Biological Investigations on some Danish Hymenopterous Egg-Parasites, especially in Homopterous and Heteropterous Eggs, with Taxonomic Remarks and Descriptions of New Species.

By
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(With 164 original figures).

Preface.

In the first instance I want to render Mr. J. P. Kryger my sincerest thanks for the great interest with which he followed the preparation of this work and to mag. sc. Kai L. Henriksen for his kind assistance as to the present paper. I also owe a dept of gratitude to Inspector Wm. Lundbeck for permission to make use of the material of the Zoological Museum of Copenhagen, to the Trustees of the Steenstrup Legacy for the receipt of a travelling studentship in 1926, and to the Rask-Ørsted-Foundation for a grant which has allowed this paper to be so fully illustrated.

In 1926 "Entomologisk Forening" at Copenhagen proposed the following prize question: "The Danish Parasites of Homoptera" which problem I intended to solve. On working at the topic during the first summer it became evident that the work of collecting the bigger parasites could not pretty well be combined with the investigations of the egg-parasites on which I was beforehand focussed. Consequently the *Acarina*, the *Diptera*, the *Strepsiptera et alii* were entirely excluded, and of the *Hymenoptera* the egg-parasites only became the object of my attention, and only my results as to these latter are incorporated in this work. During the first winter I realised that it would be possible to identify the larvae of some of the most common egg-parasites, *Polynema*, and *Lymaenon* or *Ooctonus*, which are living in the same kind of eggs, and I was actually succesful in the identification, although not until during the succeeding two winters; this period exceeded the original term fixed for solving the prize question which term however was extended. My investigations comprised as many new egg-parasites as it was possible to find, and gradually, as the hatchings came to an end, I finished the collection of material in 1929.

Knowledge has been forthcoming of a single Proctotrypid, viz.

Phanurus angustatus Th.,

of 3 Chalcidids, viz.

Anellaria conomeli n. sp.
Chalcididae sp. (in eggs of Lestes)
?Chalcididae sp. (in eggs of Rhynchites betulae),

of 21 Mymarids, viz.

Alaptus minimus (Hal.) Walk.
Lymaenon effusi n. sp.
— sulphuripes Först.
— tremulae n. sp.
— sp. (in eggs on Salix pentandra)
Ooctonus heterotomus Först.
Stethynium triclavatum Enock
Erythmelus goochi Enock
Anagrus incarnatus Hal.
Anaphoidea conotracheli Girault
Cleruchus pluteus Enock
Polynema similis Först.
— fuscipes Hal.
— pusillus Hal.
— atratus Hal.
— euchariformis Hal.
— longula Först.
— fumipennis Hal.
— ovulorum Hal.
— microptera n. sp.
?Mymar pulchellus Curt.

and of 3 Trichogrammids, viz.

Ophioneurus signatus Ratz.
Chaetostricha pulchra Kryger
Oligosita nudipennis Kryger,

thus most fully of the Mymarids. I have more or less completely ascertained the development of 10 of the about 20 known genera of Mymaridae.

Proctotrypidae.

Phanurus angustatus Thomson.

Development.

Only in one case I succeeded in following this species from the first larval instar to the imaginal stage. On January 15th 1928 I found in the wood Dyrehaven on *Urtica dioeca* L. a heteropterous egg, which by being pressed strongly was found to contain a larva in its first instar; on February 4th it had assumed its second instar

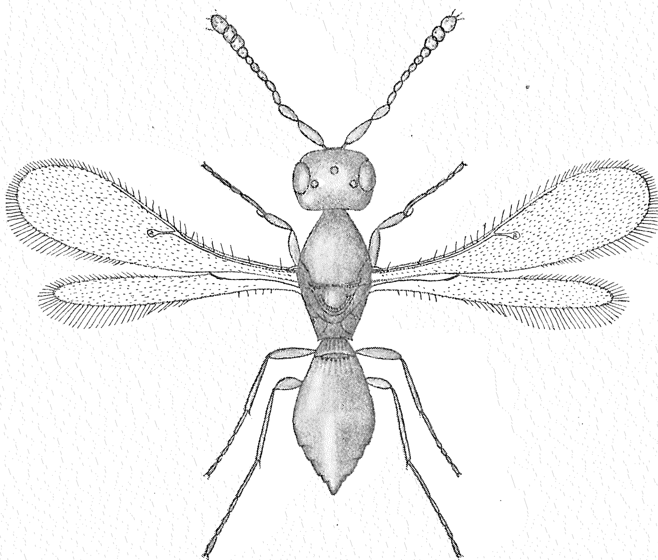

Fig. 1. *Phanurus angustatus* Th.
Female. × 60.

and on May 9th the imago was seen to move in the pupal cuticle, still without emerging.

Fig. 2. *Phanurus angustatus* Th. Antenna of male. × 60.

In several cases I took the larva in its first instar out of the eggs. Its roundish body (figs. 3–4) is by a constriction divided in two parts; the cephalic one is anteriorly dominated by powerful mandibles below which there is an unpaired process; the posterior part, which includes the stomach, is laterally in front armed with setae implying one or perhaps more segments; it terminates in a stiff forward directed caudal appendage with a spine at base and a claviform tip. The caudal appendage is slightly curved and extends on the young larva as far as above the head. The two mandibles have a powerful, muscular base, which causes a bifurcate shape of the head perceptible at a frontal view. Between the mandibles is the orifice of the mouth, and below them is the process mentioned above, being probably the labium and bearing perhaps the orifice of the salivary duct.

The larva devours the contents of the host egg; its posterior part attains a size several times the original one and assumes the form of a vesicle causing the larva to be immovable and difficult to recognise, because the dif-

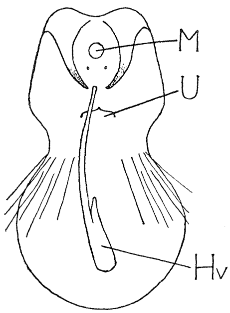

Fig. 3.

Fig. 4.

Phanurus angustatus Th. First instar larva.
Fig. 3, frontal view; Fig. 4, lateral view. × 188.

ferent outgrowths cannot easily be perceived. After a development of about 3 weeks the larva moults.

This "cyclopoid" larval type is known in several Proctotrypids. Thus Marchal (1901) has found it in the new species *Limnodytes*[1]) *gerriphagus* described by him. The "*Teleas*"-larva described by Ganin (1869) from eggs of *Gerris* resembles the larva of *Limnodytes* and is therefore by Henriksen (1918) referred to this latter genus; Ganin explained the bifurcation of the head as 2 antennal processes which interpretation, however, seems to be wrong. Similar forms are further found amongst others in *Eumicrosoma* and "*Teleas*", dealt with by Mc. Colloch (1915) and Ayers (1884) respectively. With respect to the last mentioned author a confusion has evidently taken place. To the genus *Teleas* 2 cyclopoid larvae are referred; the one, however, (Ayers pl. 24 figs. 2—14) can be identified with the larva of a *Polynema* (the lips being interpreted as mandibles and the real mandibles being overlooked owing to their minuteness), whereas the other larva (Ayers figs. 16—30; pl. 25 figs. 1—21) is a Proctotrypid closely allied to Ganin's "*Teleas*"-larva but like *Phanurus* with a small club at the caudal tip.

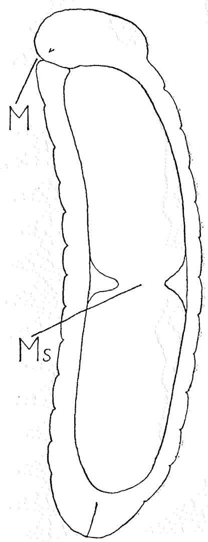

Fig. 5. *Phanurus angustatus* Th. Outline of second larval instar.
Ms, current constriction on the stomach. × 80.

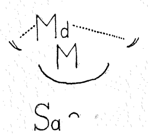

Fig. 6. *Phanurus angustatus* Th. Second larval instar, mouth region. × 80.

