger long bones shows longitudinal striation, indicative of a fibrous structure like that of the bones in some fishes. The maxillary fragment in the slab,

No. 1, which Dr. Dawson supposes to belong to another individual of *Hylonomus*, is figured of twice the natural size in Pl. IX. fig. 5. The bone, in respect to its proportions as to length and depth, to the number, size, and shape of the teeth it contains, and to the indications of sculpturing of the outer surface, resembles the maxillary and dentary bones of *Archegosaurus*. A series of twenty-four teeth occupies a part of the alveolar border, *a*, 6 millimeters (nearly 3 lines) in extent; but impressions and fragmentary traces of others beyond show that there were at least 40 teeth in a row on one side of the upper jaw. There is an indication of the lower border of the orbit *o*, above the hinder third of this series. The teeth increase gradually in length as they approach this part; their crowns are slender, subcompressed transversely, pointed, but not sharply, with evidence of alternate shedding. They are partially anchylosed to shallow alveolar depressions on the border, towards the inner side, of the jaw-bone. Their enamelled surface is smooth, and shows a whiter colour than the bone itself.

"Box No. 2.—*Hylonomus aciedentatus*, Dawson."

This contains two portions of shaly carbonaceous matter. In one is imbedded the major part of a maxillary bone (Pl. IX. fig. 6), with the inner side exposed, which is smooth, and demonstrates the fixation of the teeth not to be as in the pleurodont lizard, but according to the acrodont type; the sockets, however, are shallow, and the simple bases of the teeth are partially anchylosed thereto, as in *Archegosaurus* and *Labyrinthodon*, and that of the largest tooth (being exposed by removal of the inner alveolar wall) shows the fossa due to the matrix of the successional tooth. The teeth are not so bent as to indicate which is the front or which the hind end of this maxillary bone. The teeth are the smallest at both ends, gradually increasing as they recede from one end, and rapidly from the other, near to which are four or five teeth, four times the length of the terminal ones of the series. I suspect this to be the fore part of the bone. The proportions and shape of the crown are much as in the *Hylonomus Lyelli*; but there seems to be a greater variety of length in the teeth of *Hylonomus aciedentatus*. In both species the dentition indicates a small insectivorous or vermivorous reptile.

A second portion of coal-shale, in box No. 2 (marked 5 *a*), contains the impression, with a small portion of one end, of a dentary bone of the lower jaw, which held a series of at least 40 teeth (Pl. IX. fig. 7*a*). These, in size and proportion, agree with those of *Hylonomus Lyelli*, in No. 1. The teeth very gradually decrease from the middle to the two ends, especially to the anterior one. In the number, proportions, and close arrangement of the teeth, this dentary bone agrees with that of the *Archegosaurus*. Lizards have not so many teeth.

A third portion of coal (5 *a*), in box No. 2, contained the slender-pointed end of a jaw-bone, with a close-set series of about 25 teeth in an extent of 13 millimeters, or 6½ lines (Pl. IX. fig. 9). These teeth

increase from the pointed end of the bone to about the tenth tooth, and thence continue with little difference of size: the crown expands slightly beyond the implanted base, before narrowing to the rather blunt-pointed end. The outer surface of the jaw-bone shows a striated or strio-punctate pattern of sculpture.

A fourth portion (5 *b*) included parts of the bones of a short natatory fore limb (Pl. IX. fig. 10). The humerus (*h*) has an expanded proximal end, with three ridges, two of them more extended than the other; the shaft of the bone is rather bent. This bone has been dislocated from the radius (*r*) and ulna (*n*), beyond which are evidences of three, if not four, digits; these progressively increase in length to the fourth (*iv*), of which, and of the third, impressions and parts of three successive phalanges are shown. These are slightly expanded at their flattened articular ends, at which the longitudinal impressions may be seen in two instances; but the joints were syndesmotic, as in *Archegosaurus* and modern aquatic batrachian reptiles; and the humerus and antebrachium are short in proportion to the manus, although not to such a degree as in *Archegosaurus*.

The group of dermal scutes includes some (Pl. IX. fig. 13 *b*,*c*) which are nearly perfect, of an oval form, smooth on the inner surface, with a low longitudinal ridge, half the length of the scute, on the outer surface; the external layer is of ganoid hardness; the internal structure is cellular. They indicate the nature of the covering of one of the species of *Hylonomus*.

"Box No. 3.—*Hylonomus Wymanni*, Dawson."

The remains of foot-bones (Pl. IX. fig. 11) in one of the portions of coal-shale in this box show a tridactyle structure, with more slender proportions than in the *Hylonomus aciedentatus*; but the phalanges have the same flat joints and incomplete ossification, a thin external crust of bone enclosing a cavity which had been occupied by cartilage: they much resemble the phalanges of the Axolotl.

A second portion contains a series of six or seven crushed neural arches of vertebræ (Pl. IX. fig. 12), of a length twice their breadth, with horizontal zygapophyses—the spines probably broken away. In the proportion of length to breadth, these vertebræ resemble those of *Proteus**. There is no evidence of an ossified centrum in any part of this series; but there are some elongated vacuities, which seem to represent the unossified parts of centrums, partially cased by thin bone. The impressions, with filmy remains of bones of a second series of six vertebræ, of similar slender proportions, are preserved in the same portion of coal.

Pl. IX. fig. 13 *a* represents one of the largest specimens of a rib, partly in bone, partly in impression, with an expanded, slightly notched head, as in the ribs of the Axolotl, but of greater length and more curved than in any modern naked Batrachian: it is hollow, as in the shorter specimens, with a thin outer crust.

* Cuvier, Ossemens Fossiles, v. pt. ii. pl. xxvii. fig. 14.

Near the specimen, and near the jaw of *Hylonomus* (fig. 7*a*), are specimens of the dermal scutes. They are oval, flattened, smooth and slightly concave on the inner side, with parallel curved striations on the outer surface.

