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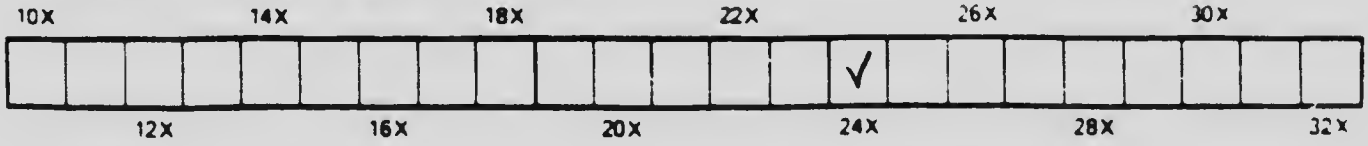

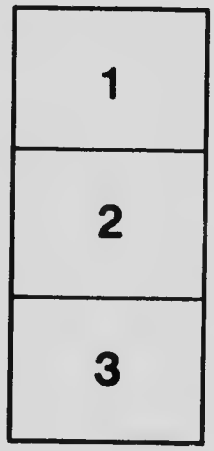

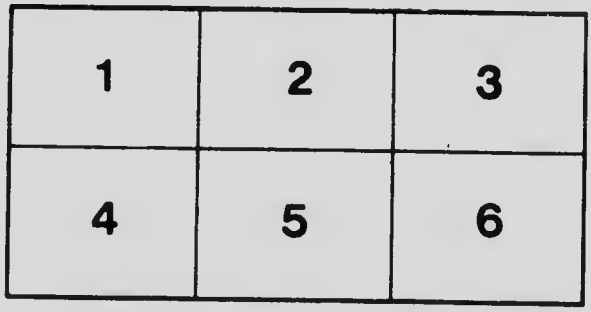

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BIOLOGICAL SERIES.

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ON THE IDENTIFICATION OF MECKELIAN AND MYLOHYOID GROOVES IN THE JAWS OF MESOZOIC AND RECENT MAMMALIA,

BY B. ARTHUR BENSLEY.

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ON THE IDENTIFICATION OF MECKELIAN AND MYLOHYOID GROOVES IN THE JAWS OF MESOZOIC AND RECENT MAMMALIA

BY

B. ARTHUR BENSLEY, B.A.

LECTURER ON ZOOLOGY IN THE UNIVERSITY OF TORONTO

ON THE IDENTIFICATION OF MECKELIAN AND MYLOHYOID GROOVES IN THE JAWS OF MESOZOIC AND RECENT MAMMALIA

Owen, in his well-known Monograph of the Mesozoic Mammalia, noted the common occurrence of a linear furrow on the inner surface of the jaw in Jurassic mammals which he designated as a "mylohyoid groove," and Marsh ('87) has described a similar groove for several species from the Jurassic deposits of America. The possible significance of this structure was first commented upon in the discussion which took place during the years 1838-39 as to the mammalian or non-mammalian nature of the original specimens of *Amphitherium* and *Phascolotherium* from the Stonesfield Slate, De Blainville ('38, p. 733) having called attention to an inferior marginal groove, in *Amphitherium*, which he regarded as a suture and thus indicative of the composite structure of the jaw in question. De Blainville's opinion was criticized at the time by Duméril, but accepted by Grant ('39), the latter considering the composite structure of the jaws to be obvious "from the distinct deep fissure extending along their base between the dental and opercular pieces." Owen ('38), on the other hand, believed the grooves to be due to the pressure of a nerve or vessel, although he appears to have been, at the time, a little uncertain of his interpretation, partly, perhaps, on account of the presence of a second upper groove in the specimen of *Phascolotherium*, and partly, doubtless, on account of the criticisms of Ogilby ('38) who, while having no explanation of his own to offer as to the significance of the grooves, objected to their being regarded as of vascular origin. In his "British Fossil Mammals," published some years later ('46), however, Owen replied to the opinions of Ogilby and Grant, and showed that the groove in the specimens of *Amphitherium* possessed an entire surface, and was therefore not referable to a suture. In his subsequent monograph ('71) he repeated his opinion, referring to the groove as "mylohyoid." Following Owen, Osborn ('88) has compared the structure with the true mylohyoid groove in the human jaw, at the same time considering it to be of little taxonomic value on account of its variable presence in recent mammals. In the ninth edition of the Encyclopædia Britannica we find the following statement by