After the moult the larva assumes its second instar, which is cylindric

[1]) The name *Limnodytes* has by Bradley been altered to *Typhodytes* because the name *Limnodytes* was preoccupied.

and seems to have the usual 13 segments; current constrictions are seen on the stomach, which becomes yellowish and still is a closed sac (fig 5). In the course of a week the contents of the egg are devoured; the movements of the gut may still be seen, and clear, whitish fat cells are foreshadowed. The larva has 2 small mandibles (fig. 6), behind which the rent-like orifice of the mouth is seen and behind this again a smaller semicircular figure, which may be supposed to be the orifice of the salivary duct.

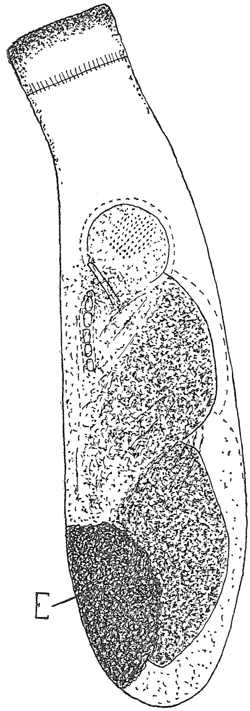

Fig. 7. *Phanurus angustatus* Th. Pupa with foreshadowed imago within the host-egg. × 80.

After about a month the pupa is seen to be foreshadowed, simultaneously the stomach is shrunk and presents itself as a dark patch, which is yellowish by incident light. The excrements are evacuated before the imago is foreshadowed, perhaps already at the transformation of the larva into pupa; they are in some cases observable within the host-egg near the posterior extremity of the pupa (fig. 7 E).

The time passing from the hatching from the egg until the imago is foreshadowed within the pupal integument seems to be about 2 months, and 3 months altogether elapse before the imago is ready to emerge. I observed that the apical part of the antenna of the imago was bent forward at the fifth joint counted from the tip of the antenna, but I am not sure whether this is normal or caused by my rolling the host-egg. Still Thomson (1860) states that in the males of the *Telenominae* the above mentioned joint is sinuate, what speaks in favour of the said features in the egg being a normal one.

The bred imago (figs. 1—2) was determined as *Phanurus angustatus* Thoms.

Host.

Phanurus angustatus develops in eggs, which are deposited by an undetermined heteropterous insect in the soft parts, especially in the nodes of the stalk, of *Urtica dioeca* L. (fig. 156).

Cycle.

From the developmental facts and from the breedings specified below—in which *Phanurus* was bred together with *Erythmelus* (which latter is treated more fully later in a subsequent chapter)—it will appear that there is but one generation a year.

Breedings.

No. 1. On January 10th, 1926 a number of heteropterous eggs were taken in Dyrehaven (North Sealand) in nodes of *Urtica dioeca* and scattered on moist filter-paper.

From February 25th to March 3rd	59 heteropterous larvae hatched.
From April 18th to May 16th	50 *Erythmelus* emerged.
On April 25th	2 *Phanurus* (males) emerged.
On April 27th	3 *Phanurus* (2 males, 1 female) emerged.
On May 1st	1 *Phanurus* (male) emerged.
On May 2nd	1 *Phanurus* (female) emerged.

As no further individuals emerged between May 2nd and June 5th, I considered the breeding as concluded; the total outcome of *Phanurus* was thus 5 males and 2 females.

No. 2. On April 1st, 1926 another lot of heteropterous eggs were taken in Dyrehaven in nodes of *Urtica dioeca*, the nodes were cut off and moistened during the breeding period.

From April 17th to May 1st	56 heteropterous larvae hatched.
From May 27th to June 5th	97 *Erythmelus* emerged.
On May 27th	2 *Phanurus* (males) emerged.
On May 28th	5 *Phanurus* (males) emerged.
On May 29th	5 *Phanurus* (males) emerged.
On May 31st	2 *Phanurus* (1 male, 1 female) emerged.
On June 1st	2 *Phanurus* (1 male, 1 female) emerged.

As no further individuals emerged between June 1st and 19th, I considered the breeding as concluded; the total outcome of *Phanurus* was 14 males and 2 females.

No. 3. On May 2nd, 1926 a further lot of heteropterous eggs were taken in the enclosure of Fortunen (in Dyrehaven) in nodes of *Urtica dioeca* and treated like the preceding lots.

From May 18th to 21th	14 heteropterous larvae hatched.
From June 9th to 29th	124 *Erythmelus* emerged.
On June 11th	1 *Phanurus* (male) emerged.

As no further individuals emerged between June 11th and July 24th, I considered the breeding as concluded.

Chalcididae.

Anellaria n. g. **conomeli** n. sp.

It has been impossible to refer this tetramerous Chalcidid to any of the genera hitherto described; when we use the work of Förster (1856) it can only be stated that it belongs to the family *Entedonidae*. Therefore it is necessary to establish a new genus:

Anellaria n. g.

This genus is distinguished by having a 3-jointed funiculus and 4 anelli in the female (figs. 8, 11), and a 4-jointed funiculus and 3 anelli in the male (figs. 9, 10).

The body is of the usual chalcidid type; the tarsi are 4-jointed; the wings have a marginal vein from the apex of which a short radius issues at a rather acute angle.

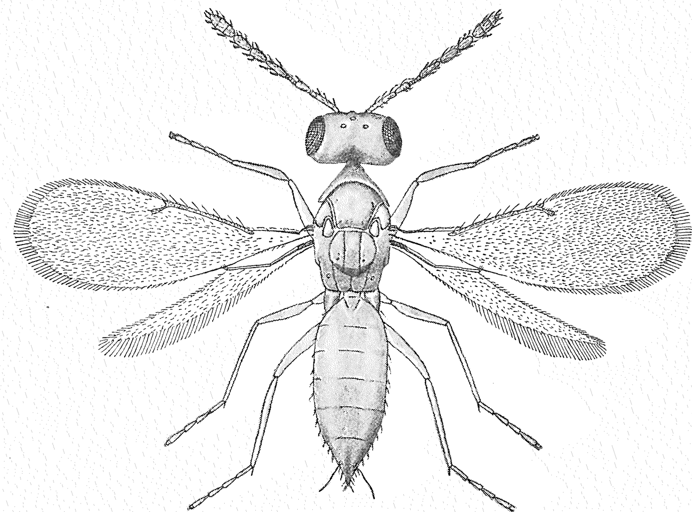

Fig. 8. *Anellaria conomeli* n. sp.
Female. × 35.

The petiole consists of one joint, right behind which there is an impression on the abdomen. The scape of the male is provided with a minute tubercle (fig. 10) on the inner side, which may be supposed to be a sense organ.

Only one species, viz.

A. conomeli n. sp.

The body is rather dark with a faintly greenish metallic lustre; the base of the abdomen and a touch on the mesothorax are brownish; the legs are light yellow with darker terminal joints; the scape and pedicel of the antennae are light yellow, their funicle and club darker. The club is 3-jointed with a minute sensilla(?) at the tip.

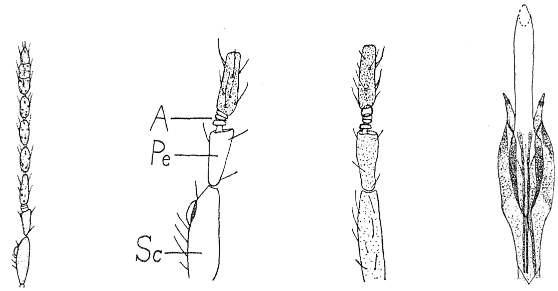

Fig. 9. Fig. 10. Fig. 11. Fig. 12.

Anellaria conomeli n. sp.

Fig. 9, antenna of male, × 45; Fig. 10, basal joints of antenna of male, × 94; Fig. 11, basal joints of antenna of female, × 94; Fig. 12, aedeagus, × 94.

