

ART. XXIX. — *Palæontological Evidence for the Original Tritubercular Theory*; by HENRY F. OSBORN. (With Plate XXI.)

THERE has been a strong reaction of late against the original tritubercular theory so far as it concerns the origin of the upper molar teeth of mammals, by embryologists, comparative anatomists and palæontologists. Among the latter, Dr. J. I. Wortman has reached especially strong conclusions, which have been published in this Journal.\*

According to the original theory of Cope as developed by Osborn, the homologue of the main reptilian cone or protocone is invariably situated on the antero-internal, or lingual side in the upper teeth.

According to the views of the earlier opponents of the tritubercular theory, the protocone is found on the antero-external side, as in the premolars, and corresponds with the cusps which Osborn called the paracone. According to the views of M. F. Woodward,† which were based on embryology, the protocone varies in position in different groups of mammals, namely, antero-internal in certain zalambdodont insectivores (Centetes), and antero-external in Dilambdodonta (Erinaceus), as well as in most other mammals. Similarly Wortman, by analogy with the premolars (this Journal, November, 1903), believes that the position of the protocone may have been variable, that is, in some cases internal, in others external.

The whole point of this very complex question turns on the simple question of evidence whether the main reptilian cone, or *protocone*, of the ancestors of mammals was found upon the antero-internal side or on the antero-external side of the upper molars.

The original evidence upon which Osborn supported and developed Cope's theory is that derived from the rare upper molar teeth of the Jurassic mammals. Osborn‡ cited (1) the upper teeth of *Triconodon*, in which the main cone is *central*, (2) the upper teeth of *Peralesstes* (British Museum) fig. 2, in which the main cone is *internal*, (3) the upper teeth of *Kur-*

\* "In view of the facts above set forth, however, I am more firmly than ever of the opinion, that all such attempts [to name the cusps of the molars in accordance with their supposed homologies, rather than with their relative positions] are foredoomed to failure, and I believe they should be abandoned as utterly useless and confusing; that of Professor Osborn, being doubly erroneous, is therefore the most open to objection in this regard." (This Journal, vol. xvi. November, 1903, p. 368.)

† Proc. Zool. Soc., Lond., 1896, pp. 557-594.

‡ On the Structure and Classification of the Mesozoic Mammalia. Jour. Acad. Nat. Sci., Phila. (2), ix, pp. 242-246.

*todon*, fig. 3, in the British Museum in which the main cone is *internal*, (4) a reference by Professor Marsh to the fact that in the upper molars of *Dryolestes* the main cone is *internal*. In each case the main cone was believed to be the protocone.

The teeth last mentioned (4) were not personally examined at the time, but through the kindness of the late Professor Charles E. Beecher I was recently enabled to study them in the Yale University Museum.

The specimens consist of two superior series. They both show that the large, single, main cusp of the crown is *internal*, and in my opinion they present *conclusive evidence of the truth of the tritubercular theory as originally proposed*.

More in detail, the two specimens taken together show perfectly the structure of both the crowns and fangs of seven superior molar teeth, and confirm entirely the general description given by Marsh, to which some important points may be added as follows:

(1) The molars are sharply distinguished from the premolars, which are bifanged teeth with simple, laterally compressed crowns. (2) The molar crowns are broadly transverse or triangular, and upon the *internal* side of each is a large, conical, pointed cusp *pr*, supported by a large, stout fang, fig. 1 A, *m6*, *m7*; around the inner side of each of these cusps is a delicate cingulum, fig. 1 A, *c*. (3) The *external* portion of the broadly triangular crown is supported on two smaller fangs, fig. 1 A, *m6*, *m7*. (4) The external portion of the crown is depressed, and bears one large antero-external cusp *?pa* and one smaller postero-external cusp *?me* which is either partly worn away or less pronounced in development. (5) Outside of this external wall there is also a faint basal cingulum, *c*, *c*, *c*. (6) Connecting these low external cusps with the elevated internal cusp are two transverse ridges; the anterior transverse ridge is higher and stronger than the posterior.

These features are clearly shown in the accompanying drawings, fig. 1, which were made and shaded under the camera lucida and therefore admit of no doubt as to interpretation.

These two specimens fully supplement and confirm each other; they also supplement the evidence derived from the study of the superior molar teeth of *Peralesstes* (fig. 2) and of *Kurtodon* (fig. 3) in the British Museum, which were cited and figured in my memoir and in various subsequent papers on trituberculy.

Again summing up this combined evidence, we find in the Jurassic period the superior molars of the only mammals known (excepting the Triconodonta and Multituberculata) to consist of a large conical internal cusp or *protocone*, which we

have every reason to believe is homologous with the large external cusp or *protoconid* in the lower jaw.

Secondly, that the external cusps in the superior molars are depressed and comparatively small, consisting of two, more or less well-defined cusps. Thirdly, that this palæontological evidence lends no support, either in crown or fang structure, to the evidence of embryology that the paracone (*?pa*, or antero-external cusp) is the oldest cusp. Fourthly, that it lends no support to the premolar-analogy theory, which was originally suggested by Huxley\* in his description of the teeth of the *Canidæ* in 1880, which has been supported by Scott and other palæontologists, and finally set forth with fresh arguments by Dr. Wortman; this 'premolar-analogy' theory is to the effect that the key to the past evolution of the molar teeth is to be found in the subsequent or present evolution of the premolar teeth, and that thus in many groups of animals at least the protocone occupies the same position in the upper molars as in the upper premolars. Fifthly, that all the known Upper Cretaceous mammals with triangular molars accord with the Upper Jurassic mammals in exhibiting the antero-internal cone as the main cone. Finally, that no such variations of structure are observed in the upper molars of the most primitive mammals as would be the case if there had been different modes of origin of the triangular or tritubercular crown.

In a succeeding article I shall take up and discuss some of the other points and theories raised in Dr. Wortman's interesting and important papers.

#### EXPLANATION OF PLATE XXI.

FIGURE 1.—Superior molars of *Dryolestes* Marsh. A. Series of the left side, external and crown views. B. Series of the right side, external, crown and internal views. Yale Museum.

*pr. pr. pr.*, main internal cusps believed to be protocones.

*?pa, ?me*, smaller external cusps believed to be para- and metacones.

*c, c, c*, external and internal cingula.

*i. o. f.*, infraorbital foramen.

FIGURE 2.—Superior molars of *Peralestes* Owen. Right side. External, oblique and crown views. British Museum.

*mts*, metastyle. Other abbreviations as in fig. 1.

FIGURE 3.—Superior molars of *Kurtodon* Osborn. Left side. British Museum.

\* Collected Memoirs, vol. iv, p. 450.