Pl. IX. fig. 14 is the dentary bone, with very small, equal, close-set teeth, eleven being in the extent of 2 millimeters; they best accord in character with those of the upper jaw of *Hylonomus Lyelli* (fig. 5), to which species I believe this lower jaw to belong.

Pl. IX. fig. 15 is part of an upper jaw, with teeth less closely arranged, and very small in proportion to the breadth of the bone. It is of a *Hylonomus*, and exhibits on the outer surface of part of the bone the pits and radiating furrows which characterize the outer sculpturing of the skull-bones of *Archegosaurus*.

"Parcel No. 4.—Jaw of a Reptile, supposed to be new."
Hylerpeton Dawsoni, Ow. (Pl. IX. fig. 16).

This specimen consists of the left ramus of a lower jaw, which has been dislocated from the crushed head, of which the fore end of the left premaxillary (*p*) is preserved, terminating near the middle of the series of the teeth of the more advanced mandible. A fragment of the left maxillary (*m*), which has been separated from the premaxillary, overlaps the hinder mandibular teeth. The fore part of the mandible is wanting. The teeth in the remaining part are larger and fewer, in proportion to the jaw-bone, than in *Hylonomus* or *Dendrerpeton*. They have thicker and more obtusely terminated crowns; they are close-set where the series is complete at the fore part of the jaw, and their base appears to have been anchylosed to shallow depressions on the alveolar surface. The shape of what is preserved of the upper jaw affords the only evidence, and not very decisively, that the present fossil is not part of a fish. It inclines the balance, however, to the reptilian side; and, accepting such indication of the class-relations of the fossil, it must be referred to a genus of *Reptilia* distinct from those it is associated with in the Nova-Scotian coal, and for which genus I would suggest the term *Hylerpeton*.

A small part of the external surface of the dentary bone shows a longitudinally wrinkled and striate or fibrous character. The outer bony wall, broken away from the hinder half of the dentary, shows a large cavity, now occupied by a fine greyish matrix (*x*), with a smooth surface, the bony wall of which cavity has been thin and compact. We have here the mark of incomplete ossification, like that in the skeleton of *Archegosaurus*. The crushed fore part of the right dentary bone, with remains of a few teeth, is below the left dentary, and exemplifies a similar structure. The teeth slightly diminish, though more in breadth than length, towards the fore part of the series: here there are nine teeth in an alveolar extent of 10 millimeters, or nearly 5 lines. The portion of jaw, figured of twice the natural size, in fig. 17, shows the anchylosis of the base of the teeth in a shallow groove or alveolus: the base of the teeth is

longitudinally fissured, but the fissures do not extend upon the exserted crown. In their general characters, the teeth manifest at least as close a resemblance to those of *Ganocephala* as of *Lacertia* or any higher group of *Reptilia*; whilst their mode of implantation, with the structure and sculpturing of the bone, weigh in favour of its relations to the lower and earlier order of the cold-blooded Vertebrates.

"No. 5.—Skin and dermal plates of *Hylonomus* (?), probably *H. Lyelli*."

The specimen so marked shows three oblong plates (Pl. X. *a*, *b*, *c*, fig. 2), with a slightly concave surface, finely striate transversely, and with one margin free, obtuse, and well defined. Continuous with this is a granulate surface, like shagreen, of small, close-set, subelliptic scales or tubercles (*d*).

Another portion of coal-shale shows a layer, and an impression of a continuous part of the same layer, of integument (Pl. X. fig. 1) which has been defended by similar small and subimbricate scales. From their state of preservation, these were probably bony or ganoid. I do not know the evidence in proof of their belonging to *Hylonomus*.

Pl. X. fig. 3 is a portion of the bones of the cranium, including the frontal and parts of the prefrontal, postfrontal, parietal, postorbital, and supertemporal bones of probably a *Hylonomus*. They show the skull to have been broad and much depressed: the superorbital border (*o*) is formed by the pre- and post-frontals. In most of the bones, and especially the supertemporal plate, *s*, the outer surface is sculptured according to the pattern shown in the skull of *Archegosaurus*.

Pl. X. fig. 4 is a portion of a jaw, with small equal teeth having the characters of those of *Hylonomus*, and with a sculptured external surface like that in Pl. X. fig. 3 and in Pl. IX. fig. 15.

Passing over the interesting examples of probably the food of the small reptiles, shown in No. 5 (*Pupa vetusta*, Dawson) and No. 7 (*Xylobius sigillarius*, Dawson), I come to

"No. 8. Loose specimens of *Dendrerpeton Acadianum*, Ow. (a nearly complete skeleton)."

The chief addition to the evidence already recorded of the characters of this reptile* are, 1st, the incompletely ossified conditions of the endoskeleton, manifested even in the slender ribs, which have their cavities filled with matrix, as formerly with the primitive cartilage; 2nd, the shape of the head (Pl. X. fig. 5 *a*); 3rd, the superficial markings of the cranial bones (fig. 6) and scutes; 4th, the batrachian type of the ilium, and probably of the pelvis, fig. 7.

The skull (Pl. X. fig. 5 *a*) is broad, depressed, obtusely rounded anteriorly, rather Labyrinthodontal than Archegosaural in shape; although, in the species of both these early types of batrachian air-

* Quart. Journ. Geol. Soc. vol. ix. p. 64, &c.

breathers, there is such a known range of variation as to detract from the value of the character of the degree of obtuseness of the muzzle. Unfortunately, the occipital part of the skull, which would have afforded the test of the mode of its articulation with the atlas, is wanting. The Labyrinthodonts have a pair of condyles, as in *Rana*: the *Ganocephala*, like *Lepidosiren*, show no bony joint between the basi-occipital and atlas.