The proportions of length of the joints of the antennae will appear from figs. 8—11. The mesopostphragma extends to the posterior end of the thorax and terminates broadly. Length of body: in female 1,4 to 1,2 mm., in male 1,2 to 1 mm.

The base of the ovipositor is situated close to the base of the abdomen. The claspers of the male sexual organ terminate pointed (fig. 12).

Development.

I found 3 specimens of the larva in its first instar, one on August 31st, 1926 and two on August 28th, 1927 in eggs of *Conomelus limbatus* from *Juncus effusus*. On a young larva (fig. 13), taken out of the host-egg, the body is seen to consist of 13 segments in addition to the head. A faint line, the oesophagus, is seen to extend from the mouth to the mid-gut, which is closed posteri-

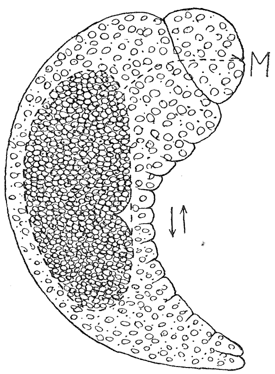

Fig. 13. *Anellaria conomeli* n. sp. First larval instar. × 188.

orly. In the terminal segment the hind-intestine is seen to be foreshadowed. In another somewhat bigger specimen the stomach was proportionally larger and the segmentation of the body almost effaced. On the stomach peristaltic constrictions may be seen, which — as indicated by the arrows in the figure — are running forward and backward. At the mouth two minute mandibles, crossing each other, are seen. No other organs were observed. The small size and the said organisation of the larva indicates that it is really in its first instar.

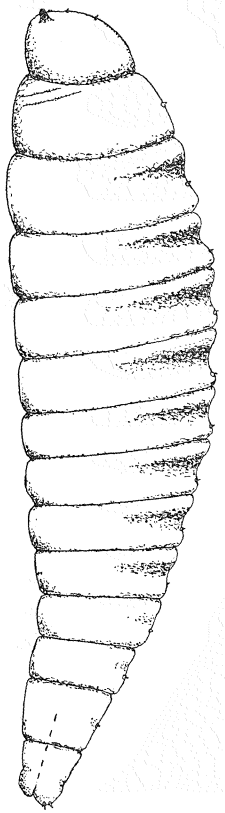

Fig. 14. *Anellaria conomeli* n. sp. Second larval instar. × 100.

On August 28th, 1927 I had a larva in its first instar, which occupied half the length of an egg of *Conomelus*. On September 1st the larva occupied two thirds of the length of the egg and now presented distinct mandibles shaped as to mark the second instar; on September 3rd the larva had left the host egg. In this, the second, instar (fig. 14) the body is distinctly segmented, consisting of 13 segments in addition to the head. On the dorsal side a few minute spines are seen. By pressing the larva (fig. 15) a stomach with yellow "symbiotic" cells*) is seen; through a string it is in connection with the anus, but seems to be closed posteriorly. Four elongate, clear white fat-bodies are seen, and segmental muscles are amply present. The head is provided with several minute spines, amongst others one pair above and one pair below

*) as to the reasons for using this term, see later on.

the mouth; this latter has two broad mandibles with a tooth at base of each and an interior process for attachment of muscles (fig. 16).

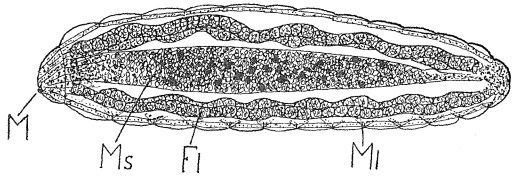

Fig. 15. *Anellaria conomeli* n. sp. Second larval instar, under a pressure. × 30.

As mentioned above this larva leaves the host-egg and is subsequently found in the pith of the juncaceous stalk directly under the bark, where it makes its way by gnawing, still without devouring the pith, which is ascertained by the fact that only contents of eggs are found in its stomach. The sucked *Conomelus*-eggs, left behind the larva on its way through the stalk, show that it attacks additional eggs and now from the outside; it may also be recognised from its multiplied size (figs. 17, 18) that it has received more nourishment than that contained in the first egg. It may be supposed that the larva, before being fully developed, is able to devour from 3 or 4 to 7 or 8 eggs. Apparently the larva does not moult after having left the host-egg, for by comparison of dissected mouth-parts of some big and small larvae the man-

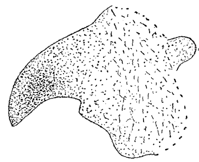

Fig. 16. *Anellaria conomeli* n. sp. Second larval instar, mandible. × 376.

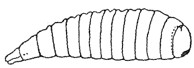

Fig. 17. *Anellaria conomeli* n. sp. Second larval instar, recently having left the host egg. × 30.

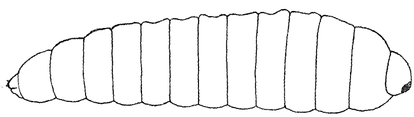

Fig 18. The same, full grown. × 30.

dibles proved to be exactly of the same size. It is a characteristic fact that the larva has no functioning tracheal system. I am not able to give any information about the other characters of the larva, for instance about the salivary glands.

The larva is transformed into a bright pupa of the general chalcidid type, which lies freely in the stalk and gradually grows darker.

Host.

Anellaria conomeli develops in eggs of the cicadellid *Conomelus limbatus* Fabr., deposited in the lower part of the stalk of *Juncus effusus* L. (figs. 137, 164 A, B).

Cycle.

As will appear from my observations *Anellaria* has only—like its host—one generation a year. The imago emerges towards the end of the summer. On July 18th, 1926 I found a female ready to break out of a juncaceous stalk. The larva hibernates in the first or second instar, according to the time where the cold stops the development. Numerous random samples showed that the larva may be found in a year old stalks even in the summer; thus on June 13th, 1926 a larva and a pale, immature pupa were found in a stalk in Dyrehaven. It will appear, too, from the below specified breedings from a good-sized bundle of juncaceous stalks, which were watered daily in room temperature, that not until after 3 months the bulk of imagines emerged.

The investigations of the biology of this species were made step by step, inverse in order, as by observing the absence of tracheae in the free-living larva in the stalk I anticipated its peculiar habits.

Breedings.

On November 1st, 1925 stalks of *Juncus effusus* L. were taken in Dyrehaven at a shallow pool.

From Dcbr. 4th, 1925 to January 4th, 1926	19	Anagrus (2 males, 17 females) emerged
On January 16th, 1926	1	Anellaria (male) emerged
On January 19th	2	Anellaria (males) emerged
On January 22nd	3	Anellaria (males) emerged
On January 23rd	3	Anellaria (males) emerged
On January 25th	3	Anellaria (males) emerged
On January 26th	5	Anellaria (males) emerged
On January 27th	4	Anellaria (males) emerged
On January 28th	1	Anellaria (male) emerged
On January 29th	4	Anellaria (males) emerged
On January 30th	3	Anellaria (males) emerged
On February 1st	6	Anellaria (males) emerged
On February 2nd	3	Anellaria (males) emerged
On February 3rd	2	Anellaria (males) emerged
On February 4th	5	Anellaria (4 males, 1 female) emerged
On February 5th	3	Anellaria (1 male, 2 females) emerged
On February 6th	6	Anellaria (males) emerged
On February 8th	5	Anellaria (1 male, 4 females) emerged
On February 11th	5	Anellaria (3 males, 2 females) emerged
On February 12th	3	Anellaria (1 male, 2 females) emerged
On February 13th	3	Anellaria (1 male, 2 females) emerged
On February 15th	3	Anellaria (females) emerged
On February 16th	1	Anellaria (female) emerged
On February 17th	4	Anellaria (females) emerged
On February 19th	1	Anellaria (female) emerged
On February 22th	3	Anellaria (females) emerged
On February 23rd	1	Anellaria (female) emerged
On February 24th	1	Anellaria (female) emerged
On February 25th	1	Anellaria (male) emerged
On March 1st	1	Anellaria (female) emerged

On March 18th 1 Anellaria (female) emerged. As no further individuals emerged between March 18th and May 7th, 1926, the breeding was considered as concluded; total outcome of Anellaria: 58 males and 29 females.

