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Article XXVI.— DENTITION OF *HYDROCYON* AND ITS SUPPOSED FOSSIL ALLIES.[1]

By Charles R. Eastman.

Plates LXXXIV–LXXXVII.

Among the interesting specimens of African fishes brought back by Mr. Herbert Lang, leader of the Belgian Congo Expedition, is one of an adult *Hydrocyon lineatus*, the skull and skeleton of which have been prepared for study. An examination of the dentition shows that this form presents novel features, not heretofore observed among teleosts.

The powerful cutting teeth are not implanted in sockets, nor coössified with the bony elements of upper and lower jaws, but are attached to these elements by ligamentous union, closely paralleling the mode of attachment of teeth to the supporting cartilage in the jaws of sharks. Associated with this peculiar modification is another and still more noteworthy parallelism with dental conditions found in elasmobranchs, namely, as regards replacement of teeth. As functional teeth become effete with use and fall out, or are crowded over on the exterior margin of the jaws, above and below, they are replaced by a series of successional teeth which are formed in separate pouches on the inner face of the premaxillary and dentary bones, and gradually work their way into position so as to stand upright along the functional margin of the jaw bones. Whereas several rows of successional teeth are developed in cartilaginous fishes, apparently not more than two series are present in *Hydrocyon*, the set which is functional at a given time, and another in process of formation. Appearances indicate that tooth formation here, as in elasmobranchs, is a continuous process.

One other remarkable modification remains to be noted. There is no rigid union of the premaxillary and dentary bones at the symphysis, but instead the anterior extremities of both pairs are movably articulated with each other, there being several perfectly formed hinge-like joints in vertical alignment at the symphysis in both jaws, the whole constituting a neat interlocking contrivance for permitting motion and allowing for a lateral expansion of the mouth-angles in the quadrate region. The device is comparable to the hinged dentary bone of mosasaurs, and, so far as known to the writer, does not occur elsewhere than in *Hydrocyon* and one other Characin among fishes. The second known instance where this hinge-like arrangement is developed, is in the South American genus *Hoplias*, as pointed out to the writer by his friend Mr. J. T. Nichols. A lower jaw of *Hoplias* from Colombia, in

[1] Scientific Results of the American Museum of Natural History Congo Expedition. Ichthyology, No. 2.

