A New Find of Rhipidius pectinicornis Thbg. (Symbius blattarum Sund.)

(Col. Rhipiphor.).

By
R. H. Stamm.

Among the late Docent R. H. Stamm's literary remains the following little entomological work was found, the manuscript for a paper, intended to be read on the 2nd Scandinavian Congress of Entomologists held in Copenhagen in 1926, but which was left out of the programme owing to the overwhelming quantity of papers. It was then read in the same year at a meeting in the Dansk Naturhistorisk Forening. The manuscript has been prepared for the press by Dr. Kai L. Henriksen.

The Coleopterous family of *Rhipiphoridae* altogether contains only a little more than 200 species, divided in several sub-families and genera, and distributed over the entire earth, particularly in the tropics (Csiki in Junk-Schenkling's Coleopterorum Catalogus pars 54, 1913). In Denmark is found at any rate one species, *Metoecus paradoxus*; several other species occur in the other European countries. That which makes the family *Rhipiphoridae* one of the most interesting Coleopterous families is the peculiar life history of the larvae; these larvae prey on other insects, as they live not only as ectoparasites, eating up the host from the outside, but even act as real entoparasites, bored into their host – which no other Coleopterous larvae (not even the closely related *Cantharidae*) do. This circumstance most likely accounts for the peculiar dimorphism of the shape of the larva, a kind of hypermetamorphosis, similar to that known from the family *Cantharidae*.

By way of an introduction to the following remarks on *Rhipidius pectinicornis* a brief summary of what is known about the biology of the Rhipiphorids may be given here.

Pelecotoma fennica Payk.

Imago is taken in old willows from holes inhabited by *Trypoxylon clavicerum* (but on the contrary not from the exit holes of Ptilinus in the same place), and it is therefore presumed to live with this fossorial wasp (according to Schumann in Ill. Zeit. Ent. IV. 1899).

Macrosiagon ferrugineum F. (= *Emenadia flabellata* F.)

According to A. Chobaut (Mœurs et metamorphoses de Emenadia flabellata F., Ann. Soc. Ent. Fr. LX. 1891. p. 447—456 and other publications from the same year) the host is an *Odynerus*, inhabiting *Arundo donax*. Oviposition takes place medio July in the earth, and the eggs are hatched in the first days of August, when *Odynerus* is making provisions. The newly hatched larva resembles in its shape, agility etc. the Triungulin type of the Cantharides, but is easily distinguished from this by the more leaf-like and not claw-like tarsus, a character which has proved to be the distinguishing mark of the Rhipiphorid larva in its first instar, which has consequently been called Triungulinid or Triunguloid. It searches an *Odynerus* and by this is introduced into its cell. When the *Odynerus* larva has attained a certain size, the Triunguloid bores into it and lives there as an entoparasite. Not until June the next year does it come out again to live as an ectoparasite, sitting as a collar round its victim, which soon perishes. After having left the host, the larva passes into the second instar and is not unlike a hornet larva. Pupation takes place medio June, Imago emerges in the first days of July.

Macrosiagon flavipenne J. Lec.

The biology of this North-American species is described by Fall & Cockerell in Trans. Am. Ent. Soc. XXXIII. 1907. p. 211.

Macrosiagon tricuspidatum Lep. (= *larvatum* Schr.).

Chobaut (Le triongulinide de Macrosiagon tricuspidata Lepech. Bull. Soc. Ent. Fr. 1906. p. 270—72) has described the Triunguloid, which is found on *Eryngium* and other flowers. According to Chobaut (1891) the host is *Eumenes* or, according to Reitter (Fn. Germ. III. p. 383), "solitary bees (*Odynerus, Megachile*)" in which case the Triunguloid waits till the hymenopterous larva has pupated. Then it bores into the pupa, feeding on it, and transforms into the second, thick, shortlegged larval stage (presumably living externally, which

(Reitter does not mention), pupating inside the cocoon of the host. Reitter has, however, no descriptions and no pictures of the larva and puparium.

Macrosiagon cucullatum Macl.

