5. *On a* Skull *of* *Megalosaurus* *from the* Great Oolite *of* Minchinhampton (Gloucestershire). By Arthur Smith Woodward, LL.D., F.R.S., Sec.G.S. (Read January 26th, 1910.)

[Plate XIII.]

Although the carnivorous Dinosaur *Megalosaurus* was first discovered in the Stonesfield Slate nearly 80 years ago, and is now represented by numerous fossils from the Bathonian and later Mesozoic formations of England, its skull has hitherto been known only by unsatisfactory fragments of jaws.[1] Our acquaintance with the Megalosaurian type of skull has depended solely on discoveries of nearly complete specimens in the Jurassic and Cretaceous formations of North America.[2] At last, however, Mr. F. Lewis Bradley, F.G.S., has been able to submit to the Society the greater part of a skull obtained some time ago from the Great Oolite in an excavation for a reservoir at Minchinhampton (Gloucestershire); and he has prepared the specimen with so much skill and success that it is beautifully exposed for study from the left side (Pl. XIII, fig. 1). It is rather small, measuring only 26 centimetres in total length, but there cannot be much doubt that it belongs to the genus *Megalosaurus* itself.

The upper portion of the fossil is unfortunately destroyed by an irregular fissure in the rock, which is partly filled with calcite. The cranium is, therefore, scarcely seen; but there are traces behind of the occiput, which is somewhat deeper than wide above the foramen magnum, and lies in a plane inclined much forwards. The external bones of the temporal region and face are remarkably thin and delicate, and in their crushed condition it is difficult to distinguish the sutures between them. The large vacuities, however, which form so conspicuous a feature in the American Megalosaurian skulls, are very clearly defined, and their boundaries are probably not distorted. The lateral temporal vacuity (*T.*) is narrow and deep; the orbit (*O.*) is wider, with a gently curved lower margin,

[1] W. Buckland, 'Notice on the *Megalosaurus*' Trans. Geol. Soc. ser. 2, vol. i (1824) p. 390 & pls. xl–xli; T. H. Huxley, 'On the Upper Jaw of *Megalosaurus*' Quart. Journ. Geol. Soc. vol. xxv (1869) p. 311 & pl. xii; J. Phillips, 'Geology of Oxford, &c.' 1871, p. 197 & diagrs. lvi–lvii; R. Owen, 'On the Skull of *Megalosaurus*' Quart. Journ. Geol. Soc. vol. xxxix (1883) p. 334 & pl. xi. The so-called brain-case of *Megalosaurus* described by F. von Huene (Neues Jahrb. 1906, vol. i, p. 1 & pl. i) from the Stonesfield Slate was found isolated, and now appears to be more likely referable to *Cetiosaurus* than to the former genus.

[2] See especially O. C. Marsh, 'The Order Theropoda' Am. Journ. Sci. ser. 3, vol. xxvii (1884) p. 330 & pls. viii–ix; H. F. Osborn, 'The Skull of *Creosaurus*' Bull. Am. Mus. Nat. Hist. vol. xix (1903) p. 697, with text-figs., and '*Tyrannosaurus*, Upper Cretaceous Carnivorous Dinosaur' *ibid.* vol. xxii (1906) p. 281 & pl. xxxix; O. P. Hay, 'On certain Genera & Species of Carnivorous Dinosaurs, with special reference to *Ceratosaurus nasicornis*, Marsh' Proc. U.S. Nat. Mus. vol. xxxv (1908) p. 351, with text-figs.

