9. *On the* CRETACEOUS FORMATION *of* BAHIA (BRAZIL), *and on* VERTEBRATE FOSSILS *collected therein.* By JOSEPH MAWSON, F.G.S., and ARTHUR SMITH WOODWARD, LL.D., F.R.S., F.L.S., F.G.S. (Read January 9th, 1907.)

[PLATES VI–VIII.]

I. STRATIGRAPHY. [J. M.]

AT the end of the year 1859, Mr. Samuel Allport[1] communicated to the Geological Society his discovery of a series of fossiliferous rocks, apparently of Mesozoic age, in the neighbourhood of Bahia (Brazil). In 1870 the same formation was more adequately described by Prof. C. F. Hartt,[2] who regarded it as probably equivalent to the Neocomian of Europe; and, in 1878, the whole of the Cretaceous basin of Bahia formed the subject of a memoir by Dr. Orville A. Derby.[3] The work of all these authors emphasized the importance of systematic collecting from the highly-fossiliferous deposits of the series in question; and it has been my pleasure and privilege, at intervals during the past thirty years, to devote considerable time to this task. Most of the fossil mollusca thus obtained have been monographed by Dr. C. A. White, while the fossil vertebrata have been described by the late Prof. E. D. Cope and Dr. A. Smith Woodward. No summary of results, however, has hitherto appeared; and, as my opportunities for continuing the work are now almost at an end, I venture to offer to the Geological Society some general observations, to precede a discussion of my collection of vertebrate fossils, which has been prepared by Dr. Smith Woodward.

As already remarked by Allport, the Cretaceous rocks of Bahia have a general north-westerly dip, but the series is so much disturbed and contorted that the actual dip differs in almost every section. It was, in fact, impossible for me to discover any regular order of zones in the deposits, which are obviously an estuarine series of lenticular beds of conglomerate, sandstone, and shale, with occasional thin layers of shelly limestone. As noted by Hartt and Derby, the conglomerates consist chiefly of stones which may be of local origin, but the rounded pebbles of compact bluish limestone appear to me to resemble a rock which I have not seen nearer than Inhambupe (130 kilometres north of Bahia) or Almas and Brejo Grande (270 to 320 kilom. west and south-west of Bahia). In places (as, for example, at Itacaránha), pieces of wood in jet-like

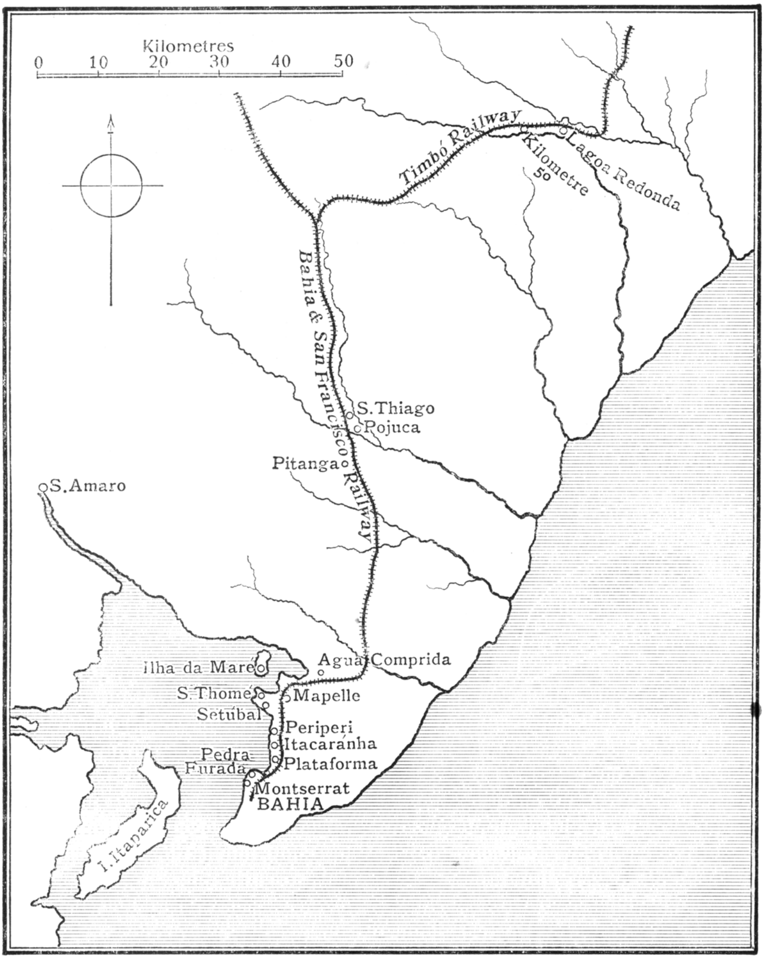
[1] 'On the Discovery of some Fossil Remains near Bahia in South America' Quart. Journ. Geol. Soc. vol. xvi (1860) pp. 263–68 & pls. xiv–xvii (with notes on the fish-remains by Sir Philip Egerton, on the mollusca by Prof. J. Morris, and on the entomostraca by Prof. T. Rupert Jones).

[2] 'Geology & Physical Geography of Brazil' Boston & London, 1870, pp. 346–60, 555.

[3] 'A Bacia Cretacea da Bahia de Todos os Santos' Archiv. Mus. Nac. Rio de Janeiro, vol. iii (1878) pp. 135–58, with map (pl. xii).

condition are mingled with the pebbles, as already observed by Dr. Derby. The sandstones sometimes exhibit ripple-marked surfaces, as at Pedra Furada and Periperi. There are also, both in the sandstone and in the shales, small patches of bone-bed,

Map showing the localities where Cretaceous fossils were found.



containing not only the scattered remains of fishes, but well-rolled pieces of reptilian bones; a particularly-noteworthy bed at San Thiago rests upon a shell-bearing layer. The shales are often calcareous, and contain both hard concretions and soft muddy pockets; some are also impregnated with oil.