The under surface of the bones forming the roof of the skull is exposed in this specimen. As in *Archegosaurus* and *Hylonomus*, the frontal (11) is separated from the orbital border (o, o) by the union of the post- (12) and pre- (14) frontals. The temporal fossæ were roofed over with bone; and these cranial bones show their external surface, fig. 6, to be sculptured with the beautiful and characteristic pattern exhibited in the supertemporal plate of the specimen of *Hylonomus*, fig. 3. This pattern may be seen on the cranial bones of some ganoid fishes, and on those of *Archegosaurus* and *Labyrinthodon*. The orbits in *Dendrerpeton* are circular, divided by a bony tract of more than their own diameter: they seem to have been midway between the two ends of the skull; but the hinder part of this is not complete in the specimen. The small nostrils are not midway between the orbits and the muzzle, but nearer the latter. The few teeth preserved at this part of the skull show the plication of the base due to the entering folds of the cement, and yield, on a transverse section (fig. 5 *b*), the same approach to the labyrinthic character as in *Archegosaurus*. Their bases are confluent with the alveolar depressions: there are no tusks as in *Labyrinthodon*.

A short straight bone, uniting with two other divergent ones, appears to be the ilium; and I regard the specimen Pl. X. fig. 7 as part of the pelvis of *Dendrerpeton*: the ossified part of each of these bones is a thin outer crust. The ilium, by its shortness and straight subcylindrical rib-like form, agrees with that in *Archegosaurus* and in modern Perennibranchiate reptiles. In *Labyrinthodon* the ilium expands in some measure according to the Crocodilian type of the bone.

The short proportions and simplicity of shape and structure of the limb-bones combine, with the above-mentioned characters, to demonstrate the Ganocephalous nature of this Nova-Scotian reptile of the Coal-period.

Dendrerpeton, like *Hylonomus* and *Archegosaurus*, shows the affinity (shall we call it?) or analogy to the ganoid fishes, not only in the character of the cranial bones, but in the retention of a covering of the body by ganoid scales: these are elliptic, smooth on their inner surface, with a slight indication of a ridge, about half the length of the scale, on the external surface,—at least, in certain of the scales, and probably those along the back.

The genus *Hylonomus* also, although with more minute and simple teeth, had the skin defended by similar elliptic or suboval ganoid scales. Much remains to be determined as to the structure of the skull: nevertheless such cranial bones as have been obtained (Pl. X. figs. 3, & 5*a*, 6) exemplify the Ganocephalous sculpturing; while the arrested state of ossification of the endoskeleton and the characters

of the limb-bones sustain the reference of the genus to the order *Ganocephala*.

After careful scrutiny of all the specimens confided to my inspection by Dr. Dawson, I have not met with decisive evidence of a member of any of the orders of *Reptilia* represented by species of the Oolitic or later series of deposits. Some, as (*e. g.*) *Baphetes*, may be Labyrinthodont, but the rest are Ganocephalous; and *Baphetes* may possibly belong to this lower group of palæozoic air-breathing Vertebrates.

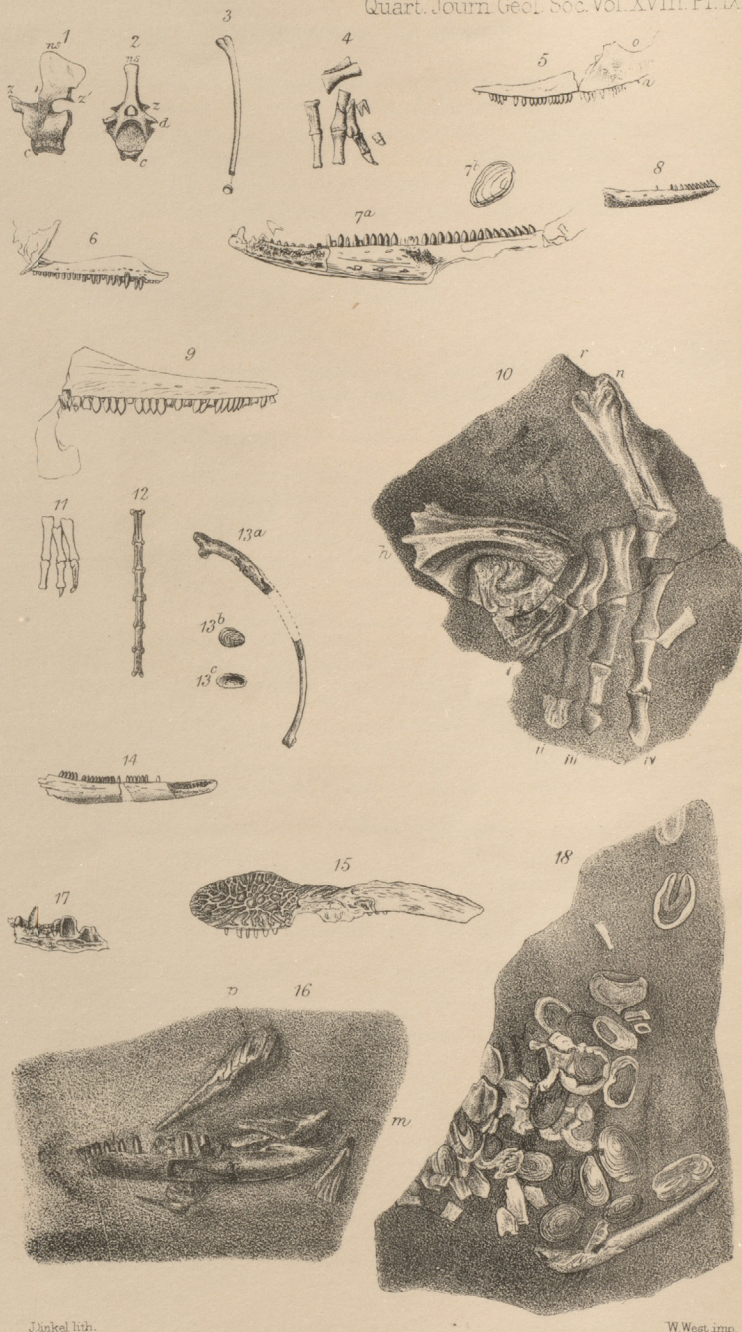
DESCRIPTION OF THE PLATES.

Plate IX.

