ART. X V. — *The* STYLINODONTIA, *a Suborder of Eocene Edentates;* by O. C. MARSH.

IN the autumn of 1873, the writer obtained in the Eocene deposits of Wyoming the remains of an extinct mammal of great interest. The most striking feature was the lower molar teeth, all essentially alike, and inserted in deep sockets. They were nearly cylindrical in form, and all grew from persistent pulps. The outer and inner faces were covered with a thin layer of enamel. This type specimen was described by the writer, in this Journal, vol. vii, p. 532, May, 1874, under the name *Stylinodon mirus*, as representing a new genus and species. The affinities of this new form, so far as then determined, were recorded as follows:

"These specimens resemble in some respects the corresponding parts of the genus *Toxodon* Owen, from the Quaternary of South America; but may, perhaps, have some more affinities with the Edentates."

The writer subsequently made this new form the type of a distinct family, the *Stylinodontidæ*, and placed it under the order *Tillodontia* (this Journal, vol. ix, p. 221, March, 1875), and this reference, instead of the original suggestion as to its affinities with the Edentates, has been generally followed.

Fragmentary remains of the genus *Stylinodon* were subsequently obtained by the writer from time to time, in essentially the same horizon, but none of them threw much additional light on the affinities of this peculiar form. A fortunate discovery, in the spring of 1882, at a new locality, was a considerable part of the skull and skeleton of a second specimen apparently of the same species, and this material seemed sufficient to determine definitely the systematic position of *Stylinodon*, as soon as the specimen could be fully prepared for investigation. Owing to a pressure of other work, it was not until ten years later that this specimen was ready for the artist, and careful drawings made, when the Edentate affinities of the animal became more strongly apparent. The problem, however, was not a simple one, and the relation of the genus to other allied forms required careful consideration.

In an interesting paper recently published, Dr. J. L. Wortman discusses the affinities of this family, and presents an argument in favor of their being true Edentates.* This announcement makes it more important that the type specimen of the genus *Stylinodon* be figured, and that the second more perfect specimen be also illustrated and described, and this is the main object of the present communication.

* Bulletin American Museum of Natural History, vol. viii, pp. 259–262, 1896.

The Skull and Teeth.

Figures 1 and 2, below, represent respectively a portion of a large front incisiform tooth of the lower jaw of *Stylinodon*, and several of the adjacent molar series, all natural size, and pertaining to the original type specimen of *Stylinodon mirus*. The peculiar sculpture of the enamel of the anterior tooth, showing both the longitudinal grooves and the transverse lines of growth, is a characteristic feature of these teeth. In the molars, the two bands of enamel, external and internal, show markings similar, but less distinct. The large front tooth is apparently from the left side, the enamel shown being thus on the outer face. The other specimen containing the molar teeth is part of the right lower jaw, with the inner face removed, showing the base of the teeth. The sockets of six of these are represented in figure 2, and behind them one more may be seen in the inner part of the jaw, making together seven in this series, all of similar form and size. The lower jaw containing these eight teeth was short, deep, and massive, with a strong coronoid process, the base of which was in advance of the posterior teeth.

In the second specimen of *Stylinodon* already mentioned, the lower jaws agree in all respects with the type. The seven molar teeth have the same position and proportions as in that specimen. The roots of the large incisiform teeth extended backward as far as the base of the penultimate molars. The condyle of the lower jaw is massive and transverse, the articulation looking upward. Its motion was not limited by a post-glenoid process. The posterior margin of the jaw above the angle is thickened into a distinct process, which is somewhat incurved. The lower jaw is especially deep below the last molars, and the entire ramus is robust. The teeth of this genus and the great depth of the jaw below the last molars will distinguish it from *Dryptodon*, described by the writer from a lower horizon.

The skull of *Stylinodon* is short and massive. The temporal fossæ are especially large, and are separated above by a high ridge. The brain cavity was small. The occipital plane is narrow, and the sides converge above and meet at the junction with the sagittal crest. The occipital condyles are small, and there are no distinct paroccipital processes.

The Vertebræ.

