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ON THE INNER STRUCTURE OF THE SHELLS OF HEMIPHAEDUSA CAMBOJENSIS PFR. AND PHAEDUSA PAVIEI MORLET (GASTROPODA, PULMONATA),

by Fredrik Elisa Loosjes (Wageningen).

In a collection of south-east asiatic Phaedusinae, got on loan from the U. S. National Museum, Washington I found, among other species, forty-five specimens of a large species from Kao Sabab (Southern Siam), which I could identify as *Hemiphaedusa (Formosana) cambojensis* Pfr. As the clausilium of this species has never been described, I seized the opportunity to open some of the shells in order to investigate the inner structure. This structure turned out to be very interesting and that is why I give here a description of the features I found.

The superior lamella is continuous with the spiral lamella, which is a low fold, gradually rising near its end and then ending rather abruptly almost ventrolaterally at the left side, mostly before the subcolumellar lamella and the inferior lamella.

The inferior lamella is ascending obliquely becoming very high at a dorsal position and there forming a clearly visible sacklike structure that is sometimes supported by an edge or rim, running like a « keel » along the periphery of this sagging. This edge is running nearly half way up the lamella, parallel

to its outer margin and its base. Laterally at the right side, the inferior lamella becomes normal and low again, the « keel » has joined the outer margin or has ended diffusely.

The lamella is ending laterally at the left side, beyond the spiral lamella and mostly at the same height as the subcolumellar lamella.

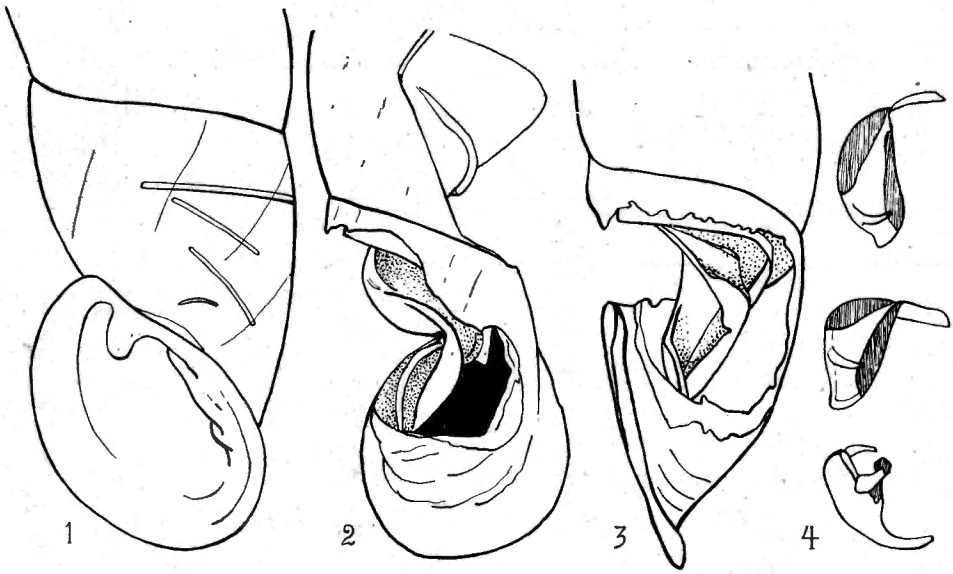

Fig. 1-4. — *Hemiphaedusa cambojensis* PFR. (all figures × 5. Only outlines are given).

1. seen from ventrolaterally at the right side to show the palatal plicae;
2. inner structure of the last whorl from the dorsal side (1);
3. inner structure of the last whorl from the right side (1);
4. three views on the clausilium.

Beyond the inner ends of the lamellae, at a position almost between the produced parts of the inferior lamella and the subcolumellar lamella is the place where the inner end of the filament of the clausilium adheres to the parietal wall.

The closing apparatus lies ventrolateral-right. The principal plica is running from ventral to left-dorsolateral, it is clearly visible within the aperture and nearly a half-whorl long. Below it there are three rather long plicae palatales. The upper two diverging with the principal plica into the direction of the

(1) Clausilium omitted.

aperture, the lowest one converging with it, this plica might be considered as the lower end of a lunella (BOETTGER, 1877).