The precise extent and boundaries of the Cretaceous basin of Bahia still remain to be determined, but the accompanying sketch-map (p. 129) bears the names of all the localities at which I have discovered the typical fossils of the formation. A few notes on some of the sections are appended.

Montserrat, Pedra Furada, and Bomfim.—The general features of this section have already been sufficiently described by Allport. . Gasteropod-shells are commonest and best preserved in the ridges of sandstone at various points, and in the hard, fine-grained, brownish limestone near Pedra Furada. Scales of *Lepidotus* and fragments of reptilian bones, mostly rolled, occur nearly everywhere; while complete examples of a small species of *Diplomystus* have been found, in a very thin layer of compact greenish mudstone, between Pedra Furada and Bomfim. In a large calcareous concretion, in the shales near Bomfim, I once discovered a nearly-complete specimen of *Lepidotus*. Beyond Bomfim northwards the Cretaceous deposits sink beneath low sandy flats, and only reappear on the opposite side of the bay at Cabrito and Plataforma.

The Bahia-and-San Francisco Railway.—Cretaceous strata are first seen on this railway between 3 and 4 kilometres away from Bahia (Calçada Station). The Amioid fish *Megalurus Mawsoni*, and numerous well-preserved entomostraca (described by Prof. T. Rupert Jones [1]) were found in shale on the beach just beyond Kilom. 4. A bluish-grey sandstone in the railway-cutting is also fossiliferous. Between Plataforma, Itacaránha, and Escada, the beach has yielded more remains of fishes and reptiles than any other section of the Bahia Cretaceous Series—among others, the well-preserved skeletons of *Diplomystus longicostatus* and *Chiromystus Mawsoni*, and the skull of the large new Cœlacanth fish, *Mawsonia gigas*. Teeth of crocodiles are abundant, as already noticed by Allport. Large and small coprolites occur almost everywhere. Entomostraca are also common, but mollusca are very rare, only *Planorbis* having been found. Near Periperi (kilom. 11) there are very few fossils, but fragmentary vertebrate remains are common again at Setúbal (kilom. 12½). The shales between Olaria and Mapelle (kilom. 22) are also fossiliferous, but they become too friable on exposure. The hard conglomerate of Mapelle Quarry (near kilom. 23) has yielded numerous dinosaurian and crocodilian bones, besides remains of *Mawsonia*. At Agua Comprida (kilom. 29) the shales and flaggy limestones are highly fossiliferous, and well-preserved skeletons of *Diplomystus longicostatus* occur here. Between Agua Comprida and Matta (kilom. 69) no fossils have been found; but a few occur again at rare intervals between the latter station and Pitanga (kilom. 75), where a reddish and yellowish clay contains freshwater bivalves. From Pojuca Tunnel (kilom. 78) to San Thiago (kilom. 86) the characteristic shales, limestones, and sandstones yield numerous vertebrate fossils like those of the beach near Bahia.

[1] 'On some Fossil Entomostraca from Brazil' Geol. Mag. dec. 4, vol. iv (1897) pp. 195–202 & pl. viii.

This is the farthest point from Bahia at which Cretaceous fossils have been found in the cuttings of this railway.

San Thomé de Paripe.—Cretaceous conglomerates, sandstones, and shales, with the characteristic fossils, are seen in the small semicircular bay of San Thomé, which is reached from Olaria Station (kilom. 13). The series corresponds with that exposed at Setúbal. In the sandstone near Toque Toque are thin layers of fossilized wood, with fragments of resin.

Santo Amaro and road to Alagoinhas.—Highly fossiliferous Cretaceous rocks occur in the neighbourhood of Santo Amaro, and for nearly 8 miles along the road towards Alagoinhas. Scales of *Lepidotus* are especially common, and entomostraca are found in a bright-yellow clayey rock.

The Timbó Railway.—This railway runs north-eastward from Alagoinhas to Timbó, a distance of 83 kilometres. I have found Cretaceous fossils in the cuttings between Kilometres 47 and 51, and again at Kilometre 63½, beyond which the rocks do not appear to belong to the series under consideration.

Ilha da Maré and the vicinity.—Entomostraca occur in the yellow sandstone of Mochado, across a small arm of the bay 1 mile west of Mapelle. They are also found with fish-remains at Ponta do Matoim. Scales of *Lepidotus* and crocodilian bones have been obtained from a thick, massive, calcareous, yellow sandstone, which overlies a bluish shale in the Ilha da Maré.

II. The Vertebrate Fossils. [A. S. W.]

The collections both of the late Mr. Allport and of Mr. Mawson have been presented to the British Museum (Natural History), where they can now be readily studied with ample material for comparison. The vertebrate fossils, which are the more important in this case for stratigraphical purposes, may be enumerated as follows:—

Reptilia.

Dinosaurian indet., Allport & Owen, Quart. Journ. Geol. Soc. vol. xvi (1860) p. 266 & pl. xvii.

Goniopholis Hartti (Marsh): *Crocodilus Hartti*, O. C. Marsh, Amer. Journ. Sci. ser. 2, vol. xlvii (1869) p. 391; figs. of teeth by Allport, *op. supra cit.* pl. xvi, figs. 1, 2, 3, & 5.

Goniopholis bahiensis (Marsh): *Thoracosaurus bahiensis*, O. C. Marsh, *op. supra cit.* p. 392.

Pterosaurian indet., A. S. Woodward, Ann. & Mag. Nat. Hist. ser. 6, vol. viii (1891) p. 314, fig. 2.

Plesiosaurian indet., A. S. Woodward, *ibid.* p. 316, fig. 1.

Pisces.

Chiromystus Mawsoni, E. D. Cope, Proc. Amer. Phil. Soc. vol. xxiii (1886) p. 4; A. S. Woodward, Catal. Foss. Fishes Brit. Mus. pt. iv (1901) p. 90.