The cervical vertebræ of *Stylinodon* are well shown in figure 3, below, which represents the series in the natural position essentially as found. The centra are very short, with the articular faces nearly flat. The axis has a long neural spine directed backward, but the succeeding cervicals have only rudimentary spines, as indicated in the figure.

The first dorsal vertebra has a very high, strong spine, as shown in figures 3 and 4. The other anterior dorsals have also elevated neural spines, and nearly flat articular faces on the centra.

The Scapular Arch.

The scapula of *Stylinodon* is narrow, with the acromion projecting but slightly below the glenoid fossa, as shown in figure 5. The posterior border is not expanded. The anterior portion is somewhat wider than the posterior, and there is no coracoid process. There is a well-developed clavicle. This is of moderate size, with the shaft somewhat flattened. It articulated above with the lower end of the acromion, and below with the sternum, but is not represented in the figures.

1. 2.

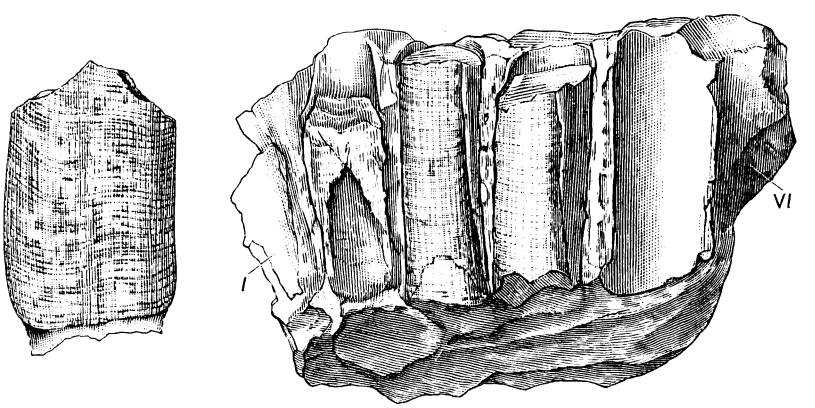

FIGURE 1.—Left incisiform tooth of *Stylinodon mirus*, Marsh; outer view.
FIGURE 2.—Molar series of right lower jaw of same individual; inner view. I, socket of first premolar; VI, socket of penultimate molar.
Both figures are natural size.

The Fore Leg.

The fore leg of *Stylinodon mirus*, as represented in the second specimen above mentioned, is shown in figure 5, one-fourth natural size, with the scapula (*s*), the whole nearly in the position in which it was found. The humerus (*h*) is seen in this figure from the outside, and its connections above and below are clearly indicated. As this bone is especially characteristic, both of the genus and to a certain extent of the order, it is important to present here all its typical features.

3.

