THE DUMB-BELL-SHAPED BONE IN THE PALATE OF *ORNITHORHYNCHUS* COMPARED WITH THE PRENASAL BONE OF THE PIG.[1] By Professor W. TURNER, M.B., F.R.S.

As an additional argument in support of his view that the intermaxillary bone consists of an inner, or mesial, and an outer, or lateral part, Dr Albrecht refers to the arrangement of the bones of the beak of *Ornithorhynchus paradoxus*. All anatomists have recognised as intermaxillary bones the pair of bones articulating with the nasals and superior maxillæ, which form the anterior end of the beak of this animal, and which curve inwards in front, but do not meet mesially. Rudolphi described[2] them as the outer intermaxillaries, and gave the name of inner intermaxillary to an ossicle situated on the palate, and separated from the outer intermaxillary by a considerable interval. J. F. Meckel described this ossicle as an unsymmetrical 8-shaped bone[3] attached by membrane to the anterior end of the palatal portion of the superior maxilla, and he also considered it as a division of the intermaxilla. Sir Richard Owen regarded[4] this detached intermediate bone as a separate centre of ossification of the palatine process of the intermaxillaries. Albrecht has also examined this ossicle, and has pointed out that the incisive or naso-palatine canal opens on each side of it. He considers that its position between these two canals incontestably demonstrates it to be the two internal intermaxillary bones united together, and he calls it *l'os paradoxe*. As this bone is separated on each side from the outer intermaxilla, Albrecht regards the *Ornithorhynchus* as having normally a submucous double maxillary cleft and four intermaxillary bones.

Since reading Albrecht's paper, I have examined both a carefully prepared skull and a recent dissection of the head of

[1] *Sur la Fente maxillaire et les 4 os intermaxillaries de l'Ornithorynque*, Bruxelles, 1883.

[2] Quoted by Meckel and Albrecht.

[3] *System der vergleichenden Anat.*, Bd. 2, Ab. 2, 1825; and *Descr. Anat. Ornithorhynchi paradoxi*, Lepsiæ, 1826.

[4] "Monotremata" in Todd's *Cyclopædia*, vol. iii.

Ornithorhynchus, with the view of studying the relations of this ossicle. It is exposed by reflecting the mucous membrane of the anterior part of the roof of the mouth. In shape it resembles a dumb-bell, in which the more posterior of the two swellings is larger than the more anterior. It is not a single mesial bone, but consists of two symmetrical and lateral halves united mesially by a suture, the line of which may be seen on the palatal surface of the bone, though the two halves obviously become fused together at a comparatively early period of life. This dumb-bell-shaped bone is situated in the hinder part of a fibrous membrane, which is attached behind to the anterior free border of the palate plate of each superior maxilla, on each side to the inner border of the intermaxilla, and in front it fills up the interval between the recurved tips of the intermaxillæ. This membrane, therefore, prolongs the palate forwards to the tip of the beak. The edge of the dumb-bell bone is surrounded by the membrane, and is attached by it to the anterior free border of the palate plate of the superior maxilla.

The upper surface of the dumb-bell bone lies immediately subjacent to the anterior somewhat expanded end of the vomer, which is fused with it along its mesial line.

Opening on the surface of the palate immediately superficial to the concave lateral border of the dumb-bell bone, is the incisive foramen, which lies therefore in the interval between it, the superior maxilla and the intermaxilla forming the anterior end of the beak. A bristle readily entered the incisive foramen, and could without difficulty be passed backwards for some distance. It did not, however, lie in the cavity of the nose, but in a distinct canal situated in relation to the septum nasi. The canal with its walls formed the organ of Jacobson in this animal. When the nasal chamber was opened into a ridge was seen, which projected transversely from the side of the nasal septum, nearly half-way across the nasal chamber, and the canal of Jacobson was contained in this ridge. The wall of this canal consists partly of cartilage and partly of membrane continuous with the mucous membrane covering the nasal septum.

The cartilage formed a curved plate on the upper and outer wall of the canal, but below it was apparently deficient, as the outline of the bristle within it could be distinctly seen beneath

the mucous membrane. In its relation, therefore, to the incisive foramen, the dumb-bell-shaped bone corresponded with that portion of the palate plate of the intermaxillary in other Mammalia which lies between the incisive foramen and the mesial palatal suture. It would further seem that in *Ornithorhynchus* the ossification of the fibrous membrane which forms the septum between the nose and the mouth is defective, so that the more anterior part of the roof of the mouth does not undergo an ossific change, but remains as a fibrous membrane, except in the limited area where the dumb-bell-shaped bone is produced.

Some anatomists have, however, expressed a different opinion on the homology of the dumb-bell-shaped bone. In his *Comparative Anatomy of Vertebrates*, Sir Richard Owen[1] speaks of it as a small prenasal ossicle, and does not, as in his previous article "Monotremata," associate it with the palatine process of the intermaxilla. Professor Flower regards it[2] as situated in the triangular interval between the diverging premaxillæ, placed in, or in front of, the anterior extremity of the mesethmoid cartilage, and apparently corresponding to the so-called prenasal of the pig.

I felt it to be necessary, therefore, to dissect the naso-palatine region of the pig in order to compare it with the dissection of the *Ornithorhynchus* just described, and I shall now give a short account of the position and relations of the prenasal bone in this animal. The prenasal of the pig is articulated with a definite area on the nasal surface of the alveolar part of the two intermaxillary bones, which bones articulate with each other anteriorly and mesially. It curves upwards and forwards in front of the anterior end of the vomer, and the anterior end of the septal cartilage, to the latter of which it is intimately connected. By its upper end it is connected with the cartilage which forms the roof of the anterior nares. It has no relation whatever either to the palatal aspect of the mouth or to the incisive canal. This canal in the pig opens in the usual way on the roof of the mouth immediately behind the upper incisor

[1] Vol. ii, p. 322, 1866.

[2] *Osteology of Mammalia*, p. 219, 2nd ed., 1876.

teeth. Its opening, when the soft parts are in place, is very small, and partially concealed by a projecting fold of the mucous membrane. In the macerated skull it is seen to be bounded externally and anteriorly by the thick alveolar border of the intermaxilla, posteriorly by the anterior border of the palate plate of the superior maxilla, and internally by a comparatively thin plate of bone which the intermaxilla sends back from the region of the central incisor tooth to join the palatal plate of the superior maxilla, and which bounds the mesial palatal suture. This plate of the intermaxilla and not the prenasal bone corresponds in position to the dumb-bell-shaped bone of *Ornithorhynchus.*

The prenasal bone of the pig therefore has a very different position and relation from the dumb-bell-shaped bone of *Ornithorhynchus.* It lies in front of the vomer and mesethmoid septal cartilage; it assists in bounding the anterior nares; it lies on a plane dorsad to the premaxilla, and has no relation either to the palate or naso-palatine canal. The dumb-bell-shaped bone, on the other hand, is inferior to the vomer, and fused with its inferior border; it has no relation to the anterior nares; it enters into the constitution of the hard palate, and it forms the inner boundary of the entrance into the naso-palatine canal. In its position and relations it corresponds with that part of the intermaxilla which lies between the incisive canal and the mesial palatal suture. All these facts therefore support the opinion advanced so many years ago by Rudolphi, by J. F. Meckel, and by Owen, in his article "Monotremata," and to which attention has anew been directed by Albrecht, viz., that in *Ornithorhynchus* the intermaxilla is divided into two bones by a considerable interval,—an outer part which enters into the formation of the beak, and an inner part which lies on the palatal aspect of the jaw, in front of palatal plate of the superior maxilla, and in relation to the mesial line of the palate.