ON THE STRUCTURE OF THE TONGUE IN HUMMING BIRDS.

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(With Plate IV.)

Although it is evident from Dr. Gadow's paper on the Suctorial Apparatus of Tennirostres* that he is well acquainted with the structure of the tongue of Humming Birds, he merely alluded to this group, and as so much misinformation on this subject is current in ornithological literature, it is hoped that the present paper may be of service in correcting some of the many misstatements.

The paper is based on the examination of the species noted below, and it is probable that the type of tongue herein described will be found to prevail throughout at least the greater portion of the *Trochilidæ*, and should exceptions exist, they will most likely be found in the *Phæthornithinæ*.

Species examined:

Lampornis sp.
Eulampis holosericeus.
Florisuga mellivora.
Mellisuga minima.
Trochilus colubris.
Calypte annæ.
Selasphorus platycercus.
Selasphorus rufus.
Stellula calliope.
Doricha evelynæ.
Lophornis sp.
Bellona exilis.
Chlorostilbon sp.

The tongue of Humming Birds, like that of such woodpeckers as *Colaptes* and *Hylotomus*, is extremely long, but there is little or no structural similarity between them.

In *Colaptes* the tongue is not continued beyond the anterior end of the short, fused, ceratohyals, and the basihyal is extremely long, while in *Trochilus* the greater portion of the tongue consists of the cartilaginous sheath of the ceratohyals, and the basihyal is short.

The reason for this difference is quite evident. The tongue of the woodpecker is a barbed spear, which to be effective needs to be more or less rigid. The tongue of the Humming Bird is used to entrap, not to impale, insects, and for extracting honey from flowers, and for these purposes it does not need to be especially stiff.

* Proc. Zoöl. Soc. London, 1883, pp. 62–69, Pl. XVI.

In both *Colaptes* and *Trochilus* the ceratobranchials are moderate, the epibranchials extremely long.

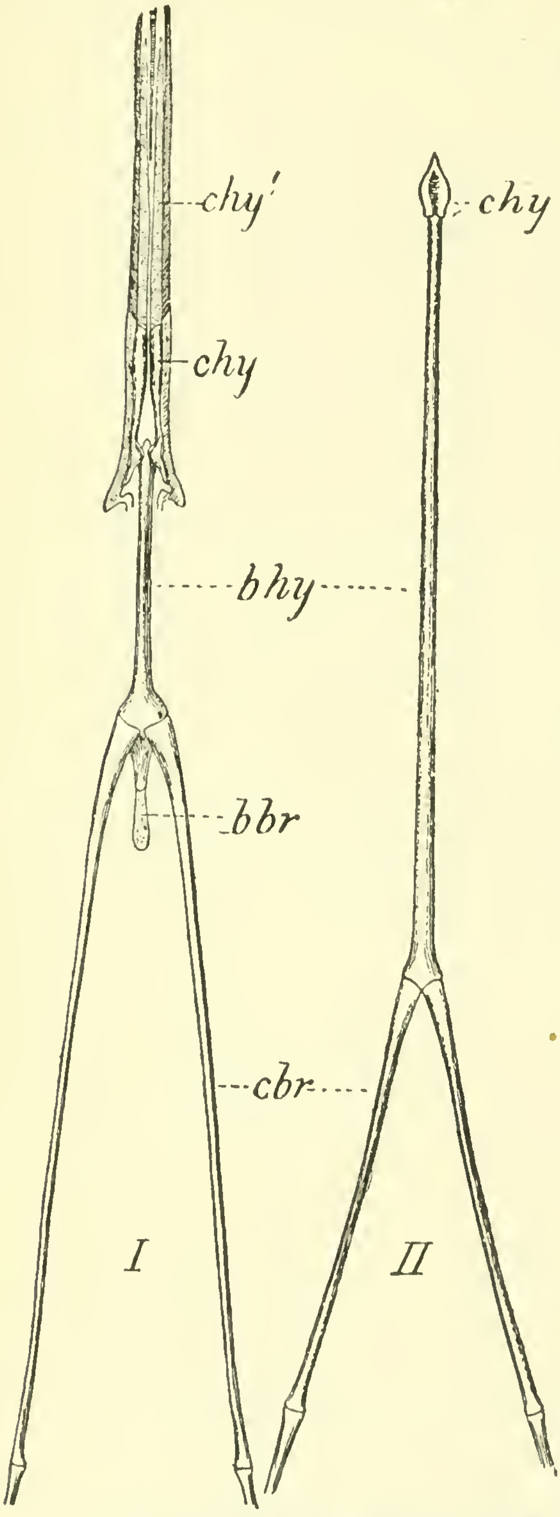


FIG. I. Hyoid of *Selasphorus rufus* × 8. *chy'*, cartilaginous prolongation of the ceratohyals. A portion of the surrounding sheath is shown, the difference in the shading indicating where the ceratohyal sheath becomes detached; *chy*, ceratohyal; *bhy*, basihyal; *bbr*, basibranchial; *cbr*, ceratobranchial.
Only the distal portions of the epibranchials are shown.