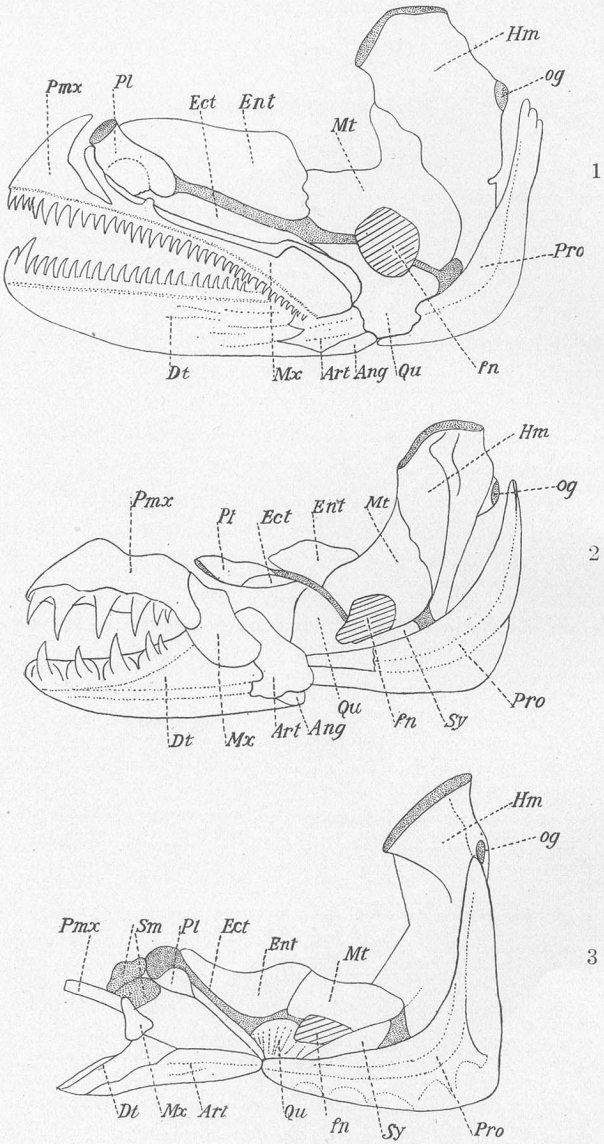


Fig. 1. Suspensorial and mandibular apparatus of *Erythrinus*. $1\frac{1}{2}$. *Ang.*, angular; *Art.*, articular; *Dt.*, dentary; *Ect.*, ectopterygoid; *Ent.*, entopterygoid; *fn.*, vacuity between the metapterygoid, symplectic and quadrate; *Hm.*, hyomandibular; *Mt.*, metapterygoid; *Mx.*, maxilla; *og.*, articular surface for the operculum; *Pl.*, palatine; *Pmx.*, premaxilla; *Pro.*, præoperculum; *Qu.*, quadrate.

Fig. 2. Suspensorial and mandibular apparatus of *Hydrocyon forskalii*. $\frac{1}{1}$. Notations same as for Fig. 1. *Sy.*, symplectic.

Fig. 3. Suspensorial and mandibular apparatus of *Citharinus*. $\frac{3}{1}$. Notations same as for Fig. 1. *Sm.*, submaxillary cartilage.

which this character is distinctly shown, has recently been presented to the American Museum by Mr. Leo E. Miller, who collected it.

The articulations observed in a few specimens of *Coccosteus* along the front margin of the jaws appear to have been in the nature of teeth, and to have subserved a different function than that here noted for *Hydrocyon* and *Hoplias*.

An excellent description of the structure of the skull in Characins is given by M. Sagemehl in the 'Morphologisches Jahrbuch' for 1885 (Vol. 10, pp. 1–119). The article is accompanied by illustrations, reproduced in Text Figs. 1–3, which show the formation of the mouth-parts in two genera of carnivorous and one of herbivorous Characins. The latter type, such as is presented by *Citharinus* (Text Fig. 3) recalls conditions found in *Amia*, and is regarded as "weit primitiver" than the type of jaw-structure found in *Hydrocyon* and *Erythrinus*. Nothing is said by the author regarding the mode of replacement of the teeth or of the movable articulation at the symphysis in *Hydrocyon*.

Fossil predecessors of Characins have not been hitherto identified with certainty, and accordingly any information regarding the geological history of the group is to be welcomed. Now it is an interesting fact that in searching fossil records for a type of tooth-structure similar to that represented by *Hydrocyon*, a very close approximation is found in the species of detached teeth from late Cretaceous and early Tertiary strata which have been described under the names of *Onchosaurus*, *Ischyrhiza* and *Gigantichthys*.[1]

All of these forms, like *Hydrocyon*, have elongated, acuminate crowns with slightly compressed, trenchant edges, and covered with a thin layer of enamel. The root is vertical, abruptly truncated below and hollowed interiorly, with coarse crenulations on the outer surface near the base. Examining the root from below, the basal portion is seen to be deeply excavated along the median line by a longitudinal groove. The characters last described evidently provide means for securing a firm attachment of the teeth to the supporting tissue of the jaws, since the teeth are not implanted in alveoli. In all of these respects, there is remarkably close agreement between the above-named fossil teeth and those of the recent genus *Hydrocyon*. The conclusion appears inevitable that all these forms are related, and that the ancestry of modern Characins may be traced back to *Onchosaurus* of the Cretaceous. One of the fossil species, *O. pharao* (Dames) is found in the Upper Cretaceous of Africa, and other representatives occur in Europe and North America. The type of *O. mira* (Leidy), now preserved in the American Museum of Natural History, is shown in Plate LXXXVI, B–C.

[1] For a discussion of the synonymy and probable relationships of these forms, see an article by the present writer in the 'American Naturalist' for 1904, Vol. 38, p. 298.

EXPLANATION OF PLATES LXXXIV–LXXXVII.

PLATE LXXXIV.

Lower jaw of *Hydrocyon lineatus* to show the peculiar interlocking hinge-joint at the symphysis.