Undetermined Chalcidid from eggs of Lestes (?).

On October 6th, 1924 and on September 24th, 1926 I found, in Dyrehaven, in *Juncus effusus*, a few specimens

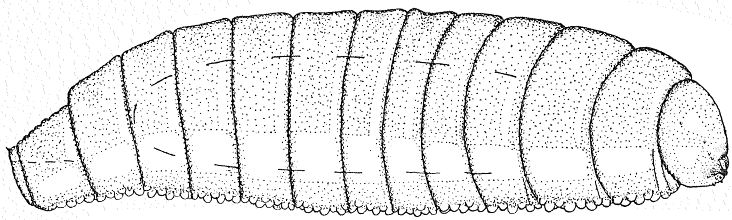

Fig. 19. Undetermined Chalcidid from eggs of Lestes. Larva (the gut slightly indicated).
Lateral view, × 100.

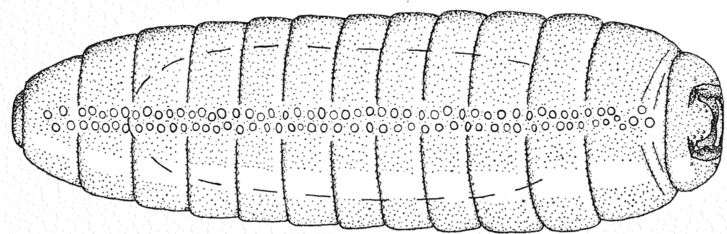

Fig. 20. The same.
Ventral view, × 100.

of a chalcidid larva (figs. 19—20) at an advanced stage of development, sitting in a gnawed egg presumably of *Lestes* (figs. 161—162). This larva differs considerably from that of *Anellaria* by having two series of minute tubercles on the ventral side and somewhat smaller mandibles, which are less

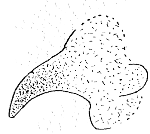

Fig. 21.
The same.
Mandible.
× 376.

distinctly marked at base (fig. 21). The larva has 13 segments in addition to the head, and the contents of its gut are perceptible as a dark mass. Although I am not able to give further informations of this larva I have thought it practical to publish these scarce informations here in order to prevent a confusion with the larva of *Anellaria.*

Undetermined Chalcidid (?) in eggs of Rhynchites betulae.

During my investigations of the larva of *Ophioneurus* I several times found, in Frerslev and Rude Forests (North

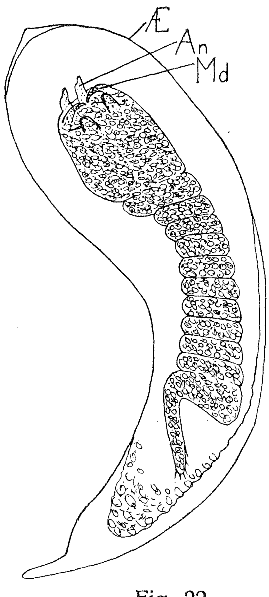

Fig. 22.

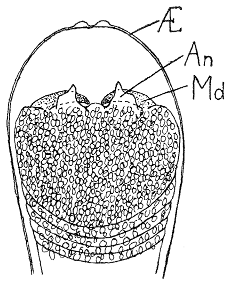

Fig. 23.

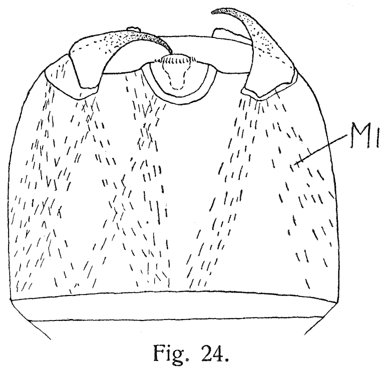

Fig. 24.

Undetermined Chalcidid (?) in eggs of Rhynchites betulae.

Fig 22. Chalcidid egg with embryo; this latter in oblique lateral view, × 188. Fig. 23. Anterior end of the same; oblique frontal view of head of embryonic larva, × 188. Fig. 24. Ventral view of head of embryonic larva, × 341.

Sealand), a larva (possibly of a Chalcidid) in eggs of *Rhynchites*. I did not succeed in bringing this larva beyond its first instar, although in one instance I kept it alive from June 5th, 1927 to June 28th, 1927 and in another case from June 24th, 1928 to July 5th, 1928. It seems to be the larva of a species with one generation a year. In fig. 22 the larva is seen still to lie in the egg shell, which shows a pedicel. On the larva are seen a flat anterior part, composed of the head and probably some thoracical segments, and a narrower abdominal region consisting of 10 segments and an additional larger terminal segment with caudal appendage. The head (figs. 23—24) has two powerful mandibles and above these two gibbous processes, the antennae. On the under side there are two processes whose nature is doubtful. The head is strongly chitinised, and powerful muscles are perceptible in it. On the body are seen some groups of short bristles, which are arranged segmentally; the finger-shaped caudal appendage has some bristles at the tip. The larva does not seem to cause a so quick destruction of the embryo of *Rhynchites betulae* as the larva of *Ophioneurus*, at any rate the beetle-embryo was observed to be alive for a long time while the parasite was active in the head end of it. The larva moves vivaciously; its motions are jerky and winding; the mandibles and the antennae are seen moving. However, during the motions the larva remains nearly on the same spot.

Mymaridae.

Alaptus minimus (Haliday) Walker.

Besides *Alaptus minimus* (Hal.) Walker (1846)—which species is treated here—I reared on June 12th, 1926 a bigger species, *Alaptus fusculus* (Hal.) Walker, from Psocid eggs, which were deposited as dark crusts on branches of *Alnus glutinosa*, and collected on March 28th, 1926 at Kobberdammene (North Sealand). This species has a stout, projecting ovipositor, issuing from the base of the abdomen (fig. 27), whereas that of *A. minimus* (fig. 25) is short and slender and issues from the middle of the abdomen. *Alaptus excisus* Westwood (1879) is no doubt

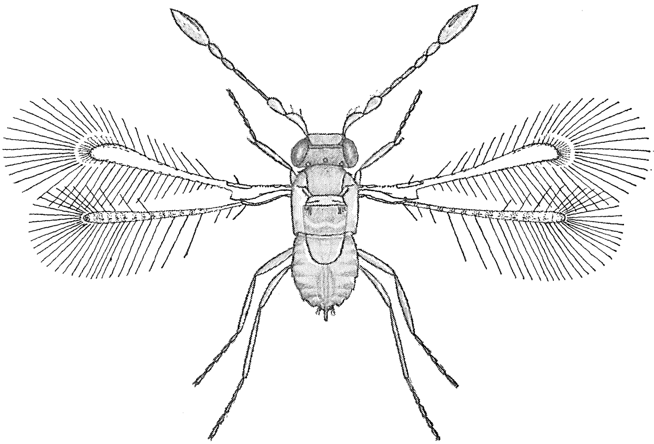

Fig. 25. *Alaptus minimus* (Haliday) Walker.
Female. × 60.

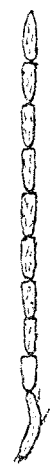

Fig. 26.
Alaptus minimus (Hal.) Walk.
Antenna of male. × 60.

