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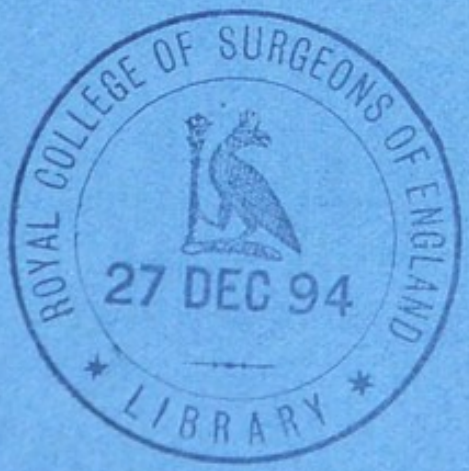


THE GUSTATORY ORGANS OF *BELIDEUS ARIEL.*

By FREDERICK TUCKERMAN, M.D., *Amherst, Massachusetts.* (PLATE V.)

I AM indebted to Professor John M. Tyler, of Amherst College, for kindly placing at my disposal a tongue of this animal.

The organ measures 21 mm. in length, 6 mm. in breadth, and 5 mm. in thickness. Anteriorly, it is free from the frænum linguæ for 9 mm. The upper surface is transversely impressed, corresponding to the roof of the palate, which is traversed by several small elevated ridges slightly curving forwards. Fungiform papillæ are thinly scattered over the dorsum. They are very small, averaging only about 0·20 mm. in height.

At the posterior part of the dorsal surface, directly in the median line of the tongue, and 3·5 mm. from the base, is situated a single circumvallate papilla. About 1 mm. anterior to this papilla, and 2 mm. distant from each other, are two short furrows, running parallel to the long diameter of the tongue. The papilla and furrows thus form a triangle, the apex of which looks towards the epiglottis. The furrows lie somewhat concealed, and are scarcely distinguishable without a lens. At the bottom of each furrow is a ridge, which bears taste-bulbs over nearly its entire surface. Although no search was made for the lateral gustatory organs, there is little doubt of their existence, as they have been found in every marsupial in which the taste-areas have been studied. Poulton[1] mentions finding them in Phalangista, though with a less number of furrows, and with a less regular arrangement than in the higher Mammalia.

The Circumvallate Papilla.—This papilla measures 0·55 mm. at its widest part, and is 0·54 mm. in height. The upper surface, which overtops the adjacent lingual surface a trifle, is marked by vertical clefts, the spaces between which are filled nearly to a common level by the epithelium. The sides are fairly symmetrical, and at their lower part bend inwards and

[1] *Quart. Jour. Micr. Sci.*, vol. xxiii., 1883, p. 471.

downwards. The trench, which is nowhere very wide, becomes gradually narrower as it curves inwards at the base of the papilla. Serous glands are fairly abundant, and their ducts discharge into the trench at its lower part.

The taste-bulbs of this gustatory area are chiefly confined to the lower half of the lateral wall of the papilla, which they almost completely fill. They are disposed in six to eight tiers. Bulbs are also present in the epithelium lining the bottom of the trench, and isolated ones occur at the upper angle of the outer wall of the latter. The bulbs have more or less of a neck, and bear a resemblance in their general contour to those of the Rabbit and Musk-Rat. They measure 0·044 mm. in length, and are 0·022 mm. in breadth. In transverse sections of a bulb, having a diameter of 0·021 mm., I counted eleven cells grouped about the axis of the bulb, most of which were probably sensory cells.

Nerve-fibres, many of them non-medullated, enter the axis of the papilla, and their branches run to its upper part and sides. Beneath the bulb-bearing region they form a plexus, from which terminal fibrils (many of them having a primitive sheath), run either directly to the bases of the bulbs, or pass between them and enter the epithelium. A great number of very delicate fibrils enter the epithelium, and there form a network. Other intra-epithelial nerve-fibrils appear to end freely, while still others terminate in loops. At the upper part of the papilla were what seemed to be rather large ganglion cells, but owing to certain alterations which their constituent elements had evidently undergone, I was unable to positively identify them as such.

The Gustatory Ridges.—The bulb-bearing ridges of *Belideus ariel* are two in number. Each ridge rises from the bottom of a deep furrow or groove, the crown of the ridge at its highest point being 0·1 mm. below the opening of the latter. Anteriorly, the ridge is not unlike a deeply sunk circumvallate papilla. As it is followed backwards, however, it grows smaller, and becomes more perfectly arched. At the posterior limits of the ridge, the furrow is wholly closed above, thus protecting completely the portion of ridge beneath it (the figs. 2–6 show the general shape of the ridges). Serous glands are scattered

through the membranous stroma underlying the ridge, and their ducts open into the furrow at its base and deeper part.