but is also evidently deeper than wide; the antorbital vacuity (*A.*) is especially large, as wide as the other two together, and distinctly wider than deep; while the narial opening (*N.*) is elongate-oval in shape, three times as wide as deep, with its long axis inclined downwards and forwards. As shown by the position of the overlying quadrato-jugal (*qj.*), the quadrate bone is nearly vertical, not inclined backwards; and the lower temporal arcade is slightly bent downwards from the hinder end of the maxilla, as if the axis of the facial region were inclined a little to that of the cranium. The jugal bone (*j.*) clearly rises into the postorbital bar, seems to be truncated in front where it meets the maxilla in a jagged suture below the lachrymal, and is excluded by the latter element from the margin of the antorbital vacuity. The lachrymal (*l.*) forms the lower part of the antorbital bar, and tapers above, where it must have articulated originally with the prefrontal. The maxilla (*mx.*) is a relatively large triangular bone, excavated in its hinder half by the antorbital vacuity, beneath which it remains as a narrow bar. Its anterior ascending portion is truncated where it reaches the cranial roof, and its straight anterior border forms the lower margin of the narial opening. The outer face immediately in front of the antorbital vacuity is impressed by an extensive fossa; and in the middle of this is a small deeper depression (*x*) which may even be another vacuity. The oral margin of the bone is straight, and bears sockets for eighteen teeth; while above this margin there occurs the usual series of nervous or nutritive foramina. The premaxilla (*pmx.*) is distinctly separated from the maxilla by a suture, which is vertical below, but curves gently backwards above; it is also separated with equal distinctness from its fellow of the opposite side. This bone is about as deep as wide, vertically truncated in front, and with a straight oral margin, which bears sockets for four small teeth. Its antero-superior angle is produced upwards and backwards to form a narrow bar, separating the right and left narial openings in their front half, and then uniting in an extended suture with the attenuated end of the nasals (*na.*), which continue the bar between the hinder half of the same openings. The nasal bar is of extreme interest, as bearing a laterally-compressed bony excrescence (*h.*), of which only an anterior basal fragment remains in the fossil. This excrescence has a roughened surface with indications of vertical grooves, and may be appropriately described as a horn-core. It obviously corresponds with the nasal horn-core already discovered by Marsh in *Ceratosaurus nasicornis*, from the Upper Jurassic of Colorado.[1]

A narrow, longitudinally-extended plate of bone appears within the antorbital vacuity, and evidently represents a fragment of the palate crushed upwards. It is suggestive of a pterygoid element (*pt.*), and from its hinder portion there projects downwards and outwards another small bar of bone, which may perhaps be ecto-pterygoid (*ecpt.*).

[1] Am. Journ. Sci. ser. 3, vol. xxvii (1884) p. 330 & pl. viii.

The shape of the left ramus of the mandible is completely shown, but its hinder half is so much fractured that its constitution cannot be exactly determined. The very slender dentary bone (*d.*) tapers to a blunt point at the symphysis, where its four anterior teeth are relatively small. It gradually deepens in its hinder half, and its >-shaped sutural union with the angular (*ag.*) is distinct below the small oval vacuity (*V.*), which occurs behind it between the angular and surangular bones. On its outer face may be observed a sparse longitudinal series of large nutritive foramina, those in the hinder half being placed in a shallow groove which inclines upwards posteriorly. The coronoid region is the deepest part of the mandibular ramus, its maximum depth equalling a seventh of the total length; but its upper margin is only gently rounded (not raised into a process), and it rapidly tapers behind to the very low articulation for the quadrate bone.

Most of the teeth are well displayed, and exhibit a tendency to replacement alternately, as in crocodiles. Those of the premaxilla are remarkable for their very small size, the height of the third or largest tooth not quite equalling half the height of the largest maxillary tooth. They are thick, round or oval in cross-section, very slightly recurved, and only compressed to a sharp edge behind, where they are regularly serrated to the base. Their outer face is marked by a few slight vertical flutings, which are best seen in the third tooth (Pl. XIII, fig. 2). The fourth or hindmost premaxillary tooth is not exserted; but the other three are completely in functional position, and gradually decrease in size forwards. The foremost tooth of the maxilla, which is seen in its broken socket, is as stout and small as the premaxillary teeth; but all the others of the series are much laterally compressed and recurved, with a sharp serrated edge behind and a blunter, more finely serrated edge in front. The largest teeth of the mouth are those within the front half of the maxilla; while those in the hinder half of the same bone rapidly become smaller, until the hindmost (shown only in impression) are very short and broad. The three teeth preserved at the symphysial end of the mandible are as small as the premaxillary teeth opposed to them, and apparently similar; but the other teeth of the dentary, so far as shown, resemble the principal teeth of the maxilla in shape, and only differ in being much smaller. All the serrations of the teeth (Pl. XIII, fig. 3 *b*) are in regular series, blunt, and not inclined upwards.