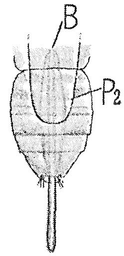

Fig. 27.
Alaptus fusculus (Hal.) Walk.
Abdomen with ovipositor. × 60.

identical with *minimus*, as the character, pointed out by Westwood, namely the shape of the wing base, may be supposed to be common to all species of the genus. The "white blotches" on oakleaves, from which, by Westwood's authority, it is stated to have been bred, have undoubtedly been Psocid eggs, and it must be owing to a mistake, when he connects it with certain lepidopterous leaf-miners. Förster (1856) mentions a species, *pallidicornis,* which is hardly sufficiently characterised. The description of *Alaptus fuscus* Förster (1861) is unknown to me. Enock, who in "Knowledge" 1897 pp. 203—205 gives some informations on Mymarids, has reared *Alaptus* from eggs of *Stenopsocus cruciatus* and mentions the egg-laying; it appears to me to require confirmation that this species should penetrate below the web of the host-eggs for depositing its eggs.

Development.

In one case I followed this species from its first larval instar to the imaginal stage. On December 26th, 1928 I took, at a shallow pool in Dyrehaven, a portion of Psocid eggs on a leaf of reed-grass, *Baldingera arundinacea.* On January 9th, 1929 the eggs were examined with the result that each of 3 of them contained one larva; two of the larvae were taken out for drawing purpose and the third one was set aside for being bred. Fig. 28 shows the larva, which is perhaps still lying in its egg-shell; its body presents a division in 3 parts. The head part is tapering somewhat but is of an irregular shape. In the orifice of the mouth two bright mandibles are seen, which are arranged like those of the larvae of *Lymaenon* and *Ooctonus*, of which this larva reminds. The median part of the body is somewhat fusiform and the wall of the body consists of big cells. No stomach was observable and nothing of the contents of the egg seemed to have been absorbed. Some lines posteriorly may no doubt be interpreted as the proctodaeum. The caudal part is dilated proximally by some bigger cells, which lie in continuation of those along the wall of the body, whereas its extreme end is thinner and devoid of cells.

On January 19th, 1929 the larva had increased so much in size as to fill up the host egg. Although no moult was observed, this, however, has most likely taken place. The larva, which now tumbles about vivaciously, seems to be of the usual type characteristic of the second instar with plenty of segmental muscles and a consequent movability, whereas the preceding form of the larva, especially with reference to the mandibles, seems to be of the type characteristic of the first instar. Mandibles could not be seen in the second instar, nor could salivary glands be discerned, whereas light imaginal buds were seen to have arisen.

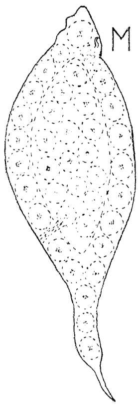

Fig. 28. *Alaptus minimus* (Hal.) Walk. First larval instar. × 188.

On January 24th, 1929 the larva still moved; it had evacuated excrements, which appeared as a dark transversal streak across the posterior part of the larva, the median part of which was pressed against the egg-shell (fig. 29); by incident light the streak looked whitish (fig. 30). Fat cells commenced to arise. Fig. 31 shows the head of a larva at an advanced stage of development; it has clear, yellow fat-cells, arranged in groups, and a neck-like constriction behind the head.

On February 8th, 1929 the pupa was seen to have been foreshadowed.

On March 7th, 1929 the imago was foreshadowed within the pupal integument. The yellow fat-cells commenced to disappear; amongst others 3 longitudinal streaks on the thorax and transverse streaks on the abdomen were seen. On March 12th the eyes could be recognised; they were faintly reddish; on March 22nd the eyes had become deep red and the fat-cells were hardly perceptible. On March 27th the imago commenced to move; its wings were bent at the subcosta, and the marginal setae of the wings vere bent down at base. On April 2nd the imago was ready to emerge; it moved its head and legs; unfortunately the animal was crushed under the cover glass. There was, however, no doubt that it was *Alaptus minimus*.

Host.

Alaptus minimus develops in different species of Psocid host-eggs; these are deposited by groups, each group covered by a small, white web and laid on leaves of different plants (see below); in one instance the imago was bred and proved to be *Pterodela pedicularia* L.

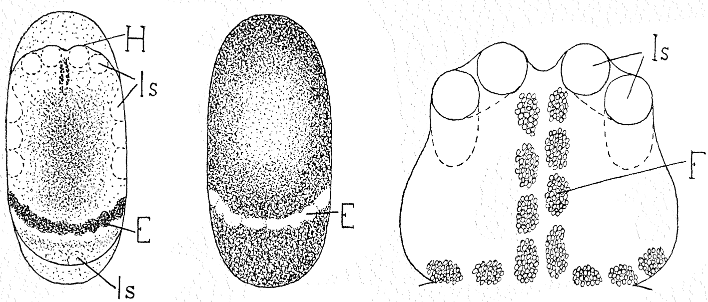

Fig. 29. Fig. 30. Fig. 31.

Alaptus minimus (Hal.) Walk.

Fig. 29. Psocid egg containing the second larval instar, × 60. Fig. 30. The same, viewed by incident light, × 60. Fig. 31. Head of second larval instar, dorsal view, × 188.

Cycle.

The number of generations a year in *Alaptus* does not appear with certainty from the investigations. The species hibernates and is bred from fallen leaves containing Psocid eggs (breedings nos. 1 and 2); as will appear from breeding no. 5 the eggs are probably stung while the leaves were sitting on the tree. As it is also bred during summer from eggs on the green leaves (breedings nos. 3 and 4), it must have at least two generations a year. On the other hand the long development of the larva does not indicate several generations, but there may be several stocks as in *Polynema ovulorum*.

Breedings.

No. 1. On April 13th, 1924 Psocid eggs were taken on fallen oak-leaves in the enclosure of Fortunen (Dyrehaven).

On May 5th Psocids hatched.

On June 1st 2 Alaptus (1 male, 1 female) emerged.

No. 2. On April 20th, 1924 Psocid eggs were taken on fallen beech-leaves at Søllerød Lake.

On May 5th Psocids hatched.

On June 1st 2 Alaptus (1 male, 1 female) emerged.

No. 3. On July 21st, 1924 Psocid eggs were taken on fallen oak-leaves in the enclosure of Fortunen.

On July 24th Psocids hatched.

On July 29th 5 Alaptus (1 male, 4 females) emerged.

On July 30th 1 Alaptus (female) emerged.

Total outcome of Alaptus: 1 male and 5 females.

No. 4. On August 31st, 1924 Psocid eggs were taken on oak-leaves in the enclosure of Fortunen.

On September 22nd 7 Alaptus (1 male, 6 females) emerged.

On September 23rd 4 Alaptus (1 male, 3 females) emerged.

On September 26th 1 Alaptus (female) emerged.

On September 28th 2 Alaptus (females) emerged.

Total outcome of Alaptus: 2 males and 12 females.

No. 5. On February 8th, 1925 Psocid eggs were taken on dead oak-leaves, still sitting on the tree, at The Eremitage Plain (Dyrehaven).

On February 22nd Psocid (*Pterodela pedicularia* L.) hatched.

On March 15th 19 Alaptus (13 males, 6 females) emerged.

On March 16th 3 Alaptus (males) emerged.

On March 17th 5 Alaptus (males) emerged.

On March 18th 6 Alaptus (males) emerged.
On March 20th 3 Alaptus (males) emerged.
On March 26th 1 Alaptus (male) emerged.
Total outcome of Alaptus: 31 males and 6 females.

No. 6. On August 27th, 1925 Psocid eggs were taken on *Archangelica sativa* at Karensby in Møen.
From September 14th to 16th 7 Alaptus (females) emerged.

No. 7. On December 26th, 1928 Psocid eggs were taken taken on a leaf of *Baldingera arundinacea* at a shallow pool in Dyrehaven.
On April 2nd, 1929 1 Alaptus ready to emerge.

Alaptus minimus is generally swept on grass-grown forest-ground, but seems not to occur on the open ground. It is known from Denmark, Germany and England.

Lymaenon effusi n. sp.

This new species may be characterised in the following way:

Lymaenon effusi n. sp.