Jarvis (28th Rep. Bur. Sugar Expt. Sta. Queensland Brisbane 1928) mentions the Triunguloid occurring inside the larva of *Campsomeris tasmaniensis* (as many as four may occur inside one host larva) and in other cases Triunguloids had entered the larvae of *Scolia soror,* but none became reared.

Metoecus paradoxus L.

According to Chapman (On the oviposition of Metoecus (Rhipiphorus) paradoxus. Ent. Month. Mag. XXVII. 1891. p. 18–20) the egg is presumably laid in cracks in dead, decayed wood, from which place the Triunguloid enters into the *Vespa*-nests, where it lives. The Triunguloid was described by Chapman (Some Facts towards a Life-History of Rhipiphorus paradoxus. Ann. Mag. Nat. Hist. (4) VI. 1870. p. 314–26), who likewise demonstrated the penetration of the Triunguloid into the *Vespa*-larva. Inside the host the Triunguloid, like a Termite queen, swells by a great distension of the intersegmental membranes. Then it forces its way out, and places itself as a collar round the host, casts its skin and becomes a plump, wasplike creature with the fore-end bent downward. When it has killed and eaten up its host larva, it leaves the remains and pupates inside the cell. The morphology and biology of the adult larva have been dealt with too by Murray (Conclusion of the History of the Wasp and Rhipiphorus paradoxus with Description and Figure of the Grub of the latter. Ann. Mag. Nat. Hist. (4) VI. 1870. p. 204–13). Cf. also E. Suenson (Om Klækninger af Metoecus paradoxus L.) in Ent. Medd. XIII. 1919. p. 17–22.

Rhipiphorus subdipterus Bosc.

Chobaut (Le triongulinide du Myiodes subdipterus Bosc. Bull. Soc. Ent. Fr. 1906. p. 238–44) has described the Triunguloid, which he found was sitting waiting on *Eryngium* flowers, on which he had also watched a female of this species in the act of ovipositing.

Fabre (Souvenirs Entomologiques. III. 1886. p. 220–22) has demonstrated that the host is *Halictus sexcinctus,* in which he found the 2nd larval stage, which does not eat up the host larva, until the latter has consumed its supply of honey. He also describes this 2nd larval stage.

Rhipiphorus solidaginis Pierce.

Dwight Pierce (Some Hypermetamorphic Beetles and their Hy-

menopterous Hosts. University Studies Univ. Nebraska IV. 1904. p. 153–60), has found the Triunguloid, which he describes, on *Solidago*, from which it passes to the bee *Epinomia triangulifera*. Silvestri (Descrizione di un nuovo genere di Rhipiphoridae. Redia. III. 1905. p. 315–24) again figures the Triunguloid (for comparison with his new form, see below).

Rhipidius pectinicornis Thbg. (= *Symbius blattarum* Sund.).

Sundevall (Beschreibung einer neuen Coleopteren-Gattung, Symbius blattarum. Isis. 1831. sp. 1222–28) on a voyage from East-India found wingless, larviform females and winged males in the open (onboard the ship)*). Further he found in the *Blatta germanica* onboard the ship (and in a single specimen of *Blatta americana*) entoparasitic larvae to be common, which as mature larvae made their way out of the cockroach, pupated in the open and were transformed into the present species. Sundevall described and figured the larva, pupa, male and female. See further below.

Rhizostylops inquirendus Silv.

This form, described by Silvestri (Descrizione di un nuovo genere di Rhipiphoridae. Redia. III. 1905. p. 315–24) on an apterous larviform female with eggs and a newly hatched larva taken under tufa („tufo di terra") in Italy, is by Csiki referred to *Rhipidiini*. The larva is not of the common triunguloid type with a leaf-like foot, but is stylopiform, with slender legs, the tibia of which ends in two claws; the female, too, is different from the Rhipiphorid type, so that its relation to this family is very questionable. The male and the life history of this form are entirely unknown.

The species *Rhipidius pectinicornis* Thbg., which is dealt with in the present communication, is no longer regarded as indigenous to Europe, but as an East-Indian species, introduced to Europe onboard ships from India. The male was described in 1806 by Thunberg under the above mentioned name. In 1831 Sundevall in a little monograph described the male and female of an insect, which he called *Symbius blattarum*, and laid clear, at any rate part of its biology, also describing larva and pupa.

