APPENDIX.

ART. XI. — *Principal Characters of the Coryphodontidæ;* by Professor O. C. MARSH. With plate IV.

NEAR the base of the Eocene, in the Rocky Mountain region, are numerous remains of a well marked group of mammals which the writer has termed the *Coryphodontidæ*.* These animals are of peculiar interest, both on account of their structure and affinities, and especially as they are among the oldest of Tertiary Mammals, and mark a definite geological horizon in this country and Europe. Only the single genus, *Coryphodon*, is known, and this was established, in 1846, by Owen, who described a characteristic fragment of a lower jaw from the London Clay of England.† Other imperfect specimens were subsequently found in France, and fully described by Hébert,‡ but up to the present time very little is known of this genus from European specimens.

The identification of the American remains with the genus *Coryphodon* of Owen, and the determination thereby of a definite horizon, common to the two countries, and containing the oldest known Tertiary Mammals, was published by the writer in April, 1876, and subsequently in the following number of this Journal (vol. xi, p. 425.)§

The Museum of Yale College contains a large collection of *Coryphodon* remains from Utah, Wyoming, and New Mexico, and this material is amply sufficient to indicate all the more important characters of the group. Among these specimens are portions of the same individuals described by Cope under the names *Bathmodon* and *Loxolophodon*,‖ both of which are synonyms of *Coryphodon*, as the remains on which they were based clearly belong to that genus. One of the species best represented in the Yale collection is *Coryphodon hamatus* Marsh, and this has afforded many of the characters given below.

* This Journal, vol. xi, p. 428, May, 1876.

† British Fossil Mammals and Birds, p. 299.

‡ Annales des Sciences Naturelles, tome vi, p. 87, 1856.

§ In the American Naturalist (vol. xi, p. 95), Prof. Cope has recently claimed this discovery on the strength of a paper which he read before the Spring Meeting of the National Academy, in 1876. He knew, however, at the time that my article was already published, and during the reading of his paper, a printed copy of my publication was in the room, in the hands of a member.

‖ Proceedings American Philosophical Society, 1872, p. 420.

The skull of *Coryphodon*, in all its more important characters, is of the perissodactyl type. It is elongated, and the facial portion is most produced. A line drawn from the lower margin of the foramen magnum along the palate is nearly straight. The zygomatic arches are expanded, but the malar is comparatively slender, and unites with the maxillary in front of the orbit. The general form of the skull is shown in the accompanying plate, figure 1. The maxillaries are massive, and usually deeply indented on the sides behind the canines. The lachrymal forms the anterior border of the orbit, and its foramen is inside the orbital margin. The nasals are slender in front, and broad posteriorly. The premaxillaries are expanded transversely, and the narial aperture is wide. The occipital condyles are well separated, and there are condylar foramina. Between the basisphenoid and the periotic, there is a large opening. There is a paroccipital, and a post-glenoid process.

The dental formula of *Coryphodon* is as follows:

$$\text{Incisors } \frac{3}{3};\ \text{canines } \frac{1}{1};\ \text{premolars } \frac{4}{4};\ \text{molars } \frac{3}{3};\ \times 2 = 44.$$

The teeth in American specimens do not differ essentially from those described by Owen and Hébert, which are well represented in the memoir of the latter author, cited above.

The brain cavity in *Coryphodon* is perhaps the most remarkable feature in the genus, and indicates that the brain itself was of a very inferior type. It was quite small, as in all Eocene mammals, but its most striking features were the small size of the hemispheres, and the expanded cerebellum. The form and relative size of these are shown in the accompanying plate, figure 1.

The olfactory lobes were large, and entirely in advance of the hemispheres. They were bounded in front by a well ossified cribriform plate, and partially separated by a vertical bony septum. The cerebral lobes were ovate in form, and very small, a transverse section exceeding but little that of the medullar opening. In shape and relative size, the hemispheres and olfactory lobes of this genus are somewhat similar to those of *Dinoceras*. The cerebellum was proportionally large, and widely expanded transversely. Its peculiar form is shown in figure 1, which is drawn from a cast of the brain-cavity of *C. hamatus*. This portion of the brain nearly or quite equaled the hemispheres in size, thus differing widely from any known mammal. There is a well marked pituitary fossa, but no clinoid process. The foramina for the exit of the optic nerves are small, but for the others very large. The brain as a whole was very low in grade, and precisely such as might be expected in a mammal from the oldest Tertiary deposits.