Female. Body brownish with paler base of abdomen. Eyes dark. Legs brownish with paler knees and trochanters. Antennae brownish, the long radicle and pedicel paler. Club and terminal joint of funicle provided with sensory lists. Regarding the proportions of length vide figs. 32—33. Length of body 0,85 mm. The ovipositor (fig. 34) is rather slender, length 0,26 mm, and does not reach the base of the abdomen.

This Mymarid is closely related to *Lymaenon litoralis* Hal., but appears to be distinguished by a shorter club.

Development.

I reared this species from some eggs of the Cicadellid *Acocephalus*, found in *Juncus effusus*, on December 26th, 1928 at a shallow pool in Dyrehaven, and was successful in following its development from the first larval instar to the emerging of a female on May 16th, 1929. On April 10th, 1929 a larva in its first instar (fig. 35) was taken out of an egg; it was still alive, but its development was hardly started. Concerning this instar reference is made to the description under *Ooctonus heterotomus*, as I did not ascertain any essential difference from the latter, except that the caudal appendage appears not to be geniculate in *Lymaenon*.

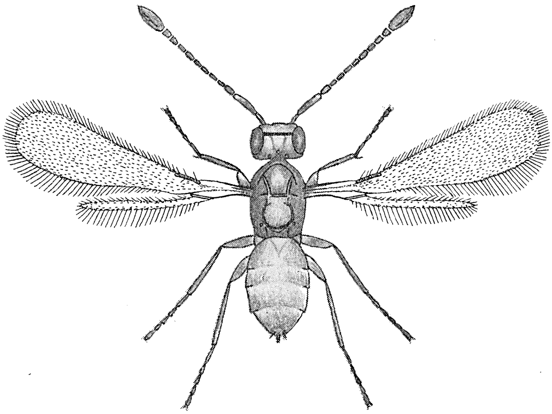

Fig. 32. *Lymaenon effusi* n. sp.
Female, × 30.

Some dates from the first breeding are set forth in the following. On December 26th, 1928 host-eggs were collected; on January 7th, 1929 a brighter blotch was seen in the contents of the eggs, a larva was seen to move; a yolk sphere, being about to be swallowed, flickered to and fro in a characteristic manner; on January 19th the large mouth with the mandibles and on February 13th the frontal process were seen; on March 30th the larva had increased in size, but was now motionless; on April 4th it was still motionless and a streak of yellowish, slightly developed fat-cells were seen; on April 8th the larva nearly filled up the egg and moved slightly; under magnifying powers the small fat cells were seen to be distinctly yellow; the two close-sitting mandibles and imaginal disks were seen and in addition some quite minute cells of the same type as particularly mentioned in a sub-

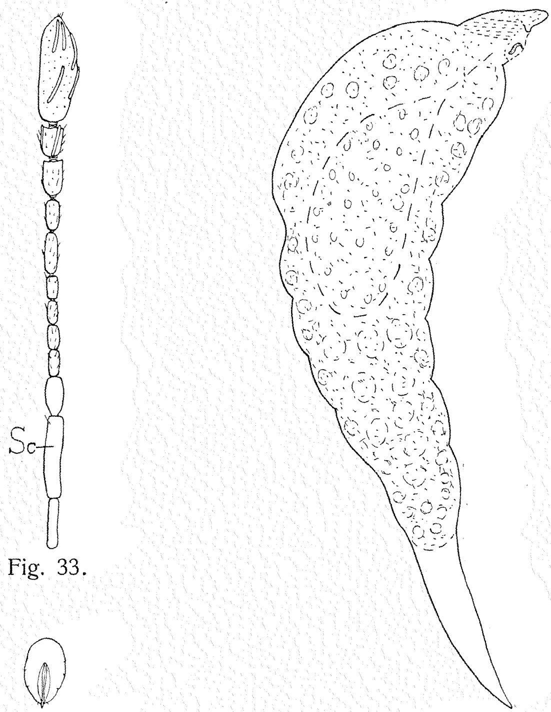

Fig. 33.

Fig. 34.

Fig. 35.

Lymaenon effusi n. sp.

Fig. 33. Antenna of female, × 94. Fig. 34. Abdomen of female, ventral view, × 20. Fig. 35. First larval instar, × 188.

sequent chapter where these have been shown to contain microorganisms, which may be supposed to play a symbiotic part; the larva was now in its second instar; on April 13th the fat cells were deeply yellow, the fluid faintly yellow; laterally a pair of long, clear spots (salivary glands) were seen; on April 15th the "symbiotic" cells were distinct and dark (by incident light they looked light yellow); on April 21st the mandibles were seen; on April 22nd moulting took place and remains of the cuticle were seen at the apex of the abdomen; on April 28th the whole of the egg was deep yellow, and the imago was foreshadowed within the pupal integument; the wing buds were seen; on May 3rd the eyes were red and the fat-cells had almost disappeared; on May 11th moulting had taken place and the imago was free; on May 13th the space round the imago was no more yellow; on May 14th there was air in the tracheae; on May 16th, 1929 a female emerged from the host egg.

In the two cases, when I followed the development of the first instar, more than 3 months passed before the first moulting; the fact that the larvae were kept in a room or perhaps other circumstances may have caused a lengthening of the normal time, which just as in *Ooctonus* ought rather be calculated at 5 or 6 weeks besides the hibernation.

After the first moult the larva assumes its s e c o n d i n s t a r, which only by degrees becomes different from the larva of *Ooctonus*. It grows so as to fill up the egg at last (fig. 36); a dense layer of small, yellow fat-cells arises, filling up the space everywhere between the imaginal disks. Somewhat later the "symbiotic" cells, mentioned later on, appear. The position of the two mandibles, fig. 37, is peculiar; they are situated close together beneath the mouth, which is situated at the tip of the head, and some way down on the under side I observed a crescentshaped figure, which I suppose to be the orifice of the salivary duct. The larva tumbles vivaciously in the remaining fluid, which commences to get yellowish. The fat-cells grow and assume a deep yellow colour; the stomach with the rather big "symbiotic" cells, which now look pale by incident light, has sunk farther down in the abdomen and the pupa is foreshadowed (fig. 38). The fluid round the larva is now deep yellow.

A moult takes place about 3 weeks after the preceding one, and the pupa is released. Remains of the cast cut-

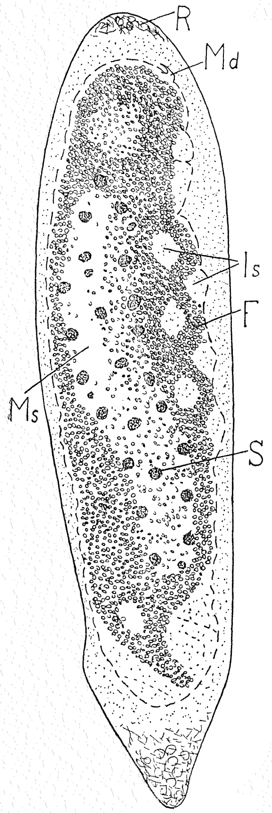

Fig. 36.

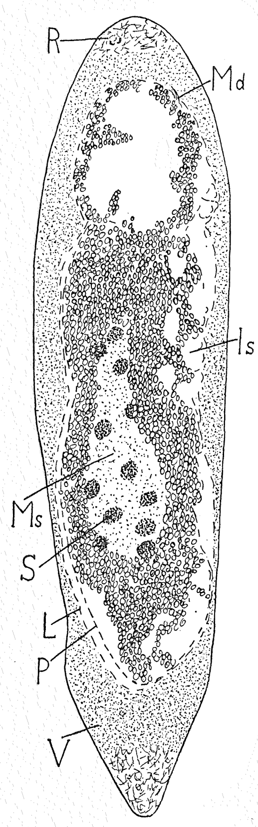

Fig. 38.