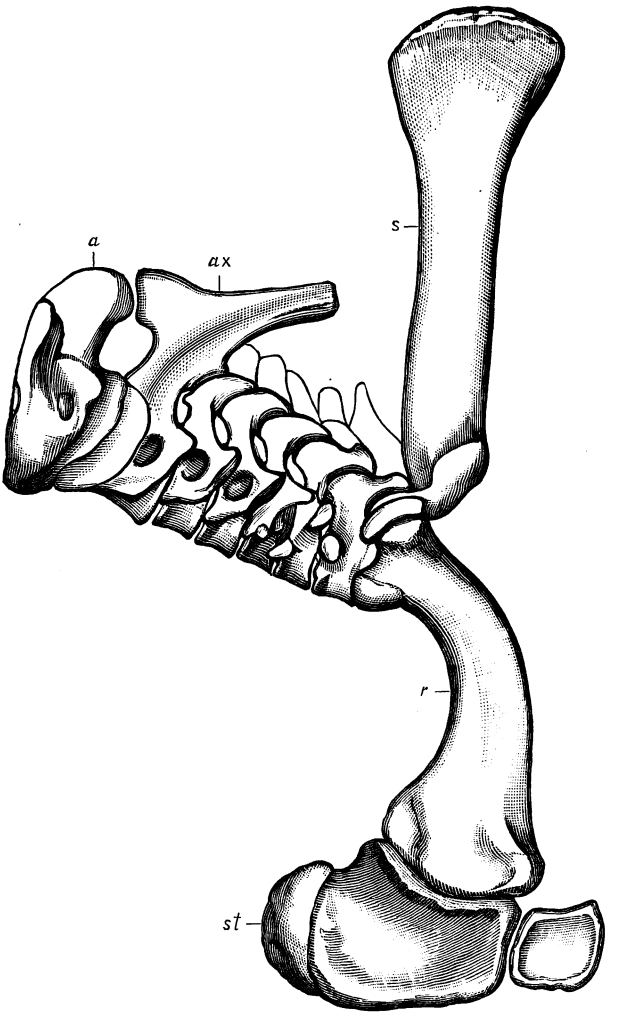

FIGURE 3.—Cervical vertebræ of *Stylinodon mirus*, with first dorsal vertebra, rib, and sternum, in position; seen from the left. One-half natural size. *a*, atlas; *ax*, axis; *r*, rib; *s*, spine of first dorsal vertebra; *st*, sternum.

These are seen to good advantage in figures 6 and 7, where the bone is represented one-half natural size. These figures render a detailed description unnecessary. This bone, like all those of the skeleton, is solid, there being no medullary cavity.

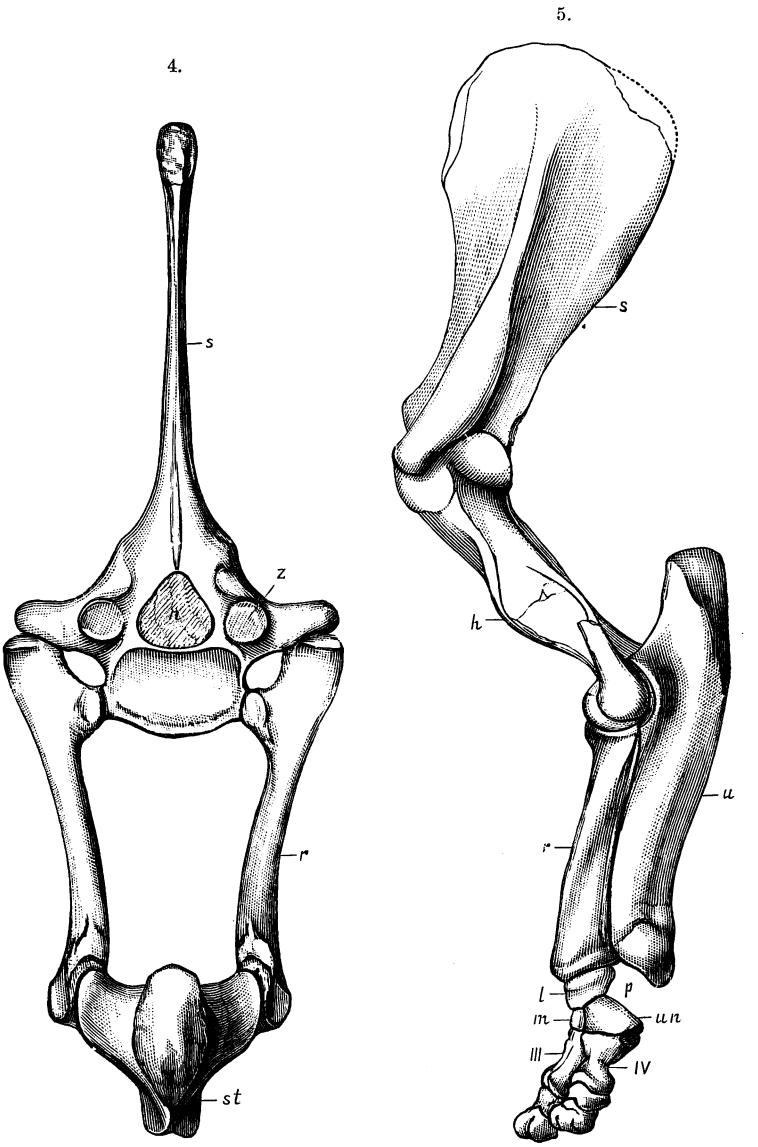

FIGURE 4.—First dorsal vertebra of *Stylinodon mirus*, with ribs and sternum in position; front view. One-half natural size.
n, neural canal; *r*, rib; *s*, spine; *st*, sternum; *z*, anterior zygapophysis.

