

IV. *On the Lingual Dentition of some West-Indian Gasteropoda.*

By R. J. LECHMERE GUPPY, Esq., F.G.S., and JABEZ HOGG, Esq., F.L.S., M.R.C.S.L. &amp;c.

(Plate XI.)

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SINCE the investigations of Lovén into the lingual dentition of the glossophorous Mollusca, various observers have studied the subject, with great advantage to our knowledge of the affinities of those animals. Thus we find, amongst other changes, that it has been necessary to remove the Proserpinadæ from the neighbourhood of the Cyclophoridæ, to which they were formerly supposed to be nearly related, and to place them in a more natural position near the Neritidæ. That these investigations are of great value is also shown by the light which has been shed on the true position of *Aporrhais*, supposed by so great a naturalist as Professor Forbes to be akin to the Cerithiidæ, but which is shown by its dentition to belong to the Strombidæ. When once we have thus ascertained the natural position of a genus whose relations are otherwise somewhat doubtful, it is surprising how the characters of the shell, perhaps misunderstood before, concur to bear out the affinities indicated by the teeth. Thus the young *Aporrhais* resembles a young *Strombus* or *Rostellaria*; and *Ceres* and *Proserpina* have evidently characters which approach them to *Nerita*. Observations on *Helicina*, published in 1864, by one of the authors, showed the relationship of that genus to *Nerita*, to which indeed in its dentition it bears a stronger resemblance than does even *Ceres*. These views have been confirmed, independently, by several authors.

It is our object, in the present paper, to make known some new forms of lingual dentition, some of which, it will be observed, point the way to further reforms in our classification of the Gasteropoda\*.

\* Dr. J. Gray, F.R.S. ('Annals of Natural History,' ser. 2, vol. x. p. 413), writes:—"One result of the study of these papers (Lovén's "On the Tongues of Mollusca") and the examination of the tongues of several mollusks has been to establish more firmly the theory which I have long entertained, that no species of gasteropodous molluscous animal can be properly placed in the system unless we are enabled to examine the animal, the shell, the operculum, and the structure of its tongue; and as none of these parts but the shell can be examined in the fossil species, their position in the various genera must be always attended with more or less uncertainty."

Professor Huxley very properly objects to the use of the commonly-accepted term *tongue* for the tooth-bearing membrane of the mollusca, and he appropriately designates it "the odontophore."

"The *odontophore* consists essentially of a cartilaginous strap, which bears a long series of transversely-disposed teeth. The ends of the strap are connected with muscles attached to the upper and lower surface of the hinder extremities of the cartilaginous cushion; and these muscles, by their alternate contractions, cause the toothed strap to work, backwards and forwards, over the end of the pulley formed by its anterior end. The strap consequently acts after the fashion of a chain-saw (*rather of a rasp?*) upon any substance to which it is applied; and the resulting wear and tear of its anterior teeth are made good by the incessant development of new teeth in the secreting sac in which the hinder end of the strap is lodged. Besides the chainsaw-like motion of the strap, the odontophore may be capable of a licking or scraping action as a whole."—*Huxley's Elements of Comparative Anatomy*, p. 36.

We shall first premise that the teeth on the dental band of the Mollusca are mostly disposed in longitudinal series. In the Pulmonata there is usually a single median row, the laterals on each side being broad and similar. But in most of the other groups the teeth are arranged in three, five, or seven dissimilar series. Taking *Nerita* or *Helicina* as a type, we designate as *laterals* the broad teeth on each side of the median row, the numerous small teeth on the outside of the band being known as *pleuræ*; and the teeth on this are termed *uncini*. The latter are found only in certain groups. Most of the Mollusca mentioned in this paper have been recently described or enumerated in the 'Annals and Magazine of Natural History'\*, where further particulars as to their habits and organization will be found.

In the genus *Bulimus* we have a dentition resembling in general characters that of *Helix*—that is to say, a broad dental band with numerous similar teeth. But the forms of the teeth themselves are very varied; and it is a subject for inquiry how far the divisions proposed by zoologists are borne out by this part of the organization. In *Bulimus oblongus* the teeth are subquadrate, with simple obtuse cusps, the laterals differing but slightly in shape and size from the medians. This species is interesting on account of the peculiar frontal appendages, first described by D'Orbigny, which recall to our minds those of the *Nautilus*, though the resemblance is not perhaps great; still it is a morphological resemblance. We find, too, that this mollusk has mandibles somewhat resembling those of a Cephalopod.

