Tongue of Two Species of *Prionochilus* from the Philippines, with Notes on Feeding Habits of Flowerpeckers (Dicaeidae)

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The tongue of flowerpeckers was summarized by Gardner (1925). He wrote that "the Dicaeidae have small tongues that are flat posteriorly but at about the middle become abruptly narrower and begin to curl into a semitube which is deeply cleft at the tip, the margins of which are smooth, forming two slender semitubular tips. This is found in *Dicaeum cruentatum*, *D. sanguinolentum*, *D. flammeum* [=D. trochileum], and *D. celebicum*. In *Acmonorhynchus* [=*Dicaeum*] *aureolimbatus* the same holds true except that the edges of each tube show a slight notching, with an attempt at the production of four tips, while in *Prionochilus* these notches have deepened to actual splitting with the formation of four semitubular fringeless projections."

Gardner's statements have been cited and provided a basis for certain statements of subsequent authors who discussed the relationships and evolution of flowerpeckers (Dicaeidae), such as Mayr & Amadon (1947) and Rand (1961, 1967). Thus Mayr & Amadon (1947) stated that in *Dicaeum* and *Anaimos* [=Prionochilus] the tongues are, in varying degrees, tubular as in other birds in which nectar is an important item of the diet and they envisaged the evolution of the flowerpecker tongue from a generalized type with frugivorous habits such as in Melanocharis and Paramythia to a more specialized one adapted for nectar feeding (*Dicaeum* and *Prionochilus*).

I have examined specimens of *Prionochilus plateni* and *P. olivaceus* and found that these two species possess an unspecialized, rather flat and fleshy tongue similar to those of Melanocharis and Paramythia. I therefore redescribe it below, with some comments on the feeding habits of flowerpeckers.

Gardner (1925) figured a number of tongues for diverse taxa of birds, but he did not illustrate any for the Dicaeidae, giving only descriptions. Nor did he mention the species of *Prionochilus* on which his description was based. Among the spirit specimens of flowerpeckers in the National Museum of Natural History, Smithsonian Institution, there are specimens which were partly dissected for examination of the tongue. These specimens, including some of *Dicaeum sanguinolentum*, *D. celebicum*, etc., could possibly be part of the material examined by Gardner. However, I did not locate his specimens of *Prionochilus*. Whether Gardner's
description of the *Prionochilus* tongue is erroneous based on a misidentified specimen or it represents another type of tongue in *Prionochilus* is a matter of conjecture until the tongue of all six species of the genus has become known, but this is not an important question for the present paper.

**MATERIAL EXAMINED**

I examined the tongues of four specimens of *Prionochilus plateni* from Palawan and one specimen of *P. olivaceus* from Mindanao. These tongues are attached to the trunks which were preserved in alcohol when skins were prepared. Several spirit specimens of *P. plateni* were examined to ensure the identification of the material.

I have also studied the tongue of the following species by opening the bill of spirit specimens and pulling the tongue sideways, but no attempt was made to remove the tongue from the spirit specimen for complete inspection: *Dicaeum agile*, *D. aeruginosum*, *D. aureolimbatum*, *D. nigrilore*, *D. bicolor*, *D. australe*, *D. trigonostigma*, *D. hypoleucum*, *D. pygmaeum*, *D. erythrothorax*, *D. aeneum*, *D. sanguinolentum*, *D. celebicum*, *D. ignipectus*, *D. cruentatum*, *D. trichileum*, *Melanocharis versteri*, *Paramythia montium*, and *Pardalotus punctatus*. Two, sometimes three or four, spirit specimens were examined for each species except for *Dicaeum agile*, *D. nigrilore* and *Paramythia montium*, which were represented by a single specimen. The majority of the spirit specimens are in the collection of the National Museum of Natural History, Smithsonian Institution, Washington, DC, and others in the National Science Museum, Tokyo.