These essential characters of the brain of *Coryphodon* were determined and published by the writer more than a year ago, with figures of a very perfect cast of the brain-cavity. (This Journal, vol. xi, p. 427.) Two skulls, in remarkable preservation, were examined during the investigation, and the results have since been confirmed by other specimens in the Yale Museum.

These facts are important, since Cope has recently published a paper on the same subject, and given descriptions and figures of the brain case of *Coryphodon* which differ materially from my own.* He makes no reference to my article, although perfectly familiar with it. A comparison of his figures with the specimens mentioned above, shows at once that he has made most serious mistakes in his observations. What he represents as olfactory lobes, are unlike anything in nature, and are merely a cast from an imperfect skull in which the mesethmoid septum, and the cribriform plate are both evidently imperfect or wanting. Similar errors are apparent in other portions of the figures, and his classification, based on these and like observations, is untenable, as the known facts are against it.

The vertebræ of *Coryphodon*, in their more important characters, resemble those of *Dinoceras*. The cervicals are proportionately longer. The odontoid process of the axis is a short peg. The articular faces of the cervicals and dorsals are nearly flat. The caudals indicate a tail of moderate length.

The limbs of *Coryphodon* were comparatively short. The scapula is acuminate above, as in *Dinoceras* and the Elephant. The humerus is much less massive than in *Dinoceras*, but otherwise resembles it. The deltoid ridge extends beyond the middle of the shaft. The distal end of the humerus is compressed antero-posteriorly, and the ulnar side of the articulation is much more prominent than the radial, thus approaching the Rhinoceros where it departs from *Dinoceras*. The radius is proximally smaller, compared with the ulna, than in Rhinoceros. Its distal end is larger than that of the ulna.

The femur of *Coryphodon* is of the perissodactyl type, and has a distinct third trochanter. The tibia, when in position, was not in the same line with the femur, as in *Dinoceras* and the Elephant, but was inclined at a moderate angle. The fibula was entire, and its distal end articulated with both the astragalus and calcaneum.

The feet of *Coryphodon*, hitherto essentially unknown, resemble most nearly those of *Dinoceras*, and can perhaps be best illustrated by a direct comparision with them. In the following figures (see plate iv), the feet of these two genera are placed side by side, and in the same position. The main points of difference between them are stated below.

* Proceedings American Philosophical Society, p. 616, 1877.

The manus and pes of *Coryphodon* had each five short digits. The carpal bones are shorter, measured in the line of the foot, than in *Dinoceras*, and the distal row present more curved articular faces to the metacarpal bones, indicating greater freedom of motion. The pyramidal is destitute of the tubercle projecting outward and forward for the support of the fifth digit, seen in *Dinoceras*. The metapodial bones and phalanges are throughout less roughened and tubercular than in *Dinoceras*, and all their articular faces indicate greater flexibility in the feet. The ungual phalanges expand laterally for the support of the hoofs, instead of being rounded, as in *Dinoceras*.

In the hind foot, the astragalus, and in a less degree the cuboid and navicular bones are shorter, along the line of the foot, than the corresponding bones of *Dinoceras*. The astragalus has the tibial articulation less convex, and the fibular articulation more extensive, covering the whole exterior or fibular side of the bone. The navicular and cuboid faces are more distinctly separated, and make a greater angle with each other than in *Dinoceras*. The calcaneum approaches the ordinary perissodactyl type, the shaft being much longer than in *Dinoceras*, and the tubercular surface below for the support of a plantar pad, seen in the Elephant and *Dinoceras*, is undeveloped. The cuboid is of peculiar shape, being sub-triangular. The calcaneal face is long and oblique, reaching nearly to the face for the fifth metatarsal. Both the metatarsal articulations are essentially in one plane, and are separated only by a very slight ridge. The navicular articulates very slightly, if at all, with the cuboid, but covers the face of the astragalus, and fully supports the ectocuneiform. The latter bone is not at all supported by the astragalus, as asserted by Cope (Catalogue of Vertebrata of the Eocene of New Mexico, p. 27). He has also published a remarkable figure of the hind foot of *Coryphodon* (Bathmodon), showing the hallux with three phalanges, and the fifth digit reduced to a rudiment (loc. cit., p. 28).