*) It is therefore erroneous when Sharp (Cambr. Nat. Hist.) – and after him several other text-books (Brehm, Maxwell-Lefroy, Imms) – states that the female remains inside the host, just as erroneus when Sharp (l. c.) states that Thunberg's material came from amber.

This species has later proved to be identical with Thunberg's species.[1])

As Sundevall's observations regarding the biology of the species are the only ones existing in print in the last 100 years, the find recorded here might be of interest in so far as it is supplementary to his statement. Sundevall relates that onboard an Indiaman he found, first the male and then the wingless female, and then, by a mere chance, he discovered that the larvae were to be found inside the cockroaches of the ship, which were *Blatta germanica*. By collecting the latter in large numbers he succeeded in discovering how the larvae made their way out of the host, pupated, whereupon imago emerged a few days later. The cockroaches of the ship were evidently highly infested with these parasites, at a certain time there was an abundancy of pupae and empty pupal skins in all the places sought by the cockroaches; the males were seen actively searching for the females, which were sitting quite still; oviposition took place in the way that the female extends her ovipositor in all directions, thus scattering the numerous tiny eggs round her. As regards the host, he states that this will always be a young wingless cockroach, and he has never met with more than one parasite in the same host individual, which was therefore not entirely eaten up.

These fine observations of Sundevall were – as said above – published in 1831, and they could have been expected to have been supplemented in the course of time, especially as regards the 1st, triunguloid larval stage, unknown to Sundevall, during which the penetration into the cockroach must occur. It must be taken for granted that the instar known to Sundevall is the 2nd one,

[1]) The Zoological Museum of Copenhagen possesses a male and a female of Sundevall's type material for *Symbius blattarum*, presented by him to Westermann, whose collections is incorporated in the Museum.

which (in contradistinction to that of the other Rhipiphorids) as yet lives internally in the host.

In the hundred years elapsed since then only a single male has been found now and then (Reitter thus states (Fn. Germ. III. p. 384) that he has never seen it, although large numbers of insects have been sent to him for determination in the course of time). And the developmental stages – as far as I know – have never been refound.

A valuable material of this species consisting of 4 male imagines, 1 pupa and more than 20 larvae (all in the second stage) have now come into my hands quite accidentally, thanks to Marine Superintendent O. Christiani, who in his younger years was attached to the East-Asiatic Company as 1. mate and as a captain, and who has proved an excellent collector on several occasions. Mr. Christiani once informed me in a letter – as far as I remember towards the end of 1914 – that onboard the steamship "Samui" he had observed a cockroach which was ill and out of which a parasite larva was making its way. He had then placed the whole thing in a box, in which the larva soon pupated, and imago emerged; this was repeated several times, and once he watched a larva come out, while another larva remained in the cockroach. What kind of animal it was I did not understand from the letter, as imago – which certainly was a *Rhipidius* male – was compared to a fly, but I wrote of course at once asking for as much material as possible, among other things I asked him to send as many cockroaches in spirit as possible. And I did get them; on his return in the summer of 1915 he carried with him – besides a few specimens of cockroaches, of which the larvae were about to emerge – 4 small tubes with cockroaches, which had been collected during February 1915; it had been intended to continue this collecting in the ensuing months, but the "Samui" soon met her fate, being shipwrecked one day in foggy weather,

and the ships, to which Mr. Christiani was attached later, were not infested with similar quantities of cockroaches.

Unfortunately, the investigations of the collected cockroaches gave no positive result, as it was impossible to find any trace of the first, triunguloid larval stage; the smallest larvae was of quite the same type as the fully grown ones. But the investigation yielded certain results, which amplified those obtained by Sundevall. As regards the frequency of the parasite I can state that out of a little over 100 cockroaches 10 were infested with the predator. The hosts were not – as recorded by Sundevall – exclusively young, wingless cockroaches, but just as often fully developed insects. Nor is it the common rule for each cockroach to contain a single parasite only; on the contrary, I found 3 infested with 5, 1 with 4, 1 with 3, 3 with 2 and only 2 specimens with one larva. Fig. 1 (to the right) shows 5 larvae lying close to each other in the abdomen of an adult cockroach and (to the left) a young cockroach, out of an intersegmental membrane of which a larva is making its way and this was a cockroach which had at any rate had two parasites, another larva had emerged earlier more posteriorly.

