REMARKS UPON THE EARLY STAGES OF *AULACODES CRASSICORNALIS* (GUEN.) AND ITS PARASITE *RHACHIOPLEX JAVANICUS* FERRIÈRE.

By

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The Hymenopterous insects collected in 1929 by members of the "Deutsche Limnologische Sunda-Expedition", during their stay in Sumatra and Java, have been worked out recently by Prof. BISCHOFF (Berlin).

Among these, a curious new Ichneumonid, named by BISCHOFF *Rhachioplex aulacodis*, gen. et spec. nov., deserves special attention because of its aquatic habitations, and by the fact that it was bred from the pupae of an aquatic Pyralid (*Aulacodes* ?), found in abundance by the German investigators while exploring the lakes and rivers of South Sumatra, along the surf-shore of the large Ranau Lake. The adults of the same species were met with on submerged stones in the bed of the Moesi River, near Tjoeroep, also in South Sumatra. In both cases the name of the host could not definitely be given, but, as we will see, it is highly probable that at least the wasps captured in the Moesi River will turn out later to be truly parasitic upon *Aulacodes* and allied genera.

Now, in December 1930, a small black Ichneumonid wasp was bred by the present writer from pupae of *Aulacodes crassicornalis* (GUEN.), one of the numerous representatives of the *Hydrocampinae*, a subfamily of the *Pyralidae* with exclusively aquatic habitations. This specimen was forwarded to Dr. CH. FERRIÈRE for identification and this gentleman at once recognized it as belonging to a previously undescribed genus of the *Campoplegini*, a description and some figures of which being sent to the editor of 'Treubia' for publication.

A few months afterwards I came across BISCHOFF's paper "Hymenoptera (excl. Formicidae und Cynipidae) der Deutschen Limnologischen Sunda-Expedition" [1]), in which the reader will find, on p. 739—742, an ample description of the above mentioned *Rhachioplex aulacodis*.

Dr. FERRIÈRE, while drawing up his notes, was still unaware of the publication of his co-worker that was completed at approximately the same time as his. But, as will appear from the re-description of the Javanese *Rhachioplex*, as it was lately received from Dr. FERRIÈRE, and printed off in the previous pages (this Volume, pp. 127-130), our insect has now proven to belong to a distinct species, for which this author has proposed the name *javanicus*, sp. n.

[1]) Quoted *antea*, p. 128.

I wish here to express my sincere thanks to Dr. FERRIÈRE for his kind assistance in identifying our Javan parasite and for his interesting comments relating to the possible habits of *Rhachioplex*.

The accompanying figures should be compared with those offered by BISCHOFF, in the paper already quoted.

Being desirous of preparing a special report on the extraordinarily rich and equally varied insect fauna of the mountain-streams in West-Java as a whole, it is proposed not to enter into details of the life-history of *Aulacodes* and immediate allies just now, nor does it seem advisable to give a very ample description of the larva or the curiously depressed pupal cases of that interesting insect found there. My remarks will, therefore, have to be directed chiefly to the parasite, a few additional observations and figures relating to its host being given in advance.

Among the many species of *Aulacodes*, known to inhabit Java, and whose preparatory states pass through in rapidly flowing water, *A. crassicornalis* is apparently restricted to higher altitudes since no specimens have ever been found in the rivers at lower elevation, where it is replaced by *A. adjunctalis* (SNELL.), *gibbosalis* (GUEN.), and possibly several more.

Our species was found at about 1000 metres above sea-level, and first attracted our attention by the silken pupal cases, which are attached to large stones lying in the very rugged and rocky bed of the Tjisaroea, a beautiful wild mountain-stream flowing through primeval forest and coming down from the slopes of Mt. Panggerango in West Java [1]).

During the whole year this stream contains plenty of water and in several spots where the water is most rapid the larvae and pupae are met with in great abundance. In the dry season, from May until the end of September, the level is rather sunken, but nevertheless, except at the shoals, the water is almost everywhere more than knee-deep. At that time the stream allows the visitor to penetrate about half a mile or more into the interior of the forest.