Diplomystus longicostatus, E. D. Cope, *op. supra cit.* p. 3; A. S. Woodward, Ann. & Mag. Nat. Hist. ser. 6, vol. xv (1895) p. 2 & pl. i, fig. 1.

Diplomystus sp. indet. Fishes from Bomfim.

Megalurus Mawsoni, A. S. Woodward, Ann. & Mag. Nat. Hist. ser. 7, vol. ix (1902) p. 87 & pl. ii.

Belonostomus (?) carinatus, sp. nov. Scales from Itacaránha, described below (p. 133).

Lepidotus Mawsoni, A. S. Woodward, Ann. & Mag. Nat. Hist. ser. 6, vol. ii (1888) p. 135; and Catal. Foss. Fishes Brit. Mus. pt. iii (1895) p. 120; figs. of scales by Allport, Quart. Journ. Geol. Soc. vol. xvi (1860) pl. xiv, figs. 5–13, pl. xv, figs. 1–4, & pl. xvi, figs. 10–12.

Mawsonia gigas, gen. et sp. nov. Described below (p. 134).

Acrodus nitidus, A. S. Woodward, Ann. & Mag. Nat. Hist. ser. 6, vol. ii (1888) p. 135; and Catal. Foss. Fishes Brit. Mus. pt. i (1889) p. 297 & pl. xiv, fig. 8.

Most of these species have already been described, so far as available material will allow; but some of Mr. Mawson's fossils need more detailed notice or description before the general relationships of the whole vertebrate fauna can be discussed.

DINOSAURIANS.

The Dinosaurians are still known only by small vertebral centra and a phalangeal bone; but it is interesting to note that the latter fossil is of the Megalosaurian type, and may belong to the same reptile as the vertebral centrum which was figured by Allport and provisionally determined by Owen as Megalosaurian. Some of the vertebral centra, however, are solid, and seem to agree closely with the corresponding bones of Iguanodonts.

GONIOPHOLIS HARTTI (Marsh). (Pl. VI, figs. 1 & 2.)

The so-called '*Crocodilus*' *Hartti* has hitherto been known only by isolated teeth, but is represented in Mr. Mawson's collection by the fine mandibular symphysis from Setúbal, shown of one-quarter the natural size in Pl. VI, figs. 1 *a* & 1 *b*. So far as preserved, this specimen measures 43 centimetres in length, although it consists entirely of the symphysial region of the mandible. It must, therefore, have belonged to a remarkably-large animal. The symphysis is elongated, narrow, and flattened from above downwards with a slightly-spatulate terminal expansion in front. Its oral surface is raised into a low median longitudinal keel, which disappears at the beginning of the shallow concavity in the anterior terminal expansion. The outer surface of the bone is very coarsely sculptured. As shown by the sockets and broken stumps, the total number of teeth on each side within the symphysis is at least seventeen. These are closely implanted in regular series along the wavy edge of the dentary as far forwards as the beginning of the terminal expansion, where the angle is occupied by two relatively large caniniform teeth, and these are followed in front by two rather small teeth. The apex of the crown of one of the caniniform teeth, still in its socket, exhibits the characters assigned by Marsh to *Crocodilus Hartti*.

Some fragments of skull display the coarse sculpturing of the external surface; but the only specimen worthy of special notice is a large dermal scute, which is doubtless referable to the same species. This scute is one of a paired dorsal series, much broader than long, and is shown of one-quarter the natural size in Pl. VI, fig. 2. It is imperfect behind, but otherwise well-preserved; and its narrow overlapped anterior border is interesting, as being produced into a large forwardly-directed peg near its outer end, for firm articulation with the scute next in front. Its outer exposed face is marked in front with large and deep pittings, which are irregular in size and shape.

The new fossils thus seem to determine the systematic position of the large extinct Bahia crocodile. It cannot belong either to the Teleosaurian *Hyposaurus* or to the Procœlian *Thoracosaurus*, with which the teeth have been compared, because the scute exhibits a peg-and-socket articulation. This structure has hitherto been noticed only in the Wealden and Purbeckian marsh-crocodiles of the family Goniopholidæ.[1] The teeth and their arrangement in the front half of the mandible resemble those of *Goniopholis* itself; and the new mandibular symphysis now described is only longer than is usual in *Goniopholis*. It is, therefore, reasonable to conclude that the Bahia specimen is not only one of the Goniopholidæ, but probably referable to the type-genus of the family. It may be added that the only portions of associated vertebral centra that might be crocodilian, are of an amphicœlian, not procœlian, type.

PTEROSAURIAN.

Since the quadrate bones of a pterodactyl from Pedra-Furada Bay were described, Mr. Mawson has found a typical pterosaurian tooth in the same locality.

BELONOSTOMUS (?) CARINATUS, sp. nov. (Pl. VI, figs. 4 & 5.)

Some rhombic ganoid scales, found naturally associated in a group near Itacaránha, represent a hitherto unknown fish, and exhibit, in an exaggerated form, a type of ornamentation which is only known among ganoids in the Cretaceous species of *Belonostomus*.[2] If, however, the scales belong to this genus, they are referable to the hinder part of the caudal region, and are thus not very satisfactory for specific determination. The smaller scales, shown in a fractured state, of the natural size, in Pl. VI, fig. 4, bear a sharp, simple keel, which arises near the middle of the exposed face and extends downward and backward into a prominent spine at the postero-inferior angle. The remainder of the exposed face is smooth, or only marked by very feeble wrinkles, which tend to range in horizontal lines near the smooth posterior border. The upper border of each scale is strongly sinuous, and its antero-superior angle is produced upwards. The few scales shown in Pl. VI, fig. 4, increase both in size and in relative depth upwards, and therefore doubtless belong to the ventral region of the flank.