Fig. 1. *Hylonomus Lyelli*, dorsal vertebra, three times magnified: side view.
Fig. 2. ————————, dorsal vertebra, three times magnified: transverse section.
Fig. 3. ————————, one of the longer ribs, twice nat. size; the end showing the hollow.
Fig. 4. ————————, metapodial and phalangial bones, twice nat. size.
Fig. 5. ————————, upper maxillary and part of orbit, twice nat. size.
Fig. 6. Part of upper maxillary and teeth of *Hylonomus aciedentatus*.
Fig. 7*a*. Impression and remains of the dentary bone of the lower jaw of *Hylonomus aciedentatus*, and of a scute, three times magnified.
Fig. 8. Part of the dentary bone of a young, or small kind of *Hylonomus*, three times magnified.
Fig. 9. The anterior end of a jaw-bone of *Hylonomus*, twice nat. size.
Fig. 10. Bones of the fore limb of *Hylonomus*, three times magnified.
Fig. 11. Bones of a foot of *Hylonomus Wymanni*, twice nat. size.
Fig. 12. Series of (caudal?) vertebræ of *Hylonomus Wymanni*, twice nat. size
Fig. 13. Rib (*a*) and two scutes (*b* and *c*) of *Hylonomus*, twice nat. size.
Fig. 14. Right dentary part of lower jaw of *Hylonomus Lyelli*, twice nat. size.
Fig. 15. Part of the upper jaw and teeth of a *Hylonomus*, three times magnified.
Fig. 16. Parts of upper and lower jaws of *Hylerpeton Dawsoni*, nat. size.
Fig. 17. Small part of jaw of *Hylerpeton*, showing the mode of implantation of the teeth; twice nat. size.
Fig. 18. A group of the scutes of *Hylerpeton* (?); twice magnified.

Plate X.

Figs. 1 & 2. Dermal scutes and markings of the skin of *Hylonomus*?
Fig. 3. Portion of the frontal and contiguous cranial bones of a *Hylonomus*, twice nat. size.
Fig. 4. Part of the lower jaw of apparently the same species of *Hylonomus*.
Fig. 5 *a*. Inner surface of upper part of the skull of *Dendrerpeton Acadianum*, nat. size. 5 *b*, magnified section of base of tooth.
Fig. 6. Outer surface of supertemporal bone of *Dendrerpeton Acadianum*, twice nat. size.
Fig. 7. Ilium and parts of pubis and ischium of *Dendrerpeton Acadianum*.



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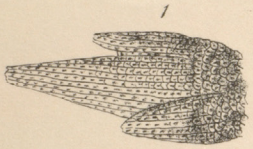
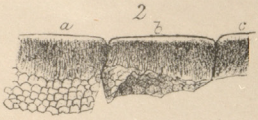
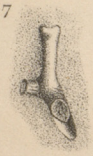
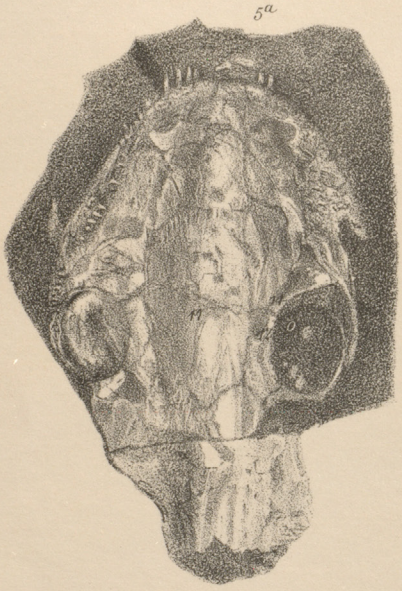
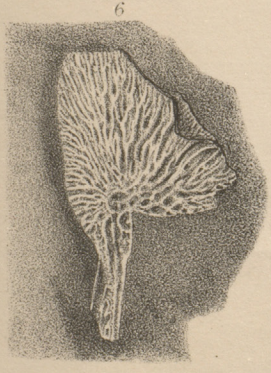
REPTILIAN REMAINS FROM NOVA SCOTIA.

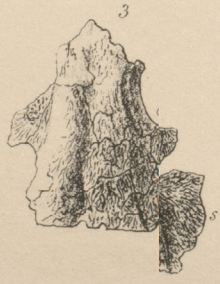












J. Dinkel lith. WWest. imp.

REPTILIAN REMAINS FROM NOVA SCOTIA.

ERRATA.

Page 239—"Box No. 2"—Paragraph first should be transposed to the beginning of "Box No. 1." It refers to a specimen of the maxillary bone of *Hylonomus Lyelli*.

Page 241—The specimens referred to in paragraphs second and third were accidentally misplaced in Box No. 3. The first is a jaw of *Hylonomus Lyelli*. The second belongs to *Dendrerpeton*. The jaw of the *H. Wymani* is that figured in Pl. IX. Fig. 8, and not mentioned in the text.

Page 244—"Fig. 6," for "*Aciedentatus*" read "*Lyelli*."

"Fig. 8," after "*Hylonomus*" read "*Wymani*," and omit "a young or small kind of."

"Fig. 9," after "*Hylonomus*" read "*aciedentatus*."

"Fig. 15," for "*Hylonomus*" read "*Dendrerpeton*."

The above errors were caused by accidental intermixture of the specimens before they reached Prof. Owen, and were not detected until after the printing of these sheets.

The following specimens were transmitted to the Museum of the Geological Society by Dr. Dawson, in a series of boxes and parcels, most of which are numbered according to a list accompanying them, and have been submitted, by his desire, to my inspection. The descriptions will follow in the order of that list.

"Box No. 1.—*Hylonomus Lyelli*, Dawson."