The same species, *crassicornalis*, was also frequently found inhabiting other waters of similar situation on Mt. Gedeh, and was particularly numerous in the torrential stream at the foot of the Tjibeureum falls, at an altitude of about 1700 m. The adult insects were also taken at light by Dr. DAMMERMAN in the forests of the Idjen Plateau in East Java, some 950 m above sea-level.

Taken on the whole the aquatic habitation of all species of *Aulacodes* is very much the same. The adult moths are well capable of remaining below the surface of the water, and the beautifully coloured eggs are laid on the wet rocks along the water's edge, or on the boulders in mid-stream and often well

[1]) The imagoes of other species of *Aulacodes* and relatives are abundant in this locality, most of these being found resting on the foliage overhanging the stream. Besides *A.crassicornalis* two species of *Cataclysta* and one *Piletocera* were captured along the river, while *Aulacodes aureolalis* (SNELL.) and a fine species of *Parthenodes* appear also common there. Only a single specimen of *Parthenodes* (very near to *vagalis* WLK.) was bred in January, 1931, from a large cocoon that was found amidst those of *Aulacodes*, but differing from these by its elongate shape, entirely lacking pillars.

under the surface of the water. The caterpillars of all of them agree most closely in spinning thin, silken shelters in the crevices of rough stones, which are loosely attached to the substratum under which the larva hides. POULTON, in his paper mentioned below, gave an account of the observations of KERSHAW and MUIR made by these naturalists in China on *A. simplicialis* (SNELL.) [1]) (E. B. POULTON, Notes on the Life-History of *Aulacodes simplicialis*, SNELL. Proc. Ent. Soc. London, 1909, pp. XL-XLIV, text-figs.).

Although differing in a few points of perhaps less importance, my observations on *A. crassicornalis* are in full accordance with these records, and agree also with those published in a lengthy and detailed account by PRUTHI on the Indian species *A. peribocalis* (WLK.) (HEM SINGH PRUTHI, Observations on the biology and morphology of the immature stages of *Aulacodes peribocalis* WLK. (Hydrocampinae — Lepidoptera). Red. Ind. Mus., Calcutta, 30, 1928, pp. 353-356, pl. XI).

In the last paper the author describes the morphology of the caterpillar and pupa and supplies admirable figures of the immature stages, clear drawings of the intricate and strong pupal case being given as well.

For a better understanding of the matter the following brief quotations of PRUTHI's description may be of some service:—

> "When the caterpillar is full grown, it starts making, under its shelter, a tough and complex cocoon in which it is to pass the pupal stage. Only a part of the larval shelter is utilized in the formation of the cocoon, and the rest is washed away when the cocoon has been constructed. The latter (pl. xi, figs. 5 & 6), unlike that of most Lepidoptera, is two layered, and is highly compressed, its lumen being just big enough to lodge the caterpillar. The cocoon is dome-shaped and is firmly cemented to the substratum along its rims (*r*), and this attachment is further strengthened by means of vertical pillars and strands (pl. xi, fig. 6, *p* & *st*). Whereas the dorsal wall of the outer layer is very tough, its ventral wall and both the dorsal and ventral walls of the inner layer are extremely thin. The central cavity of the cocoon, enclosed within the inner layer, communicates with the exterior by means of an extremely narrow and crescent-shaped slit (*em. sl.* pl. xi, fig. 5), situated in the anterior region of the dorsal surface. The head of the larva or of the pupa points towards this opening. It is through this opening that the moth emerges. The slit is so narrow that for all practical purposes hardly any water can go in through it. This opening appears to have escaped the notice of almost all previous workers. Near the anterior and posterior ends of the cocoon there are a series of holes by which the water can go in and leave the cocoon, but as will be evident from an examination of fig. 7 (pl. xi), which is a diagrammatic median longitudinal section of the cocoon, this water does not come in contact with the pupa itself. It is highly probable that the gass

[1]) =*A.plicatalis* (WLK.)? *Cfr.* HAMPSON, F.Br.India,Moths.IV.p.214.

dissolved in this water can reach the pupa through the two intervening thin membranes, if this be so, the formation of the cocoon illustrates an ingenious device by which the pupa remains almost dry and at the same time well supplied with air." (*l. c.* p. 355).

