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The Mechanism of the Protrusion of the Tongue of the Anura.

—Preliminary Note. By Prof. Marcus Hartog, M.A., D.Sc., F.L.S.*

For an explanation of the mechanism whereby the Anurous Batrachia protrude and reverse their tongue one may seek in

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vain in general textbooks of zoology and in special monographs. Almost all authors have been content to repeat after Fixsen that the genioglossus muscles are the "protractors" and the hyoglossus muscles the "retractors," though the frog has served as the object for the initiation of the student into the problems of anatomy and physiology for over forty years. As my own annual course begins with the study of the frog, this gap in our knowledge had long preoccupied me. A very simple experiment has sufficed to fill this gap and to demonstrate how the frog throws forth its tongue and turns it through an angle of 180°.

If we expose the tongue by removing the upper jaw and front of the skull (cutting straight across behind the eyes with a pair of stout scissors), remove the skin of the lower jaw, and then inject air or liquid through a small hole in the mylohyoid (mandibular) muscle, the tongue rises up and springs forward, especially if, at the same time, we draw forward the hyoid bone. Again, if we inject with melted cocoa-butter coloured with carmine or alkanet, and keep up the pressure till the mass sets, we find that it fills an enormous lymph-sac between the muscle and the body of the hyoid, extending through a median intermuscular fissure into the tongue itself, sending branches between the fan-shaped ramification of the intrinsic muscles at the edges of the tongue and into its terminal dilatations.

The whole mechanism is now obvious. The petrohyoids raise the hyoid bone and commence its protraction, an action continued by the geniohyoids. The genioglossi and hyoglossi may co-operate to some extent at first, shortening the tongue, and so expanding its cavity; but it is the MYLOHYOID which by its contraction expels the lymph of the subhyoid space into the tongue, and is the true "protrusor linguæ" muscle. In retraction the intrinsic muscles pull the tip of the tongue backwards, and the median portion of the genioglossi especially pull its base downwards and inwards. The sternohyoids and omohyoids retract the body of the hyoid bone, with its attachments to the tongue, and the closure of the mouth by the levators of the mandible presses the tongue against the roof of the mouth, and so expels the lymph from its cavity. Clearly this sudden propulsion of the tongue of the Anura is an erection, and is thus comparable with the sluggish protrusion of the foot in Lamellibranchs, also too often miscalled a "protraction."

Silvestro Baglioni, in his recent remarkable solution of the problem of the respiration of the frog *, hitherto misunderstood,

* In Arch. f. Anat. u. Physiol., Physiol. Abth. 1900, Suppl. Bd. p. 36.

has noted that during the contraction of the mylohyoid the tongue "wird nach vorn und oben gezogen." For the further development of this movement into the protrusion of the tongue all that is required is the further simultaneous advance of the hyoid bone and a more complete contraction of the mylohyoid muscle.

I propose completing this study with a detailed account of the dissection of the structures involved, for which I am awaiting the supply of larger objects than the common grass-frog, which is alone at my disposal at Cork.