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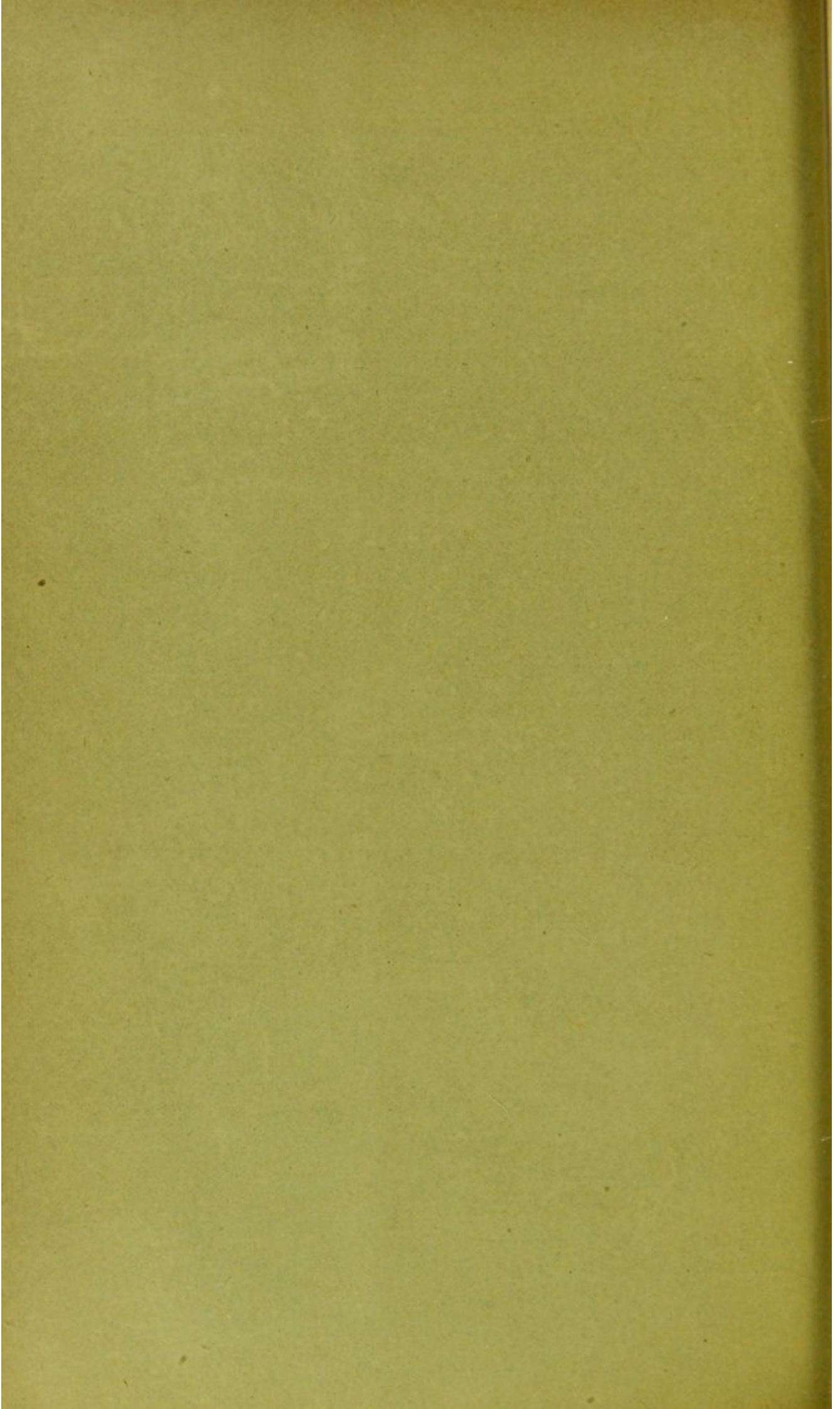
[FROM THE AMERICAN JOURNAL OF SCIENCE, VOL. XLVI, OCT., 1893.]

RESTORATION OF CORYPHODON.

WITH TWO PLATES.

By O. C. MARSH.





Restoration of Coryphodon; by O. C. MARSH.
(With Plates V and VI.)

