

XXII. OBSERVATIONS ON A CARNIVOROUS LAND-SNAIL.

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In the genus *Ennea*, H. and A. Adams, there are at present included a number of species which differ greatly in the complexity of the armature of the mouth of the shell. These were separated into subgenera by Pfeiffer in Vol. V of his *Monographia Helicorum Viventium* as long ago as 1859, but we have been unable to find any detailed description of the armature in any of the more complex forms that may be accepted as *Ennea*, s.s.¹ All descriptions of shells of this type that we have been able to find refer merely to the external appearance of the aperture and fail to discuss the internal structure of the folds and teeth connected therewith. As we have recently had an opportunity of examining the commonest and most widely distributed species of the genus both living and preserved, we propose to publish here an account of the structure of the shell and to add certain observations on other points of interest.

Ennea bicolor (Hutton).

1908. *Ennea bicolor*, Blanford and Godwin-Austen, *Faun. Brit. Ind.*, *Moll.* I, pp. 19, 20, fig. 12.

For the synonymy and literature of the species see the reference cited. Published descriptions of the shell omit several particulars of interest in connection both with the aperture and with other parts. We give, therefore, as a preliminary to the description of a new insular race, a fresh description of the shell of the species.

The shell is small but somewhat variable in size, with from 6 to 8½ whorls, subcylindrical, with the apex blunt; hyaline and almost colourless when fresh but rather thick. The whorls are never more than slightly swollen. Their proportions differ somewhat in different forms of the species. The body-whorl is compressed from side to side and bears on each side a funnel-shaped depression. That on the inner aspect surrounds the umbilicus, which is completely closed. The sculpture consists of very fine, straight vertical ribs, which are strongly developed just below the

¹ H. and A. Adams in their original description of the genus, as a subgenus of *Pupa*, selected no type-species but mentioned *E. bicolor* first on their list, see *Gen. Recent Mollusca*, II, p. 171 (1858). Whether we accept *E. bicolor* (with Blanford and Godwin-Austen) as the type-species of the genus, or *E. elegantior* (Pfeiffer) with von Martens and Nevill, *Huttonella*, Pfeiffer is synonymous with *Ennea*, s.s.

suture on all but the apical whorls and give it a fimbriated or almost subspinose appearance. On the greater part of the shell these ribs are obsolescent on the lower parts of the whorls, but on the whole surface of the outer aspect of the body-whorl they are well developed. They are absent from the first two and a half whorls. The shell as a whole has a smooth and polished surface. The aperture is subquadrate but varies somewhat in outlines and proportions. It always has the angles rounded. The armature consists of two obtuse, somewhat compressed teeth and two elongate internal folds. We will describe first its external appearance and then its internal structure. The actual orifice is conspicuously trilobed owing to the unusually strong development of the armature. The three lobes are unequal. The uppermost is a narrow sinus lying between the outer lip and a strong internal fold, which projects out of the orifice for a short distance in the form of a ridge. The second lobe, which is considerably broader, lies between this ridge and the columellar margin, while the third, which is intermediate in size, is bounded externally by a blunt tooth lying inside the outer lip at the base of the first lobe. There is a second internal tooth near the inner anterior angle of the orifice, while a second internal fold lies inside the columellar part of the peristome. The peristome itself is thickened and a little expanded. It is interrupted by the upper lobe or sinus of the orifice, which is pointed and slightly curved, and is often imperfectly developed between the termination of the upper fold and the upper extremity of the columella.

The two folds and the two teeth may now be described in detail. The upper fold arises on the floor of the shell about half way up the body-whorl and runs down, following the twist of the spiral, to emerge from the aperture at the upper extremity a short distance within the outer margin. It has the form inside the shell of a highly convex crest, but on the edge of the aperture assumes that of a low ridge. It is rather thick as a whole and has a blunt, but not thickened free edge. The lower fold, although less conspicuous externally, is considerably longer and in other respects better developed. It arises on the internal column near the suture of the body-whorl and runs along the former as a convex crest, diverging slightly from the line parallel to that of the upper fold. The free margin is considerably thickened on the inner side. A broad deep gutter, which expands somewhat towards the aperture, is thus produced between the two folds. The foot slides along this gutter as the animal emerges. The outer tooth represents on the internal surface of the shell the external funnel-shaped depression on the outer aspect and is thus to a considerable extent hollow. It forms with the upper fold a narrow sinus in which the pulmonary orifice and the anus lie when the animal is expanded. The internal or basal tooth is solid and is not represented by any external depression. The depression on the inner aspect of the whorl is represented internally by a barely perceptible thickening at the outer extremity of the lower fold.

There is preserved in the Indian Museum a series of shells from the old A. S. B. collection that Nevill¹ believed to be "probably typical specimens from Hutton." These differ constantly from the figure published in the "Fauna" and cited above, in tapering less, in having the body-whorl less swollen and in the shape of the aperture, which is more elongate and has the columellar and outer margin more nearly equal in length. The specimens have the sculpture we have described above well developed, though the shell has usually been described merely as smooth and polished.