The average size of the animals of this genus was about that of the existing Tapir. Some were smaller, and others nearly twice as large. Their mode of life was probably similar.

A careful consideration of the characters of *Coryphodon*, so far as now known, indicates that the genus represents a distinct family of perissodactyl Ungulates, the *Coryphodontidæ*. The skull is clearly of this type, and the skeleton and feet present no differences sufficiently important to justify a separation from that natural order. Only a slight modification of the limits of the *Perissodactyla*, would bring this five-toed genus into it, and simplify classification.

The geological horizon of *Coryphodon* in this country is near the base of the Eocene, in the strata named by the Survey of

the Fortieth Parallel, under Clarence King, the Vermillion Creek series, and by Hayden the Wasatch group. The known localities are in Utah, Wyoming and New Mexico. Among the associate mammals are the equine *Eohippus*, and the suilline *Helohyus*, showing clearly that we must look to Cretaceous strata at least for the parent form of the Ungulates.

Yale College, June 12th, 1877.

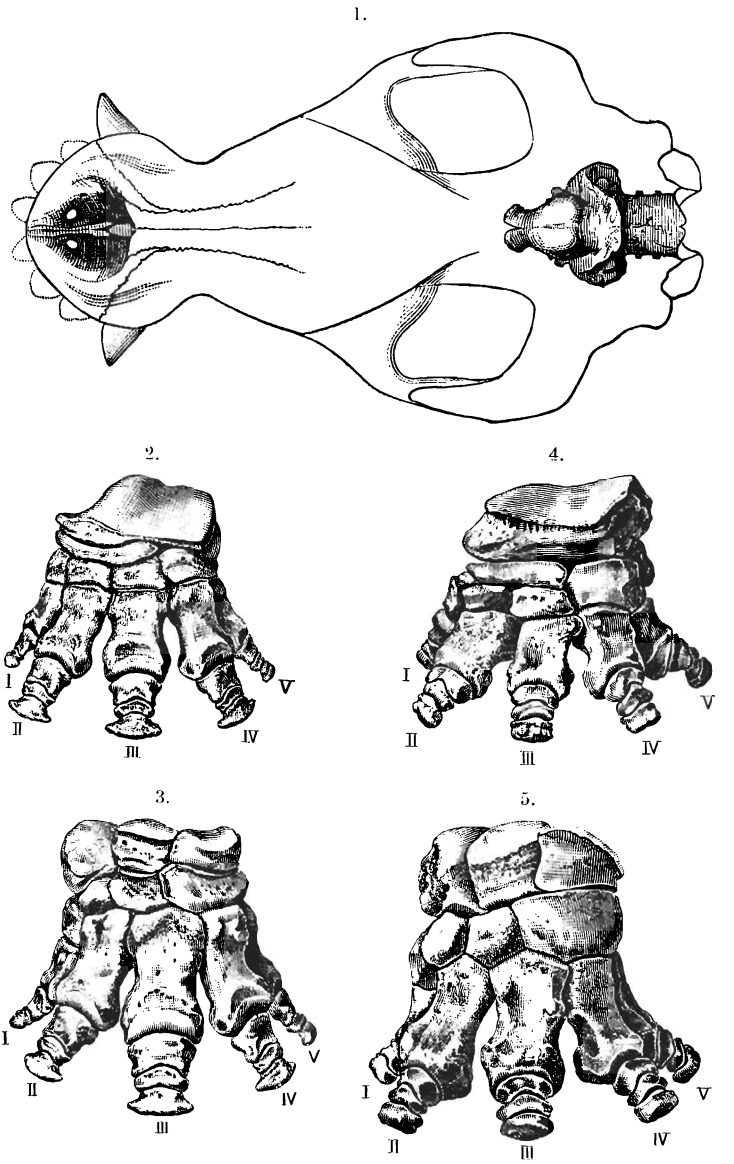

Figure 1.—Outline of skull and brain-cavity of *Coryphodon hamatus* Marsh; top view. About one-fifth natural size.
Figure 2.—Hind foot of *Coryphodon*: front view.
Figure 3.—Fore foot of *Coryphodon*; front view. Both one-third natural size.
Figure 4.—Hind foot of *Dinoceras*; front view.
Figure 5.—Fore foot of *Dinoceras*: front view. Both one-fifth natural size.