On the rock below the mandible occurs the long and slender curved bone shown in Pl. XIII, fig. 4. It is smooth, and only impressed by a shallow longitudinal groove near its thicker end. Both its ends are indefinite, as if originally cartilaginous. It is probably one of the hyoid elements, which have already been noticed by Marsh in *Ceratosaurus*.

As shown by the discoveries in North America, all the skulls of Megalosauria are remarkably similar, and it is difficult to find generic differences between them. In fact, they can scarcely be

distinguished, except by the number and arrangement of their premaxillary teeth, which appear to be constant for each genus. If the European genera of Megalosauria may be similarly characterized, the skull from Minchinhampton belongs to *Megalosaurus* itself, for the distinctive number of four premaxillary teeth has already been found both in the type species, *M. bucklandi*,[1] from the same stratigraphical horizon, and in a specimen from the Oxford Clay.[2] It cannot be referred to *Ceratosaurus*, the only other Megalosaurian in which a nasal horn-core has been observed, because in this genus there are not more than three premaxillary teeth.

If, however, the new skull be correctly assigned to *Megalosaurus*, it is readily distinguished from the only satisfactorily-defined species, *M. bucklandi*, by the shape of the maxilla and more especially by the relatively small size and stoutness of the few anterior teeth in both jaws. It is also comparatively small, though this feature may perhaps be due to immaturity. Its dentition is scarcely comparable with the isolated teeth from higher horizons which have received names; and no reference can be made to the forms known only by limb-bones or vertebræ. I propose, therefore, that the specimen now described be regarded as the type of a new species, to be known as *Megalosaurus bradleyi*, in honour of its discoverer.

EXPLANATION OF PLATE XIII.

[Skull and mandible of *Megalosaurus bradleyi*, sp. nov., from the Great Oolite, Minchinhampton (Gloucestershire). Collection of F. Lewis Bradley, F.G.S.]

Fig. 1. Left side-view, two-thirds of the natural size. *A.*, antorbital fossa; *N.*, narial opening; *O.*, orbit; *T.*, lateral temporal vacuity; *V.*, vacuity in mandible; *ag.*, angular; *d.*, dentary; *ecpt.*, ectopterygoid (?); *h.*, bony horn-core; *j.*, jugal; *l.*, lachrymal; *mx.*, maxilla; *na.*, nasal; *pmx.*, premaxilla; *pt.*, pterygoid (?); *qj.*, quadrato-jugal; *x*, depression or vacuity in antorbital fossa.

2. Third premaxillary tooth, twice the natural size.

3 *a*. Largest maxillary tooth, twice the natural size, with (3 *b*) serrations enlarged 7 diameters.

4. Supposed hyoid bone, crushed and broken, two-thirds of the natural size.

Discussion.

The President (Prof. W. J. Sollas) welcomed this remarkable accession to our knowledge of *Megalosaurus*, and only regretted that it was not to rest side by side with the original specimen in the Oxford Museum. Its resemblance to *Ceratosaurus* was very striking. Evidently part of the skull was still enveloped in the matrix, and could be displayed by serial sections without injury to the exposed portion.

