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Article XXVIII.— ON EVIDENCE OF A MAMMAL-LIKE DENTAL SUCCESSION IN THE CYNODONT REPTILES.

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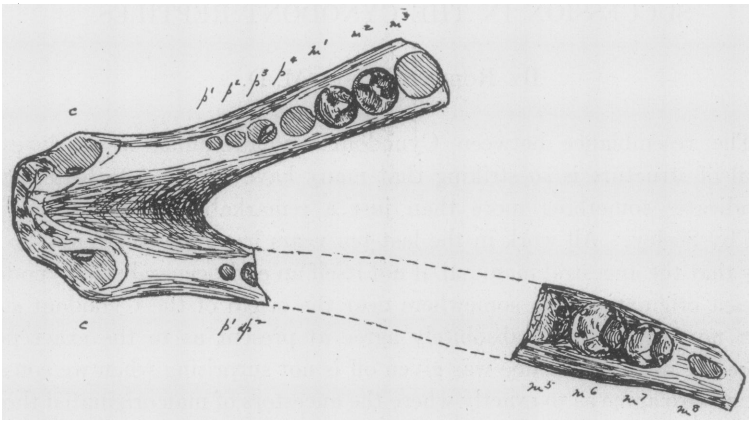
The resemblance between Cynodonts and Mammals in nearly every detail of structure is so striking that many have been led to believe that it indicates something more than just a remarkable convergence as was held by Seeley. All work in the last ten years has gone to strengthen the view that the ancestral mammal, if not itself an early generalised Cynodont, at least originated from somewhere near the origin of the Cynodont stem. That no two scientists absolutely agree at present as to the exact point where the mammalian line was given off is not surprising when we consider that no two agree as to exactly where the ancestors of man originated though in this latter case we have probably ten times as many facts.

In spite of what looks like the clearest evidence of a common ancestry of man and the higher apes, there are those who prefer to trace the origin of man back directly to some remote Eocene Lemur and it is perhaps not more surprising to find that, notwithstanding the discovery of the very mammal-like Cynodonts, and of fossils so apparently intermediate in type that it is impossible to say whether they are mammals or not, there are those who believe that all these marvellous resemblances are only superficial and misleading and that the mammals are directly descended from some early unknown vertebrate that lived in Silurian times.

There seems to be an idea that the mammalian skull is of a simpler type than that of the Cynodont and that the further back we go we are the more likely to find an ancestor with an equally simple skull. But this is entirely incorrect. If we go back to the Cotylosaur or the Stegocephalian or even to the Crossopterygian we do not get simpler types of skull and we certainly get skulls much less mammal-like, and yet we may be quite certain that all the warm blooded animals and the later reptiles are descended from Crossopterygian and Stegocephalian ancestors.

In the matter of teeth the evidence is much less conclusive than in the case of the skull structure. Simple pointed teeth in premaxilla and maxilla might readily become divided into incisors, canine, and molars by the increased development of the 1st tooth in the maxillary bone, and a develop-

ment of this sort has taken place independently in a number of reptilian groups, but in no order or suborder other than the Cynodontia do we find from 3 to 5 incisors, a single canine, and from 6 to 14 molars. In the earlier Cynodonts the formula is practically mammalian. *Ælurosuchus* has a formula of i5, c1, m8; *Nythosaurus*, i4, c1, m7. *Sesamodon*, probably the



Lower jaw of *Diademodon platyrhinus*, showing successional canines and pre-molar. Almost $\frac{5}{4}$ nat. size.

most mammal-like of known Cynodonts, also has a formula of i4, c1, m7.

In a short discussion following my delivery recently of the Croonian Lecture at the Royal Society of London, Dr. Smith Woodward spoke of the lack of evidence for anything like a mammalian dental succession in the Cynodonts notwithstanding their mammal-like dental formula. In reply I reviewed the little that was known of dental succession in the Therapsida.

