

ART. XV.—*On the gigantic fossil Mammals of the Order
Dinocerata*; by O. C. MARSH. With plates I. and II.

AMONG the many extinct animals of interest hitherto discovered in the Tertiary of the Rocky Mountain region, none, perhaps, are more remarkable than the huge mammals which have recently been described from the Eocene beds of Wyoming. It is important, therefore, that accurate information in regard to them should be promptly made public, especially as serious errors on this subject have already appeared in various scientific publications, and are being widely disseminated.

These animals nearly equalled the elephant in size, and had limb bones resembling those of Proboscidiæ, as stated in the original description of the type species, *Tinoceras anceps* Marsh. The skull, however, presents a most remarkable combination of characters. It is long and narrow, and supported three separate pairs of horns. The top of the skull is deeply concave, and on its lateral and posterior margin there is an enormous crest. There were large decurved canine tusks resembling those of the walrus, but no upper incisors. The six premolar and molar teeth are quite small. Several species of these remarkable animals have already been named, but at present they cannot all be distinguished with certainty. The type species of the group (*Tinoceras anceps* Marsh) was based on the specimen first discovered; which was found by the Yale College party in September, 1870, and described by the writer in June, 1871, under the name *Titanotherium? anceps*.† To this description, the authors who have since described the same, or allied, species have not referred. In the following year Prof. Cope gave the name, *Loxolophodon semicinctus*, to a single premolar tooth, which perhaps belongs to this group, and may prove to be identical with the above species.‡ In August last, in a paper issued in advance of the Proceedings of the Philadelphia Academy, Dr. Leidy described a characteristic specimen as *Uintatherium robustum*, and likewise gave the name *Uintamastix*

* As an example of the utility of this little apparatus, I may refer to Mr. R. H. Lee's paper on the atomic weights of cobalt and nickel. See this Journal, vol. ii, July, 1871.

† This Journal, vol. ii, p. 35.

‡ American Philosophical Soc., vol. xii, p. 420

atrox to an upper canine tooth, probably of the same animal, on the supposition that it pertained to a carnivore.*

The remarkable feature in the skull of this group was first indicated in the name *Tinoceras*, proposed by the writer (August 19th, 1872) for the genus represented by the type species, and subsequently mentioned in this Journal.†

Prof. Cope has since proposed the generic name *Eobasileus*,‡ and indicated three species, which apparently are not distinct from those previously described by Dr. Leidy and the writer. Many of the characters given by Prof. Cope in his description of these animals do not indeed apply to the other known species, but it is evident he has made several serious mistakes in his observations. Among the more important of these errors are the following:—What Prof. Cope has called the incisors are canines, and hence his statement that there are large incisor tusks, but no canines, should be reversed. 2d. The stout horns he described are not on the frontals, but on the maxillaries. 3d. The orbit is not below these horns, but quite behind them, and it has over it a prominent ridge on the frontal. 4th. The occiput is not vertical, but extends obliquely backward, the occipital crest projecting behind the condyles. 5th. The temporal fossæ are not small posteriorly, but unusually large. 6th. The great trochanter of the femur is recurved, although Prof. Cope says not. 7th. The spine of the tibia is not obtuse, but wanting. One of the species named by Prof. Cope (*Eobasileus furcatus*), is based on what he regards as portions of the nasal bones. The description, however, indicates that these specimens are merely the posterior horn cores of well known species.

The Museum of Yale College contains the remains of many individuals of the order *Dinocerata*, including the types of the various species described by the writer.§ All of these are well represented by characteristic specimens, and one species, *Dinoceras mirabilis* Marsh, by an entire skull, and a nearly perfect skeleton. An opportunity has thus been afforded of determining with some certainty the nature and affinities of this most sin-

* Proceedings Philadelphia Academy, 1872, p. 169.

† Vol. iv, September, 1872, Erratum; also October, 1872, p. 332.

‡ It is uncertain what date should be assigned to the name *Eobasileus*, and the species included under it by Prof. Cope. After a very careful investigation, I cannot ascertain that the descriptions were published before Oct. 29th, 1872, when copies were first received by the Philadelphia Academy of Nat. Science, of which Prof. Cope is secretary. The dates on the papers (Aug. 20th and 22d, 1872) certainly do not represent those of actual publication. The descriptions have not yet appeared in the Proceedings of the American Philosophical Society, where they were read (Sept. 20th, 1872), and hence no exact reference to them can at present be given. Several other papers by Prof. Cope on fossil vertebrates from Wyoming bear various dates from July 11th to October 12th, 1872, but apparently none of them were published before October 29th, and some of them certainly not until about a month later.