FIG. II. Hyoid of *Colaptes auratus* × 2⅔ Letters as before.

Basibranchial is wanting in *Colaptes*, very small and cartilaginous in *Trochilus*.

The base of the Humming Bird's tongue is formed of the soft, fatty, fibrous envelope of the basihyal, which, when the tongue is protruded, stretches like a spiral spring, and like a spiral spring contracts as the tongue is withdrawn.

As the tongue is extended the ceratobranchials are apposed and pressed forward into this fibrous sheath, and even when at rest these little bones lie close together, only separating when the tongue is convulsively retracted, as in the act of gasping.

The soft base is succeeded by the dense, cartilaginous sheath of the ceratohyals, and this practically consists of two portions, that investing the osseous part of the ceratohyals and that surrounding their cartilaginous anterior portions.

In badly preserved specimens this latter part can be slipped off intact, and its structure readily studied.

At first the cartilaginous sheath forms a single tube, somewhat elliptical in transverse section, grooved along the center above and below, and showing a slighter groove on the upper exterior surface.

The central grooves indicate the present division of the tube by a vertical partition, the lateral grooves the formation of a flange along the outer edge.

A little more than halfway between base and tip the tongue becomes forked, each division being a rod bordered by a wide flange of thin membrane, the external fold of cartilage becoming thus transformed before the fork of the tongue is reached.

This membrane curls upward and inward, much as one might roll a piece of paper, so that toward the apex two very delicate parallel tubes are formed.

This tubular part of the tongue, formed by the curled-up membrane, exists only for a short distance towards the anterior end, so that the common statement that the tongue of the Humming Bird consists of two parallel muscular tubes is quite erroneous.

So also is the statement that the tubular part of the tongue when at rest is drawn back into a muscular sheath.

When the flange is flattened out each moiety of the tongue suggests a feather with the vane on one side only, a resemblance that is heightened by the fact that toward the anterior end the membrane is more or less fimbriated.

Just how much of this fimbriation is normal and how much due to wear is somewhat of a question, although it is very evident that use has something to do with the lancination of the membrane, for it varies in individuals of the same species, and in some cases whipping out by wear is very apparent.

Dr. Gadow, indeed, speaks of specimens in which the membrane was entire, but does not mention the species, and none have come under my own notice in which the membrane was not somewhat lancinated.

The width of the bordering membrane varies in different genera, being for example very wide in *Florisuga* and very narrow in *Bellona*, the width doubtless bearing some direct relation to the food of the bird.

In a nestling of *Calypte annæ*, shown in Fig. 6, Pl. IV, the bordering membrane was longer than the cartilaginous rod supporting it, and the tongue but little cleft.

No fresh specimens of Humming Birds have been available, but in all birds examined the two branches of the tongue have more or less of an outward spiral twist, as shown in Fig. 3, Pl. IV, and I suspect that this may be the normal condition, although it is not mentioned by Gosse, who gives a very good description of the Humming Bird's tongue.

This author states that he is unable to quite understand the action of the tongue in sucking up liquids, and that while drinking sirup the tongue is protruded for half an inch or so and worked rapidly backward and forward.

Certainly there can be no sucking in the proper meaning of the word, since no vacuum can be formed at the back of the tongue, and liquids probably pass through the tubular portion by capillary attraction.

It seems probable, as stated by Professor Newton, that the chief use of the tongue is to capture small insects, and the size of the salivary glands suggests that the tongue may be covered with a viscous secretion to which minute insects would adhere, and thrust into crevices beyond the reach of the beak.

It is worthy of remark that the Golden-winged Woodpecker (*Colaptes auratus*), a species with unusually large salivary glands, employs its tongue in this manner to extract ants from their abiding places.

The principal muscles of the tongue are as follows:

Serpio hyoideus.—Probably owing to my lack of skill in dissection this muscle proved hard of detection, but although extremely delicate it is probably always present. It was unusually well defined in one specimen of *Selasphorus rufus.*

Mylo hyoideus.—Well developed, filling much more than two-thirds of the space between the rami of the jaw.

Stylohyoideus.—This large and important muscle arises at about the junction of the frontals with the premaxillaries, and curves around the skull external to the hyoid with its enveloping geniohyoideus.

At the angle of the jaw it turns inward, passes below the geniohyoideus, turns upward and outward to make a half turn around the epibranchial, and is continued along the outer side of this bone and the ceratobranchial to the anterior point of attachment on the upper side of the ceratobranchial.

By this peculiar half turn around the epibranchial the pull of the muscle is in a great measure transferred from the ceratobranchial to that point.

Geniohyoideus.—This muscle to a great extent underlies rather than envelopes the epibranchial, and it is but little twisted around this bone. As just stated, it passes above (dorsad) the stylohyoideus and becomes free from the epibranchial just where stylohyoideus passes around the epibranchial. The muscle is then continued to the symphysis of the mandible.

This arrangement of the stylo and genio hyoideus not only gives these two muscles a remarkably long pull, enabling them to act with great force, but also eases the strain on the long, slender epibranchial.