[1] [Since the reading of this paper, Mr. A. N. Leeds, F.G.S., has submitted to me the dorsal scute of *Steneosaurus* shown in Pl. VI, fig. 3, proving that, in this Teleosaurian genus, the dorsal armour was made rigid by the peg-and-socket articulation.—*A. S. W., February 13th, 1907.*]

[2] Compare the scales of *Belonostomus Sweeti*, R. Etheridge, jun., & A. S. Woodward, Trans. Roy. Soc. Victoria, vol. ii, pt. ii (1891) pl. i, figs. 6 & 7.

Some larger scales (Pl. VI, fig. 5), which are slightly wider than deep, have the same general shape as those just described, with the ascending antero-superior angle; but their oblique keel is less prominent, and is subdivided into a pair of nearly-parallel ridges. These scales are united by a peg-and-socket joint, in which the peg is subdivided into fine digitations at the end; but their inner face is not strengthened by a vertical keel. The new species may be named *Belonostomus (?) carinatus*, in allusion to the peculiar ornamentation and armature of the smaller scales.

MAWSONIA GIGAS, gen. et sp. nov. (Pls. VII & VIII.)

For many years Mr. Mawson has obtained pieces of coarsely-sculptured bony plates and large fish-bones, especially on the beach near Plataforma; but, until the recent arrival of the last instalment of his collection at the British Museum, it was impossible to interpret these fossils. A large fragmentary skull now furnishes a clue to their true nature, and shows that they represent a gigantic Crossopterygian ganoid of the family Cœlacanthidæ. The species may be regarded as referable to a new genus, *Mawsonia*, with the skull closely similar to that of the European Cretaceous *Macropoma*, though the external bones are destitute of enamel and ornamented with more or less radiating ridges, which are mainly longitudinal on the cranial roof and angular bone, but diverge from the point of suspension on the operculum. In *Mawsonia gigas*, as I propose to name the typical species, the angular bone of the mandible measures 40 centimetres in length, and is thus four times as large as the largest Cœlacanth angular bone hitherto discovered.

The skull just mentioned, which must be regarded as the type-specimen of *M. gigas*, is fragmentary, and distorted by lateral compression, but displays very well many of the principal bones. It is shown, of one-third the natural size, from the right side in Pl. VII, fig. 1, with drawings of the left frontal and left quadrate bone in figs. 2, 3, and of the left mandibular ramus, articular bone, coronoid bone, pterygoid teeth, and gular plate in Pl. VIII, figs. 1–5. The cranium (*cr.*) has collapsed in the crushing and seems to have been imperfectly ossified, except in the postero-superior part of the otic region (*ot.*), which is prominent on each side of the fossil. The cranium is underlain by the long and slender parasphenoid (*pas.*), seen from below in fig. 1, and tapers forward to a broken extremity, which may, or may not, have been continued into an anterior spatulate end. So far as it is preserved, the oral face of the parasphenoid is toothless, while the hinder portion of its upper face is slightly excavated by a longitudinal channel. Of the cranial roof, only part of the left frontal (Pl. VII, fig. 2) is preserved, showing its irregularly-wavy but smooth hinder border, which would articulate with the parietal element. Its outer face is ornamented with longitudinal ridges, which diverge slightly and increase both in strength and in number as they extend forward, but are apparently destitute of an enamel-layer. The right parietal bone (Pl. VII, fig. 4 *a*), preserved in a fragment of another skull, shows that this element was similarly ornamented with longitudinal ridges, which diverge and multiply backwards, while they tend to become irregularly nodose, and even ramify into a network. The parietal bone, as usual in Cœlacanths, is much wider behind than in front, and meets its fellow of the opposite side in a straight median suture. Its thickened and slightly-wavy anterior border, which would articulate with the frontal, is curiously excavated by a groove, which causes the outer and inner laminæ of the bone to overhang the thick middle lamina (fig. 4 *b*). The pterygo-suspensorial arcade (*pts.*) forms the usual irregularly-triangular plate of bone, in which no suture can be distinguished. The quadrate (Pl. VII, fig. 3) terminates below in a very stout ginglymoid articulation for the mandible, its outer condyle being much smaller than the inner condyle. The postero-external margin of the quadrate, directly above its outer condyle, is coarsely rugose, as if for loose union with a superficial plate of bone. In some respects, the articular end of this element resembles that of a pterosaurian quadrate; and I was once misled by the similarity in question to describe one of Mr. Mawson's specimens as probably referable to a gigantic pterodactyl.[1] The upper end of the hyomandibular (*hm.*) is much expanded forward, so that it is not only firmly fixed to the ossified otic mass, but must also have had an extensive articulation with the unossified postfrontal (or sphenotic), which is represented by a vacant space in the fossil. The entopterygoid and ectopterygoid (*pt.*) form a very thin lamina, tapering to a point in front. Its lower margin is quite smooth; its inner face (Pl. VIII, fig. 4 *a*) is covered, however, with minute tubercular teeth, which are not enlarged towards the border, but are all rounded or bluntly conical, and invested with enamel, which is finely sculptured with delicate lines radiating from the apex (fig. 4 *b*). The most conspicuous bone of the mandible is the angular (Pl. VII, fig. 1, *ag.*), which must have extended for considerably more than half the length of each ramus. It is deepest just in advance of its middle point, where it rises into an acute coronoid eminence. Its anterior half tapers more rapidly than its posterior half, and two facettes show that it must have been overlapped and underlapped in front by the dentary and infradentary bones respectively. Its outer face is ornamented with longitudinal ridges, like those of the cranial roof, which have mainly a longitudinal direction, although slightly radiating upwards into the feebly-sculptured coronoid region. These ornamental ridges are not tuberculated or enamelled, and they scarcely form any reticulations. The articular bone (Pl. VII, fig. 1, *art.* & Pl. VIII, figs. 1 *a* & 1 *b*) is a separate element, uniting in squamous suture with the inner face of the angular, just behind the coronoid elevation. It is relatively small, short and stout, and well ossified, with two distinct facettes for exact articulation with