This specimen is imbedded in a portion of a thin layer of carbonaceous matter, measuring six inches by four inches. It consists of scattered parts and impressions of vertebræ, ribs, limb-bones, and part of a cranium crushed, including part of a maxillary bone with teeth (Pl. IX. figs. 1–5). Not any of the bones are entire: all the long bones, even the ribs, are hollow; and the cavity is enclosed by a compact wall of almost uniform thinness throughout each bone, indicative that such cavity was not properly a medullary one, in the sense of having been excavated by absorption after complete consolidation of the bone by the ossifying process, but was posthumous, and due to the solution of the primitive cartilaginous mould of the bone, which had remained unchanged by ossification in the living species. I conclude, therefore, that these hollow long bones (and, indeed, the bodies of the vertebræ seem only to have received a partial and superficial crust of bone) were originally solid, and composed, like the bones in most *Batrachia*, especially the Perennibranchiates, of an external osseous crust, enclosing solid cartilage. The body of the vertebra (figs. 1 & 2) is chiefly represented by a downward growth of the base of the neural arch (*n*); and in the best-preserved specimen there seems to be a distinct inferior plate (*c*), with a median longitudinal channel on the lower surface,—such vertebræ belonging to the dorsal region: the cylindrical cavity of the centrum was doubtless occupied by the notochord. The neural arch developes a short, broad diapophys is (*d*), to which the rib articulates: it also has zygapophyses both before (*z*) and behind (*z'*), and a moderately long truncate spine (*n s*), slightly expanding in the fore-and-aft direction to its summit. The ribs are of various lengths, the shorter ones straight, the longer ones slightly bent; the best-preserved of these have an expanded end, slightly notched (fig. 3), but none show a distinctly bifurcate extremity. Those limb-bones, metapodials or phalanges, which have their articular end preserved, show it to be flattened (fig. 4),—not fashioned for a condyloid or trochlear joint with articular cartilage and synovial membrane, but adapted for a simple ligamentous union, as in the digits of the Salamanders, Turtles, *Amphiume*, and *Proteus*. One end of some of these bones shows a short longitudinal impression at the middle. The surface of some of the larger long bones shows longitudinal striation, indicative of a fibrous structure like that of the bones in some fishes. The maxillary fragment in the slab,

No. 1, which Dr. Dawson supposes to belong to another individual of *Hylonomus*, is figured of twice the natural size in Pl. IX. fig. 5. The bone, in respect to its proportions as to length and depth, to the number, size, and shape of the teeth it contains, and to the indications of sculpturing of the outer surface, resembles the maxillary and dentary bones of *Archegosaurus*. A series of twenty-four teeth occupies a part of the alveolar border, *a*, 6 millimeters (nearly 3 lines) in extent; but impressions and fragmentary traces of others beyond show that there were at least 40 teeth in a row on one side of the upper jaw. There is an indication of the lower border of the orbit *o*, above the hinder third of this series. The teeth increase gradually in length as they approach this part; their crowns are slender, subcompressed transversely, pointed, but not sharply, with evidence of alternate shedding. They are partially anchylosed to shallow alveolar depressions on the border, towards the inner side, of the jaw-bone. Their enamelled surface is smooth, and shows a whiter colour than the bone itself.

"Box No. 2.—*Hylonomus aciedentatus*, Dawson."

This contains two portions of shaly carbonaceous matter. In one is imbedded the major part of a maxillary bone (Pl. IX. fig. 6), with the inner side exposed, which is smooth, and demonstrates the fixation of the teeth not to be as in the pleurodont lizard, but according to the aerodont type; the sockets, however, are shallow, and the simple bases of the teeth are partially anchylosed thereto, as in *Archegosaurus* and *Labyrinthodon*, and that of the largest tooth (being exposed by removal of the inner alveolar wall) shows the fossa due to the matrix of the successional tooth. The teeth are not so bent as to indicate which is the front or which the hind end of this maxillary bone. The teeth are the smallest at both ends, gradually increasing as they recede from one end, and rapidly from the other, near to which are four or five teeth, four times the length of the terminal ones of the series. I suspect this to be the fore part of the bone. The proportions and shape of the crown are much as in the *Hylonomus Lyelli*; but there seems to be a greater variety of length in the teeth of *Hylonomus aciedentatus*. In both species the dentition indicates a small insectivorous or vermivorous reptile.

A second portion of coal-shale, in box No. 2 (marked 5 *a*), contains the impression, with a small portion of one end, of a dentary bone of the lower jaw, which held a series of at least 40 teeth (Pl. IX. fig. 7*a*). These, in size and proportion, agree with those of *Hylonomus Lyelli*, in No. 1. The teeth very gradually decrease from the middle to the two ends, especially to the anterior one. In the number, proportions, and close arrangement of the teeth, this dentary bone agrees with that of the *Archegosaurus*. Lizards have not so many teeth.

A third portion of coal (5 *a*), in box No. 2, contained the slender-pointed end of a jaw-bone, with a close-set series of about 25 teeth in an extent of 13 millimeters, or 6½ lines (Pl. IX. fig. 9). These teeth

increase from the pointed end of the bone to about the tenth tooth, and thence continue with little difference of size: the crown expands slightly beyond the implanted base, before narrowing to the rather blunt-pointed end. The outer surface of the jaw-bone shows a striated or strio-punctate pattern of sculpture.

A fourth portion (5 *b*) included parts of the bones of a short natatory fore limb (Pl. IX. fig. 10). The humerus (*h*) has an expanded proximal end, with three ridges, two of them more extended than the other; the shaft of the bone is rather bent. This bone has been dislocated from the radius (*r*) and ulna (*n*), beyond which are evidences of three, if not four, digits; these progressively increase in length to the fourth (*iv*), of which, and of the third, impressions and parts of three successive phalanges are shown. These are slightly expanded at their flattened articular ends, at which the longitudinal impressions may be seen in two instances; but the joints were syndesmotic, as in *Archegosaurus* and modern aquatic batrachian reptiles; and the humerus and antebrachium are short in proportion to the manus, although not to such a degree as in *Archegosaurus*.

The group of dermal scutes includes some (Pl. IX. fig. 13 *b*,*c*) which are nearly perfect, of an oval form, smooth on the inner surface, with a low longitudinal ridge, half the length of the scute, on the outer surface; the external layer is of ganoid hardness; the internal structure is cellular. They indicate the nature of the covering of one of the species of *Hylonomus*.