The larvae examined are at most 7 mm long and 2 mm broad, most of them are however 4–5 mm long; body elongate, oval, with sides almost parallel and a faint pleural fold along the sides of the segments. The general appearance of the animal is faintly red and fleshy, all chitineous parts being very thin. The smaller specimens are relatively more slender than the bigger ones.

The posterior part of the dorsal surface of the head (fig. 2–3) lies in continuation of and on level with the dorsal surface of the segments of the body, but in front of a line drawn between the antennae the head slopes considerably towards the convex front margin. In the bigger larvae the head is usually bent downward. The antennae are pale like the body, 2-jointed, short and plump,

their basal joint short conical. Almost amidst the antennae and the posterior margin of the head two eyes can generally be distinguished, in the shape of distinct,

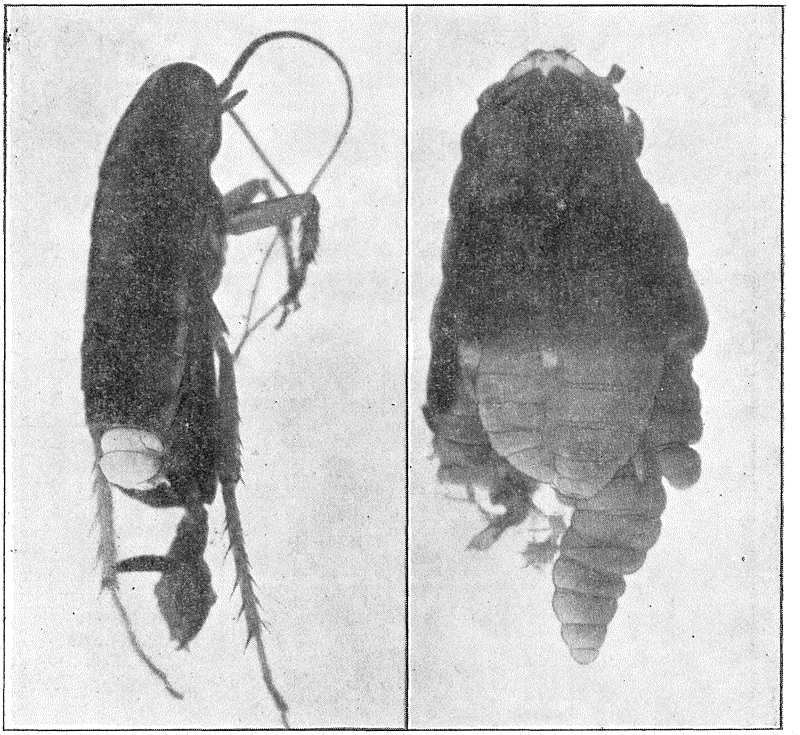

Fig. 1.

To the left: A young cockroach *(Blatta germanica)*, out of an inter-segmental membrane of which a larva of *Rhididius pectinicornis* is making its way out.

To the right: Five larvae of *Rhipidius pectinicornis* in the (opened) abdomen of an adult cockroach.

convex lenses with pigment spots underneath (fig. 3 A). In several specimens it has however been impossible for me to find anything which could be interpreted as eyes, while other specimens have an additional posterior row,