[1] A. S. Woodward, 'On the Quadrate Bone of a Gigantic Pterodactyl discovered by Joseph Mawson, Esq., F.G.S., in the Cretaceous of Bahia, Brazil' Ann. & Mag. Nat. Hist. ser. 6, vol. xvii (1896) pp. 255–57.

the ginglymoid end of the quadrate bone. In shape and relationship it agrees precisely with the articular bone of *Macropoma* (Pl. VIII, fig. 7, *art.*). Behind the articular there is at least one other stout ossification of the meckelian cartilage, which extends backward even beyond the angular and is visible from the outer face of the mandible (Pl. VIII, fig. 2, *m.*), where its thickened upper portion is conspicuous and peculiar, leaving a pit between this thickening and the posterier edge of the angular element (*ag.*). The same arrangement is also seen in *Macropoma* (Pl. VIII, fig. 8). Within the articular and the hinder ossification just mentioned, the inner face of the mandibular ramus is formed by one or more thick splenial bones, of which the precise extent forward is unknown. A much elevated coronoid process is formed by a separate bone, articulating with the outer face of the splenial in a narrow facette which is deepest behind (Pl. VIII, fig. 3, *f*). This element, which corresponds with the ascending process of the splenial in *Polypterus*, is seen from the outer aspect on the right side of the type-skull (Pl. VII, fig. 1, *co.*), and is detached on the left side of the same specimen, thus displaying also its inner aspect (Pl. VIII, fig. 3). It is triangular in shape, with the middle of its antero-superior edge thickened, indented, and projecting outward; while its sigmoidally-bent inner face is covered with minute tubercular teeth like those of the pterygoid bones. The anterior part of the mandible remains to be discovered, but it probably bore small conical sculptured teeth rather longer than those of the pterygoid plates, because a few such teeth are scattered on the inner side of the left mandibular ramus in the type-specimen.

Broken remains of the characteristic branchial arches project behind the cranium in the type-specimen (Pl. VII, fig. 1, *br.*), and one detached ceratobranchial, from Mapelle Quarry, is especially well preserved. This bone measures 48 centimetres in length, tapers at each end, is laterally much compressed, and exhibits the usual deep groove posteriorly.

One of the gular plates found with the type-skull is nearly complete (Pl. VIII, fig. 5), and its length equals about $3\frac{1}{2}$ times its maximum width. Its outer face is raised into a smooth longitudinal ridge, slightly curved, near the outer border of the bone; and from this radiates a fine ridged ornament, which is in places feeble, in places reticular.

Isolated portions of the operculum, undoubtedly of the same species, indicate that this bone was shaped as usual in Cœlacanths, but much produced downward at its antero-inferior angle. It is completely covered with radiating ridges, which resemble those of the head-bones in being destitute of enamel and nearly smooth; and they radiate from the point of suspension, where they are fewest and tend most towards reticulation (Pl. VIII, fig. 6).

An isolated clavicle from Itacaránha (B. M., No. P 10061), large enough to have belonged to the type-specimen, is typically Cœlacanth in its slightly-expanded, rounded upper end, and in the small postclavicular expansion of its middle part. The bone is marked only by the ordinary lines of the structural fibres.

Mr. Mawson has also obtained from the beach between Plataforma and Itacaránha one fragment of a small Cœlacanth fin-ray, exhibiting the characteristic denticles arranged in an irregular double series on the anterior face.

Besides the typical remains of *Mawsonia gigas*, there are others of the same genus which are doubtfully referable to this species. One imperfect right parietal bone (B. M., No. P 86), for example, is much shorter in proportion to its width than the original of Pl. VII, fig. 4, while its external ornament is much coarser; and this specimen is interesting as being still articulated with the postero-lateral plate of bone, which is usually interpreted as squamosal + post-temporal. Part of a relatively-small ornamented bone is suturally united with the inner border of the latter element, and with the hinder border of the parietal. There is also a nearly-complete left angular bone, not more than 27 centimetres in length, resembling the corresponding element of the typical *Mawsonia gigas* in shape, but with a coarser ornament forming large reticulations on the lower part of the coronoid elevation. Finally, there is a still smaller right angular from the Mapelle Quarry, in which external ornament is almost lacking. With the latter must be associated the hinder portion of an equally-small left dentary from the same quarry, showing the raised portion which would abut against the splenial.

Mawsonia gigas is of especial interest as showing that, although the Cœlacanth fishes were, as a rule, of comparatively-small size (the largest measuring considerably less than a metre in length), one at least attained gigantic proportions just before the final extinction of the family.

Conclusion.

If the vertebrate fauna now enumerated be compared with European standards, it will be noticed that two of the four commonest species are essentially Wealden in character, while the two others are chiefly Middle or Upper Cretaceous forms. The Goniopholid crocodiles are confined to the Wealden and Purbeck horizons in Europe, while *Lepidotus Mawsoni* (although known only by fragments) is evidently one of the latest species of the genus closely similar to the well-known Wealden *L. Mantelli*. *Chiromystus Mawsoni*, on the other hand, must be regarded as one of the Chirocentridæ or Ichthyodectidæ which range upwards from the Neocomian; while *Diplomystus longicostatus* belongs to a genus which is common in the Upper Cretaceous of the Lebanon, and is abundant later in the freshwater Lower Tertiaries both in Europe and in North America. Of the other species, *Megalurus Mawsoni* is a Jurassic, rather than a Cretaceous type of Amioid fish; and *Mawsonia gigas* may be either Jurassic or Cretaceous, although theoretical considerations suggest that it should be referred to the latter period. The unique tooth of *Acrodus nitidus* is very small, and belongs to a diminutive shark like that indicated by the equally-small teeth of *Acrodus ornatus* from the Wealden of the Isle of Wight. The vertebrate fossils, therefore, confirm Hartt's determination of the Bahia estuarine deposits as referable to the beginning of the Cretaceous Period. It is certainly disappointing to find that at that time the land in the South-American region was as destitute of mammalian life as the continent in the Northern Hemisphere drained by the river which deposited the Wealden formation of Western Europe.