§ This Journal, vol. iv, pp. 322, 323, 343, Oct. 1872. Also Proc. Am. Philosophical Soc., vol. xii., Dec., 1872, and Am. Naturalist, vol. vii, p. 52, Jan., 1872.

gular group of animals, and the more important characters are here mentioned, preliminary to the full description. Most of the cranial characters are derived from a very perfect skull of *Dinoceras mirabilis*, figured in the accompanying plates.

The skull is unusually long and narrow. The three pairs of horn cores, rising successively above each other, and the huge crest around the deep concavity of the crown, together with the large decurved trenchant tusks, unite in giving a most remarkable appearance to the entire head (Plates I–II), which differs widely from anything known among living or fossil forms.

The structure of the skull presents many features of interest. The supraoccipital is greatly developed, and, after rising above the brain case, forms an enormous crest which projects obliquely backward beyond the condyles. This crest is continued forward on either side, each lateral portion sloping outward, and overhanging the large temporal fossa. This portion of the crest is formed largely of the parietals. The posterior pair of horns rise from this crest, which is thickened below on the inner side to support them. In front of these horns the crest descends rapidly, and subsides nearly over the center of the orbit. These posterior horn-cores are higher than those in front, and have obtuse summits, flattened transversely. (Plates I–II.) The frontal bones have no postorbital process, and the orbit is not separated from the temporal fossa. The latter is very large posteriorly. (Pl. II, fig. 1.) The squamosal forms the lower portion of the temporal fossa, and sends down a massive post-glenoid process. It likewise sends forward a zygomatic process, which resembles that of the Tapir. The malar completes the anterior portion of the arch, which is not the case with any known Proboscidian. The lachrymal is large, and forms the anterior border of the orbit, as in the Rhinoceros. It is perforated by a large foramen on its facial surface. Over the orbit, the frontal sends out laterally a prominent ridge, which afforded good protection to the eye in the combats of these animals with each other. On this ridge, there is a small protuberance, which resembles a diminutive horn-core, but its position, immediately in front of the lateral crest, indicates that it did not support a true horn.

The maxillaries are massive, and quite remarkable in supporting a pair of stout conical horn-cores. The bases of these cones approximate, and their summits are obtuse and nearly round. (Plates I–II.) Below these horns are the huge decurved canines, the extremity of the fang being implanted in the base of the horn-core. Behind the canine, there is a moderate diastema, followed by six small premolar and molar teeth. The crowns of the molars are formed of two transverse ridges, separated externally, and meeting at their inner extremities. The nasals are massive, and greatly prolonged anteriorly. In

front of the zygomatic arch they contract, and form the inner inferior surface of the maxillary horn-cores, as well as an elevation between them. From this point forward to the anterior margin of the suture with the premaxillary, they increase slightly in width, and then contract to the end of the muzzle.

Near the anterior extremity of the nasals, there is a pair of low tubercles which evidently supported dermal horns (plate II, fig. 3). The premaxillaries are without teeth, and quite peculiar. They unite posteriorly with the maxillaries just in front of the canine, and then divide, sending forward two branches, which partially enclose above and below the lateral portion of the nasal opening. The upper branch is closely united with the adjoining nasal, thus materially strengthening the support of the nasal horns. The lower portion is slender, and resembles the premaxillary of some Ruminants. The extremity is somewhat behind that of the nasals. The anterior nares are comparatively small, the aperture being more contracted than in the Rhinoceros. The lower jaw was slender, and the tusks small.