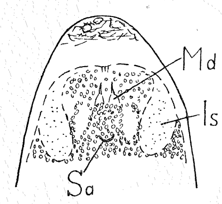

Fig. 37.

Lymaenon effusi n. sp.

Fig 36. Second larval instar in egg of Acocephalus, × 60. Fig. 37. Head of second larval instar; ventral view; **Is**, marginal disks of antenna, × 60. Fig. 38. Pupal "anlage" in host egg, × 60.

icle are seen at the apex of the abdomen of the pupa, and the imago now appears to be foreshadowed within the pupal integument. Simultaneously the "symbiotic" cells disappear rather quickly, and the fluid round the pupa gets still darker yellow (fig. 39). The imago now commences to be chitinised, eyes and ocelli assume a red

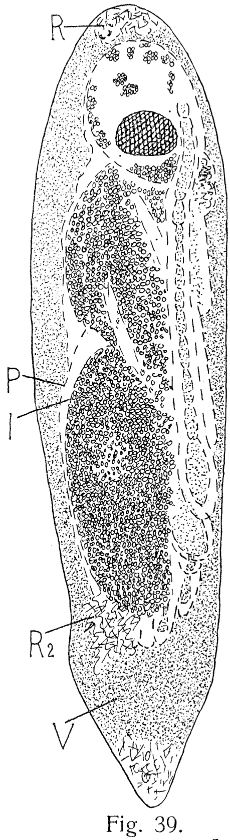

Fig. 39.

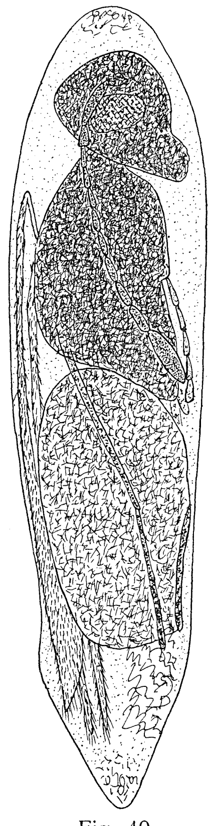

Fig. 40.

Lymaenon effusi n. sp.

Fig. 39. Imago in the pupal cuticle within the host egg, × 60. Fig. 40. Imago lying detached in the host egg, × 60.

colour and after about 3 weeks a moult takes place, after which the i m a g o lies detached in the egg (fig. 40). The yellow fluid disappears—dries up—, air enters the tracheae, and after a few days the imago forces its way out of the egg.

Cycle and host.

The long larval development implies, that there is probably only one generation a year. On account of the scarcity of the material it cannot be ascertained, whether there might be several stocks.

Lymaenon effusi develops in eggs of the Cicadellid *Acocephalus sp.*, deposited in stems of *Juncus effusus* (figs. 139, 164 J.).

Lymaenon sulphuripes Förster.

On January 15th, 1928, 6 eggs were collected at a

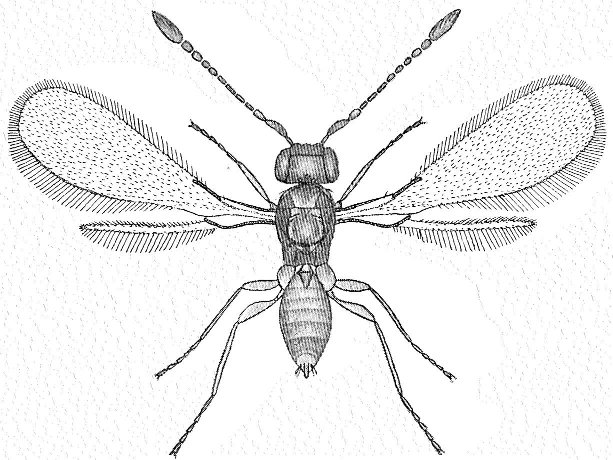

Fig. 41. *Lymaenon sulphuripes* Förster.
Female, × 30.

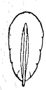

Fig. 43.
Lymaenon sulphuripes Förster.

Fig. 42. Antenna of male, × 30. Fig. 43. Abdomen of female, ventral view, × 20.

Fig. 42.

shallow pool in Dyrehaven; on January 23rd each of the eggs contained one *Lymaenon*-larva in its second instar. From February 26th to 29th 4 males and 2 females of the present species emerged (figs. 41—43).

The larval development seems to be like that described of *Lymaenon effusi* above and indicates one generation a year.

Lymaenon sulphuripes develops in eggs on *Baldingera arundinacea*, probably deposited by a heteropterous insect (fig. 160).

Lymaenon tremulae n. sp.

This new species may be characterised in the following way:

Lymaenon tremulae n. sp.

Body (fig. 44) blackish brown with paler sutures. Fore legs pale with darker terminal joint and femora. Intermediate and hind legs dark with paler trochanters, knees and tarsi; terminal joint of tarsi darker. Antennae of female (fig. 45) darkish brown with blackish brown scape.

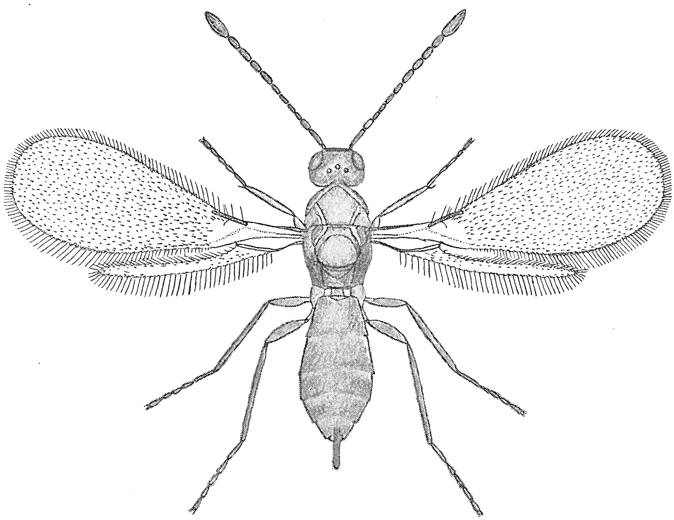

Fig. 44. *Lymaenon tremulae* n. sp.
Female, × 30.

Club and terminal joint of funicle with sensory lists. Antennae of male (figs. 46—47) have all joints of funicle provided with sensory lists. As to proportions of length cfr. the figures. The postphragma of the mesonotum extends to the posterior end of the thorax and terminates broadly with obtuse angles laterally. Length of body in female 1,3 mm., in male 1 mm. The ovipositor of the fe-

Fig. 45.

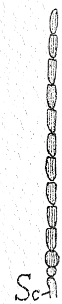

Fig. 46.

Fig. 47.

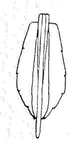

Fig. 48.

Lymaenon tremulae n. sp.

Fig. 45. Antenna of female, × 188. Fig. 46. Antenna of male, × 130. Fig. 47. Apex of antenna of male, × 188. Fig. 48. Abdomen of female, ventral view, × 20.

male (fig. 48) projects as much as 0,1 mm. behind the apex of abdomen; its entire length is 0,75 mm. and cephalad it may extend to under the petiole.

This rather big species seems to remind of *Oophilus* Enock, which latter, I suppose, has wrongly been considered a separate genus. However, *Oophilus*, which may be swept in the same locality in which *Lymaenon* occurs (J. P. Kryger), is easily distinguished by its size, the long, slender abdomen of the female, and the length of the antennal joints.

Breeding.

On August 29th, 1929 in the enclosure of Fortunen, I took some branches of aspen, *Populus tremula*, with eggs of *Idiocerus populi*, from which the breeding specified below took place; this breeding is a supplement to that mentioned under *Polynema atratus**)

On August 30th, 1929 1 Lymaenon tremulae (female) emerged.

On August 31st, 1929 5 Lymaenon tremulae (females) emerged.

On September 2nd, 1929 9 Lymaenon tremulae (females) emerged.