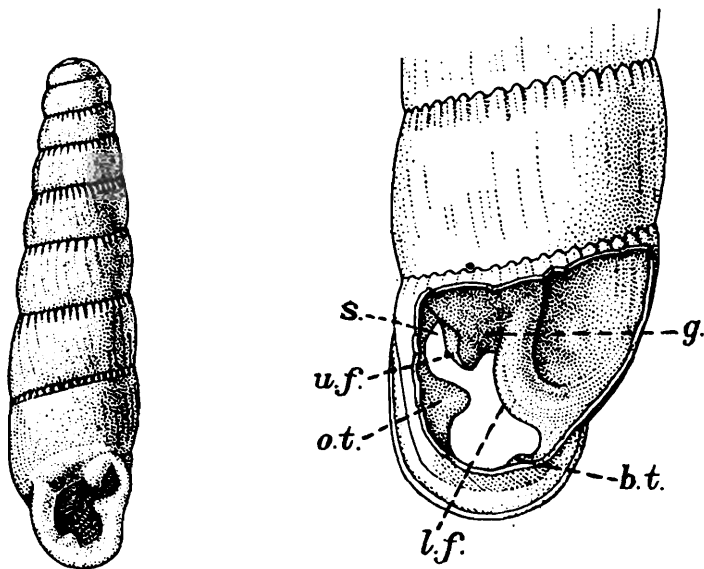


FIG. 1.

FIG. 2.

FIG. 1.—Shell of *Ennea bicolor* race *barkudensis*, Annandale & Prashad. Ventral view, x 8.

FIG. 2.—*E. bicolor* race *barkudensis*, dorsal view of the last two whorls with the shell of the body-whorl removed to show the folds and teeth, x 16.

b.t. basal tooth, *g* gutter, *l.f.* lower fold.
o.t. outer tooth, *s.* sinus, *u.f.* upper fold.

Race *barkudensis*, nov.

As we find that individuals from a small island in the Chilka Lake differ quite constantly from what we take to be the *forma typica* from the Ganges valley, and also from any of the forms already described and relegated to the synonymy of the species, we propose to describe the race as new under the above name.

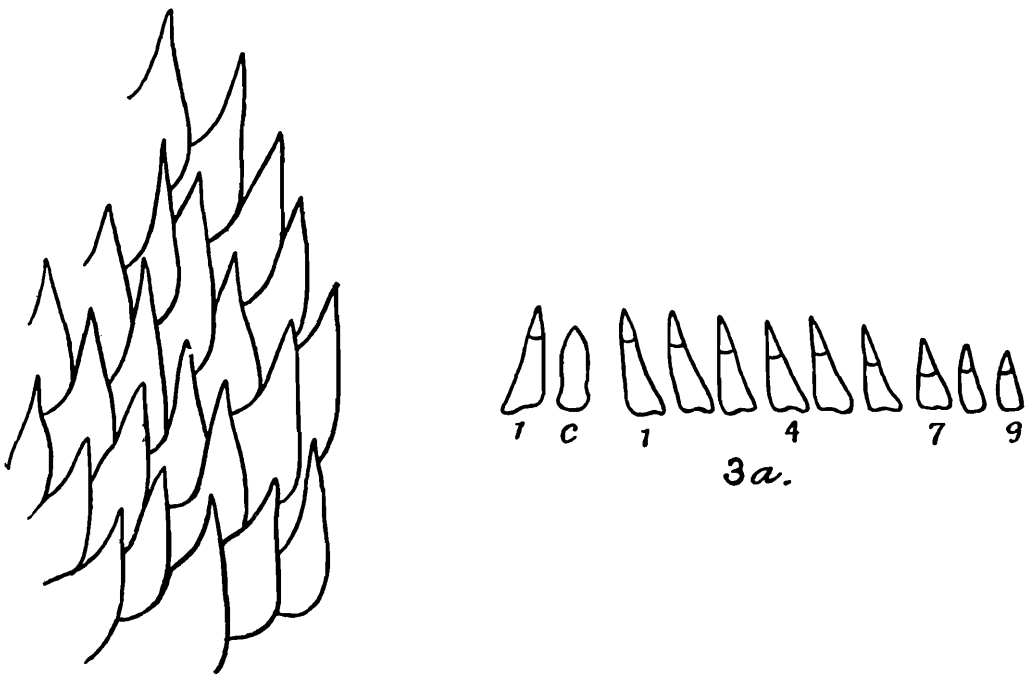
The shell is considerably narrower than that of the *forma typica*, the proportions of breadth to height being 1 : 4.5; it tapers less and has when mature 8½ whorls; the apex is usually a little swollen and the aperture is relatively smaller and narrower. The structure and sculpture of the shell, however, are precisely similar to those of the typical form.

¹ *Hand List Moll. Ind. Mus.* 1, p. 6 (1878).

Measurements of shells (in millimetres).