The taste-bulbs seem to almost fill the epithelium covering the ridge. Some of the largest bulbs are 0·054 mm. long and 0·027 mm. broad, but the average bulb is not more than 0·042 mm. in length and 0·021 mm. in breadth. They appear to be rather loosely constructed, and of a somewhat lower type of terminal sense-organ than the bulbs of the circumvallate papilla. The gustatory pores vary slightly in size and form. They are usually, however, more or less oval, and their diameter is about 0·0033 mm. Many of the bulbs lie partly in the epithelium and partly in the mucosa, but I failed to detect any which were wholly subepithelial in position. This taste-area is abundantly supplied with nerves. Nerve-fibres enter the base of the ridge, and their branches radiate apparently to all parts of it. The distribution and arrangement of the terminal fibrils is similar to that which exist in the circumvallate papilla.

We are indebted to Poulton for first directing the attention of anatomists to the gustatory ridges of Mammalia. This observer found at the posterior part of the dorsal surface of the tongue of *Ornithorhynchus* two pairs of these ridges. The anterior pair lie below the surface in a furrow. The posterior pair are likewise in a furrow, but their crests are on a level with the adjoining lingual surface. The ridges of both areas bear taste-bulbs over the whole of their convexity.[1]

There exist in the gustatory ridges of *Belideus ariel* structural characters which are common to both the circumvallate type of taste-area and the bulb-bearing ridges of *Ornithorhynchus*. The ridges of *Belideus* furnish us with an intermediate or transitional stage in the process of development of the former from the latter, the more recent from the more primitive type of taste-area. Consequently, the finding of these ridges supplies an important link in the history of the development of gustatory areas. Now that the two types have been found to occur together, it is not at all improbable, from all indications, that further investigation will reveal the foliate

[1] Poulton's admirable description of the tongue and gustatory organs of *Ornithorhynchus* may be found in the *Quarterly Journal of Microscopical Science*, vol. xxiii., 1883, p. 453.

type, though doubtless in its simplest form, coexisting with them.

The Fungiform Papillæ.—Taste-bulbs were more plentiful on these papillæ than I had expected to find them. Those about the tip are seldom without one or more at their upper part. The bulbs, when single, lie vertically in the long axis of the papilla. When two are present, they are placed obliquely, with apices directed upwards and outwards. The bases of the bulbs in most instances rest in depressions of the mucosa. Some of the bulbs have a well-defined neck, while others are without it. They vary in length from 0·039 mm. to 0·044 mm., and in breadth 0·024 mm. to 0·030 mm.

EXPLANATION OF PLATE V.

Reference Letters.

f, Furrow.
gl, Serous gland.
gld, Duct of serous gland.
gr, Gustatory ridge.
mm, Mucous membrane.
n, Nerve.
pp, Papillary processes of mucous membrane.
sp, Secondary papillæ.
t, Trench.
tb, Taste-bulb.

Fig. 1. Vertical section through the circumvallate papilla. × 50.

Fig. 2. Vertical section through the anterior part of the left gustatory or bulb-bearing ridge. This portion of the ridge, although entirely below the surface, is in many respects not unlike the circumvallate papilla of some of the higher mammals. The taste-bulbs are confined to the lateral area. × 60.

Fig. 3. Vertical section through the anterior part of the same ridge. The ridge has lost its apex, and the bulbs are arranged in a continuous belt entirely covering its crest and sides. × 60.

Fig. 4. Vertical section through the middle of the same ridge. The ridge has decreased in size, and the opening of the furrow has become much narrower. × 60.

Fig. 5. Vertical section through the posterior part of the same ridge. The lips of the furrow have coalesced, and the ridge is completely roofed over. × 60.

Fig. 6. Vertical section through the extreme posterior part of the same ridge. The ridge is smaller and more constricted at the base. The bulbs are distributed over the circumference, and are of a more simple type than those at the anterior end of the organ. × 60.

Fig. 7. Vertical section through a fungiform papilla of the tip of the tongue, bearing a single taste-bulb at its upper part. × 100.

Fig. 8. Vertical section through a fungiform papilla from the mid-dorsal surface of the tongue, bearing two taste-bulbs at its upper part. × 130.

Fig. 1.

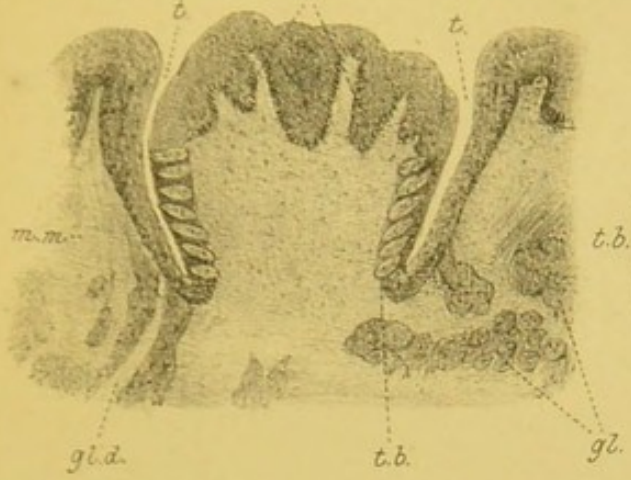


Fig. 4.