"Box No. 3.—*Hylonomus Wymanni*, Dawson."

The remains of foot-bones (Pl. IX. fig. 11) in one of the portions of coal-shale in this box show a tridactyle structure, with more slender proportions than in the *Hylonomus aciedentatus*; but the phalanges have the same flat joints and incomplete ossification, a thin external crust of bone enclosing a cavity which had been occupied by cartilage: they much resemble the phalanges of the Axolotl.

A second portion contains a series of six or seven crushed neural arches of vertebræ (Pl. IX. fig. 12), of a length twice their breadth, with horizontal zygapophyses—the spines probably broken away. In the proportion of length to breadth, these vertebræ resemble those of *Proteus**. There is no evidence of an ossified centrum in any part of this series; but there are some elongated vacuities, which seem to represent the unossified parts of centrums, partially cased by thin bone. The impressions, with filmy remains of bones of a second series of six vertebræ, of similar slender proportions, are preserved in the same portion of coal.

Pl. IX. fig. 13 *a* represents one of the largest specimens of a rib, partly in bone, partly in impression, with an expanded, slightly notched head, as in the ribs of the Axolotl, but of greater length and more curved than in any modern naked Batrachian: it is hollow, as in the shorter specimens, with a thin outer crust.

* Cuvier, Ossemens Fossiles, v. pt. ii. pl. xxvii. fig. 14.

Near the specimen, and near the jaw of *Hylonomus* (fig. 7*a*), are specimens of the dermal scutes. They are oval, flattened, smooth and slightly concave on the inner side, with parallel curved striations on the outer surface.

Pl. IX. fig. 14 is the dentary bone, with very small, equal, close-set teeth, eleven being in the extent of 2 millimeters; they best accord in character with those of the upper jaw of *Hylonomus Lyelli* (fig. 5), to which species I believe this lower jaw to belong.

Pl. IX. fig. 15 is part of an upper jaw, with teeth less closely arranged, and very small in proportion to the breadth of the bone. It is of a *Hylonomus*, and exhibits on the outer surface of part of the bone the pits and radiating furrows which characterize the outer sculpturing of the skull-bones of *Archegosaurus*.

"Parcel No. 4.—Jaw of a Reptile, supposed to be new."
Hylerpeton Dawsoni, Ow. (Pl. IX. fig. 16).

This specimen consists of the left ramus of a lower jaw, which has been dislocated from the crushed head, of which the fore end of the left premaxillary (*p*) is preserved, terminating near the middle of the series of the teeth of the more advanced mandible. A fragment of the left maxillary (*m*), which has been separated from the premaxillary, overlaps the hinder mandibular teeth. The fore part of the mandible is wanting. The teeth in the remaining part are larger and fewer, in proportion to the jaw-bone, than in *Hylonomus* or *Dendrerpeton*. They have thicker and more obtusely terminated crowns; they are close-set where the series is complete at the fore part of the jaw, and their base appears to have been anchylosed to shallow depressions on the alveolar surface. The shape of what is preserved of the upper jaw affords the only evidence, and not very decisively, that the present fossil is not part of a fish. It inclines the balance, however, to the reptilian side; and, accepting such indication of the class-relations of the fossil, it must be referred to a genus of *Reptilia* distinct from those it is associated with in the Nova-Scotian coal, and for which genus I would suggest the term *Hylerpeton*.

A small part of the external surface of the dentary bone shows a longitudinally wrinkled and striate or fibrous character. The outer bony wall, broken away from the hinder half of the dentary, shows a large cavity, now occupied by a fine greyish matrix (*x*), with a smooth surface, the bony wall of which cavity has been thin and compact. We have here the mark of incomplete ossification, like that in the skeleton of *Archegosaurus*. The crushed fore part of the right dentary bone, with remains of a few teeth, is below the left dentary, and exemplifies a similar structure. The teeth slightly diminish, though more in breadth than length, towards the fore part of the series: here there are nine teeth in an alveolar extent of 10 millimeters, or nearly 5 lines. The portion of jaw, figured of twice the natural size, in fig. 17, shows the anchylosis of the base of the teeth in a shallow groove or alveolus: the base of the teeth is

longitudinally fissured, but the fissures do not extend upon the exserted crown. In their general characters, the teeth manifest at least as close a resemblance to those of *Ganocephala* as of *Lacertia* or any higher group of *Reptilia*; whilst their mode of implantation, with the structure and sculpturing of the bone, weigh in favour of its relations to the lower and earlier order of the cold-blooded Vertebrates.

"No. 5.—Skin and dermal plates of *Hylonomus* (?), probably *H. Lyelli*."

The specimen so marked shows three oblong plates (Pl. X. *a*, *b*, *c*, fig. 2), with a slightly concave surface, finely striate transversely, and with one margin free, obtuse, and well defined. Continuous with this is a granulate surface, like shagreen, of small, close-set, subelliptic scales or tubercles (*d*).

Another portion of coal-shale shows a layer, and an impression of a continuous part of the same layer, of integument (Pl. X. fig. 1) which has been defended by similar small and subimbricate scales. From their state of preservation, these were probably bony or ganoid. I do not know the evidence in proof of their belonging to *Hylonomus*.

Pl. X. fig. 3 is a portion of the bones of the cranium, including the frontal and parts of the prefrontal, postfrontal, parietal, postorbital, and supertemporal bones of probably a *Hylonomus*. They show the skull to have been broad and much depressed: the superorbital border (*o*) is formed by the pre- and post-frontals. In most of the bones, and especially the supertemporal plate, *s*, the outer surface is sculptured according to the pattern shown in the skull of *Archegosaurus*.

Pl. X. fig. 4 is a portion of a jaw, with small equal teeth having the characters of those of *Hylonomus*, and with a sculptured external surface like that in Pl. X. fig. 3 and in Pl. IX. fig. 15.