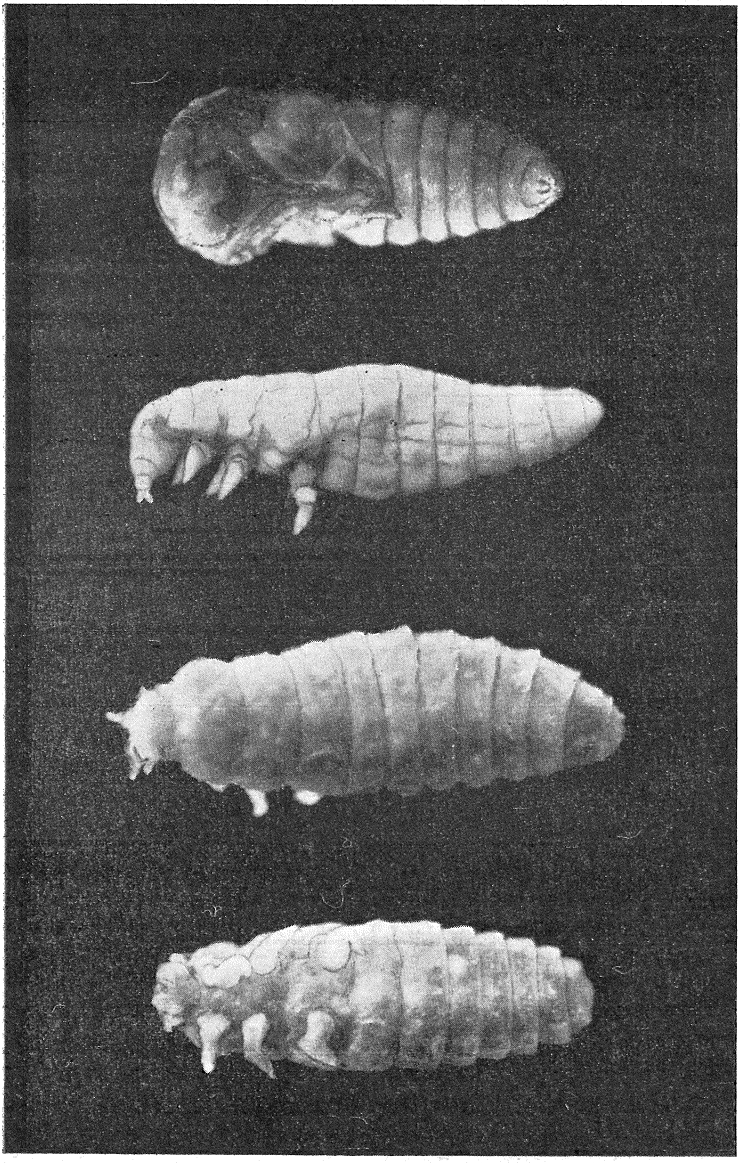

Fig. 2.
Three mature larvae (abt. 7 mm long) and a pupa of *Rhipidius pectinicornis*.

consisting of 3 pigment spots (for which however I have not been able to find any lenses) (fig. 3 B). I cannot say if this is due to an actual variation in the individuals, designating a different degree of reduction (which is by no means improbable, as the internal parasitism of this larval stage must have been commenced rather recently, the other Rhipiphorids having no internally living second stage larva) or if it is only due to the poor preservation, which latter cannot be denied. — Above the head carries two low, hard yellowish chitinized ridges, which converge posteriorly, but to a less degree anteriorly, where they are in return more elevated. The free border is smooth and sharp, and the two ridges encloses an almost rhomboid, faintly concave area. — Of mouth parts nothing but a very big labium, white and fleshy as the rest of the larva, is discernible. The basal parts (gula, submentum, mentum) are not separated *inter se.* The labium ends in two 3-jointed palpi, the individual joints of which are short and plump, the outermost joint much resembling in shape and size the outermost joint of the antenna (fig. 3 C).

The three thoracic segments are broader than they are long, and just like the dorsal surface of the head they are faintly covered with short hairs, so faintly that very bright light is necessary to discern them. Each of the three segments carries on its dorsal surface, rather laterally, two longitudinal ridges, quite low and hardly visible, consisting of hard yellow chitin corresponding to the ridges present on the head. On pro- and metathorax they diverge considerably posteriorly, whereas on mesothorax they are faintly angular, diverging anteriorly as well as posteriorly. The free margin of these ridges is rough or dentate, most distinctly on prothorax. These ridges on the head and on thorax have been demonstrated with certainty in 1 (rather slender) specimen only of 4,7 mm's length (fig. 3 A); that I have not found them in the other specimens, is presumably due to the poor state of preservation.