FIGURE 5.—Left fore leg of same individual; outside view. One-fourth natural size.
h, humerus; *l*, lunar; *m*, magnum; *p*, place for pyramidal; *r*, radius; *s*, scapula; *u*, ulna; *un*, unciform; III, third metacarpal; IV, fourth metacarpal.

The inner structure of the shaft is shown in figure 7, *b*. The peculiar head of this humerus, with its strong tuberosity, the prominent deltoid ridge, and the supinator crest below, together with the supracondylar foramen and distal articulation, are all characteristic features, and taken together clearly indicate the Edentate nature of the animal to which this bone belonged.

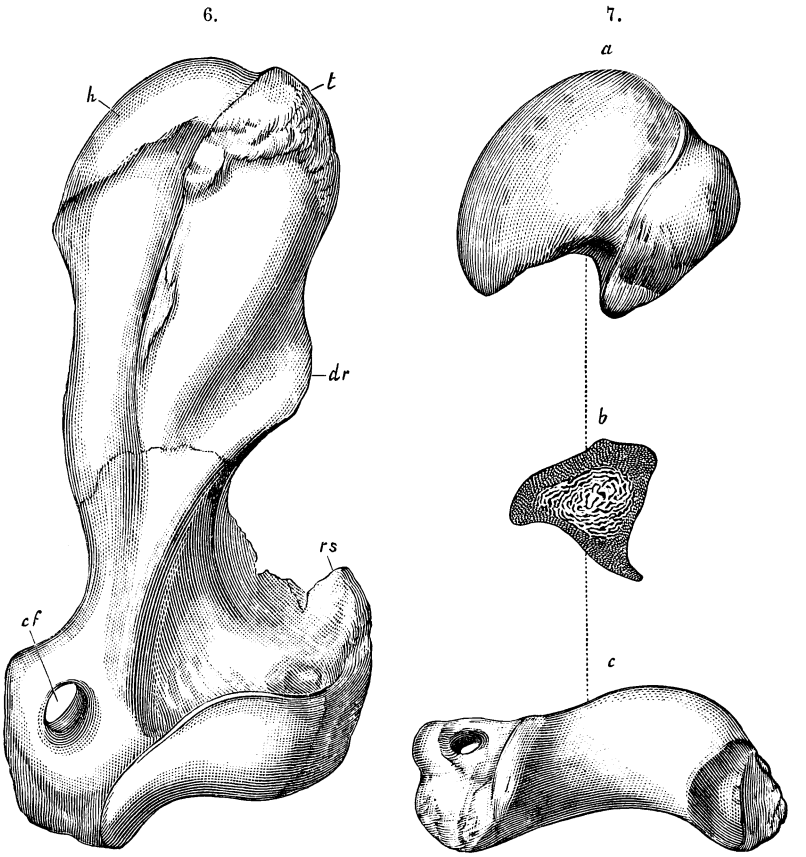

FIGURE 6.—Left humerus of *Stylinodon mirus;* front view.
cf, supracondylar foramen; *dr*, deltoid ridge; *h*, head; *t*, external tuberosity; *rs*, supinator ridge.
FIGURE 7.—Ends and section of same bone.
a, proximal end; *b*, transverse section; *c*, distal end.
All the figures are one-half natural size.

The radius and ulna are shown in position in figure 5. The radius (*r*) is much the smaller bone, and is placed nearly in front of the ulna (*u*). The latter is quite robust, and has a strong, powerful olecranon process, as shown in the figure. These bones also are Edentate in type.

The bones of the carpus and manus of this individual are only in part preserved, but those represented in figure 5 will serve to indicate the general nature of the fore foot. There were apparently five digits in this foot, although the fifth was small or rudimentary. The metacarpals were quite short, as indicated by the third and fourth. The phalanges were also short, and the median ones, at least, possessed claws.

The above description and figures of *Stylinodon* will in themselves be conclusive evidence to most anatomists that this genus has close affinities with the Edentates, if it is not a typical member of that group. Its relation to other allied genera will be discussed in a later communication.