The teeth of *Bulimus zebra* have considerable resemblance to the preceding. The animal has no peculiar frontal appendages, like those of *B. oblongus*; and its mandible is not different from those of other members of the group.

*Bulimus virgulatus*, a mollusk of the Antilles, presents a different type. The teeth are in divergent rows, the medians small, with a round reflexed tricuspid point, the laterals, on subquadrate bases, with denticulate reflexed edges, the cusp on the inner side being rather long. The denticles appear to be 3-4 in number, of which two only are usually seen at one view with the microscope.

The teeth of *Bulimus multifasciatus* (Plate XI. fig. 1), *B. immaculatus*, and *B. aureolus* are so nearly alike, that one description will serve for them all. In general arrangement they are like the preceding species'; but the medians are minute, and the laterals are armed with three long acute cusps, which frequently escape observation, being as pellucid as glass. We have ourselves overlooked them; and owing to this the teeth of this species have on former occasions been wrongly described.

In *Bulimus caracasensis* the medians, so extremely difficult to make out from their minuteness, are simple, the laterals symmetrical; that is, they are equal-sided, differing in this respect from those of most other mollusks. We have observed that several of the species classed under *Bulimus* present this form of teeth, which is also found in *Stenogyra octona* (fig. 2). In *Tornatellina lamellata* (fig. 5) the dentition somewhat resembles that of *Bulimus multifasciatus*, the laterals having long acute pellucid cusps.

In *Plecocheilus auris-sciuri* (fig. 4), a species very near *P. glaber*, the median row is

\* Ser. 3, vol. xiv. p. 243, and vol. xvii. p. 42.

remarkable for the great length of the imbricating pellucid cusps. The laterals seem also to have a similar cusp; but it appears to be more often absent than present: as, however, their extreme fragility renders them very likely to be broken off, it is in all probability due to this cause that they are so often found wanting.

*Macroceramus signatus* (fig. 7) resembles *Helix* more than any of the *Bulimi* here described in its dentition. The medians are elongate, with a single obtuse rounded cusp; the laterals have two round subequal cusps, of which the inner one is situate on the side of the tooth.

*Pupa striatella*, a species inhabiting Porto Rico and other West-Indian islands, has a dentition somewhat resembling that of *Bulimus*. The teeth are obtusely tricuspid, the medians not any smaller than the laterals. *Succinea approximans* has teeth possessing characters of *Bulimus*, but differing in details, as will be seen by the specimens. In *Veronicella* (*Vaginulus*) *Sloanei* the medians are small, and the laterals as well as the medians are tricuspid. This dentition does not resemble that of *Oncidium*, with which the genus has hitherto been associated.

In *Physa rivalis* the teeth are slender, and bear no great resemblance to those of any of the terrestrial forms. In *Planorbis terversanus* the median teeth are largest, and have three acute points, of which the middle one is the smallest. The laterals have three acute points, of which the outer one is largest. The edges of the teeth are not reflexed. Amongst the marine mollusca which have teeth somewhat of this shape are *Voluta* and *Marginella*; but these have very much fewer teeth, with usually more numerous denticles.

*Marginella cærulescens* (fig. 3) has a small subquadrate band of acute pellucid teeth, the medians of which are shortest; the laterals are alternately long and short, set on a delicate homogeneous basement membrane.

*Streptaxis deformis* (fig. 6) has aculeate teeth, resembling those on the lateral portion of the dental membrane of *Zonites cellarius*. The young shell is like a *Zonites*; so that we may readily infer the close affinity of these genera.

The dental apparatus of *Cylindrella trinitaria* (fig. 12) is a singular modification of the inoperculate type. The band is very long, resembling in this respect that of *Littorina*. The individual teeth have a certain likeness to those of *Helix*, but they also recall to our minds, in their mode of arrangement, the Operculata.