THE genus *Coryphodon*, established by Owen in 1846, is of great importance alike to geologists and paleontologists. It represents a remarkable group of large ungulate mammals now known to have lived both in America and Europe during early Eocene time. The remains are found in a distinct horizon, essentially the same in each continent. This horizon is so well marked that geologists may use it as a base for determining the age of other strata. The coryphodont mammals themselves are of special interest to anatomists, owing to the primitive characters shown in the skeleton. Perhaps their greatest importance lies in the fact, that these large hoofed mammals make their appearance suddenly in great numbers at the base of the Tertiary, without a hint as to their ancestral line, and with only diminutive generalized forms for their Mesozoic predecessors.

In Europe, various coryphodont remains, especially teeth, have been known under various names since the time of Cuvier, the first specimen, a molar tooth, having been found in 1807. All the remains since discovered there have likewise been fragmentary, and descriptions of them will be found in the works of Owen, Hébert, de Blainville, and more recent authors. A summary of the literature is given in the Palæontology of von Zittel, Volume IV, now in press.

The first specimen of *Coryphodon* discovered in America was found in 1871, near Evanston, Wyoming, by William Cleburne, while engaged as surveyor for the Union Pacific Railroad. He secured various remains, chiefly teeth and vertebræ, which were found together, and apparently belonged to a single individual. Some of these specimens he gave the same year to Prof. F. V. Hayden for transmission to Dr. Joseph Leidy, who failed to receive them. They were subsequently described by Prof. E. D. Cope under the new generic names *Bathmodon* and *Loxolophodon*.* Portions of the same skeleton, including both teeth and vertebræ, were later given to the writer by Mr. Cleburne, and with them the above statement of the discovery and disposition of the specimens found. Prof. Cope, in 1872, gave the name *Metalophodon* to a specimen from another locality in Wyoming, and subsequently (1873-1875), in several papers, and under the above generic names, described various remains from Wyoming and New Mexico. He also gave figures of a molar tooth, the hind foot, and a skull, all of which he referred to his genus *Bathmodon*.

* Proc. Amer. Philos. Soc., vol. xii, pp. 417 and 420, 1872.

In the meantime, the writer had been investigating remains of the same group from Wyoming and New Mexico, including portions of the original specimen found by Mr. Cleburne, and other material of much interest. It was soon ascertained (1) that all these remains were apparently identical with those of the genus *Coryphodon*, Owen, as described and figured by him and Hébert;* and (2) that the geological horizon of these fossils was essentially the same both in America and Europe. An investigation was made of the skull, and especially of its brain-cavity, the latter indicating a brain of very inferior type. The feet proved to be of a primitive form, the manus and pes each having five, very short, functional digits. The remains studied belonged to a new family, named by the writer the *Coryphodontidæ*. These and other results were brought together in a paper entitled "On some Characters of the genus *Coryphodon*, Owen," and in it were given figures of the skull and the brain-cavity of a new species, *Coryphodon hamatus*. This paper was published separately, April 15, 1876, and subsequently appeared in this Journal, vol. xi, p. 425, May, 1876.

Subsequent to the publication of these determinations by the writer, Prof. Cope admitted, in several papers, the reference of these remains to the genus *Coryphodon*, and the identity of the horizons in this country and Europe in which they were found, but without referring to the above article on the subject. He likewise described in detail, and figured, in 1877, what he considered a brain-cast of *Coryphodon*, but again without any reference to the paper in which, the year before, the writer had given accurate figures of the brain-cast of that genus. In the specimen described by Prof. Cope, the cribriform plates of the brain-case were apparently wanting, so that in the cast figured the olfactory lobes appear to extend far forward, thus giving a wrong idea of the original brain.†

In the same year, 1877, the writer published a second article under the title, "Principal Characters of the *Coryphodontidæ*," in which he gave more in detail a description of the skull and brain-cast of *Coryphodon*, with a figure, and also the main facts in regard to the skeleton. The feet of this genus, before practically unknown, were described and figured, and especially compared with those of *Dinoceras*, which were also represented for comparison.‡ In Plate V of the present article, the original figures of the feet of *Coryphodon*, as given by the writer in 1877, are repeated. The original figure, also, of the

* British Fossil Mammals and Birds, p. 299, 1846; and Annales des Sciences Naturelles, tome vi, p. 87, 1856.

† Proc. Amer. Philos. Soc., vol. xvi, p. 616, plates i-ii, 1877. See also Amer. Naturalist, vol. xi, p. 312, and p. 375, 1877.

‡ This Journal, vol. xiv, p. 81, plate iv, July, 1877.

skull and the brain-cast, given by the writer first in 1876, and again in 1877, is repeated below, figure 1.