The extremities in the *Dinocerata* resembled very nearly those in the *Proboscidea*, but were proportionally shorter. The fore legs were somewhat stouter than those behind. The humerus was short and massive, and in its main features much like that of the elephant. One of the most marked differences is seen in the great tuberosity, which does not rise above the head, and is but little compressed. The condylar ridge, moreover, of the distal end is tubercular, and not continued upward on the shaft. The lower extremity of the humerus is much like that of the Rhinoceros, and the proportions of the two bones are essentially the same. The head of the radius rests on the middle of the ulnar articulation, and hence the shaft of this bone does not cross that of the ulna so obliquely as in the elephant. The femur is proportionally about one-third shorter than that of the elephant. The head of this bone has no pit for the round ligament, and the great trochanter is flattened and recurved. Prof. Cope states that this part of the femur is not recurved, but several perfect specimens in the Yale Museum are conclusive on this point. There is no indication of a third trochanter. The distal end of the femur is more flattened transversely than in the Elephant, and the condyles are more nearly of the same size. The corresponding articular faces of the tibia are consequently about equal, and also contiguous, with no prominent elevation between them. When the limb was at rest, the femur and tibia were nearly in the same line, as in the Elephant and Man. The astragalus has no distinct superior groove. Its anterior portion has articular faces for both the navicular and cuboid, thus differing from Proboscidians, and approaching Perissodactyls. The calcaneum is very short. The phalanges are short and stout, and resemble those of the Elephant.

The vertebræ of this group are not unlike those of Proboscidi-ans in their main characters. The cervicals are materially longer than in the Elephant. There are four sacral vertebræ, the last quite small, and supporting a short and slender tail. The ribs have rudimentary uncinæ processes, as in the Mastodon.

Such being the more important characters of these gigantic fossil mammals, it remains to state briefly what these characters collectively indicate, and likewise to give reasons for placing the group in an order distinct from the *Proboscidea*.

The vertebræ and limb-bones in the *Dinocerata* are in many respects remarkably like those of Proboscidi-ans, the exceptional characters being those of the Perissodactyl type. The skull, on the contrary, presents no distinctive proboscidian features. The presence of horns in pairs, the absence of teeth in the premaxillaries, together with the large canine, point toward the Ruminants. The nasal horns, the structure of the anterior portion of the skull, the molar teeth, the zygomatic arch, the elongated temporal fossæ, the large postglenoid processes, as well as other less important cranial characters, show affinities with the Perissodactyls. The horns on the maxillaries, the deep concavity of the crown, and the huge lateral crests are quite peculiar to this order.

Some of the most marked characters that distinguish these animals from the *Proboscidea* are the following:—1st. The absence of upper incisors. 2d. The presence of canines. 3d. The presence of horns. 4th. The absence of large air cavities in the skull. 5th. The malar bone forms the anterior portion of the zygomatic arch. 6th. The presence of large postglenoid processes. 7th. The large perforated lachrymal, forming the anterior portion of the orbit. 8th. The small and horizontal narial orifice. 9th. The greatly elongated nasal bones. 10th. The premaxillaries do not meet the frontals. 11th. The lateral and posterior cranial crests. 12th. The very small molar teeth, and their vertical replacement. 13th. The small lower jaw. 14th. The articulation of the astragalus with both the navicular and cuboid bones. 15th. The absence of a true proboscis. The last character may be fairly inferred from the short anterior limbs, the moderately lengthened neck, and the very elongated head, which rendered a proboscis unnecessary, as the muzzle could readily reach the ground. The small nasal opening—smaller even than that of the Rhinoceros or Tapir—also testifies against it, while the nasal horns, and the sharp decurved canines would seriously have interfered with such an organ, had it been present.

The horns of the *Dinocerata* were a remarkable feature. Those on the nasal bones were probably short, dermal weapons, something like those of the Rhinoceros, but much smaller. Those

on the maxillaries were conical, much elongated, and undoubtedly formed most powerful means of defence. The posterior horns were the largest, and their flattened cores indicate that they were expanded, and perhaps branched. All the horn cores are solid, nearly smooth externally, and none of them show any indication of a burr. Whether both sexes had horns, cannot at present be decided, but this was probably the case.

The remains on which this description is based are all from the Eocene deposits of Wyoming. A more complete description, with full illustrations, is in course of preparation.

YALE COLLEGE, New Haven, Jan. 13th, 1873.