Ceratoglossus.—This slender muscle arises at the posterior third of the epibranchial and runs, as usual, to the basihyal.

Tracheohyoideus.—Although slender, this muscle is well defined, running from the upper part of the trachea, just below the arytenoid cartilage, to the basihyal.

EXPLANATION OF PLATE IV.

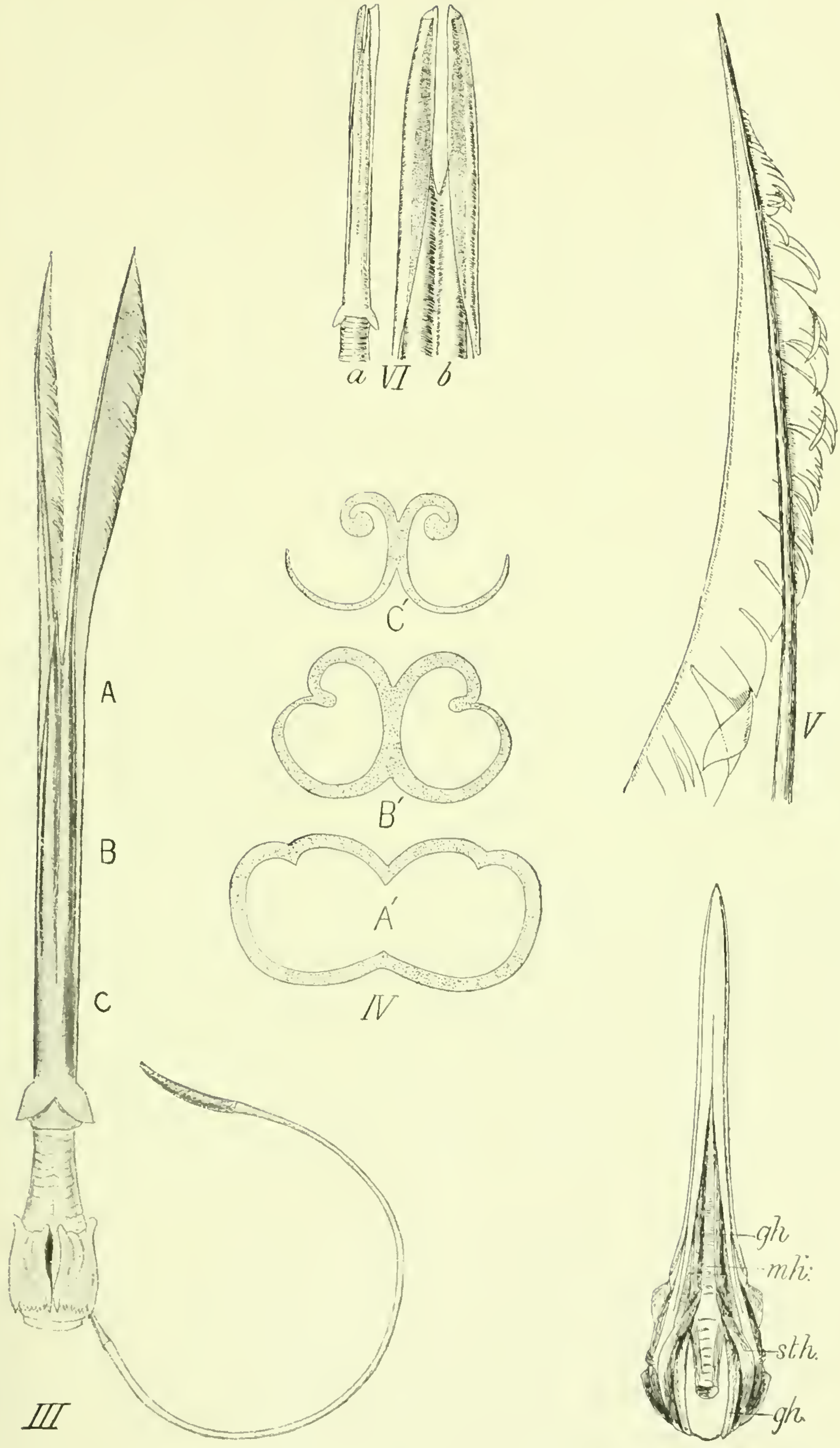
Fig. 3. Tongue of *Eulampis holosericeus*, enlarged. The membrane of the right side is opened out, that of the left retains the spiral twist commonly seen.

4. AB′C′, Sections through the sheath of the ceratohyals at CBA. Very greatly enlarged. From camera lucida drawings.

5. Tip of tongue of *Eulampis holosericeus*, left side, from below, the membrane being flattened upon itself. Greatly enlarged. From a camera lucida drawing.

6. *a*, Tongue of nestling of *Calypte anna* × 6. *b*, Tip of same greatly enlarged, with the membrane curled inward as in nature.

7. Head of *Eulampis holosericeus* seen from below, slightly enlarged: *gh*, geniohyoideus; *mh*, mylohyoideus; *sth*, styolohyoideus.



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