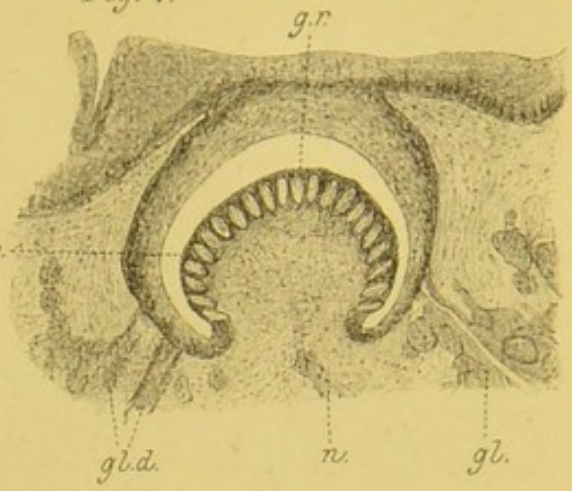


Fig. 2.

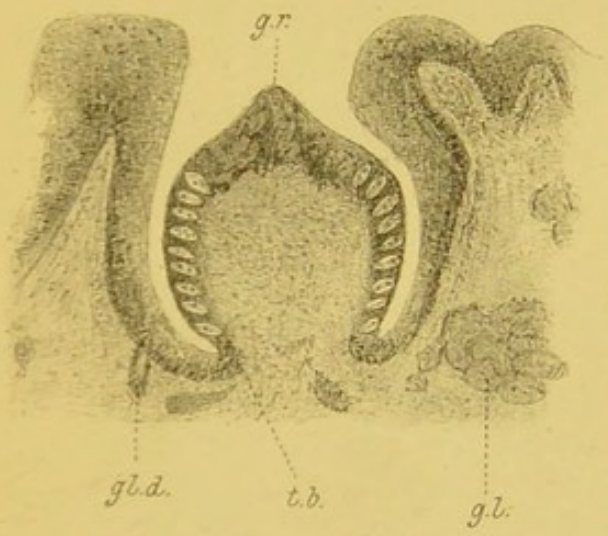


Fig. 5.

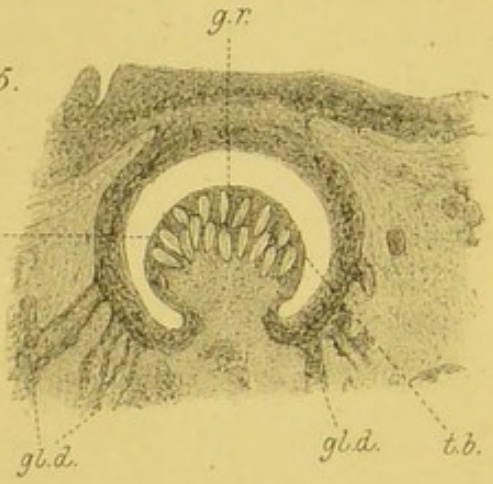


Fig. 6.

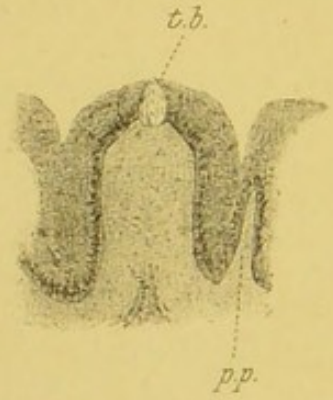


Fig. 3.

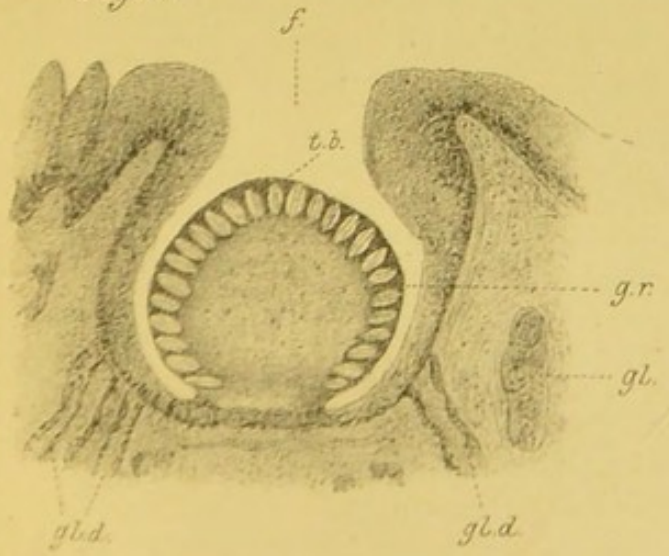
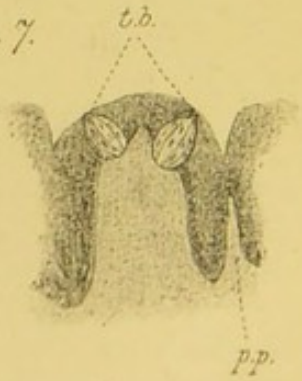


Fig. 7.



F. Huth, Lith.r Edin.r

GUSTATORY ORGAN.