The outer margin of the cocoon is not, in our species, of simple form as seems to be the case in *peribocalis*, but is provided along its anterior and posterior edges with a series of very tough sucker-like pillars, descending on both ends from the dorsal wall of the cocoon and fastened down to the rock. The inner, vertical, rim of the dome is firmly attached to the stone along its entire margin, its wall being regularly perforated in front and behind by a double series of holes through which the water flows (fig. 1).

It had always struck me as strange that so many of the cocoons, when opened for examination of their contents, were found to be empty, the significance of the crescent-shaped ridge found on one side of the back of the cocoon being at first underestimated. A more careful examination of this small lobe brought to light the extremely fine emergence slit of the imago, ingeniously pre-constructed and well concealed as it is by the two flaps that enclose it. PRUTHI was the first who recognised the correct meaning of this structure.

As was also observed by MUIR in *A. simplicialis*, the shape and size of the cocoon of *crassicornalis* vary much according to the position in which it is built. This will appear also from the accompanying figures. Besides, pupal cases containing male specimens are much smaller than those lodging the bigger females.

PRUTHI's supposition (*l.c.*, p. 354, 355) of the food of the caterpillar consisting most probably of minute particles of vegetable matter suspended in the surrounding water, appears — it may be said incidentally — to be highly improbable, since the larva possesses strong and well developed mandibles most useful in scraping off the often dense growth of algae and Hepaticae (in suitable places also the leaves of the Podostemonacea *Cladopus nymani* MÖLLER) covering the stones in the bed of the stream, the older cocoons being sometimes so overgrown with these plants as to render them difficult to detect.

Turning now to the remarkable parasite of these moths, named by Dr. FERRIÈRE *Rhachioplex javanicus*.

I may first call attention to a note in Mr. MUIR's letter to Prof. POULTON that came under my notice after having successfully bred several imagoes of *Aulacodes* and a single female specimen of its parasite in the laboratory at Buitenzorg. These passages run as follows:—

"We took several pupae home and constructed a suitable breeding-case, in which we hatched out the moth, and also a large Ichneumonid. We had noticed the cocoon and emergence holes of this parasite at the time when we were collecting the material." — And: "We were not fortunate enough to observe the method of oviposition of the parasite." (*loc. cit.*).

It is thus evident that the Chinese *simplicialis* is also seriously attacked by an Ichneumonid wasp, and it would be of great interest to learn as to whether it may be generically distinct from *Rhachioplex.*

The very striking, rounded emergence holes of *Rhachioplex* (fig. 1) were observed from the outset of my visits to Tjisaroea but as I first considered them to be caused by the moths themselves, I did not take notice of them until the true emergence slits of the latter were discovered. This induced me to pay several more visits to that attractive spot, in order also to get the adults, but I have never been so fortunate to take any under natural circumstances. Therefore, *i.e.* on December 14, 1930, many cocoons of *crassicornalis* were brought home for breeding purposes, with the result that nearly all of them produced the moths, and only one yielded an imago of the wasp, hatched out on December 17. Unfortunately, the pupae of several others did not reach the imaginal state and remained inside the inner layer of their host's cocoon.

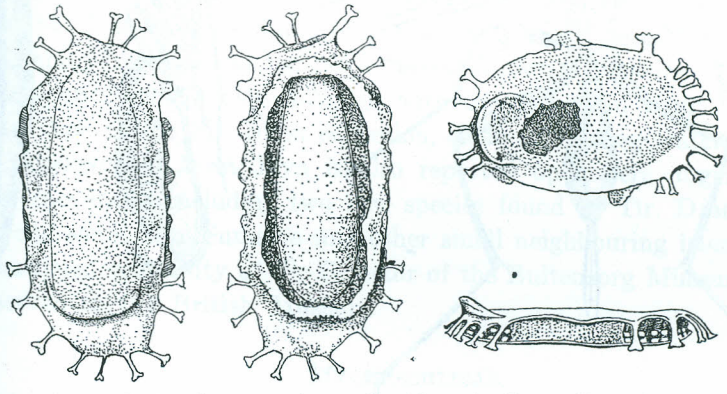

Fig. 1. — *Aulacodes crassicornalis* (GUEN.), Java. Dorsal, ventral and lateral aspect of pupal case, showing details of structure, and dorsal view of another cocoon, showing emergence slit and exit-hole of *Rhachioplex.* × 1½.