EXPLANATION OF PLATES VI–VIII.

Plate VI.

Figs. 1 *a* & 1 *b*. *Goniopholis Hartti* (Marsh); the greater portion of the mandibular symphysis, oral aspect (1 *a*), with anterior expansion (1 *b*) seen from below, one-quarter of the natural size.—Setúbal. [Brit. Mus., No. R 3423.]

Fig. 2. Ditto; incomplete dorsal scute, outer aspect, showing the antero-external peg, one-quarter of the natural size.—Ponta de Tinuaba, Ilha Maré. [Brit. Mus., No. R 3224.]

3. *Steneosaurus* sp.; dorsal scute, outer aspect, showing the antero-external peg, three-quarters of the natural size.—Oxford Clay; Peterborough. [Collection of Alfred N. Leeds, Esq., F.G.S.]

Figs. 4 & 5. *Belonostomus (?) carinatus*, sp. nov.; scales, partly broken, probably of the caudal region, natural size.—Itacaránha. [Brit. Mus., No. P 10062.]

Plate VII.

Fig. 1. *Mawsonia gigas*, gen. et sp. nov.; remains of skull and mandible, right lateral aspect (type-specimen). [Brit. Mus., No. P 10355.]

2. Ditto; left frontal of the same specimen, outer aspect.

3. Ditto; left quadrate of the same specimen, outer aspect.

Figs. 4 *a* & 4 *b*. Ditto; right parietal of another specimen, outer aspect (4 *a*), with (4 *b*) transverse section of edge of bone, showing overhanging outer lamina, natural size. [Brit. Mus., No. P 10356.]

ag.=angular; *art.* = articular; *br.* = displaced branchial arches; *co.* = coronoid; *cr.* = cranium; *hm.* = top of hyomandibular; *ot.* = otic region; *pas.* = parasphenoid; *pt.* = front end of ectopterygoid; *pts.* = pterygo-suspensorial plate; *qu.* = quadrate.

Plate VIII.

Figs. 1 *a* & 1 *b*. *Mawsonia gigas*, gen. et sp. nov.; left articular of type-specimen, outer (*a*) and (*b*) condylar aspects.

Fig. 2. Ditto; posterior end of the left mandibular ramus of the same specimen, outer aspect, showing the meckelian ossification (*m.*) projecting beyond the angular bone (*ag.*).

3. Ditto; left coronoid of the same specimen, inner aspect, showing the granular teeth and facette (*f.*) for the overlap of the splenial.

Figs. 4 *a* & 4 *b*. Ditto; portion of ectopterygoid of the same specimen (4 *a*) inner aspect, natural size, and (4 *b*) some teeth enlarged 15 times.

Fig. 5. Ditto; gular plate of the same specimen, outer aspect.

6. Ditto; portion of right operculum, outer aspect, showing place of suspension (*s.*). [Brit. Mus., No. P 10357.]

Fig. 7. *Macropoma Mantelli*, Agass.; portion of the left mandibular ramus, outer aspect, showing articular (*art.*) and angular (*ag.*) bones, natural size.—English Chalk. [Brit. Mus., No. P 6454.]

8. Ditto; portion of the left mandibular ramus, outer aspect, showing the meckelian ossification (*m.*) projecting beyond the angular bone (*ag.*), and the quadrate (*qu.*) in position, natural size. [Brit. Mus., No. 49094.]

[Unless otherwise stated, all the figures on Plates VII & VIII are drawn of one-third the natural size.]

Discussion.

Mr. E. T. Newton congratulated one of the two Authors on the interesting and valuable material which he had collected, and the other upon the admirable use which he had made of this material; especially in regard to the monster Cœlacanth fish, the structure of which had been so clearly pointed out to the Fellows present.

Mr. Lydekker, after referring to the possible bearing of the paper on the evolution of the Crocodilia and on continental connexions and disconnexions, congratulated the Authors on the result of their work.

Mr. R. B. Newton, in thanking the Authors for their valuable paper, stated that Mr. Mawson's collections contained some interesting molluscan remains, among which were a number of Anodont—or Unioniform—shells suggestive of *Unio porrectus* and *U. antiquus* of British Wealden areas, associated with *Vivipara*- and *Melania*-like gasteropods, all of which had been studied by Prof. Hartt and later by Dr. C. A. White, both being of opinion that they belonged to the Lower Cretaceous. The vertebrate evidence now brought forward by Dr. A. S. Woodward, especially the newly-recorded occurrence of *Goniopholis*, together with the *Lepidotus*-scales originally determined by Egerton, was strong confirmation as to the Lower Cretaceous age of these deposits. Contrary to these views, it might be mentioned that Prof. A. de Lapparent's 'Géologie' contains a statement to the effect that the fauna of these freshwater deposits of Bahia shows resemblances to that which characterizes the Laramie Beds of North America.

Dr. C. W. Andrews congratulated the Authors on the valuable results that had been attained through the long and patient collecting carried out by Mr. Mawson. He enquired whether any crocodilian vertebræ showing traces of a form intermediate between the earlier amphicœlian and the later procœlian types had been found, since it was about this horizon that the transition between the two must have occurred. In fact, intermediate forms had already been described in the vertebræ of Goniopholid crocodiles from the Lower Cretaceous in North America.

Dr. Smith Woodward apologized for the absence of Mr. Mawson, and briefly replied. The only vertebral centra that he had observed which might be crocodilian were typically amphicœlous.