Flower ('83, p. 376)—"the mylohyoid groove [is] persistent [in *Amphitherium*], as in some of the existing Marsupials and the Whalebone Whales. This groove, a remnant of that which originally lodges Meckel's cartilage, mistaken for a suture, was once considered evidence of the reptilian nature of these jaws." It thus appears that two somewhat similar, but fundamentally distinct structures have been confused under the designation "mylohyoid groove," and it is chiefly towards pointing out their distinction and distribution, and the taxonomic importance of that occurring in the mesozoic Mammalia, that the following remarks[1] are directed.

The true mylohyoid groove appears to be typically developed only in the primates and artiodactyl Ungulata, although it is by no means always present in the former, as, for example, in *Loris*, *Lagothrix*, *Tarsius*, and *Galago demidoffi*. It is fairly frequent in the Edentata (*Tatusia*, *Bradypus*, *Cholæpus*). It is present in *Lepus* among the Rodentia, and possibly also in other forms, but is difficult to identify in this group on account of the presence of other mandibular grooves. As to its general character it is usually a broad superficial furrow (*cf.* Plate, fig. 3, my.), beginning near and below the dental foramen and terminating abruptly a short distance forwards. It is frequently double, and its extent of development varies somewhat in different individuals. In the human jaw this groove is stated by Quain ('82, p. 56) to lodge the mylohyoid nerve with its accompanying artery and vein.

The relations of the groove which occurs in the mesozoic Mammalia have been amply illustrated by Owen ('71), Marsh ('87), Osborn ('88), and Goodrich ('94). Two of its modifications are here represented by figs. 1 and 2 in the plate (*Amblotherium*, *Spalacotherium*), copied from Osborn's memoir. Apart from its regular linear outline its more important features are as follows: (a) its close relation with the dental foramen; in many forms (*Amphitherium*, *Amblotherium*, *Amphilestes*, *Spalacotherium*, *Tinodon*) it appears to be simply an anterior continuation of the latter; (b) the fact that while sometimes confined to the posterior part of the jaw (*Spalacotherium*, *Phascolotherium*, *Amphilestes*) it frequently traverses the whole length from the dental foramen to the symphysis (*Amblotherium*, *Achyrodon*, *Dryolestes*, *Docodon*). As regards the distribution of this groove it is typically

[1] Where not otherwise noted these are based on the osteological collection of the British Museum (Natural History), London.

developed only in the presumably higher mesozoic forms, being absent as far as known in the Multituberculata.

There can be no doubt that Flower's opinion as to the relation of this structure with Meckel's cartilage is the correct one. An exactly similar groove lodging Meckel's cartilage may be seen in embryos of existing mammals, and its somewhat close resemblance to the true mylohyoid groove may be easily shown to be the result of coincidence. In the plate (figs. 10*a*-*d*) will be found illustrations of four transverse sections through the lower jaw of a 6cm. pouch-fœtus of *Macropus*[1]. Section *a*, taken immediately behind the symphysis, passes through what is at this stage the anterior limit of Meckel's cartilage. The symphysial portion of the latter has already been reduced or the anterior part of the jaw has grown beyond it. This section and section *b*, which is taken further back, show Meckel's cartilage lodged in a groove on the inner surface of the bony mandible, and separated by a bony strand from the dental nerve and artery in its interior. Section *d*, taken immediately behind the dental foramen, shows the dental nerve and artery in close relation with Meckel's cartilage, while section *c* shows the condition at the foramen where the nerve and artery become separated from the cartilage, the two former passing into the body of the jaw while the latter enters the groove on its inner surface. A short distance posterior to section *d* in this series the nerve and artery are seen to give off mylohyoid branches.