The following is a description of the external morphology taken from a few pupae of *Rh. javanicus,* the only immature stage that has come to our knowledge so far.

The cocoon (fig. 2) is variable in size (from 9-11 mm long, and from 3—3.8 mm broad), about three times longer than wide and evenly rounded at both ends. It is dark reddish brown in colour with slight purplish bronzed reflex, the thin wall consisting of a very tough silken substance. In ventral aspect there is a flattened strip running from pole to pole, with which the cocoon is firmly pressed against the ventral wall of the inner cover of the host's pupal case, both ends of which appear collapsed when no longer containing the chrysalis of *Aulacodes.* Each cocoon of the latter never lodges more than one parasite.

The pupa (fig. 2), 7.2 cm long in the figured specimen, is pale yellowish brown in colour, the head, pronotum and the abdominal tergites being decidedly

darker, whilst the apical half of the antennae, the legs and the remainder of abdomen are pale yellowish. The head is deflexed upon the prosternum, and the antennae lie along the outer edge of the abdomen. Legs pressed closely to the sides of the body with femora drawn forwards and the tibiae folded back upon them; the posterior tarsi extend to the apex of abdomen. Abdomen fully developed, the lateral tubercles being inconspicuous. First segment rather shorter than second, this longer than third, which is about equal in length to the next two segments. Pygidium well visible, whitish in colour.

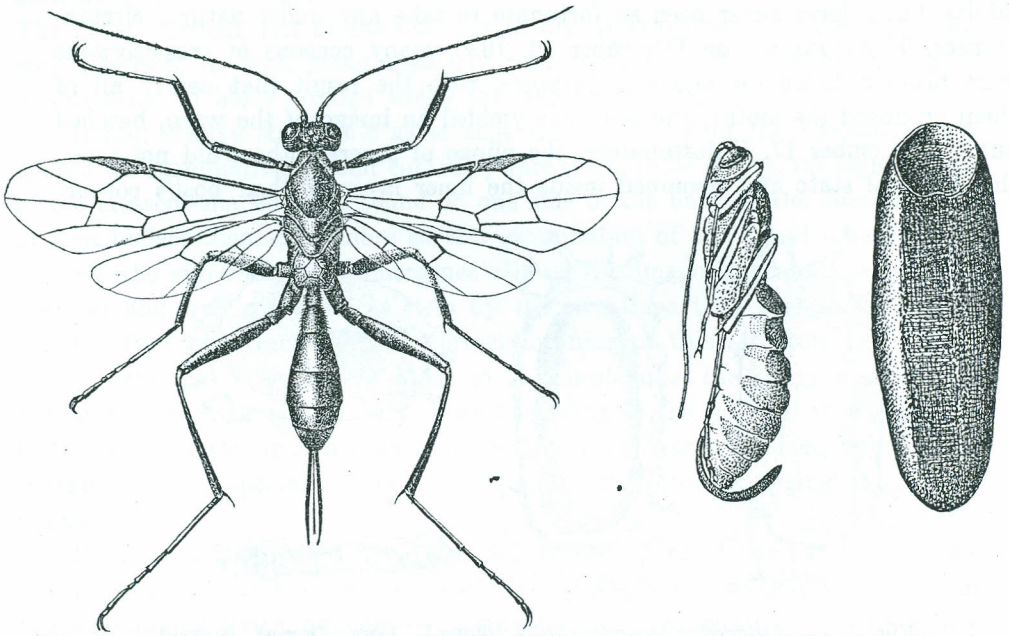

Fig. 2. — *Rhachioplex javanicus* FERRIÈRE. ♀ Java. Adult female (left), left side view of pupa, and ventral aspect of cocoon (right). × 6.

Ovipositor rather long, gradually curved upwards and strongly bent dorsad, the apices of valves reaching to the middle of the sixth abdominal tergite. Valves growing darker towards the end, depressed and lanceolate distally.

Further observations in the field are badly needed, especially with a view to learning the method of oviposition and to find out what are the conditions responsible for the subsistence of the previous larval instars, the latter being still quite unknown.