

that species is intercalated at the inner angles of the four plates in front of the median occipital. Fig. 3 represents the broad rounded operculum. The scales seem to be very thin, so much so that the internal skeleton is often seen through them, the axis being notochordal, and well-developed ribs being present. The leading feature of the species is seen in the form of the second dorsal fin, which has its base proportionally nearly twice as long as in *D. Valenciennesii*, while the shape of the fin, instead of being triangular-acuminate, is broad and oblong-rounded, the posterior rays being nearly as long as the anterior ones. Both pectoral and ventral fins are as in *D. Valenciennesii* "archipterygian" in their conformation, the pectoral being represented in Fig. 4. The first dorsal and the anal are narrow-lanceolate, the heterocercal caudal is triangular, and not bifurcated.

EXPLANATION OF PLATE II.

- Fig. 1. *Dipterus macropterus*, Traquair, natural size. From the Lower Old Red Sandstone, John O'Groats, Caithness.
 Fig. 2. Outline of posterior cranial plates, from another specimen.
 Fig. 3. Operculum.
 Fig. 4. Pectoral fin and shoulder girdle.

II.—RESTORATION OF *BRONTOPS ROBUSTUS*, FROM THE MIOCENE OF AMERICA.¹

By Professor O. C. MARSH, Ph.D., LL.D., F.G.S.

(PLATE IV.)

THE largest mammals of the American Miocene were the huge *Brontotheridæ*, which lived in great numbers on the eastern flanks of the Rocky Mountains, and were entombed in the fresh-water lakes of that region. They were larger than the *Dinocera* of the Eocene, and nearly equalled in size the existing Elephant. They constitute a distinct family of Perissodactyles, and were more nearly allied to the Rhinoceros than to any other living forms.

The deposits in which their remains are found have been called by the author the *Brontotherium* beds. They form a well-marked horizon at the base of the Miocene. These deposits are several hundred feet in thickness, and may be separated into different subdivisions, each marked by distinct genera or species of these gigantic mammals.

The author has made extensive explorations of these Miocene lake-basins, and has secured the remains of several hundred individuals of the *Brontotheridæ*, which will be fully described in a monograph, now well advanced towards completion, to be published by the United States Geological Survey. The atlas of sixty lithographic plates is already printed, and the author submitted a copy to the Section. The last plate of this volume is devoted to a restoration of *Brontops robustus*, one-seventh natural size, and a diagram enlarged from this plate to natural size was also exhibited.²

¹ Abstract of a paper read before Section D of the British Association for the Advancement of Science, at the Bath meeting, Sept. 7th, 1888.

² The present Plate (IV.), one twenty-fourth natural size, shows a reduced copy of the same restoration.

The skeleton represented in this restoration is by far the most complete of any of the group yet discovered. It was found by the author in Dakota, in 1874, and portions of it have been exhumed at different times since, some of the feet bones having been recovered during the past year. It is a typical example of the family, and shows well the characteristic features of the genus and species which it represents.

The most striking feature of the restoration here given, aside from the great size of the animal, is the skull. This is surmounted in front by a pair of massive prominences, or horn-cores, which are situated mainly on the frontal bones. The nasals contribute somewhat to their base, in front, and the maxillaries support the outer face. These elevations, or horn-cores, vary much in size and shape in the different genera and species. They are always very small in the females.

The general form of the skull and lower jaw is well shown in the figure. The prominent occipital crest, the widely-expanded zygomatic arches, and the projecting angle of the lower jaw, are all characteristic features. In general shape, the skull resembles that of *Brontotherium*, but may be readily distinguished from it by the dental formula, which is as follows:—

Incisors $\frac{2}{1}$; canines $\frac{1}{1}$; premolars $\frac{4}{4}$; molars $\frac{3}{3}$.

The presence of four premolars in each ramus of the lower jaw is a distinctive feature in this genus. This character, with the single, well-developed lower incisor, marks both the known species.

The number of teeth varies in the different genera. The form of the teeth, especially in the molar series, is more like that in *Chalicotherium* and *Diplacodon* than in any other known forms. The teeth in the allied genus *Brontotherium* have already been figured and described by the author.