The Inoperculata seem hardly to furnish us with much evidence as to their alliances with truly marine genera; but the operculate land-shells, on the contrary, exhibit unmistakeable affinities with several groups. As we have previously remarked, *Helicina* shows relations with *Nerita*: a comparison of them with *N. microstoma* (fig. 9) will prove the fact. A study of the lingual teeth has further made obvious what we might have expected from other characters, that the Cyclostomatidæ must be separated altogether from the Cyclophoridæ. The latter have teeth resembling those of *Littorina*. As examples we may cite *Cyclotus translucidus* (fig. 11) and *C. rugatus*. This dentition is represented by the formula 3 . 1 . 3. The animals of the Cyclostomatidæ, on the other hand, have a foot divided into two longitudinal portions by a groove. As examples of their dentition (00 . 2 . 1 . 2 . 00) figures are given of *Cistula pupi-*

*formis* (fig. 8) and *Adamsiella aripensis* (fig. 10). It would seem from this that the Cyclostomatidæ are probably not very closely related to the Littorinidæ. Their lingual teeth seem rather to point out an alliance with the Trochidæ, or one of the groups possessing *pleuræ*. But without attempting at present to decide this question, which can only be determined by the examination of several species, we may remark that the Cyclostomatidæ will probably be found a natural and defined group, perhaps entitled to the rank of a suborder, and not very closely related to any existing marine forms.

The relations of the freshwater Operculata are as varied as are those of the land. *Ampullaria* doubtless finds its nearest marine relative in *Natica*,—an opinion which seems confirmed by the form of the shell. The dentition of *Ampullaria urceus* and that of *A. effusa* (fig. 13) are very much alike, and *Marisa cornu-arietis* (fig. 14) does not differ very greatly; the mandible is also similar, showing that the claims of the latter to generic rank must be sought rather in the shape of the shell and the differences of the siphons than in the teeth. *Hydrobia spiralis* appears to be akin to the Melaniidæ; but we should not be surprised if it were found to be as close to *Skenea*.

The horny mandibles of the Mollusca may be deserving of some attention, with a view to the elucidation of their affinities. In *Cyclotus (translucidus)* the mandible (fig. 11a) is divided into two portions by a median articulation, and it is covered with fine acute denticulations in regular rows\*. In most of the Inoperculata the mandible is horseshoe-shaped, and striate or corrugate. In *Ampullaria* the same organ is beak-shaped, like the upper mandible of *Octopus* or *Loligo*.

## EXPLANATION OF PLATE XI.

### *Lingual Dentition of some West-Indian Gasteropoda.*

Fig. 1. *Bulimus multifasciatus*, magnified 250 diameters. A wide band,  $\frac{1}{8}$  of an inch in length, consisting of numerous rows of similar teeth; *medians* with a central toothlet, and a smaller point on each side; *laterals* in divergent rows, each with three toothlets, and an oblique, broadly reflexed cutting-edge. Mandible semicircular and corrugated.

Fig. 1a. Side view of central cusps.

Fig. 2. *Stenogyra octona*, magnified 300 diameters. A narrow band,  $\frac{1}{20}$  of an inch in length; *medians* simple, minute, inconspicuous, central cusps longest; *laterals* tricuspid, with central cusp much prolonged. The ova of this species are subspherical, with a white testaceous envelope, sometimes remaining in the shell, whose aperture is thereby nearly filled up; they hatch after the death of the parent.

Fig. 3. *Marginella cærulescens*, magnified 300 diameters. A band  $\frac{1}{6}$  of an inch long, of very pellucid, acute pyramidal teeth; *medians* shorter than laterals; *laterals* alternately a long and a short, set on the same plane; basement membrane homogeneous, very pellucid.

\* Like *Aptychus*, but more horseshoe-shaped; it is more probable that these problematical fossils are the mandibles of Cephalopoda than the plates of their gizzards. They bear no resemblance in shape to the horny plates of the gizzard of a mollusk.