The clausilium is large and slender, strongly and regularly curved in both directions, its top rather pointed, its dimensions are about: length 3.5 mm, width 1.6 mm.

At nearly one third of the length from the top there is a distinct hook on the outer surface of the plate of the clausilium. This hook has its base inserted near the palatal side and its top pointing to the columellar side of the clausilium. It is regularly curved and amply 0.9 mm long. When the clausilium closes the shell, the hook is at the outside as stipulated above, so when « the door » is opened by the pressure and passing of the snail, the plate of the clausilium is placed against the inferior lamella; its inner edge leaning against the sub-columellar lamella. In this situation the hook is included in the above mentioned sack-like structure of the lamella inferior.

On the whole I opened four shells and saw four clausiliae, three of them had a hook as described above and in one I only saw the base of a hook, just as if the point itself had been broken off. It is very likely that all or most of the shells of *cambojensis* possess this hook; but as unfortunately it is impossible by looking into the aperture to see the hook in an undamaged shell and on the other hand it is not desirable to break up all shells, we are not sure of this presumption.

Of two of four clausiliae, membranous parts of the mantle were visible as brown, dried up strips along the sides of the plates, not touching each other on the middle of it. The lateral « strip » reaches from the base of the hook up to the filament, the median one reaches from somewhat beyond the top of the clausilium upwards to some distance from the beginning of the filament. These strips formed by the edge of the mantle distinctly embrace the plate of the clausilium from behind.

Of course, we need not ask for the meaning of every peculiar formation nature shows us; but if we consider this hook in respect of its usefullness, we can only think it to be not useful at all, only defilements may be adhering much more easily, and so the chance of stoppage and blockade of the aperture will be greater, which must be detrimental to the snail.

We cannot imagine that there may be attached any importance to this phenomenon, when the snail is creeping and baring or trailing its shell.

According to EDLAUER (1941) in her explanation on the origin

of the lamellae, plicae and the clausilium, this hook must have come into existence by the reaction of the mantle on the proportions of the shell, there at that place.

Giving a survey of the literature on the subject we note that a similar hook was first described by PILSBRY in 1908. He detected on the outer face of the clausilium of the chinese *Pseudonenia bocki* SYKES, at its lower third « a stout acute hook, arising near the palatal side and directed transversely to the length of the plate ». He states that a structure like this was never encountered in *Pseudonenia* or *Clausilia* before. He does not record any pecularities of the inferior lamella.

This statement of PILSBRY was used by LINDHOLM in 1924 when he projected a « Revised systematic list of *Clausiliidae* ». Because of the hook he created a new sectio *Calcariclavis* of *Phaedusa* with *C. bocki* SYKES as the type.

EHRMANN 1927 described the hook from « the multiform Tonkinese species *Phaedusa paviei* MORLET », in just the same appearance. After a careful comparison he came to the conviction that *bocki* SYKES 1895 (south-eastern Yunnan) and *paviei* MORLET 1892 (Tonkin) are synonymous as was already supposed by ANCEY in 1904.

In contradiction with those statements BAVAY and DAUTZENBERG (1919) say that « La *Clausilia Bocki* SYKES, du Yunnan, que feu ANCEY signalait comme très voisin de *Cl. Paviei*, lui ressemble en effet beaucoup; il en diffère cependant très nettement: 1° par son pli pariétal plus faible et droit; 2° par la sculpture des tours complètement différente. Nous n'avons d'ailleurs jamais rencontré chez *Cl. Paviei* l'étrange crochet signalé sur le clausilium de *Cl. Bocki* par M. PILSBRY. »

So according to EHRMANN, if *Calcariclavis* will be maintained as a section, it should be placed into the subgenus *Phaedusa* AD. (= *Pseudonenia* BOETTGER) with *paviei* MORLET as the type. But EHRMANN is not of that opinion as the character turned out to be inconstant, he namely observed that not all specimens of *bocki* or *paviei* possessed the hook. It is either present or not. Out of 25 specimens from different localities, he found but eight shells with a hook on the clausilium. Most of the localities yielding a uniform appearance of the clausiliae of the shells, only at two of them there was individual variation.