	A.	B.	C.
Length	6·8	6·3	6·5
Maximum breadth	1·6	1·5	1·5
Length of the mouth	1·5	1·5	1·6
Breadth of the mouth	1·2	1·3	1·3

The animal agrees in colouration with those originally described by Hutton¹ and only differs from Stoliczka's description² and Semper's coloured figure³ in that the scarlet colour of the head and body is completely restricted to the internal structures connected with the eye-stalks. The rest of the extruded parts are of a



3.

FIG. 3.—Radular teeth of *E. bicolor* race *barkudensis*, general arrangement.
 ,, 3a.—Radular teeth, one side of a complete row of teeth.
 c. central; 1, 4, 7, and 9 lateral teeth.

bright shade of lemon-yellow and the mantle is orange-scarlet. We figure the radular teeth. Their shagreen-like arrangement is shown in fig. 3. In general facies, doubtless also in function, it has an interesting resemblance to that of the papillae on the tongue of certain carnivorous mammals.

Type-specimen. No. M $\frac{11719}{2}$, Zoological Survey of India (*Ind. Mus.*).

We found this race of *E. bicolor* fairly common, but by no means abundant, on Barkuda Island in the Chilka Lake in the

¹ *Four. As. Soc., Bengal*, III, pp. 86, 93 (1824).

² *Ib.*, XI, pt. 2, pp. 169-171, pl. viii, figs. 7, 8 (1871).

³ *Reis. d. Philippinen*, III, p. 250, pl. viii, fig. 14 (1870-1894).

latter half of June, 1920. The snails were taken on a low flight of stone steps leading to a bungalow. They emerged in wet weather, and especially on damp evenings, from the interstices of the stone-work and the earth at its base. The largest number of individuals we saw on any one evening was half a dozen. The *Ennea* was accompanied, in much larger numbers, by an *Opeas*, which Col. Godwin-Austen¹ has identified provisionally as *O. gracilis* (Hutton). The *Ennea* was evidently preying upon the *Opeas*, for we found one or two individuals of the former attached to the foot of individuals of the *Opeas*. The attack, however, was by no means vigorous and we could discover very few fresh empty shells. Probably this was due to the fact that the carnivorous species was just recovering from its hot-weather aestivation. Godwin-Austen in the "Fauna" records another instance of the association of the two species, observed by Mr. Collet on the sea-wall at Galle, Ceylon. Semper also found *E. bicolor* in the Philippines preying on a form of *O. gracilis*.²

It would appear, therefore that these two species (both of which are remarkable for their wide distribution and are often found in India in places where pot-plants are kept) or closely allied forms habitually occur together. On Barkuda the vegetarian snail is, as might be expected, very much the more abundant of the two. As Godwin-Austen points out in the "Fauna," there is a certain resemblance between the shells, and this is also so with the animals; but they are readily distinguished in life by the scarlet markings of the *Ennea*. These are entirely absent in the *Opeas*, the mantle and exposed parts of which are of a uniform bright yellow colour.

The resemblance between the gutter produced by the internal folds of the shell in *Ennea* and *Clausilia*³ is very close and must be entirely convergent. There is, of course, no clausilium in *Ennea* and the origin of the two main folds is slightly different in the two genera. Moreover, supplementary palatal plicae are absent in *Ennea*, as are oral teeth in *Clausilia*. In other words, the internal armature has become exceedingly complex in *Clausilia*, doubtless in correlation with the production of the clausilium, while in *Ennea* the external armature is better developed. In the latter genus the armature does not suffice to close the shell completely when the animal is retracted, but seems rather to protect the more important external parts of the body in the act of and on the completion of expansion. This may perhaps be useful to a carnivorous animal which burrows into soft tissues and mucus while feeding, at any rate so far as the upper sinus and the pulmonary orifice are concerned. The walls of the gutter between

¹ *Rec. Ind. Mus.* XIII, p. 351 (1917). Col. Godwin-Austen informs us that he proposes to describe this form shortly as a new species.

² Semper, *loc. cit.* pp. 137-138, where the species is referred to as *Stenogyra panayensis*; on pl. viii, fig. 15, Semper calls it *Subulina panayensis*; for synonymy see Gude, *Faun. Brit. Ind. Moll.* II, pp. 355, 357 (1914).

The association of the two species is referred to by Semper on p. 250.

³ Smith and Woodward, *Ann. Mag. Nat. Hist.* (6) V, pp. 209-213, pl. xi, A (1890).

the two main folds may also assist in cleaning the foot and head as they are retracted. It is possible, therefore, that whereas, as is clearly the case, the whole structure is protective in function in *Clausilia*, in *Ennea* it assists in active aggression. The case is all the more remarkable in that *Ennea* belongs to a family (the Testacellidae) in which the shell is often completely degenerate; but it is perhaps more common¹ than is generally realized to find animals of similar habits and related structure adopting in the course of evolution diametrically opposite methods of improving their means of attack or defence.

¹ See Annandale, *Four. As. Soc. Bengal* (n.s.), IX, p. 75 (1913); *Mem. Ind. Mus.* V, p. 54 (1915) and *Mem. As. Soc. Bengal*, VI, pp. 196-197 (1918) and Prashad, *Rec. Ind. Mus.* XVI, p. 401 (1919).