A. View from above of dentaries spread apart to greatest extent. $\frac{1}{2}$.

B. Same view; dentaries approximated as closely as possible. $\frac{1}{2}$.

C. Posterior view of the hinge when fully opened. $\frac{2}{3}$. Although the dentaries can be freely moved, they cannot be separated without injury as in *Hoplias*. The successional teeth may be seen, lying in the alveolar pits with the points directed backward, so that a rotation is necessary to bring them in functional position. Note the peculiar form of attachment of the teeth suggesting *Onchosaurus mira* (Plate LXXXVI, Figs. *B* and *C*).

PLATE LXXXV.

Ventral view of anterior portion of skull of *Hydrocyon lineatus* with the tooth bearing premaxillæ and the hinged symphysis. $\frac{1}{1}$. The mesethmoid is expanded laterally to furnish an articular surface for the necessary movements of the premaxillæ. The successional teeth are clearly shown in their alveolar pits.

PLATE LXXXVI.

Two distal teeth (*A*) of right dentary of *Hydrocyon lineatus* compared with front (*B*) and side (*C*) views of tooth (type specimen No. 10452, A. M. N. H.) of *Onchosaurus mira* (Leidy) from the Cretaceous of New Jersey. (Natural size.) Note the remarkable similarity in general form, especially near the base, that suggests the same mode of attachment.

Right lower jaw (*D*) of *Hoplias* (a South American Characin) viewed from inside ($\frac{3}{2}$), and outer view of the largest anterior tooth (*E*). ($\frac{4}{1}$). As in *Hydrocyon* and *Onchosaurus*, all these large teeth are slightly hollow inside and are fastened to the dentary by only ligamentous connection. The gum-covered, basal, ridged portion is completely free from enamel and in this feature and its strongly trenchant edges, *Hoplias* resembles even more the Cretaceous form, whereas in *Hydrocyon* the enamel often reaches nearly to the base of the teeth.

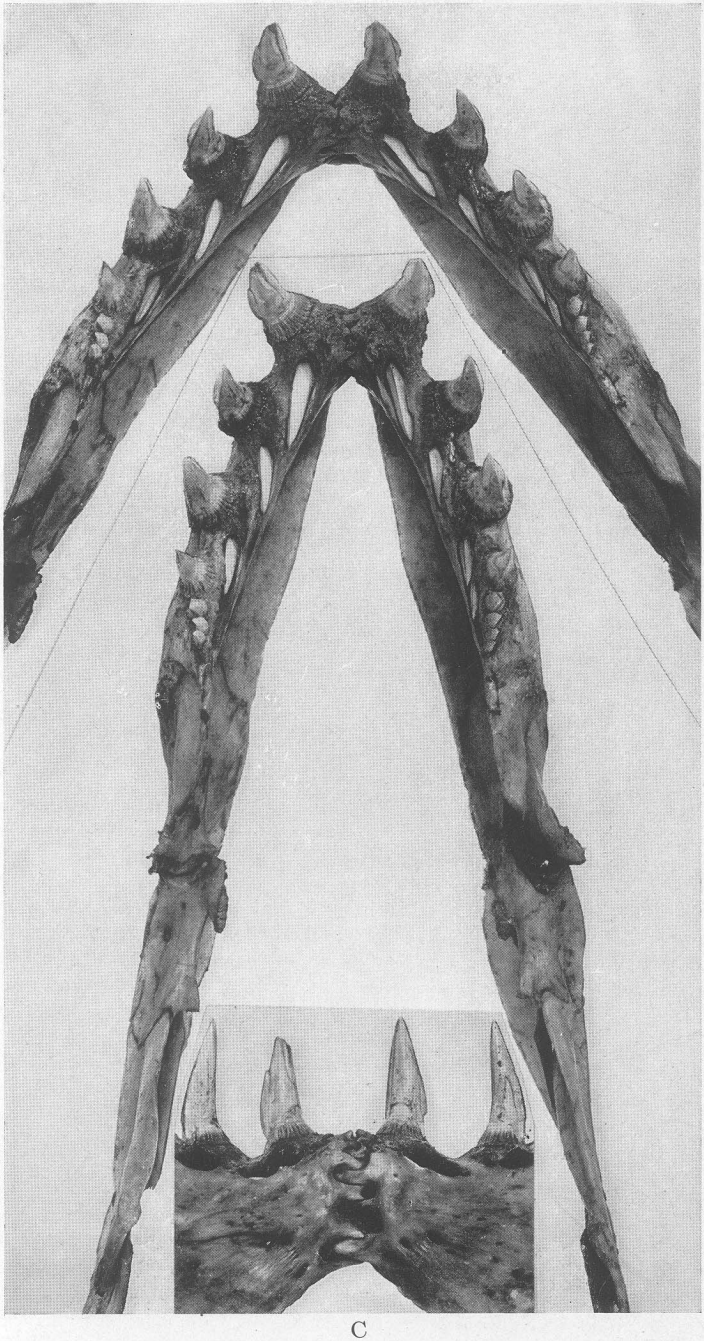
The hollow rear portions of some of the successional teeth are seen in their natural position near the front of the jaw; they become functional without rotation.