**DESCRIPTIONS OF THE TONGUE**

The two species of *Prionochilus* (*P. plateni* and *P. olivaceus*) agree closely in the structure and shape of the tongue. It is more or less fleshy, relatively thick, shallowly concave on the dorsal surface, and distinctly notched (but not deeply cleft or split) at the tip, with a fine hair-like fimbriation along the anterior third of the lateral margins (the fimbriation is somewhat variable individually and totally lacking in one specimen of *P. plateni*). As usual of the passerine bird

![Figs. 1–2 Tongues of 1. Prionochilus plateni, 2. Melanocharis versteri. Drawn not to the same scale.](image-url)
tongue, there is a row of fringes at the posterior end. In these features the tongue of *Prionochilus* (Fig. 1) is very similar to that of *Melanocharis* (Fig. 2), the two differing chiefly in shape (more slender in the former), but is quite unlike those of many species of *Dicaeum* (described below).

In *Paramythia* the tongue is small for the size of bird, rather flat and thin, and more or less cornified anteriorly, but the tip is not deeply split (see the figure in *Mayr & Amadon* 1947). In both *Melanocharis* and *Paramythia* the lateral margins are smooth.

The typical tongue of *Dicaeum* is fleshy only at its posterior half. The anterior half is horny, thin and translucent, and is deeply cleft to form two ribbon-like projections, which are often flat but sometimes semitubular because the edges are curled. The lateral margins are usually smooth (occasionally there is some fimbriation as in Fig. 6), whereas the dorsal surface is more or less deeply concave by curling of the lateral margins or, in a few species, distinctly grooved along the median line. However, in the specimens examined, the curling of the lateral margins is incomplete and in no case was a tubular structure formed by the curled edges meeting dorsally. I have found this type of tongue in *D. pygmaeum*, *D. erythrothorax*, *D. aeneum*, *D. sanguinolentum*, *D. ignipectus*, *D. cruentatum*, and *D. trochileum* (Figs. 3–7).

The tongues *D. hypoleucum* (Fig. 8) and *D. trigonostigma* (Fig. 9) represent a slight modification of the typical one. In these species the tip is cleft into four parts of varied length and shape (some individuals have only two tips) and the semitubular nature of the structure is more pronounced than in the other species.

Among *Dicaeum* the most specialized tongue may be found in *D. nigrilore* (*Rand* 1961). In this species (Fig. 10) the tip of the tongue is tripartite, instead of bifid in the typical tongue, and the central element is further subdivided into two parts, resulting in four flat ribbons at the tip (the central pair have an additional short cleft to produce six separate tips). The outer margins of the anterior half are frayed to the tip. My specimen differs from *Rand*'s (1961) description and figure only in minor details, the differences being chiefly in the extent of the marginal fraying and due probably to individual, age, or seasonal variation.

To the other extreme, thick-billed species (*D. bicolor*, *D. aureolimbatum*, *D. aeruginosum*) have a tongue which is flat, rather thick and fleshy, and notched at the tip (Figs. 13–15). This condition is much the same as in *Melanocharis and Prionochilus*, but has hitherto been unknown in *Dicaeum*.

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The tongue of *Pardalotus punctatus* is flat, broad, and thin, rather than fleshy, with an irregularly notched tip (Fig. 16).

**DISCUSSION**

Most flowerpeckers are tiny, restless birds with a small bill. They congregate at flowers, but the exact manner of their feeding and the kind of food taken are usually difficult to observe, due to the small size and the tendency to feed in more or less higher branches. The analysis of stomach contents reveals only part of the actual food habit of these birds since nectar and pollen leave no visible traces in the alimentary tract. Thus, except for a few species, the feeding habits of flowerpeckers are little known and this holds true of *Prionochilus*. The structure of the tongue may then be used as an indication of their food in the absence of useful information.