Passing over the interesting examples of probably the food of the small reptiles, shown in No. 5 (*Pupa vetusta*, Dawson) and No. 7 (*Xylobius sigillarius*, Dawson), I come to

"No. 8. Loose specimens of *Dendrerpeton Acadianum*, Ow. (a nearly complete skeleton)."

The chief addition to the evidence already recorded of the characters of this reptile* are, 1st, the incompletely ossified conditions of the endoskeleton, manifested even in the slender ribs, which have their cavities filled with matrix, as formerly with the primitive cartilage; 2nd, the shape of the head (Pl. X. fig. 5 *a*); 3rd, the superficial markings of the cranial bones (fig. 6) and scutes; 4th, the batrachian type of the ilium, and probably of the pelvis, fig. 7.

The skull (Pl. X. fig. 5 *a*) is broad, depressed, obtusely rounded anteriorly, rather Labyrinthodontal than Archegosaural in shape; although, in the species of both these early types of batrachian air-

* Quart. Journ. Geol. Soc. vol. ix. p. 64, &c.

breathers, there is such a known range of variation as to detract from the value of the character of the degree of obtuseness of the muzzle. Unfortunately, the occipital part of the skull, which would have afforded the test of the mode of its articulation with the atlas, is wanting. The Labyrinthodonts have a pair of condyles, as in *Rana*: the *Ganocephala*, like *Lepidosiren*, show no bony joint between the basi-occipital and atlas.

The under surface of the bones forming the roof of the skull is exposed in this specimen. As in *Archegosaurus* and *Hylonomus*, the frontal (11) is separated from the orbital border (0, 0) by the union of the post- (12) and pre- (14) frontals. The temporal fossæ were roofed over with bone; and these cranial bones show their external surface, fig. 6, to be sculptured with the beautiful and characteristic pattern exhibited in the supertemporal plate of the specimen of *Hylonomus*, fig. 3. This pattern may be seen on the cranial bones of some ganoid fishes, and on those of *Archegosaurus* and *Labyrinthodon*. The orbits in *Dendrerpeton* are circular, divided by a bony tract of more than their own diameter: they seem to have been midway between the two ends of the skull; but the hinder part of this is not complete in the specimen. The small nostrils are not midway between the orbits and the muzzle, but nearer the latter. The few teeth preserved at this part of the skull show the plication of the base due to the entering folds of the cement, and yield, on a transverse section (fig. 5 *b*), the same approach to the labyrinthic character as in *Archegosaurus*. Their bases are confluent with the alveolar depressions: there are no tusks as in *Labyrinthodon*.

A short straight bone, uniting with two other divergent ones, appears to be the ilium; and I regard the specimen Pl. X. fig. 7 as part of the pelvis of *Dendrerpeton*: the ossified part of each of these bones is a thin outer crust. The ilium, by its shortness and straight subcylindrical rib-like form, agrees with that in *Archegosaurus* and in modern Perennibranchiate reptiles. In *Labyrinthodon* the ilium expands in some measure according to the Crocodilian type of the bone.

The short proportions and simplicity of shape and structure of the limb-bones combine, with the above-mentioned characters, to demonstrate the Ganocephalous nature of this Nova-Scotian reptile of the Coal-period.

Dendrerpeton, like *Hylonomus* and *Archegosaurus*, shows the affinity (shall we call it?) or analogy to the ganoid fishes, not only in the character of the cranial bones, but in the retention of a covering of the body by ganoid scales: these are elliptic, smooth on their inner surface, with a slight indication of a ridge, about half the length of the scale, on the external surface,—at least, in certain of the scales, and probably those along the back.

The genus *Hylonomus* also, although with more minute and simple teeth, had the skin defended by similar elliptic or suboval ganoid scales. Much remains to be determined as to the structure of the skull: nevertheless such cranial bones as have been obtained (Pl. X. figs. 3, & 5*a*, 6) exemplify the Ganocephalous sculpturing; while the arrested state of ossification of the endoskeleton and the characters

of the limb-bones sustain the reference of the genus to the order *Ganocohala*.

After careful scrutiny of all the specimens confided to my inspection by Dr. Dawson, I have not met with decisive evidence of a member of any of the orders of *Reptilia* represented by species of the Oolitic or later series of deposits. Some, as (*e. g.*) *Baphetes*, may be Labyrinthodont, but the rest are Ganocephalous; and *Baphetes* may possibly belong to this lower group of palæozoic air-breathing Vertebrates.