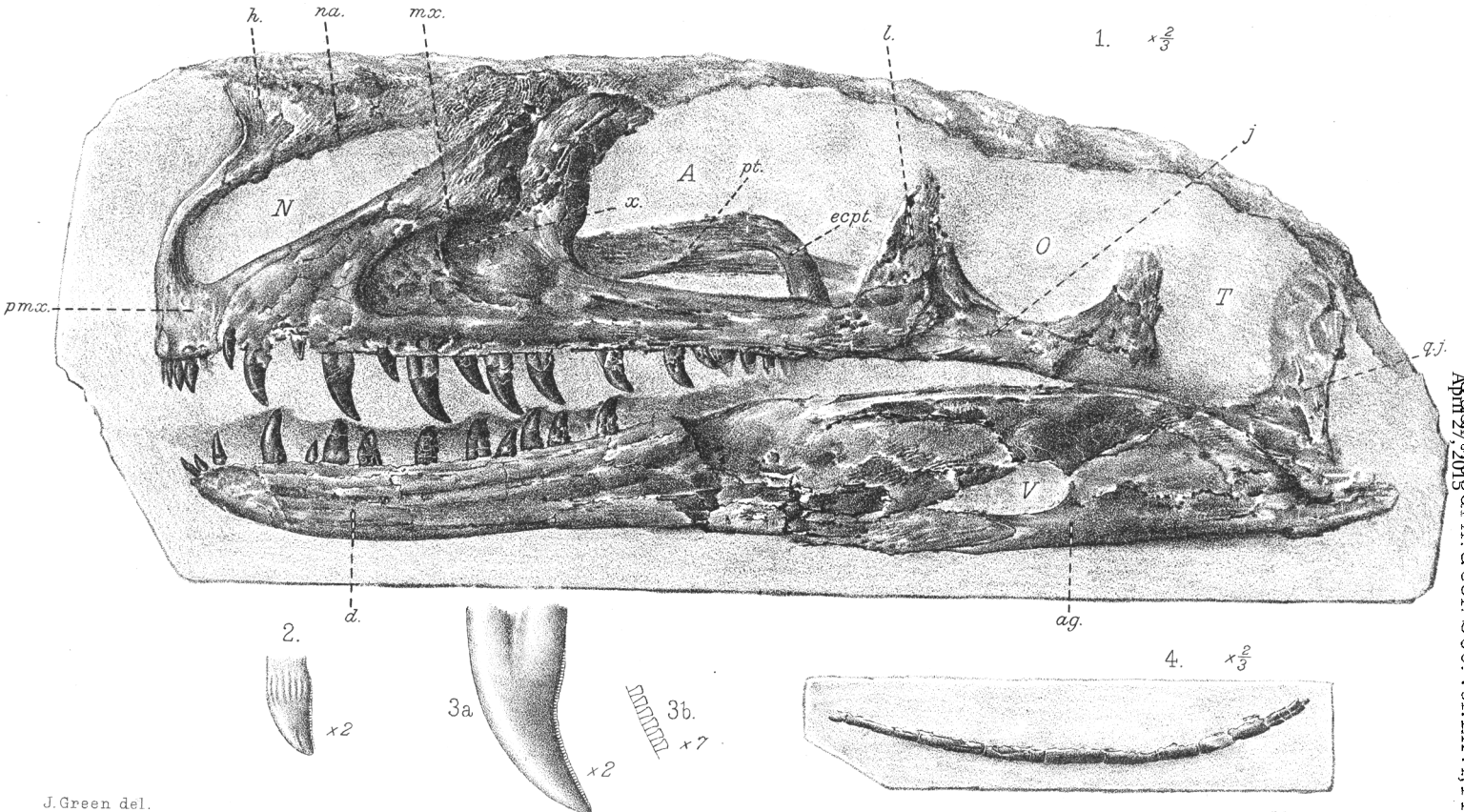
Dr. C. W. Andrews congratulated Mr. Bradley on having had the good fortune to preserve so beautiful a specimen, and remarked

[1] R. Owen, Quart. Journ. Geol. Soc. vol. xxxix (1883) p. 336.
[2] J. Phillips, 'Geology of Oxford, &c.' 1871, p. 320 & diagr. cxxiii.

on the importance of his work in collecting from temporary exposures.

Mr. E. T. Newton also congratulated Mr. Bradley and the Author. He remarked on the great difference in the form of the premaxillary teeth and those of the maxilla, which showed how easily one might be misled in trying to identify isolated teeth. Mr. Newton asked the Author to what extent the front margins of the maxillary teeth were serrated, and whether the teeth themselves were lodged in distinct alveoli or in an alveolar groove.

The Author, in reply, said that the serrations of all the teeth, except those in the front part of the jaw, appeared to resemble those of the teeth in *M. bucklandi*. He could not determine definitely that the teeth were in distinct sockets, but thought appearances suggested that this was the case. He had noticed thick Megalosaurian teeth, much resembling those of the new fossil, among the isolated specimens from the Wealden.



MEGALOSAURUS BRADLEYI, sp. nov.