A comparison of these sections and of the dissection of a fœtal jaw represented in the plate (fig. 5) will suffice to show the identity of the groove lodging Meckel's cartilage in the embryo with that in the mesozoic Mammalia. The cause of its resemblance to the true mylohyoid groove will also be apparent, since in the embryo we find Meckel's cartilage leaving the dental nerve and artery at the dental foramen and passing into a groove on the inner surface of the jaw, in much the same way that, at a later stage, the mylohyoid branches leave the inferior dental trunks at the foramen and pass into the mylohyoid groove. It is probable that the condition described above for *Macropus*, namely, the lodging of Meckel's cartilage in a groove, represents the general one in the Mammalia. Parker ('85) has described and figured it for several of the Edentata and Insectivora, and

[1] For this specimen, with many others, the writer is indebted to Professor Bashford Dean, of Columbia University, New York.

the writer has observed it in the case of several genera of marsupials, including *Myrmecobius*, *Phascogale*, *Trichosurus*, *Phalanger*, *Dasyurus*, *Perameles*, and *Thylacomys*[1].

It is obvious that in many cases the mylohyoid groove must, during development, become superposed to the Meckelian groove. Magitot and Robin ('62) have described what is apparently that condition for man. But that such is not always the case may be seen from the forms represented in figs. 8[2] and 9 of the plate, in which both grooves are present with similar relations to the dental foramen but with different positions in the jaw.

Considering the nature of the groove represented in the mesozoic Mammalia we can scarcely expect to find it fully developed in adults of recent mammals. Owen ('38, '71) described and figured a groove in the jaw of *Myrmecobius*, which he regarded as equivalent to that in the mesozoic forms, but Osborn ('88) was unable to recognize this structure in two specimens belonging to the Yale University collection, and he has further stated, on the authority of Mr. Thomas, that it is absent in the British Museum specimens. Leche ('91) also failed to find it in three of his specimens, but has mentioned its presence in a fourth immature one. The fact of the matter is that a short broad furrow does occur in *Myrmecobius* exactly as Owen has described and figured, but its great width almost precludes its being spoken of as a groove, and it has obviously nothing to do either with the mylohyoid or the Meckelian groove. Its presence is due simply to the elevation of the internal alveolar edge. A much more definite groove, due to the same cause, is frequently present in recent mammals (*cf.* Plate, fig. 4).

Owen also mentioned a similar groove for *Phascolomys*. This structure, which is amply illustrated in the British Museum specimens, appears to represent a mylohyoid groove. In adult jaws it is frequently found to be branched. In a young animal of which the writer dissected this region, the posterior portion of the groove was alone developed, and it lodged the mylohyoid nerve. In the young wombat the groove is placed just at the point where the anterior portion of the inflected angle joins the body of the jaw. A similar structure is frequently present in other marsupials. Its somewhat

[1] The specimens representing these genera were kindly lent by the late Mr. Martin F. Woodward, of the Royal College of Science, London.

[2] For the loan of this specimen—a foetal jaw of *Propithecus*—the writer is indebted to Dr. Forsyth Major, of the British Museum, London.

different appearance as compared with the mylohyoid groove of placentals is due to the presence of the angular inflection.

Undoubted traces of the Meckelian groove are, however, to be seen in adults of recent mammals, although in most cases only as variations. Fig. 4 of the plate shows the appearance of it in an aged specimen of *Didelphys*. This may be compared with fig. 9 which shows the normal condition in a young animal. Figs. 6 and 7 show the condition in two other specimens representing *Tatusia* and *Chrysochloris*; the former is not fully adult. Similar conditions are observable in some specimens of the following forms,—*Trichosurus*, *Phalanger*, *Perameles*, and *Petauroides*, among the marsupials, *Xenurus* and *Dasypus* among the Edentata, *Hemicentetes* and *Echinops*, among the Insectivora. The groove is doubtless frequently present in many other forms, but such a reduced and variable structure almost defies recognition. As stated by Eschricht and Reinhardt ('66) it is present in the adult of *Balæna mysticetus*.