As *Phaedusa paviei* is closely related to several species of typical *Phaedusae*, and the above mentioned « inconstant » feature is the only base for *Calcariclavis*, EHRMANN does not

think it advisable to include this section into his classification.

In connection with EHRMANN's statement I made inquiries into the presence or absence of the hook in *Phaedusa paviei* MORLET, collected at different localities.

In behalf of this investigation I had by the kindness of the Director of the Museum, Prof. Dr V. VAN STRAELEN the opportunity to study the material of *paviei* of the collection DAUTZENBERG, now in the collections of the Musée royal d'Histoire naturelle de Belgique.

For means of comparison I will give here a short description of the lamellae and the inner structure of the shell of *paviei* first.

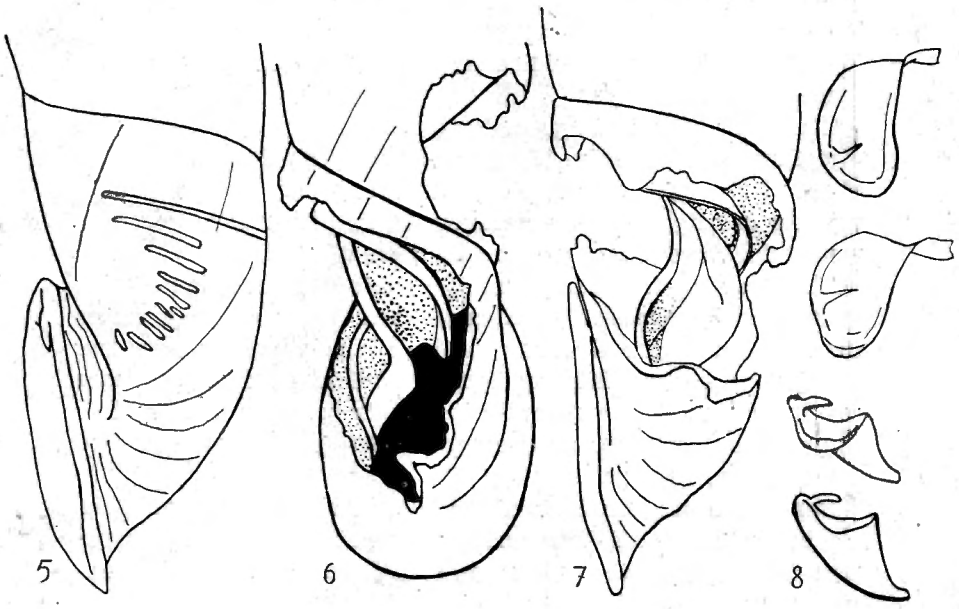

Fig. 5-8. — *Phaedusa paviei* MORLET (all figures × 5. Only outlines are given).

5. seen from the right side, to show the palatal plicae;
6. inner structure of the last whorl from the dorsal side (1);
7. inner structure of the last whorl from the right side (1);
8. four views on the clausilium.

The superior lamella is most often continuous with the spiral lamella, which is a fold of moderate height, gradually rising near its ventral lying end and there rapidly decreasing.

(1) Clausilium omitted.

The inferior lamella is ascending obliquely becoming very high at a dorsal position. A sack-like structure, however, is either not or scarcely visible.

Right laterally the inferior lamella is gradually decreasing, it is ending nearly ventral together with the subcolumellar lamella, sometimes slightly beyond the end of the spiral lamella. The filament of the clausilium is attached to the parietal wall beyond the ends of the three lamellae dorso-lateral left between the produced parts of the inferior and subcolumellar lamella.

The closing apparatus lies at the middle of the right side, the principal plica is running from a place between ventral and lateral-right up to somewhat beyond dorsal. It is visible in the aperture. Below it there is a series of parallel palatal plicae. There are ca 10 of them regularly distributed between the principal plica and the subcolumellar lamella, the upper ones being longest.