One side of the large interlocking hinge at the mandibular symphysis is clearly shown and resembles much in form and in function that of *Hydrocyon*.

PLATE LXXXVII.

Head of *Hydrocyon lineatus* (*A*) to illustrate the interlocking of the teeth when the mouth is closed. It is interesting to note that about half of the entire length of the teeth is embedded in the gum. The wide-open mouth of this specimen is figured in Plate LXX, Fig. 1. Photo by H. Lang from a freshly captured specimen (total length 61 cm.), Faradje, Uele District, Belgian Congo.

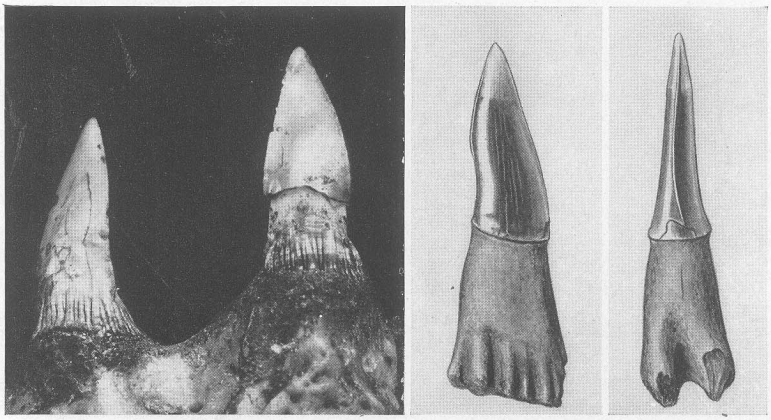
Left premaxilla of *Hydrocyon lineatus* (*B*), viewed from inside ($\frac{3}{1}$), showing the one and only series of reserve teeth. These are obliged to rotate into functional position like those of sharks and are attached to the jaw by simple ligamentous connection, without sockets or coössification.



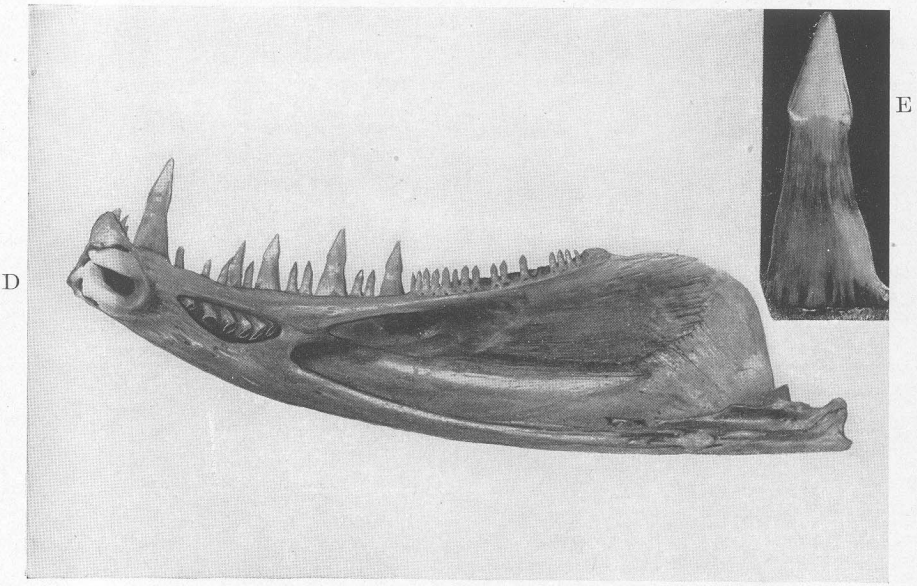
Lower jaw of *Hydrocyon lineatus* to show the peculiar interlocking hinge-joint at the symphysis.