It is an interesting question why the Meckelian groove is not present in the Multituberculata. Following Cope's suggestion ('88) as to the monotreme affinities of these animals, the writer examined the condition in three specimens of *Echidna* of 2, 9, and 16cm. head and body lengths. The relations in this form, however, proved disappointing. In the 2cm. egg-embryo there were only a few traces of bone formation in the lower jaw, while in the two larger animals the dentary element was well formed but was not in relation with Meckel's cartilage posteriorly. In both of the later stages the symphysial portion of the cartilage was seen to be very much elongated, and for a short distance behind the symphysis the cartilage was lodged in a concavity of the dentary bone. Immediately posterior to this point, however, the cartilage was found to leave the jaw, and to pass backwards independently of it. In the 9cm. embryo its position was internal and ventral with reference to the jaw, and in the older animal its separation from the jaw and its internal position were still more marked.

The condition in *Echidna* is apparently the result of the great reduction or degeneration of the jaw characteristic of this form. It is possible that the conditions in *Ornithorhynchus* might throw some light on the question, but no embryos of this form were available. It seems most unlikely that in the Multituberculata the Meckelian cartilage could have had the same relations as in existing mammals,

and was absent in the adult stage. There is a possibility that in the mammalian prototype the cartilage was either completely enclosed in the dentary bone or co-ossified with it. It is interesting to note that Parker (*op. cit.*) has described a partial ossification of the cartilage in the young of *Centetes* and *Talpa*, and a partial enclosure of it in the latter form and in *Erinaceus*. The frequent exposure of Meckel's cartilage in the jaws of lower Vertebrata, however, warns against the adoption of such an explanation before the acquisition of more definite evidence.

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EXPLANATION OF PLATE

Fig. 1. *Amblotherium soricinum.* Right mandibular ramus, showing the groove for Meckel's cartilage. (After Osborn.)

" 2. *Spalacotherium tricuspide* . Left ramus reversed, showing the relation of the groove for Meckel's cartilage with the dental foramen. (After Osborn.)

" 3. *Mycetes ursinus.* Right ramus, showing the true mylohyoid groove.

" 4. *Didelphys marsupialis.* Right ramus of an old individual, in which traces of the groove for Meckel's cartilage are present as a variation.

" 5. *Macropus sp.* Moist preparation of the left ramus of a 7cm. pouch-fœtus, showing Meckel's cartilage lodged in its groove. The ear-bones are schematically represented.

" 6. *Talusia novemcincta.* Right ramus of an immature individual, showing the groove for Meckel's cartilage and the mylohyoid groove below it.

" 7. *Chrysochoris trevelyanus.* Left ramus, showing traces of the groove for Meckel's cartilage in the adult.

" 8. *Propithecus sp.* Right ramus of fœtus; the mylohyoid groove is here formed below that lodging Meckel's cartilage.

" 9. *Didelphys marsupialis.* Right ramus of an young individual showing the normal appearance of the groove for Meckel's cartilage in the later stages of its reduction.

" 10. a-d. *Macropus sp.* Transverse sections through the right ramus of a 6cm pouch-fœtus, showing the relations of Meckel's cartilage and the dental nerve and artery to the jaw. For explanation see text.

Abbreviations

mg—groove for Meckel's cartilage.
my—mylohyoid groove.
mc—Meckel's cartilage.
ml—malleus.
i—incus.
st—stapes.
ty—tympanic annulus.
n—dental nerve.
a—dental artery,
c—coronoid process of mandible.
fm—masseteric foramen.