- Fig. 4. *Plecocheilus auris-sciuri*, magnified 100 diameters. A broad ribbon,  $\frac{1}{5}$  of an inch long, of subquadrate pellucid teeth; *medians* remarkable for the great length of their imbricated pellucid cusps; *laterals* having bases produced on both sides, and differing from medians in having similar central cusps, on each side of which is a nearly obsolete toothlet; the extreme outer rows modified in form as well as in character.
- Fig. 4a. Side view of central cusps. Mandible semicircular, with coarse denticulations.
- Fig. 5. *Tornatellina lamellata*, magnified 300 diameters. A narrow band,  $\frac{1}{12}$  of an inch in length, of numerous pellucid teeth; *medians* small, simple, and inconspicuous, central cusps prolonged; *laterals* large and simple, with long pellucid acute central cusps, and two obsolete dentations on the outer side.
- Fig. 5a. Side view of central cusps. The mandible is horseshoe-shaped, and composed of a number of pentagonal prisms laid obliquely, resembling the shell-structure of Brachiopoda. This species is viviparous, and during July and August is found full of young animals.
- Fig. 6. *Streptaxis deformis*, magnified 150 diameters. Band  $\frac{1}{8}$  of an inch long. Formula 10.1.10. *Medians* simple, aculeate; *laterals* subopaque, irregular, aculeate, enlarged at their insertion into the basement membrane. The animal is of a delicate pink or yellow colour; it is found both on trees and the ground in the forests.
- Fig. 7. *Macroceramus signatus*, magnified 150 diameters. A narrow band,  $\frac{1}{10}$  of an inch in length, filled with divergent rows of pellucid teeth; *medians* simple, elongated, with simple obtuse cusps; the *laterals* have two reflexed subequal cusps.
- Fig. 7a. Side view of central cusps.
- Fig. 8. *Cistula pupiformis*, magnified 300 diameters. 00.2.1.2.00. Lingual band small and delicate; *medians* denticulate, with acute cusps, outer cusps prolonged; 1st *laterals* broad at bases, with prolonged central cusps, and with subdued denticulations on either side; 2nd *laterals* broad, recurved, cusps well developed; *uncini* numerous and slender.
- Fig. 9. *Neritina microstoma*, magnified 150 diameters. 00.3.1.3.00; *medians* subquadrate, narrowest towards their bases, subopaque; 1st *laterals* subtrapezoidal, with outer corner most produced; 2nd *laterals* prolonged, strongly curved outwards; 3rd *laterals* convex, broad, glassy, denticulate, with curved tips; *uncini* strong and numerous. Between the 2nd and 3rd laterals there appears to be a smaller or intermediate set of finer uncini; but whether they form a portion of the odontophore, and have become accidentally turned down, or really are another set, we have not been able to determine; the peculiarities, however, of the band appear to have been heretofore overlooked.
- Fig. 10. *Adamsiella aripensis*, magnified 300 diameters. 00.2.1.2.00. A long slender band; *medians* denticulate, with acute cusps; inner *laterals* broad; outer denticulate on the reflexed edge; *uncini* numerous, slender, curved at their terminations: *a*, separated *uncini*; *b*, inner laterals; *c*, outer laterals, more highly magnified. The mollusk is frequently found suspended by two or three glutinous threads from under branches of low-growing shrubs.
- Fig. 11. *Cyclotus translucidus*, magnified 150 diameters. 3.1.3. A narrow band  $\frac{1}{2}$  an inch long; *medians* subquadrate, denticulate, cusps recurved, central ones large and acute; 1st *laterals* broad, more obtuse than the central, recurved, denticulate; 2nd & 3rd *laterals* simple, convex, or claw-shaped; bright amber-colour. The animal is of a pinkish colour, which is lighter about the body and foot, but deeper about the tentacles.
- Fig. 11a. Mandible of *Cyclotus*, magnified 150 diameters. It is divided into two portions by a median articulation, and covered with fine acute denticulations in divergent rows.
- Fig. 12. *Cylindrella trinitaria*, magnified 200 diameters. Formula 2.1.2. A narrow band  $\frac{3}{10}$  of an inch in length; *medians* well developed, acute, tricuspid, tubercles on their bases; 1st *laterals*

with simple inconspicuous cusps; 2nd or outer more conspicuous, with recurved claw-shaped cusps.

- Fig. 13. *Ampullaria effusa*, magnified 60 diameters. 3.1.3; *medians* broad, but smaller than those of *A. urceus*; central dentations strong, with three smaller obtuse ones on each side; 1st *laterals* with broad apical dentation on the inner edge, two less developed; 2nd & 3rd *laterals* smaller, and claw-shaped. Band  $\frac{4}{10}$  of an inch long.
- Fig. 14. *Marisa cornu-arietis*, magnified 60 diameters. 3.1.3. Band  $\frac{2}{10}$  of an inch long; *medians* broad, with three dentations on each side of a strong acute central point; 1st *laterals* recurvate, claw-shaped, with three dentations on the inner side of a longer central tooth; 2nd & 3rd simple, claw-shaped, with broad basis firmly set in basement membrane. Mandible very similar to that of *A. effusa*.