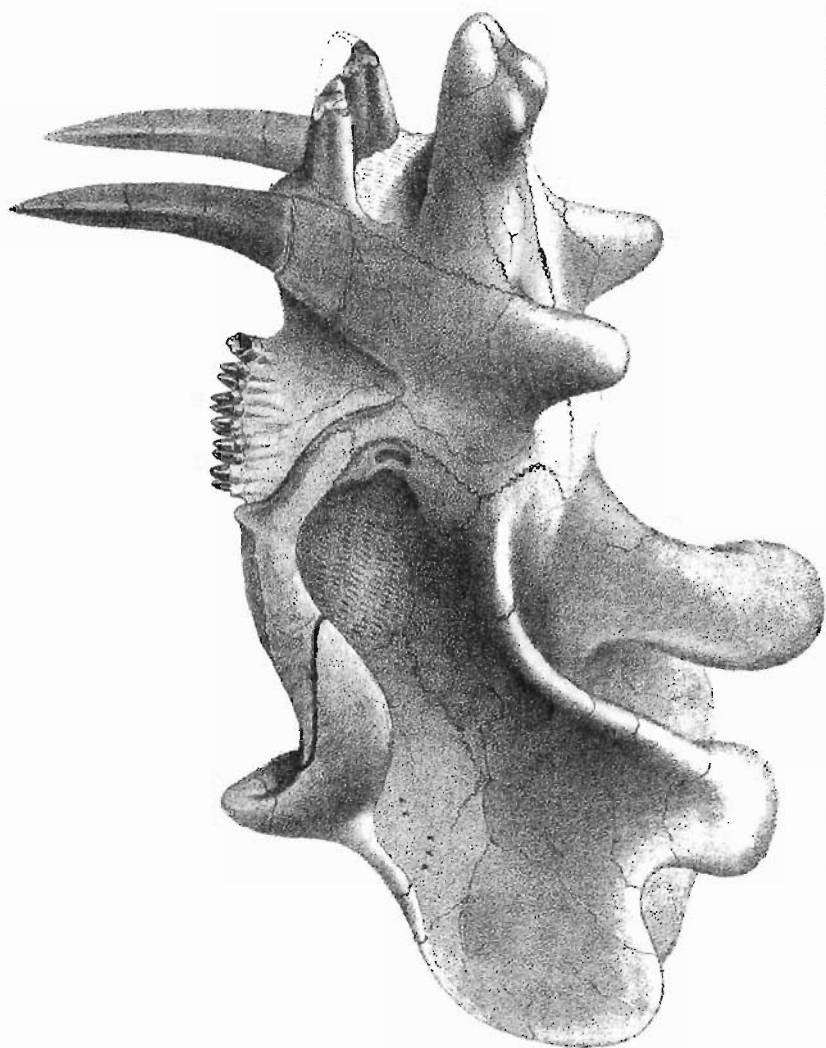
Postscript.

Since the above was in type, a short paper by Prof. Cope on the same subject, read before the Philadelphia Academy, and bearing the date of Jan. 16th, 1873, has been received. The paper contains no new points of importance, and is marred by many errors. The author aims to show that these animals are true *Proboscidea*, and possessed a proboscis. As I have already answered both these points fully, it is unnecessary to discuss them here. It is, however, important to promptly correct some of the more palpable mistakes in the paper, among which are the following: 1st. The genus *Dinoceras* was not originally referred to the Perissodactyls, but to a new order. 2d. The type species of this order was not described as *Titanotherium anceps*, but as *Titanotherium? anceps*, a difference of importance, as the reference was merely provisional, and the characters given pointed, not to the Perissodactyls, but to Proboscidians. 3d. The date given to *Eobasileus* (Aug. 20th, 1872) is not correct, as is stated above, page 118. 4th. The name *Tinoceras* was not first proposed Aug. 24, 1872, but Aug. 19, 1872, and on that day I mailed Prof. Cope the pamphlet containing it. 5th. The communication I made on this subject before the American Philosophical Society was not Dec. 30th, 1872, but Dec. 20th, 1872, Prof. Cope being present. 6th. The nasal bones in the *Dinocerata* are not exceedingly short, but much elongated. 7th. The malar bone does not form the middle element of the zygomatic arch, but the anterior, as in the Tapir. 8th. The frontals do not have a great prolongation forward, and it is very doubtful if they support horns or processes at both extremities. 9th. The nasal bones are not deeply excavated at their extremities. The assertion that it is "exceedingly probable that the tusk of the Mastodon and Elephant, regarded as an incisor by Cuvier, is really a canine," needs no refutation. If Prof. Cope will examine the skull of a young elephant, he will probably find that Cuvier was right after all.