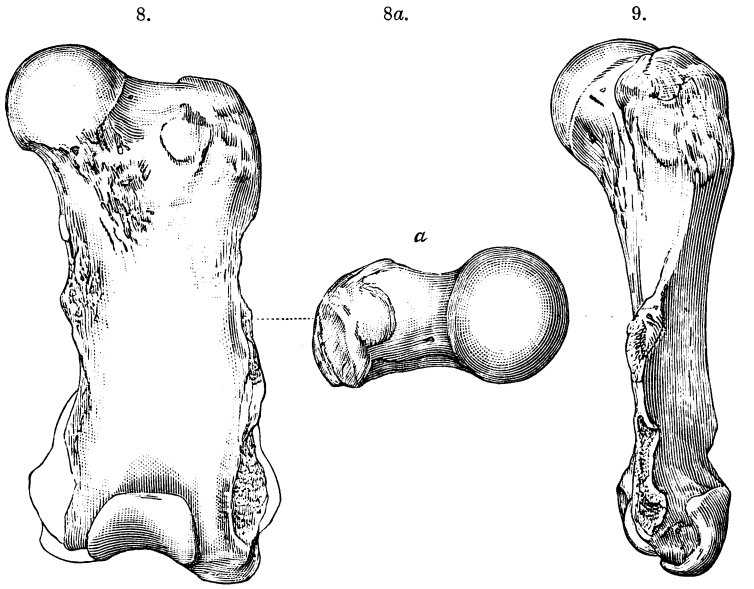

FIGURE 8.—Left femur of *Morotherium gigas*, Marsh; front view.
FIGURE 8*a*.—Proximal end of same bone.
FIGURE 9.—The same bone; outer view.
All the figures are one-sixth natural size.

The reference in the original description of *Stylinodon* to its resemblance with *Toxodon* is also worthy of some consideration, as the latter genus is now believed to be nearly related to various forms long considered Edentates, but at present regarded by many as aberrant Ungulates, since, notwithstanding the apparent resemblance of the feet to those of Edentates, the teeth indicate affinities with the perissodactyles.

This peculiar group, the *Chalicotheria*, of which *Chalicotherium*, Kaup, is the type genus, is now known to have its

representatives in America, Europe, and Asia. One genus, *Ancylotherium*, from the Miocene of Greece, was described by Gaudry as an Edentate. The term *Ancylopoda* derived from this genus has been recently used for the whole group, but, as the writer has already suggested, should be replaced by the name *Chalicotheria*.*

To this group, the genera *Moropus* and *Morotherium*, described by the writer as Edentates,† have been recently referred by some authors not familiar with the specimens on which these genera were based. While it is possible that the nature of some of the remains attributed to the former genus may be fairly in doubt, there can be no question that the two known species of *Morotherium* are both true Edentates. The type specimen of the latter genus is well represented in figures 8 and 9, above. It was mainly the remains of these two genera that suggested to the writer some important conclusions as to the early history of Edentate mammals, which are in part quoted below, since they seem to have been overlooked by recent writers.

Origin of the Edentates.

The affinities of the *Stylinodontia* as now determined have brought up again a most interesting question as to the origin and former geographical distribution of the Edentates, and it may not be out of place to repeat here what the writer said on this subject nearly twenty years ago, in an address before the American Association for the Advancement of Science, at the Nashville meeting, August, 1877.‡ The main passages relating to the Edentates are as follows:

"The Edentate mammals have long been a puzzle to zoölogists, and up to the present time no clew to their affinities with other groups seems to have been detected. A comparison of the peculiar Eocene mammals which I have called the *Tillodontia*, with the least specialized Edentates, brings to light many curious resemblances in the skull, teeth, skeleton, and feet. These suggest relationship, at least, and possibly we may yet find here the key to the Edentate genealogy. At present, the Tillodonts are all from the lower and middle Eocene, while *Moropus*, the oldest Edentate genus, is found in the middle Miocene, and one species in the lower Pliocene." * * *

*The term *Ancylopoda* is preoccupied, having been used by Gray, in 1848, for a group of Brachiopoda.