In the Therocephalia we have long known that most skulls show evidence of dental replacement in the incisors and canines, though not in the molars, and I think we may conclude in this suborder there is an indefinite succession of incisors and canines, and just possibly also in the molars.

In the Anomodontia there is no evidence known in any skull of replacement of the canine, but in those genera with numerous small molars such as *Diœlurodon*, *Prodicynodon*, *Pristerodon*, and many of the Endothiodonts there is abundant evidence of apparently indefinite replacement of the molars.

In the Gorgonopsians we have certain evidence of dental succession only in the case of the canine, and slight evidence that it also occurred in the case of the incisors, and possibly it may have occurred also in the molars.

Hitherto while we have in the Cynodonts had clear evidence of a dental succession in the case of the canine we have not had in the case of the other

teeth. In a specimen, however, which I discovered recently at Winnaarsbaken in the Burghersdrop dist. C. C. I think we have conclusive evidence of a dental succession not only in the canines but also in the premolars and in the incisors.

The specimen consists of most of the skull and lower jaws of a small species of *Diademodon* which may be called *D. platyrhinus*. I have compared it carefully with all the described species and am quite satisfied that it is specifically distinct. The specimen is that of a nearly adult animal and before fossilization took place there must have been considerable maceration as most of the teeth have fallen out. In the upper jaw every tooth is gone and in the lower there only remain a few molars and one premolar. There has manifestly been a large canine in each upper and lower jaw, and in each case the tip of the replacing canine is seen in the socket. In the right lower jaw the four supposed functional premolars are lost and in the socket of the third can be seen the tip of the crown of the replacing one. On the left side the second premolar is still in position but much worn. The jaw is broken through in the region of the third, and reveals a fragment of the root of the deciduous premolar, and a considerable portion of the replacing tooth which we are probably justified in calling the permanent premolar.

The first true molar on the left side is in position and shows signs of considerable wearing. The posterior molars of the left side are also in position, the last not yet functional, but they are all practically unworn.

As regards incisors, the front of the lower jaw shows no evidence of any replacing teeth and one hardly feels justified in grinding into the bone to hunt for them. In the upper jaw part of the front is gone but there is clear evidence of one replacing tooth — the 3rd left incisor.

We may thus safely conclude that as the Cynodont approaches full maturity the incisors, canines and premolars are replaced as in mammals, and as no completely adult specimen has ever shown any trace of a later succession we may conclude as probable that there is only a single succession.

The dental formula of *Diademodon platyrhinus* would thus be

$$\begin{array}{cccccccc} 1\,2\,3\,4 & 1 & & 1\,2\,3\,4 & & & & \\ \textit{1\,2\,3\,4} & \textit{1} & & \textit{1\,2\,3\,4} & & 1\,2\,3\,4\,5\,6\,7\,8 & & \\ \mathrm{I} \text{———} & \mathrm{C} & \mathrm{-Pm} & \text———\mathrm{M} & \text——— & & & \\ \textit{1\,2\,3\,4} & \textit{1} & & \textit{1\,2\,3\,4} & & 1\,2\,3\,4\,5\,6\,7\,8 & & \\ 1\,2\,3\,4 & 1 & & \underset{\cdot}{1}\,2\,3\,4 & & & & \end{array}$$

That such an assemblage of unusual characters as the following should have arisen by convergence in two entirely unrelated groups of animals is difficult to believe:— exoccipital condyles, large true alisphenoid bone, large median vomer, palatine processes to the premaxillæ, zygomatic arch

formed by the squamosal and jugal, greatly reduced moveable quadrate, lower jaw mainly formed by dentary, secondary palate formed by maxillæ and palatines, development of a cochlea, large cerebellum with flocculus [Watson], mammal-like arrangement of turbinals [Watson], arrangement of teeth into incisors, canines, premolars and molars with a dental succession in the incisors, canines and premolars, seven cervical vertebræ, pelvis with a large anteriorly directed ilium, large obturator foramen, mammal-like carpus and tarsus, and a digital formula of 23333.