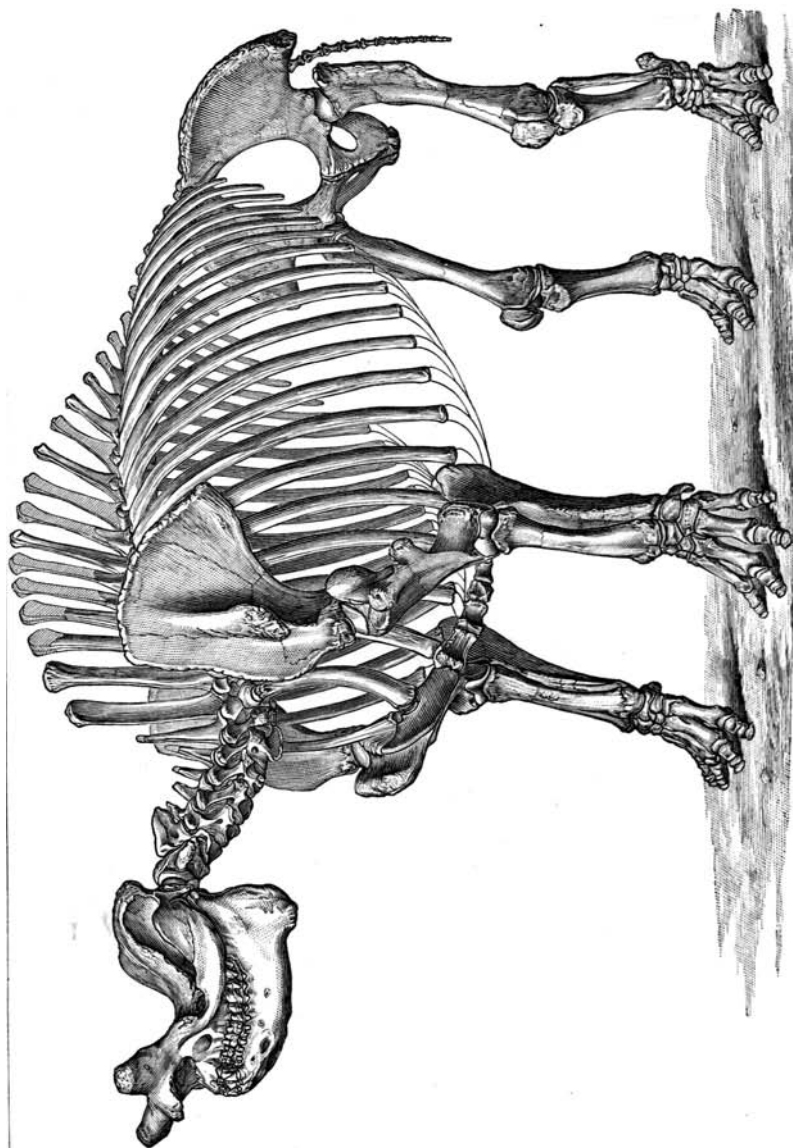
The vertebræ are somewhat similar to those of the existing Rhinoceros. In the present genus, *Brontops*, the neural spines of the dorsal vertebræ are elevated and massive. There are four sacral vertebræ in this genus, and in the known species the tail is short and slender, as in the individual here described.

The ribs are strong and massive. The sternal bones are compressed transversely. The exact form of the first one is not known with certainty, and is here restored from the Rhinoceros. This is the only important point left undetermined in the restoration.

The fore limbs are especially robust. The humerus has its tuberosities and ridges very strongly developed, and the radius and ulna have their axes nearly parallel. There are four well-developed digits in the manus, the first being entirely wanting.

The pelvis is very wide and transversely expanded, as in the Elephant. The femur is long, and has the third trochanter rudimentary. The tibia and fibula are quite short. The calcaneum is very long, and the astragalus is grooved above. There are only three digits in the pes, the first and fifth having entirely disappeared.

Diplacodon of the Upper Eocene is clearly an immediate ancestor of the *Brontotheridæ*, while *Palæosyops* and *Limnohyus* of the Middle



Skeleton of BRONTOPS ROBUSTUS, restored by Prof. O. C. Marsh, from the Miocene of Dakota, North America.

One twenty-fourth natural size.

Eocene are on the more remote ancestral line. The nearest related European form is the Miocene *Chalicotherium*. No descendants of the *Brontotheridæ* are known.

Menodus, *Megacerops*, *Brontotherium*, *Symborodon*, *Menops*, *Titanops*, and *Allops*, all belong to the family *Brontotheridæ*, and their relation to the genus here described, and to each other, will be fully discussed in the monograph, to which reference has already been made.

III.—NOTES ON ALTERED IGNEOUS ROCKS OF TINTAGEL, NORTH CORNWALL.

By W. MAYNARD HUTCHINGS, Esq.

(Continued from page 59.)

COMING along the cliffs from Boscastle towards Tintagel, at the part just seawards of the village of Trevalga, and between the outlying rocks known as "Short Island" and "Long Island," we see one or two limited outcrops of a schistose rock different from the surrounding slates, shales, etc. A thoroughly good sight of it is not, however, obtained till we reach the extreme north side of Bossiney Cove, a little way south of Long Island, when a very fine exposure of the sheet in question is observed, lying in among the sedimentary rocks, sharply marked off from them at contact, so that the junction-lines can be seen distinctly even from some distance.

It dips seawards in the cliff, and a very little way inland it rises to the surface and ends abruptly in an escarpment facing towards Trevalga. To the north, towards Boscastle, the sheet disappears and passes away under the quarries in the cliffs opposite the Growar rock. Going southwards it is not seen anywhere in the cliffs at the back of Bossiney Cove, which has been eroded through it; but at the south side of the Cove a section of it is again seen, similar to the one at the north side, the corresponding inland escarpment, on a larger scale, facing towards the village of Bossiney. The distance across the Cove in a straight line is nearly exactly a mile.

Passing through the neck of land which separates Bossiney Cove from the little cove next following it, the sheet is again exposed along the shore, here dipping steeply into the sea. The configuration of the land does not here lead to the formation of a prominent escarpment looking inland, but a small outcrop is seen here and there towards the village of Trevena (or Tintagel as it is called).

The sheet now disappears;—the mass of sedimentary rocks in which are the slate-quarries on the church glebe, curving seawards, covers it up in the cliffs, and there is no valley or broken ground to cause an exposure of it inland. It is thus hidden for a distance of rather over a mile and a quarter. Supposing it to be continuous, it is again seen at the north end of Trebarwith Strand, where it rises from beneath the slate-quarries and continues along in one uninterrupted exposure in the cliffs right away to the south end, a distance of three quarters of a mile. That what is seen at Trebarwith is really a direct continuation of what is seen at Bossiney Cove seems very little open to question. The direction of strike, position with regard to the slates, mode of occurrence, thickness and general