The abdomen tapering gradually posteriorly, consists of 8 discernible segments, the two foremost of which

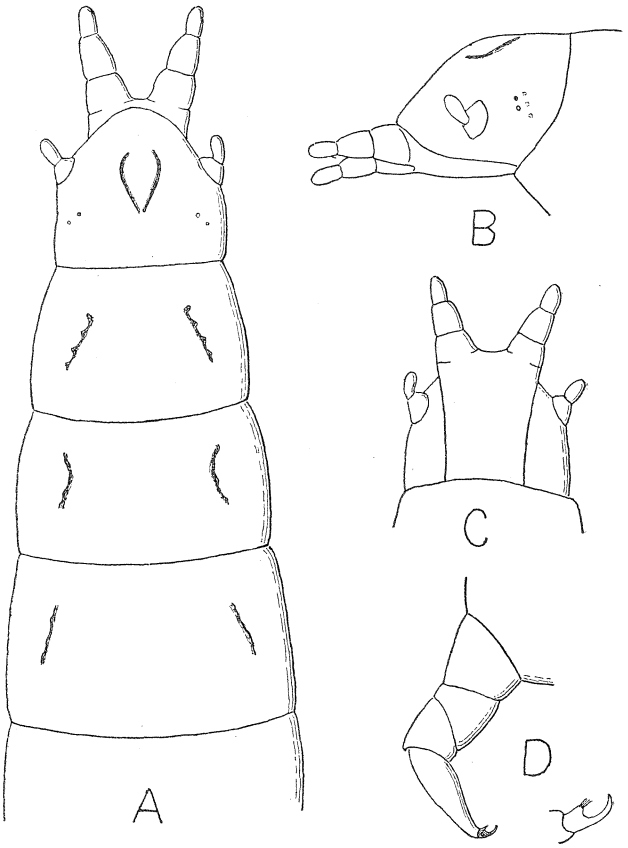

Fig. 3.

A Anterior part of a larva (4,7 mm long) of *Rhipidius pectinicornis* from above. – B Head of another *Rhipidius*-larva from the side, – C from below. – D A leg of a *Rhipidius*-larva and the clawlike tarsus, yet more enlarged.

are hairy like the thoracic segments, while the other segments are quite hairless.

The short plump legs (fig. 3 D), which on all thoracic

segments are alike, consist of coxa, trochanter, femur (which three joints are obliquely cut off, so that the outer and inner sides are of different length, the two lastmentioned joints being a trifle shorter than coxa), and of a somewhat more slender and longer tibia, tapering towards a well chitinized yellowish, clawlike tarsus, which on the inner surface carries a toothlike projection, resembling a heel, to which is attached a little tuft of hair.

As the larva lives inside the cockroach, it is natural that it is pale and fleshy, and this circumstance also accounts for the peculiar reduction of the mouth parts: no mandibles are necessary for any chewing of the food, nor does this (the fat body and genital organs of the host) require any maxillae for being grasped; in return the prolonged labium forms an excellent shovel or plate for the transfer of the food into the mouth.

Most remarkable are perhaps the chitineous ridges on the head and the thoracic segments. They bear a close resemblance to the egg-teeth which are present in many newly hatched insect larvae (see e. g. van Emden in Zeit. wiss. Zool. Bd. 126. 1925. p. 622—54, and Heymons in Biol. Zentralbl. Bd. 46. 1926. p. 51—63), and which have the function of cutting through the shell of the egg, when the larva is about to emerge. The function of the chitineous ridges of the *Rhipidius*-larva is evidently quite the same. This, too, is enclosed (in the cockroach) and the fleshy predaceous larva which among other things entirely lacks hard mandibles, would not be able to penetrate through the tough chitineous skin of the cockroach, if it was not provided with hard chitineous ridges for that purpose. This applies particularly to the ridges on the head, whereas those on the thoracic segments may act as supports (due to their roughness or dentation) during the later stages of emergence.