A, dentaries spread apart fully; *B*, closely approximated ($\frac{1}{2}$); *C*, posterior view of the hinge ($\frac{2}{3}$).

Ventral view of anterior portion of skull of *Hydrocyon lineatus* with the tooth-bearing premaxillæ and the hinged symphysis. $\frac{1}{1}$.

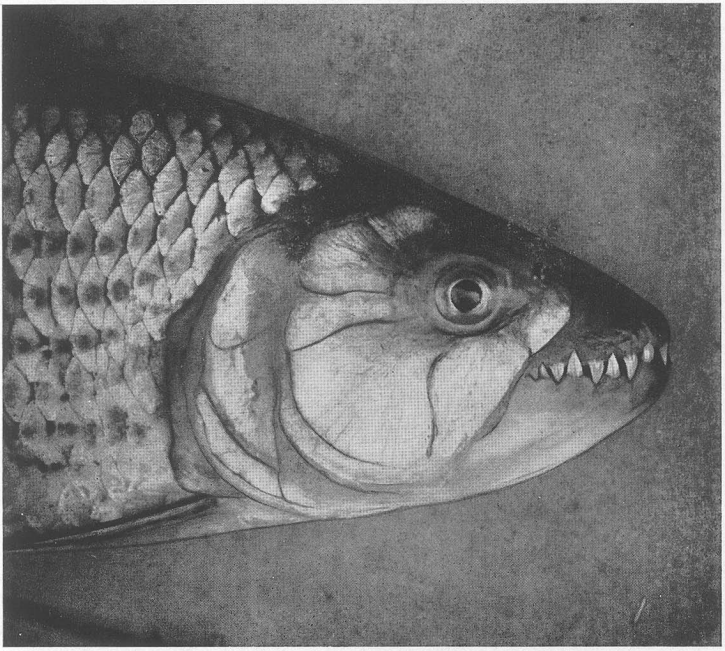


A B C

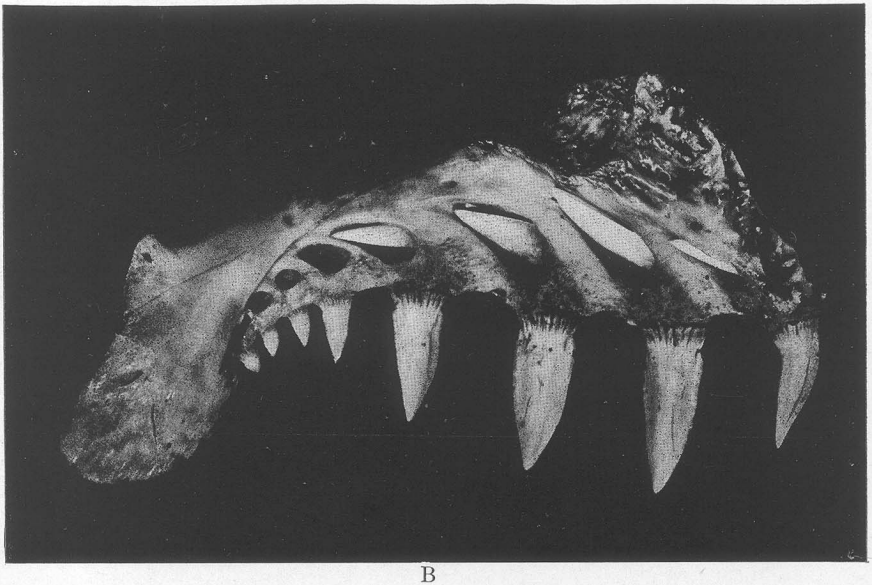


D E

Two distal teeth (*A*) of right dentary of *Hydrocyon lineatus* compared with front (*B*) and side (*C*) views of a tooth of *Onchosaurus mira* (Leidy). $\frac{1}{1}$. Right lower jaw (*D*) of *Hoplias* ($\frac{3}{2}$), viewed from inside, and outer view of the largest anterior tooth (*E*). $\frac{4}{1}$.



A



B

Head of *Hydrocyon lineatus*. *A*, to illustrate the interlocking of the teeth when the mouth is closed; *B*, left premaxilla of *Hydrocyon lineatus*, viewed from inside ($\frac{3}{4}$), showing the full series of reserve teeth.