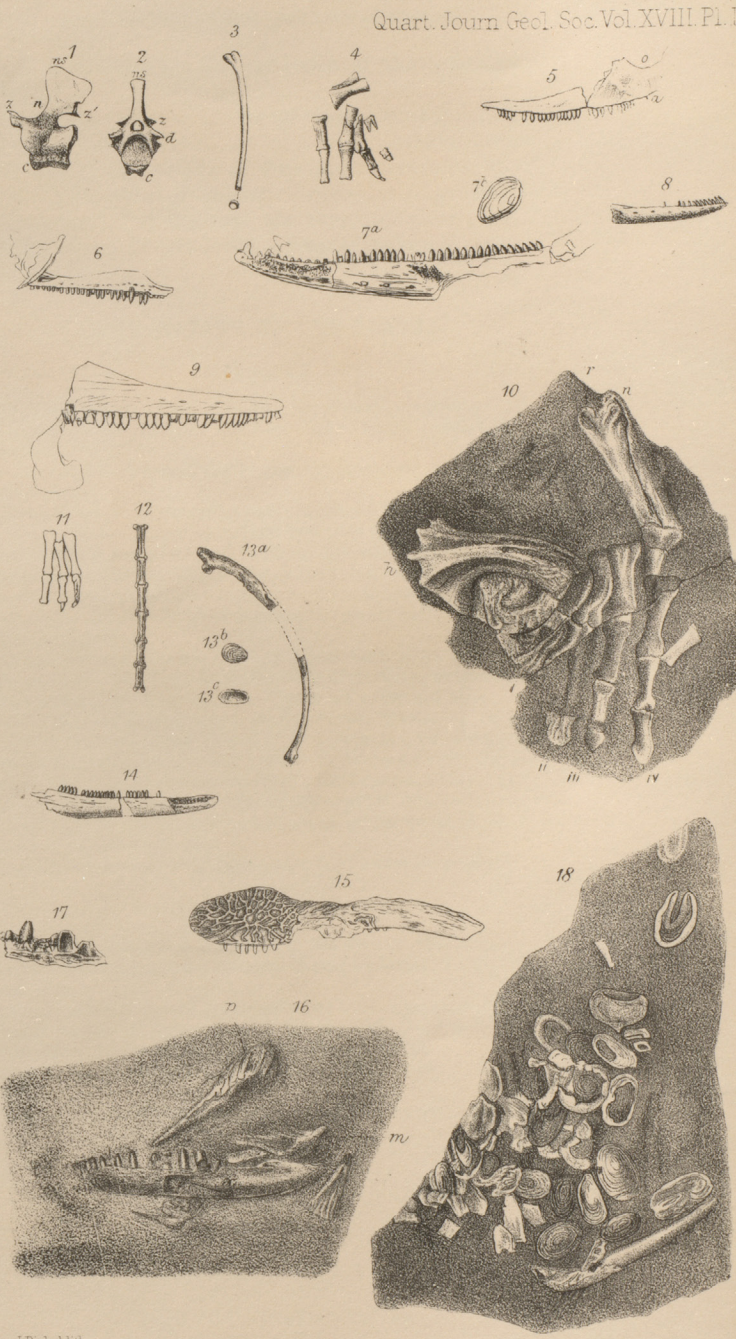
DESCRIPTION OF THE PLATES.

Plate IX.

Fig. 1. *Hylonomus Lyelli*, dorsal vertebra, three times magnified: side view.
Fig. 2. ————————, dorsal vertebra, three times magnified: transverse section.
Fig. 3. ————————, one of the longer ribs, twice nat. size; the end showing the hollow.
Fig. 4. ————————, metapodial and phalangial bones, twice nat. size.
Fig. 5. ————————, upper maxillary and part of orbit, twice nat. size.
Fig. 6. Part of upper maxillary and teeth of *Hylonomus aciedentatus*.
Fig. 7*a* Impression and remains of the dentary bone of the lower jaw of *Hylonomus aciedentatus*, and of a scute, three times magnified.
Fig. 8. Part of the dentary bone of a young, or small kind of *Hylonomus*, three times magnified.
Fig. 9. The anterior end of a jaw-bone of *Hylonomus*, twice nat. size.
Fig. 10 Bones of the fore limb of *Hylonomus*, three times magnified.
Fig. 11 Bones of a foot of *Hylonomus Wymanni*, twice nat. size.
Fig. 12 Series of (caudal?) vertebræ of *Hylonomus Wymanni*, twice nat. size
Fig. 13 Rib (*a*) and two scutes (*b* and *c*) of *Hylonomus*, twice nat. size.
Fig. 14 Right dentary part of lower jaw of *Hylonomus Lyelli*, twice nat. size.
Fig. 15 Part of the upper jaw and teeth of a *Hylonomus*, three times magnified.
Fig. 16 Parts of upper and lower jaws of *Hylerpeton Dawsoni*, nat. size.
Fig. 17 Small part of jaw of *Hylerpeton*, showing the mode of implantation of the teeth; twice nat. size.
Fig. 18 A group of the scutes of *Hylerpeton* (?); twice magnified.

Plate X.

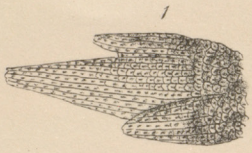
Figs. 1 & 2. Dermal scutes and markings of the skin of *Hylonomus*?
Fig. 3. Portion of the frontal and contiguous cranial bones of a *Hylonomus*, twice nat. size.
Fig. 4. Part of the lower jaw of apparently the same species of *Hylonomus*.
Fig. 5 *a* Inner surface of upper part of the skull of *Dendrerpeton Acadianum*, nat. size. 5 *b*, magnified section of base of tooth.
Fig. 6. Outer surface of supertemporal bone of *Dendrerpeton Acadianum*, twice nat. size.
Fig. 7. Ilium and parts of pubis and ischium of *Dendrerpeton Acadianum*.

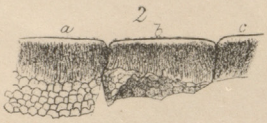


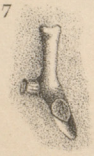
J. Dinkel lith.

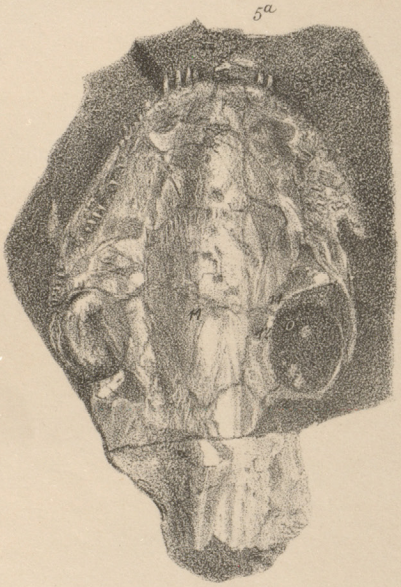
W. West imp.

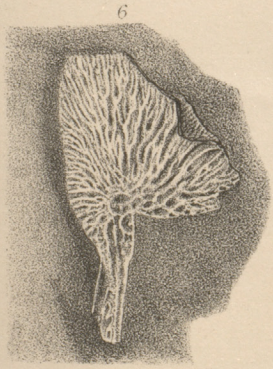
REPTILIAN REMAINS FROM NOVA SCOTIA.











J. Dinkel lith. W. West imp.

REPTILIAN REMAINS FROM NOVA SCOTIA.