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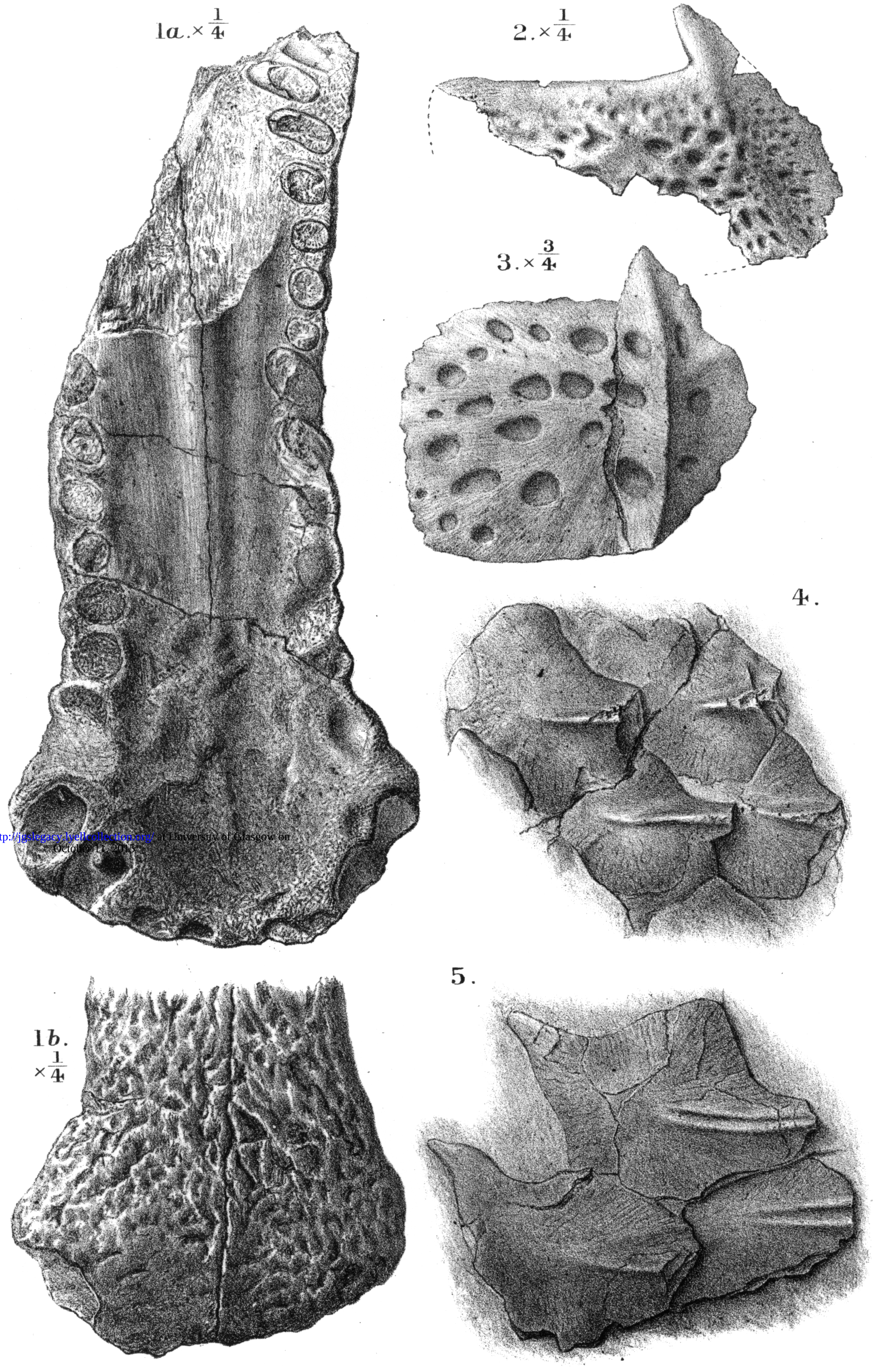

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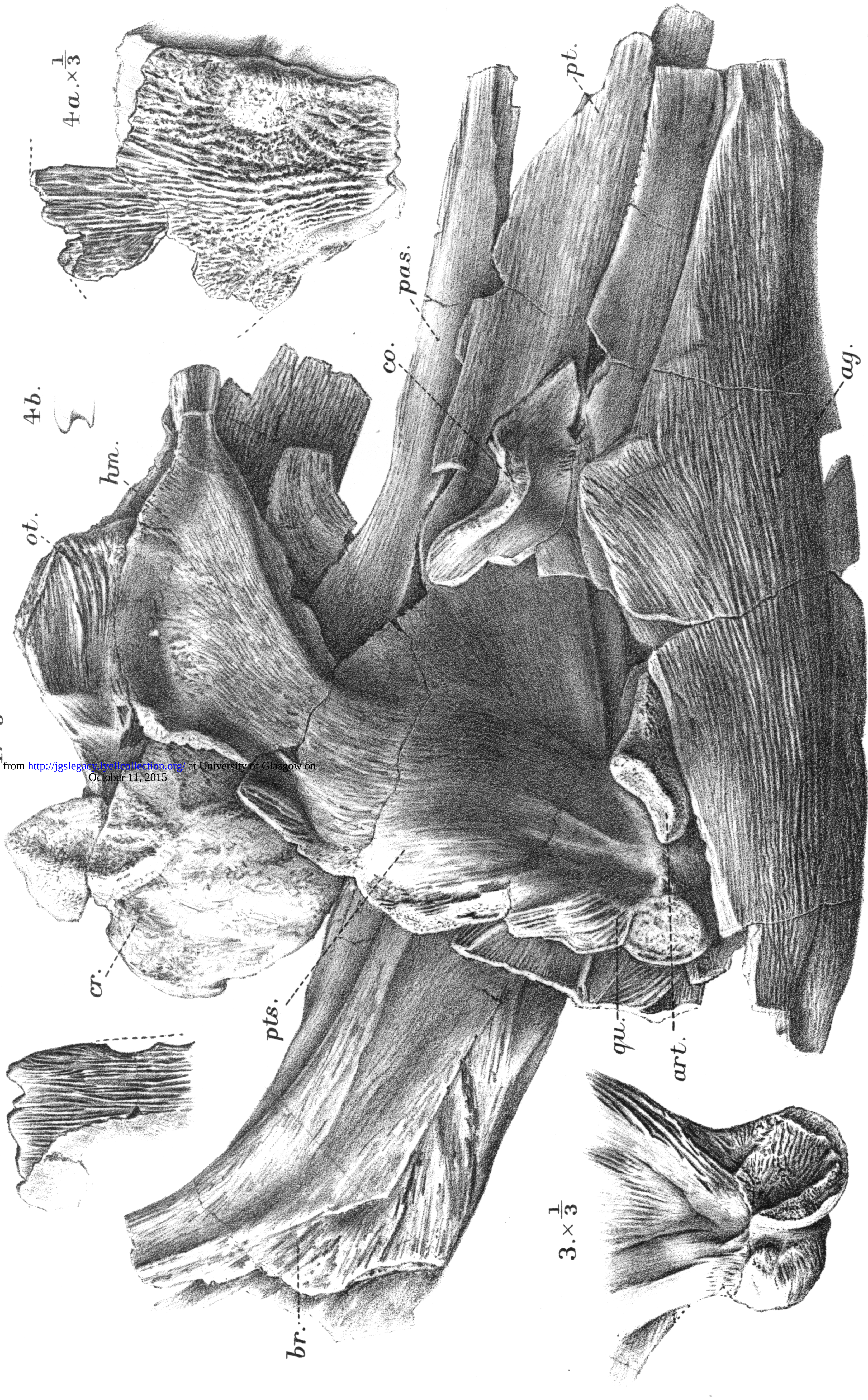
Figs. 1 & 2. GONIOPHOLIS HARTTI.
Fig. 3. STENEOSAURUS.
Figs. 4 & 5. BELONOSTOMUS (?) CARINATUS.