In another publication (this Journal, vol. xiv, p. 354, 1877), the writer defined more fully the horizon in the lower Eocene in which the *Coryphodontidæ* had been found in this country, and named the deposits the Coryphodon beds.

1.

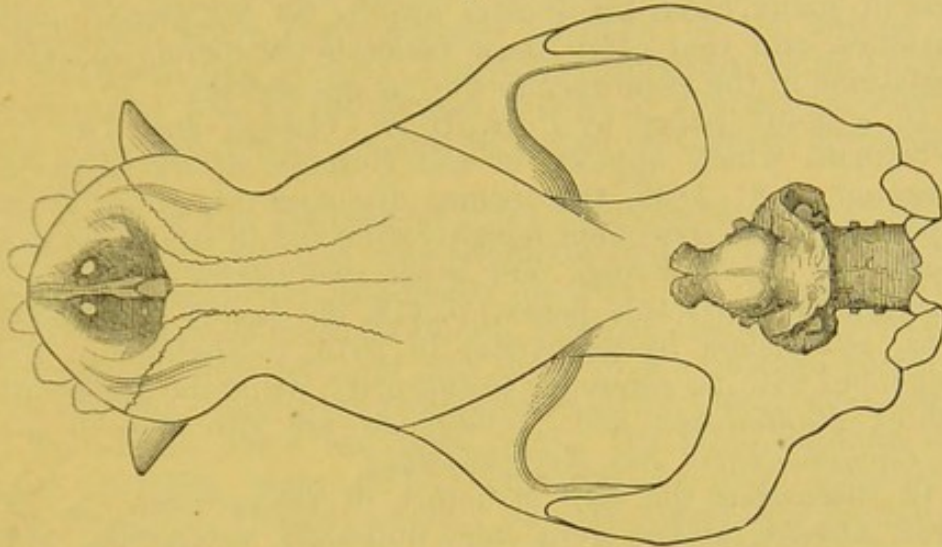


Figure 1.—Outline of skull and brain-cavity of *Coryphodon hamatus*, Marsh; top view. About one-fifth natural size.

The most important publication of Prof. Cope on the *Coryphodontidæ* will be found in Volume IV of the Wheeler Survey, published in 1877. The remains of a number of different forms, mainly from New Mexico, are described and figured, and the relations of the group to some allied mammals are discussed. In the following year, Prof. Owen published again on *Coryphodon*, in the Annals and Magazine of Natural History (vol. ii, p. 216, 1878), giving figures of some American forms. In various papers, Prof. Cope subsequently referred to the *Coryphodontidæ*, naming several supposed species and two genera, *Manteodon* and *Ectacodon*, but adding little of importance to what was already known of the group. In his volume on "The Vertebrata of the Tertiary Formations of the West," 1884, he again discusses at length the *Coryphodontidæ*, and gives a number of new figures. The historical part, pp. 513-517, is marred by many errors, characteristic examples of which may be seen in two footnotes, pp. 513 and 516. The statements there made are erroneous, as has already been shown in the present article.

In his monograph on the *Dinocerata*, 1884, the writer discussed the various relations of the *Coryphodontidæ* to the *Dinocerata*, giving figures of the skull and brain-cast, the upper and lower molar teeth, and the feet, of *Coryphodon hamatus*. The name *Amblydactyla* was substituted for *Amblypoda*, and *Coryphodontia* for *Pantodonta*, the names replaced both being essentially preoccupied.

Two recent papers by Mr. Charles Earle, on the *Coryphodontidæ*, are of interest.* He treats of the teeth of this group, especially of their variations and homologies, and gives figures of some of the most characteristic forms. He also discusses at length the various American species named, and decides "that the large number of species which have been founded by Prof. Cope should be greatly reduced; and that in many cases his species are to be considered merely varieties, and that often these varieties are merely individual variations in the same species due to age and sex."

In a joint paper by Prof. H. F. Osborn and Dr. J. L. Wortman, which appears in the Bulletin of the American Museum, p. 81, 1892, the former discusses this group briefly, especially some specimens recently collected in the Wind River region by Dr. Wortman, and gives two figures of the feet of *Coryphodon*. In this paper, p. 118, the family *Coryphodontidæ*, established by the writer in 1876, is credited to Prof. Cope, but with no reference as authority, while the preoccupied names *Pantodonta* and *Amblypoda* are also used in place of *Coryphodontia* and *Amblydactyla*.