The clausilium is large and wide, regularly curved in both directions with an often blunt, rounded apex; its measures are about: length 3.6 mm, width 2.0 mm. As *paviei* is considerably varying in height, I gave measures of clausiliae of large specimens which are nearly as long as those of *cambojensis*.

The hook on the clausilium is situated in accordance with PILSBRY's description. It is ca 0.8 mm long; it may either have its curve directly near the base, the point close to and parallel with the plate or it may be less distinct, or more regularly curved, consequently it then is pointing more or less away from the plate. Of course, all changes between the two extremes are present.

Sometimes only the base of the hook is visible as a knob, the top being broken off. It occurred too, that I got the impression that the knob was the only representative of the hook. So EHRMANN's statement, that the hook is either present or not, and that there are no intermediates, will not do only for some few exceptions. In this species too there is no indication that the presence of a faint sacklike structure of the inferior lamella corresponds with the presence of an extremely projecting hook.

Among the shells I found, just like EHRMANN, specimens with no hook at all, in the other characters of these shells, I could not detect any differences with hook bearing ones.

Independent of the presence of a hook, a few specimens had a clausilium with one or two folds on the plate, most often along the growth lines, in one case, however, it looked as if the hook had grown together with the plate.

Investigating the *paviei*-shells it soon turned out, that often the hook on the clausilium could be seen without breaking up the shells. As this was impossible for instance because of a sligthly higher inferior lamella, defilements in the shells, the position of the clausilium, or other reasons, only some of these shells were opened.

The following data were obtained :

Locality : That-Khé, one sample, of 10 specimens examined, all had a hook on the clausilium.

Muong-Hum; six samples, all together 260 shells with a hook on the clausilium and 5 without it.

Trinh-Tuong; seven samples, together 299 specimens with the hook and 3 without it, these last three shells had a scarcely developed peristomal margin; they were very thin; a fourth specimen had only a little knob on the plate, where a hook was to be expected.

Gia-Phu; three samples, 356 shells of which had a hook and 3 had not.

Cao-Pa; two samples, from one sample 107 specimens had a hook on the clausilium, and no one was found without such, from the other sample 11 out of 14 specimens had a hook and 3 had none. These two samples may have been collected on different localities and that may be the reason for the great difference. The labels accompanying the samples give, however, no information about this question.

Lao-Kay; six samples, all together 291 specimens with a hook on the clausilium and 4 without it.

Phu-Coi-Oai; one sample of 14 specimens all clausiliae without a trace of a hook.

Nat-Son; two samples, together with 96 specimens of which the clausilium has a hook and 2 specimens without a hook.

Phong-To; two samples, of which there are 174 with- and 1 without a hook on the clausilium.

From the type locality, Muong-Lai, I saw but three specimens in the collection DAUTZENBERG (provided with a label of the author of the species, L. MORLET) of which certainly two had a hook on the clausilium.

The conclusion out of these data is clear enough. At most localities the clausilium of *paviei* MORLET is normally provided with a hook, a few exceptions are, however, always present. Concerning the localities, the only exception is the material of Phu-Coi-Oai where no hook could be detected.

One sample from Cao-Pa has largely 20 % shells of which the plate of the clausilium has no hook, but as the number of shells, investigated of this sample is small, this percentage may not be reliable. If, however, this percentage is true, it is the only locality in which there are significant numbers of both forms living together.

The occurrence of a similar hook on the clausilium of *cambojensis* PFR. and of *paviei* MORLET gives rise to the question whether this is a matter of convergence, or a sign of a close relationship. According to the recent opinions, as stated above, *cambojensis* belongs to the subgenus *Formosana* of *Hemiphaedusa,* whereas *paviei* belongs to the subgenus *Phaedusa* of the genus of that name. Besides the hook, the other characters are thus, that we are inclined to accept a closer relation between the two species than finds expression in the systematic arrangement. However, a close relation between both species, as would be indicated by placing those two into one section *Calcariclavis,* is not plausible.

So for the present we are mostly inclined to think of convergence. An investigation of the anatomical characters of either form will be necessary to solve the problem.

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