Art. XLII—*Restoration of the Horned Dinosaur Diceratops;* by Richard S. Lull. (With Plate XIV.)

The new genus and species described by Hatcher in the preceding article represents perhaps the most bizarre and grotesque form among all the race of horned dinosaurs, and the author has attempted an interpretation for the purpose of emphasizing the features wherein this animal differed from any of its allies.

Diceratops comes from the Laramie of Converse County, Wyoming, and while contemporaneous with Triceratops and Torosaurus it is probably as late in geological time as any of the species of either genus, and may be said to represent the culmination of at least one phylum of the Ceratopsia. Diceratops differs from Torosaurus in the proportions of the skull, for in the latter genus the frill is relatively huge as contrasted with the abbreviated facial region. In this Diceratops and Triceratops agree, and it is quite evident that there is a genetic relationship between these genera, while Torosaurus represents a totally distinct phylum.

Perhaps the most notable point of distinction between Triceratops and Diceratops is the presence of a fairly well developed nasal horn in the former while in the latter genus it is lacking, a feature which in the author's mind represents the culmination of specialization.

The earliest known Ceratopsia are the Judith River types, characterized by an incomplete frill, by rudimentary horns above the eyes, and by a very well developed, generally erect or backwardly curved nasal horn.

The supraorbital horns are progressive structures while the nasal horn is retrogressive, and during the lapse of time between the Judith River and Laramie periods, when the marine Bearpaw shales and Fox Hills sandstones were laid down, the Ceratopsia underwent a remarkable though unrecorded evolution, for when they again come into view in the Laramie the armament is reversed, in that the great temporal horns are by far the larger and more efficient weapons, and the diminishing nasal horn, while supplementing the others in the various species of Triceratops and Torosaurus, is vestigial in the form under discussion.

This change of armament was necessarily accompanied by a change in the method of attack, for while the Judith River types probably used the one horn much as the rhinoceros does, with an upward thrust, Triceratops seems to have charged with lowered head, the small forwardly directed nasal and the larger

supraorbital horns meeting the enemy at the same moment of impact. The frill now becomes of greater protective value instead of affording leverage merely for the muscles of the neck.

Diceratops exhibits the extreme of development of this style of warfare, for the supraorbital horns are the sole aggressive weapons while the widely expanded frill served admirably to withstand the shock of the adversary's horns. We have here a precise analogy with the knight of old tilting with his spear and shield.

The skull of Diceratops shows the horns to be very erect, much more so than in Triceratops, so that the head would have to be carried much lower in charging than in the latter genus and the horns through relatively short are extremely powerful. I have indicated a callosity, the last vestige of a horn, over the nasals, for they still remain very highly arched and evidently bore some of the impact of the adversary's blow. The eyes were set in deep thick-rimmed sockets which look directly outward, evidently limiting the forward range of vision, but affording ample protection to these highly necessary organs.

If one will turn to Hatcher's figure of the Diceratops skull (Plate XIII, figures 1 and 2), he will notice in the frill several apertures which Hatcher has called "fenestræ." Two of these are through the squamosal portion of the frill, one on either side, and one through the parietal.* They are irregular in size and in position, and while the Judith River types and Torosaurus among the Laramie forms have *parietal* fenestræ, they are large and symmetrical, and there is no instance of *squamosal* fenestræ in any known genus of Ceratopsia. If the author's conception of the final function of the frill is correct, there would be no reason for the development of apertures through it, which would only tend to weaken it and mar its usefulness. It seems vastly more probable that these are "old dints of deep wounds" received in combat. None of them, not even the great one on the left, were necessarily fatal, as they all seem to be through the free portion of the frill, and, while the bone was destroyed, the horny or leathery integument may have grown again over the gap as indicated in the model. The edge of the apertures are healed, showing that the animal lived for some time after the injuries were received.

I have represented the gape of the mouth with much less

* Mr. C. W. Gilmore, who prepared the type specimen of Diceratops, is by no means sure of the "parietal fenestra." There was no bone adhering to the matrix at that point so he left the opening through the frill for want of evidence to the contrary. The bone forming the margin of the left squamosal aperture is decidedly pathologic.

backward extent than in other restorations of Ceratopsia. Here we cannot be guided by the form of the mouth in existing reptiles, for none living have the same feeding habits as these dinosaurs. Here the mouth may properly be divided into an anterior prehensile portion, the turtle-like beak, and a posterior masticating portion, the dental armature. In herbivorous mammals the gape only includes the prehensile and never the masticating portion, because of the necessity of muscular cheeks to retain the food in the mouth. The Ceratopsia had a dental apparatus which chopped the food into short lengths, and the pieces, falling outside of the lower jaw, would have been lost had the gape extended backward beyond the beginning of the tooth series.

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