In discussing the foot structure of *Coryphodon* (p. 121), Prof. Osborn makes some very emphatic statements, which are important if true, but he gives no facts to support them, and there is good evidence that he is in error. One statement is as follows: "the positions of the fore and hind feet of *Coryphodon* were absolutely different, the *fore foot was digitigrade* like that of the Elephant, and the *hind foot was plantigrade* like that of the Bear." These positions are shown in his figures, which afford no evidence to support the statement, especially in regard to the hind foot. Again, in giving the characters of the feet, Prof. Osborn adds to what was already known, that the "second metacarpal" has a vertical ectocuneiform facet; a statement likewise open to question. Another assertion (p. 122) nearly as strange is, that in "The figure of the pes of *Coryphodon* given by Marsh the astragalus is represented as *covering the entire upper surface of the cuboid*." A reference to the figure in question (Plate V, fig. 2) will, however, show this statement, also, to be wrong, as the calcaneum covers about half the cuboid. This fact was clearly stated in the text when the figure was first published. The "unique caudal appendage" described by Prof. Osborn (p. 120), and the suggestion in regard to its use, do not require special notice here. The above points will be discussed later in the present article.

* Science, vol. xx, p. 7, 1892; and Bull. Amer. Mus., vol. iv, p. 149, 1892.

Restoration of Coryphodon hamatus.

After the above brief review of the more important literature relating to the coryphodont mammals found in America, the main object of the present article, the restoration of one species of *Coryphodon*, may be considered. In Plate VI, this restoration is given, one-twelfth natural size. The position shown was chosen after careful consideration, and is believed to represent fairly one naturally assumed by the animal in life, when standing at rest. The figure represents a fully adult individual of one of the largest species of the genus, which, when alive, was nearly six feet in length, and about three feet in height.

The basis of this restoration is the type specimen of *Coryphodon hamatus*, and this was supplemented by other remains which appeared to be specifically identical. A large number of such specimens were available, some of them in excellent preservation. For parts of the skeleton where such remains were wanting, specimens from nearly allied forms were used, but no serious error can thus result. In these remains, the caudal vertebræ were seldom preserved in good condition, and although a sufficient number of such specimens from different individuals were at hand, the exact number in the present species could not be determined, and hence the vertebræ of the tail are left in outline.

No clavicles are represented in the restoration, and no evidence of their existence has been found by the writer in the many remains investigated. The specimens described by Prof. Cope as clavicles of *Coryphodon* probably do not pertain to that genus. A bone very similar in shape to the supposed clavicles was figured by him as the fifth metatarsal, in the first diagram he published of the hind foot of *Coryphodon*. The same figure has three phalanges in the first digit, and the ecto-cuneiform supported mainly by the astragalus; features not seen elsewhere by the writer.

The feet of Coryphodon.

The structure and position of the feet of *Coryphodon*, as represented in the restoration, require some consideration in this connection, in view of differing opinions on these points. The fore feet of *Coryphodon* were first figured and described by the writer, and on Plate V, figure 1, is the original cut then published. This figure was made from a well-preserved specimen in which both fore feet were present, and nearly in position when found. They were carefully kept in the matrix until prepared for the drawing, and hence the accuracy of the figure cannot well be questioned. The fore feet represented

in the present restoration are constructed mainly from the same specimen, and the position given in the original figure has been essentially retained. The small size of the restoration does not permit as accurate an exhibition of the structure of the feet as could be desired, but the main features are clearly shown. In this species, the pyramidal bone (cuneiform) touches the fifth metacarpal, and helps to support it, as in *Dinoceras*, as already shown by the writer. This is the rule in adult individuals of *Coryphodon*, but in young specimens, the metacarpal facet on the pyramidal may be indistinct or even wanting, as is sometimes the case with weathered specimens.

The hind feet of *Coryphodon* were investigated by the writer at the same time as the fore feet, and figure 2, Plate V, of the left pes was published with figure 1, and is believed to be equally accurate. Being a front view, it does not fully show the relations to each other of the astragalus, calcaneum, and cuboid, but the other elements are clearly exhibited. The position first given to the figure is retained in the restoration after a careful investigation of the whole posterior limbs in a number of well-preserved specimens. These differ considerably among themselves, but the essential structure is identical in all. The feet bones of some of these specimens are very perfect, and their relations to each other cannot well be misinterpreted.