† This Journal, vol. vii, p. 531, May, 1874; and vol. xiv, p. 249, September, 1877.

‡ Introduction and Succession of Vertebrate Life in America. This Journal, vol. xiv, pp. 338–378, November, 1877.

"The Edentate Mammals are evidently an American type, and on this continent attained a great development in numbers and size. No Eocene Edentates have been found here, and, although their discovery in this formation has been announced, the identification proves to have been erroneous. In the Miocene of the Pacific coast, a few fossils have been discovered which belong to animals of this group, and to the genus *Moropus*. There are two species, one about as large as a tapir, and the other nearly twice that size. This genus is the type of a distinct family, the *Moropodidæ*. In the lower Pliocene above, well-preserved remains of Edentates of very large size have been found at several widely-separated localities in Idaho and California. These belong to the genus *Morotherium*, of which two species are known. East of the Rocky Mountains, in the lower Pliocene of Nebraska, a large species apparently of the genus *Moropus* has been discovered. The horizon of these later fossils corresponds nearly with beds in Europe that have been called Miocene. In the Post-Pliocene of North America, gigantic Edentates were very numerous and widely distributed, but all disappeared with the close of that period. These forms were essentially huge sloths, and the more important were *Megatherium*, *Mylodon*, and *Megalonyx*." * * *

"It is frequently asserted, and very generally believed, that the large number of huge *Edentata* which lived in North America during the Post-Pliocene were the results of an extensive migration from South America soon after the elevation of the Isthmus of Panama, near the close of the Tertiary. No conclusive proof of such migration has been offered, and the evidence, it seems to me, so far as we now have it, is directly opposed to this view. No undoubted Tertiary Edentates have yet been discovered in South America, while we have at least two species in our Miocene, and, during the deposition of our lower Pliocene, large individuals of this group were not uncommon as far north as the forty-third parallel of latitude, on both sides of the Rocky Mountains. In view of these facts, and others which I shall lay before you, it seems more natural to conclude, from our present knowledge, that the migration, which no doubt took place, was from north to south. The Edentates, finding thus in South America a congenial home, flourished greatly for a time, and, although the larger forms are now all extinct, diminutive representatives of the group still inhabit the same region." * * *

"The Edentates, in their southern migration, were probably accompanied by the horse, tapir, and rhinoceros, although no remains of the last have yet been found south of Mexico.

The mastodon, elephant, llama, deer, peccary, and other mammals, followed the same path. Why the mastodon, elephant, rhinoceros, and especially the horse, should have been selected with the huge Edentates for extinction, and the other Ungulates left, is at present a mystery, which their somewhat larger size hardly explains." * * *

"I have already given you some reasons for believing that the Edentates had their first home in North America, and migrated thence to the southern portion of the continent. This movement could not have taken place in the Miocene period, as the Isthmus of Darien was then submerged; but, near the close of the Tertiary, the elevation of this region left a much broader strip of land than now exists there, and over this the Edentates and other mammals made their way, perhaps urged on by the increasing cold of the glacial winters. The evidence to-day is strongly in favor of such a southern migration. This, however, leaves the Old World Edentates, fossil and recent, unaccounted for; but I believe the solution of this problem is essentially the same, namely, a migration from North America. The Miocene representatives of this group, which I have recently obtained in Oregon, are older than any known in Europe, and, strangely enough, are more like the latter and the existing African types than like any of our living species. If, now, we bear in mind that an elevation of only 180 feet would close Behring's Straits and give a road thirty miles wide from America to Asia, we can easily see how this migration might have taken place. That such a Tertiary bridge did exist, we have much independent testimony, and the known facts all point to extensive migrations of animals over it."

The discoveries made within the last two decades, or since the above was written, have added much to a knowledge of the subject here discussed, but have not modified materially the conclusions given in the foregoing quotations. In regard to the origin and distribution of the Edentates, present evidence tends to confirm the opinion there recorded, that this great group of peculiar mammals originated in North America, and migrated to other parts of the earth, where their remains have since been found, or their living representatives still exist.

Yale University, New Haven, Conn., January 19th, 1897.