MAWSONIA GIGAS, gen. et sp. nov.

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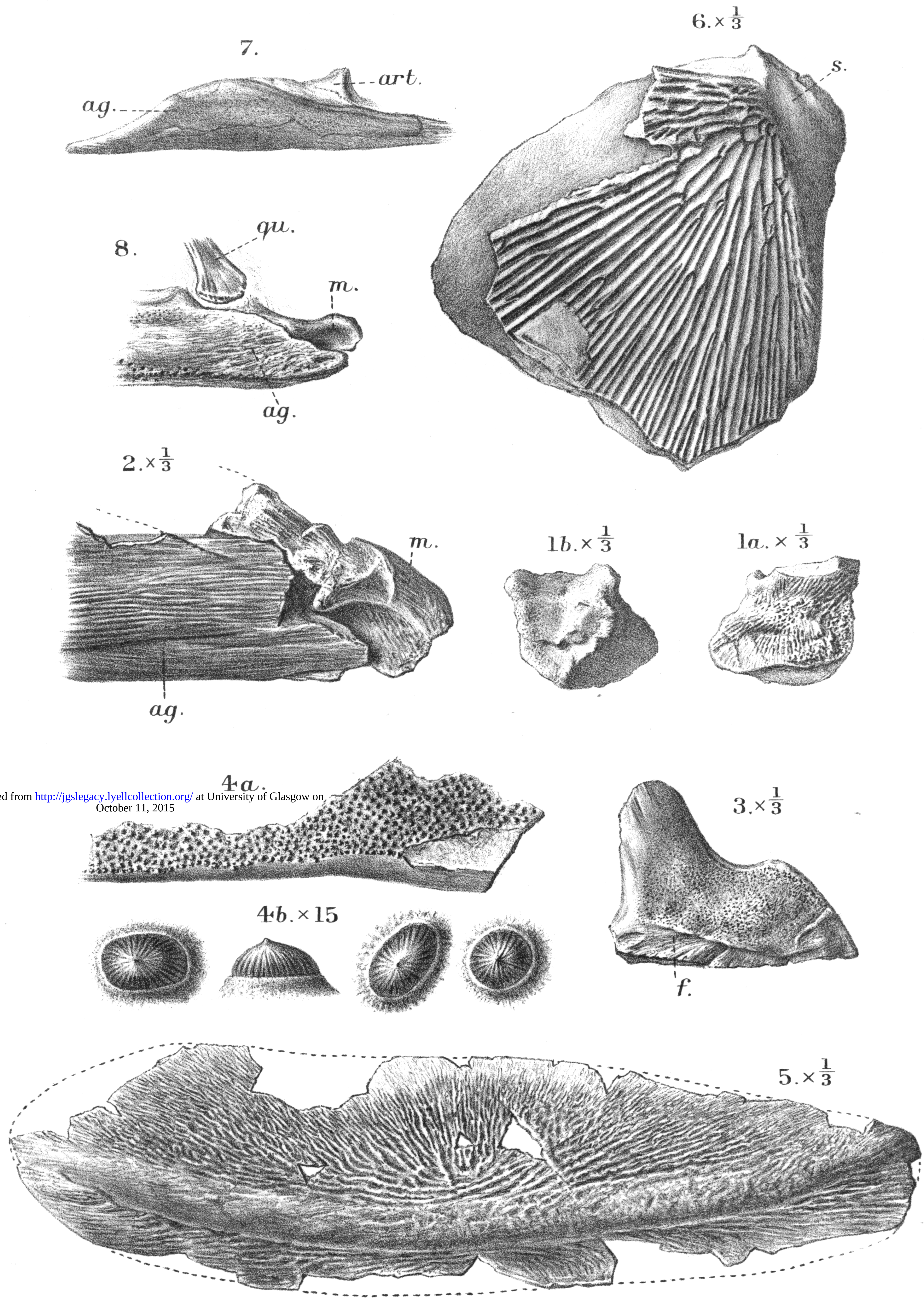

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Figs. 1-6 MAWSONIA GIGAS.
Figs. 7 & 8 MACROPOMA MANTELLI.