The accompanying Plate V gives together the left fore and hind feet of *Coryphodon*, *Dinoceras*, and *Elephas*, all seen from in front. The feet of the three genera as exhibited have many points in common, and their positions during life were probably nearly the same. The feet of *Coryphodon* are the oldest in point of time, but those of the elephant are in some respects of a more primitive type. Those of *Dinoceras* are much nearer to *Coryphodon* in their general structure, but the points of resemblance need not be enumerated here. The elephant, as well known, has all the toes of each foot enclosed in a common integument, but is really digitigrade. In *Dinoceras*, the terminal phalanges are much larger, showing that they themselves bore a greater weight, the digits being undoubtedly free, although a pad may have helped to support the foot. In *Coryphodon*, the digits were still more elongate, and the terminal phalanges proportionately larger and broader, somewhat like those of the rhinoceros, indicating that they were covered with hoofs that supported the feet. This would agree with the position given them in the restoration, which coincides with the anatomical structure of the entire hind limb.

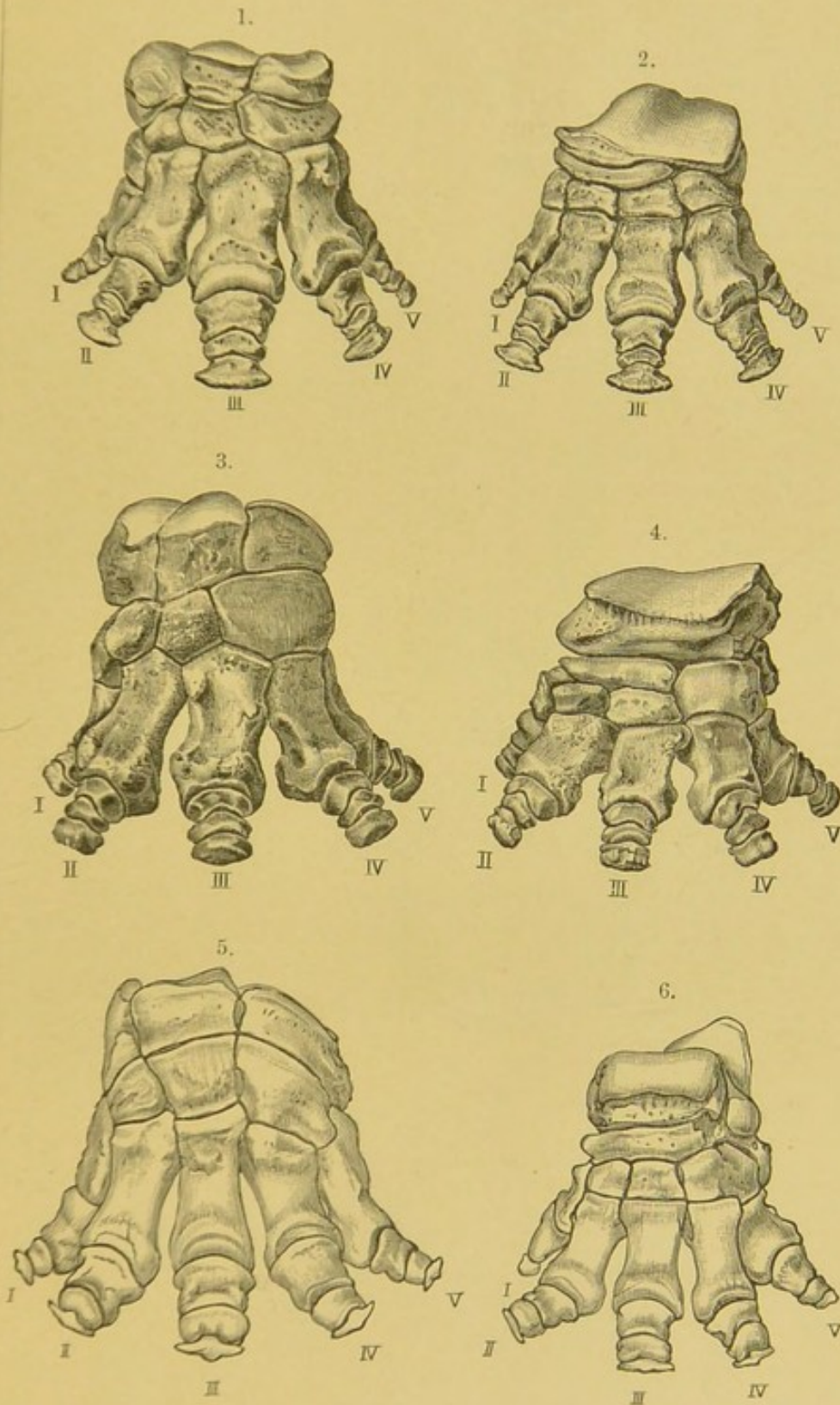
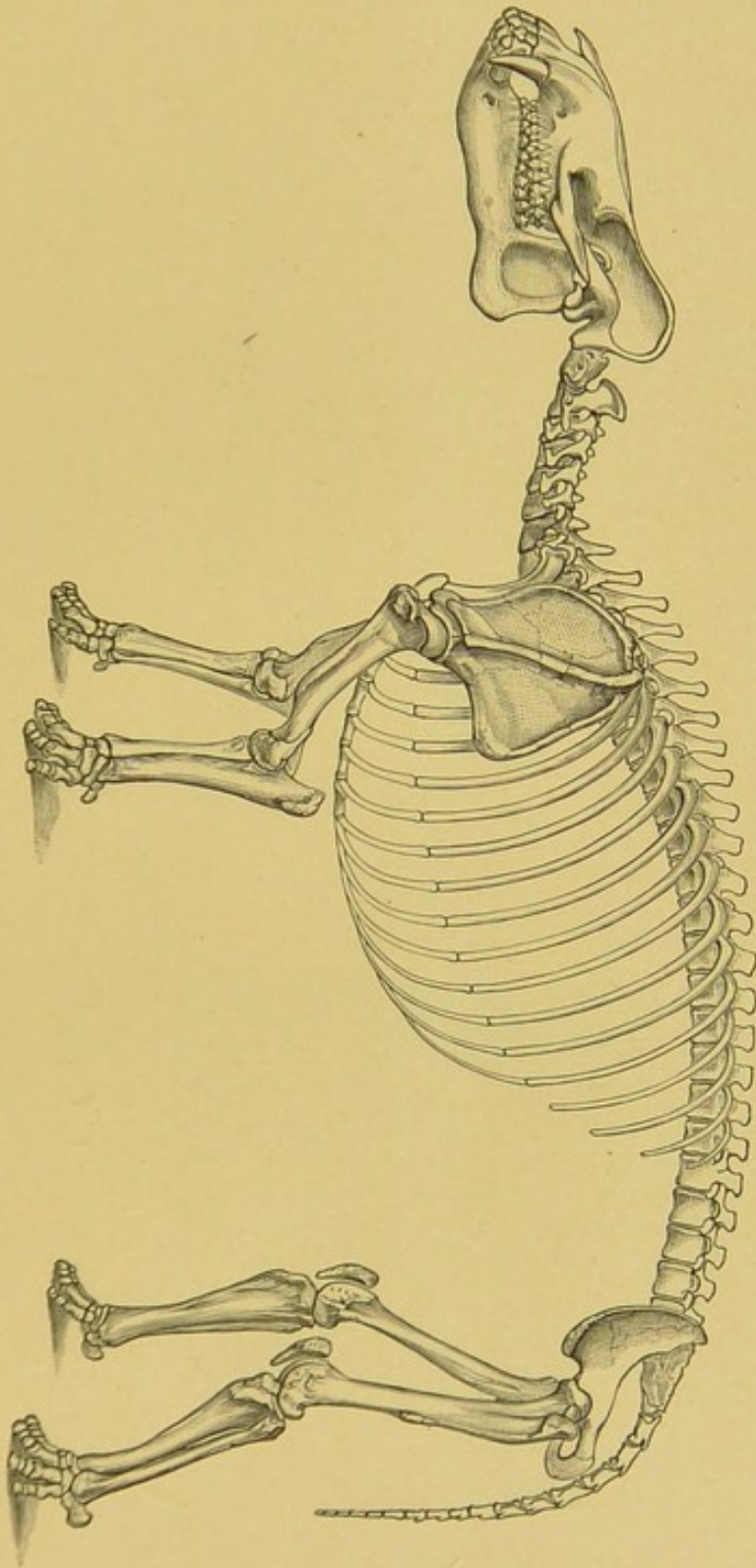


FIGURE 1.—Fore foot of *Coryphodon*; front view.
 FIGURE 2.—Hind foot of *Coryphodon*; front view. Both one-third natural size.
 FIGURE 3.—Fore foot of *Dinoceras*; front view.
 FIGURE 4.—Hind foot of *Dinoceras*; front view. Both one-fifth natural size.
 FIGURE 5.—Fore foot of *Elephas*; front view.
 FIGURE 6.—Hind foot of *Elephas*; front view. Both one-eighth natural size.



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Restoration of *CORYPHODON HAMATUS*, Marsh. One-twelfth natural size.





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