Yale College, Jan. 21st, 1873.

EXPLANATION OF PLATES.

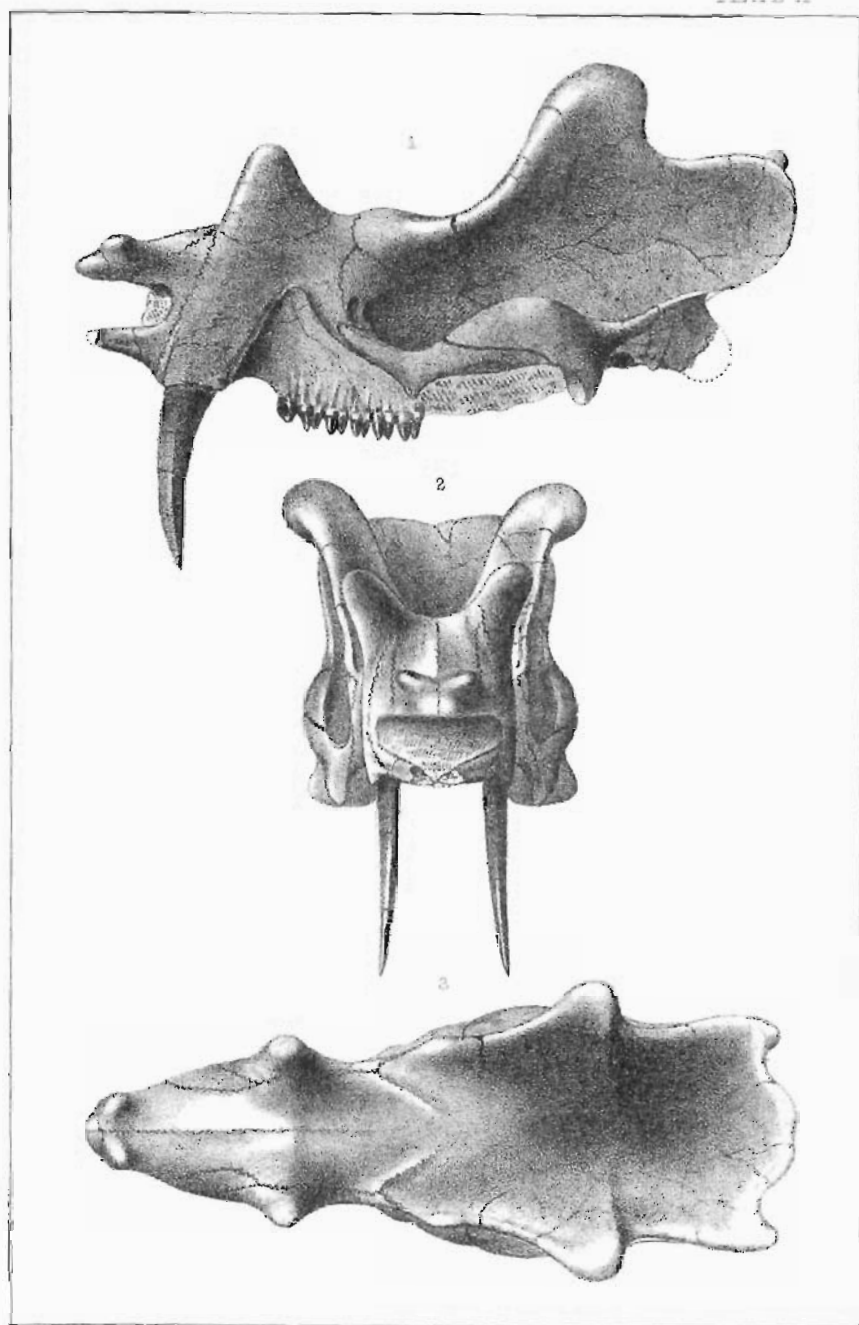
- Plate I. *Dinoceras mirabilis* Marsh. Oblique view. One-fifth natural size.
 Plate II. *Dinoceras mirabilis* Marsh. Figure 1, side view; figure 2, front view; figure 3, top view. All one-eighth natural size.



DINOCEPUS VIRENS, Marsh '66

2 inches & above the same

1 inch & above the same



Drawn from nature by I. Oswald.

The Academy & Grand, New Haven, C.

DICERURUS MIRABILIS Marsh 33