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On the meaning of movable attachment of the incisiviform teeth in *Ruminantia.*

by

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In *Ruminantia,* the roots of the incisiviform teeth in the lower jaw are only partially enclosed in the bony alveolus. Only the lingual part of the alveolus continues in oral direction, the labial part being open at the anterior side, and occupied by fibrous tissue, which is elastic and compact. One look at the skull of a cow, sheep, goat or deer will suffice to convince anybody of the correctness of this statement. Closing its mouth, the animal will press downwards the incisiviform teeth in the lower jaw with the gum pad of the upper jaw, till the lingual side of the crown of the front teeth meets the gum pad.

Curiously enough, this mobility of the incisiviform teeth in *Ruminantia* has never been explained in any handbook on dental anatomy and, in some works only, has been mentioned by the way. AITCHISON was the first author who stressed this point (P.Z.S. 116, p. 329—338, 1946).

Nevertheless, the importance of this mobility is obvious. The front teeth in the lower jaw of *Ruminantia* do not meet any other dental elements on the opposite side. If the teeth were not movably attached to the jaw, they would touch the gum pad with their sharp, cutting edge. In that case two possibililities might offer themselves: the gum pad, though being hard enough, would be damaged by the cutting edge of the teeth, or the cutting edge would be worn by the gum pad and would become blunt. Now this cutting edge is important, because in grazing the grass, being held by the tongue or by the lips, is pressed against this edge and is cut by this edge with a jerk of the head. Browsers use their incisiviform teeth in a similar way, cutting leaves and saplings or scraping bark from the branches. The teeth need sharpening regularly, which is attained by the attrition of the crown on the flat, lingual side during mastication. Here I must point to the fact that the incisiviform teeth are not indispensable. A common cow, well on in years and having lost its front teeth, nevertheless will manage to graze by pressing the grass against the sharp edge of the jaw and tearing it loose by force. But in a normal case, the animal obviously profits by its cutting apparatus as this will follow the turning movement of the head in grazing and in this way the cutting edge of the front teeth will always stay perpendicular

to the direction of the blades of grass. Mobility of the front teeth in the same way will be important for browsing ruminants because it is clearly visible in browsing deer how the teeth follow the bend of the branch and while cutting the bark will stay perpendicular to the direction of the bark fibres.

During mastication, the front teeth do not play any part. Because of their elastic attachment however, they are not in the way either during the chewing process. The presence of other dental elements than molars might hinder mastication, because they would restrict the side-to-side movement of the lower jaw. This becomes clear from the fact that in *Ruminantia* provided with canines in the upper jaw, the canines also stand in wide alveoli and are surrounded by fibrous tissue. These are not "loose teeth" for there is a definite mechanism, a hinge, which always returns the tusks to their normal position. The fibrous ring surrounding the root is connected to the gum pad by a fibrous bundle. If the mouth is closed, pressure on the gum pad diminishes the tension if the fibres and the tusks can be brought sideward by the lower lip easily. The side-to-side movement of the lower jaw is not restricted in this way. If pressure on the gum pad is released, the fibres return the tusks to their normal, upright position. The lingual side of the socket will restrict this movement. The condition as described here is realized in the genus *Muntiacus*. In the genus *Hydropotes*, the situation is even more complicated because muscular fibres of the levator complex are attached to the fibrous ring surrounding the base of the tusk, and are able to move the tusk in orocaudal direction. Hinged tusks in both genera are carefully described by AITCHISON (l.c.). As far as I could see, a similar condition seems to be present in the genus *Tragulus*. Material of the latter genus available to me was scarce and insufficient however, so further study is needed. In the three genera mentioned here attrition af tusks is obtained entirely by friction of lower lip and fur covering the lower jaw, with the lingual surface of the tusks during mastication. The surface on the lingual side is clearly polished.

Mobility of the front teeth is not present in the same degree in all *Ruminantia*. As a rule the front teeth are less movable as the upper jaw increases in height. From this fact it was concluded that the functional meaning in the first place is aiming at not restricting the side-to-side movement of the lower jaw and that the function of cutting the food is of secondary importance.

Of course, I wondered how the situation might be in those ruminating mammals which, according to most modern opinions, systematically do not belong any more to the group of *Ruminantia* sensu stricto, viz. the group of the *Tylopoda*. I found that the front teeth do not meet the gums at all in this group. The upper jaw is relatively lower than in most *Ruminantia*, but the anterior part of the upper jaw lies on a higher level than the ventral part of the molar alveoli. So the upper jaw is typically turned upwards anteriorly as is clearly visible on the accompanying figure. Even if the molars have been worn down to their roots, the mouth cannot be closed so far that front teeth and gum pad will meet. It is a well-known fact that in *Tylopoda* both one incisor and an eyetooth are

present in the upper jaws, which teeth, just as the eye-tooth in the lower jaw, are hooked. These elements of upper and lower jaw alternate with each other and will pass each other during mastication without restricting the side-to-side movement of the lower jaw. In *Tylopoda all dental elements are attached immovably* to the jaws. This, in my opinion, affirms the view on the meaning of the movable attachment of front teeth in *Ruminantia*, as expressed in this short paper.

Attrition of the incisivi in the mandible of *Tylopoda* is obtained by friction with the lingual side of the lower lip. The mandibular incisivi do show very clearly attrition on the labial side and are often markedly polished. This must have been brought about by the mucous membrane of the mouth which is very thick and hard in *Tylopoda*.

In concluding we state that the form of the upper jaw is directly related to the degree of mobility of the front teeth in ruminant mammals, in connection with the direction of the mandible during mastication. Study of the attrition and attachment of anterior dental elements may give us a clue for reconstructing the movements of the jaw in many recent and fossil forms.

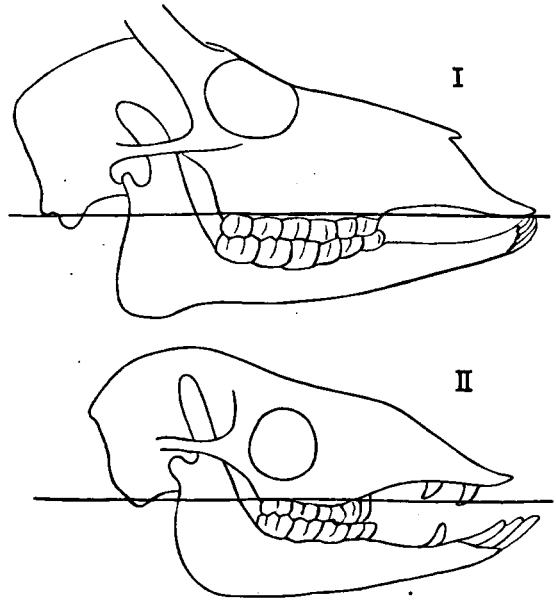

Fig. I. Sketch of a skull of a ruminant mammal (deer), gum pad meeting front teeth. Front teeth movably attached to the jaw.

Fig. II. Sketch of skull of a Tylopode mammal (lama), anterior part of upper jaw on higher level, gum pad not meeting front teeth. Front teeth immovably attached to the jaw.