The tongue of *Prionochilus* is apparently not adapted for collecting nectar and pollen. Its tongue can be protruded but little beyond the tip of the stout bill so that it would function mainly for swallowing the taken food and regurgitating undesired substances from the mouth. It is assumed that the staple food of *Prionochilus* is small berries and seeds as in *Melanocharis*, with insects and spiders also taken frequently or occasionally. Several species of *Dicaeum* that have a thick bill and a flat, non-split tongue may also be primarily berry and seed feeders.

The split, fringed, and semitubular tongues of *Dicaeum* are probably adapted for an omnivorous feeding habit. These tongues are longer and narrower, and can be protruded to some extent for feeding. They are no doubt capable of collecting nectar and pollen and these items are part of their food, in addition to berries, seeds, insects, spiders, etc. However, none of the flowerpeckers examined possesses a completely tubular tongue like those of sunbirds and spiderhunters, indicating that flowerpeckers are less specialized nectar and pollen eaters. Judging from the structure of the tongue, nectar and pollen would be second in importance to berries, seeds and insects as their food, for otherwise selection favors a tubular tongue.

The tubular tongue of sunbirds and spiderhunters (Nectariniidae), on the other hand, is so slender and thin that it cannot be used for anything but collecting nectar, juice and pollen, and these birds must rely on the action of the bill to catch insects and spiders; berries and seeds could be taken only accidentally (see Gardner 1925, Scharnke 1932, and Mayr & Amadon 1947 for description of the tongue in Nectariniidae; the tongue of *Arachnothera longirostra* I examined, a sparrow-sized spiderhunter, measured about 60 mm long, 3 mm wide at the base, and only 0.5 mm in diameter of the tube).

Among the species of *Dicaeum* there is a good correlation between bill shape and tongue
Fig. 17. Stomach of *Prionochilus plateni*. Note that the gizzard is so positioned that easily digestable berries are passed to the intestine without entering the gizzard (see arrow)

structure. In general thin-billed species tend to have a typical, split tongue. The fringed and semitubular tongues are found in species with a thin and decurved bill, whereas thick-billed species have a more fleshy, non-split tongue. However, the tongue of thin-billed *D. celebicum* (Fig. 11) is non-split, flat and fleshy, resembling those of the thick-billed species except for being narrower, in accordance with the narrower mouth cavity.

Thin-billed species are thus not always more specialized for nectar and pollen feeding than thick-billed species (the reverse may not be true; I doubt that there is any thick-billed species that is specialized for nectar feeding). The tongue of *D. australe* (a thin-billed species, Fig. 12), however, may represent a stage towards specialization.

As pointed out by Mayr & Amadon (1947), it is highly probable that the more specialized tongue of *Dicaeum* could have been evolved from a generalized type found in the primitive and omnivorous flowerpeckers (*Melanocharis*). Although the tongue of *Prionochilus* represents the primitive condition, it is not known whether *Prionochilus* is primitive and related to *Melanocharis* as sometimes suggested (cf. Salomonsen 1960). Aside from the developed tenth primary there is little evidence to show that *Prionochilus* is primitive and more closely related to *Melanocharis* than to *Dicaeum*.

In this connection it is interesting to find that the stomach of *Prionochilus* (Fig. 17) is the specialized *Dicaeum* type, and not a generalized *Melanocharis* type, although a relationship between *Prionochilus* and mistletoe berries is unknown (see Desselberger 1931 and Mayr & Amadon 1947 for the specialization of the *Dicaeum* stomach). Presumably *Prionochilus* and several thick-billed species of *Dicaeum* have retained the primitive, unspecialized tongue in the absence of the need for nectar feeding.

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The tongues of *Prionochilus plateni* and *P. olivaceus* were examined and redescribed. These tongues are very similar to the primitive condition found in *Melanocharis*. Implications of these facts are discussed. *Prionochilus* and several thick-billed species of *Dicaeum* probably retained the primitive, unspecialized tongue in the absence of a need for nectar feeding, while they are typical *Dicaeum* in many respects.

**LITERATURE CITED**


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