On September 3rd, 1929 3 Lymaenon tremulae (females) emerged.

As no further individuals emerged between September 3rd and 10th, 1929, the breeding was considered as concluded; total outcome of *Lymaenon tremulae* 18 females (besides 1 male and 2 females breeded previously).

Development, cycle, and host.

As regards the larval development I may state that on October 11th, 1928 and on January 20th, 1929 I found a larva in its first instar and on May 26th, 1929 and June 17th, 1929 larvae in their second instar with "symbiotic" cells and yellow fat-cells. The development does not appear to differ essentially from that described under *Lymaenon effusi.*

The breeding mentioned above indicates one generation a year.

Concerning the host (*Idiocerus populi*) reference is made to the statement set forth under *Polynema euchariformis*, where a specification is given of the breedings (on August 27th, 31st and September 2nd) of some females, which I consider to belong to this species, although

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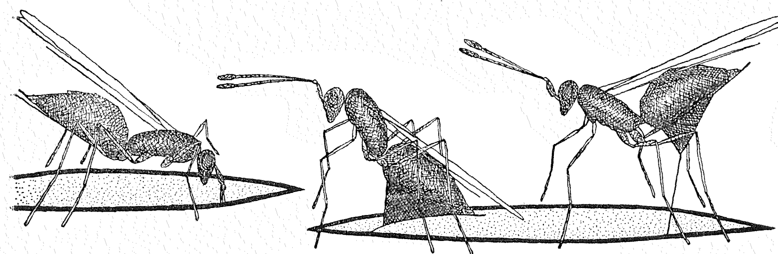
*) In this latter breeding 1 male *Lymaenon tremulae* was reared on August 16th, 1 female on August 22nd, and 1 female on August 27th (cf. p. 69).

they are bred from eggs of *Idiocerus confusus* on *Salix cinerea*.

O v i p o s i t i o n.

On September 19th, 1928 I had an opportunity to observe the egglaying of *Lymaenon tremulae* on branches of aspen with eggs of *Idiocerus* (fig. 49). At first the animal examines the crack, in which the eggs of *Idiocerus* are laid, with its antennae; these are moved tentatively, in a playing manner, far down in the crack, so that the head of the animal is almost concealed; subsequently it



49. *Lymaenon tremulae* n. sp.
3 females during oviposition, × 20.

advances a little, sinking its ovipositor at an angle to the underlying surface down in the crack, even leading it farther onward so as to cause it to point entirely forward and simultaneously stinging the eggs, which action lasts about one minute or sometimes several minutes; the sting is carried so far down that the abdomen disappears in the crack; it is not carried into its original position between the borings, and, as shown in the figure, it is situated beneath some of the anterior segments, which are therefore brought along in a dilated condition.

Lymaenon sp.

On December 18th, 1927 and on June 5th, 1928 at Ryget in indeterminable eggs from *Salix pentandra* I found a larva in its second instar, which on account of the presence of "symbiotic" cells and yellow fat-cells is referred to this genus.

Besides, in 9 instances in the same kind of eggs I found during winter larvae of the *Lymaenon-Ooctonus* type in their first instar.

Ooctonus heterotomus Förster.

The genus *Ooctonus* is a close relative of the genus *Lymaenon*, but it is distinguished by having a long abdominal petiole. However, in the first larval instar *Ooctonus* is hardly to be discriminated from *Lymaenon*, which fact confirms the relationship of the two genera. But in the second larval instar the larvae of the two genera are well distinguished. In the imaginal stage the relationship is conspicuous especially as to the wings. On account of the short petiole of the abdomen *Lymaenon* is apparently to be considered the primitive type.

Development.

Only in two instances I succeeded in following the species *O. heterotomus* from its first larval instar to the emergence of the imago (figs. 50—52). Two (hemipterous?) eggs of a series, taken on December 26th, 1928 under the sheathing leaf of *Baldingera arundinacea* at a shallow pool in Dyrehaven, were examined on January 6th, 1929 and the larva in the eggs was identified by means of the vesicular stomach, which could be traced through the thick shell of the yellow eggs. On March 30th a male came out, which, however, was drowned during the emergence, and on April 25th, 1929 another male emerged.

From one of the breedings some dates are set forth in the following. On January 19th the larva is seen to move in a wriggling manner; the wide mouth with the mandibles is seen and a yolk sphere is sucked to and fro at the orifice of the mouth; on February 12th the larva is seen to swallow yolk spheres, which apparently is caused by the larva being moved, as it occurred when the eggs was rolled and light simultaneously was thrown on it; the larva swallows a yolk sphere a second; on February 19th it is motionless, on March 4th it fills up the egg and has imaginal disks, white fat-cells and a yellow stomach with bright spots; it is accordingly in its second instar; on March 16th the pupa is foreshadowed and the stomach extends into the thorax; on March 22th the

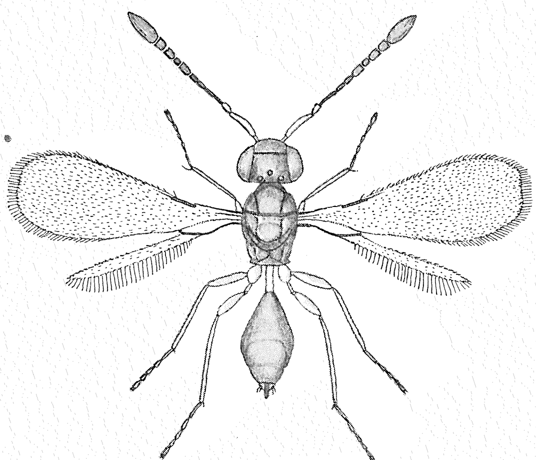


Fig. 51.

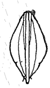


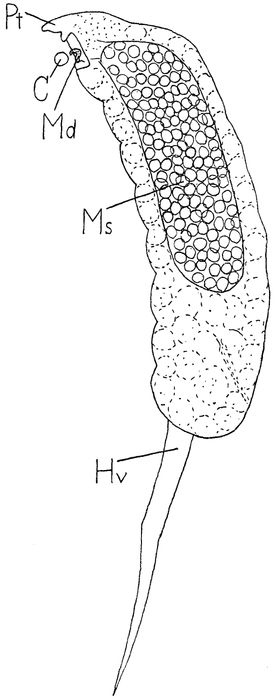
Fig. 50. Fig. 52.

Ooctonus heterotomus Förster.

Fig. 50. Female, × 30. Fig. 51. Antenna of male, × 30. Fig. 52. Abdomen of female, ventral view, × 20.

pupa is seen lying within the larval integument; on March 24th the pupa is free; on March 25th the imago is foreshadowed and the blotches in the stomach become merged; on April 13th the wing-buds are seen; on April 15th the imago is free, the wings are free, and the animal moves energetically; on April 25th a male of *Ooctonus heterotomus* emerged.

Larvae in their first instar were taken out of a few of the host eggs (fig. 53). They have a cephalic part, a segmented body and a caudal appendage. The head is provided with a minute, rather strongly chitinised frontal process and is characterised by its wide, round mouth (fig. 54) with two mandibles, which are moved alternately towards each other; the wide orifice of the



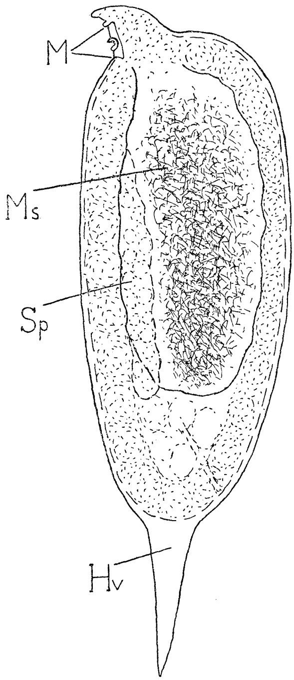


Fig. 53. Fig. 54. Fig. 55.

Ooctonus heterotomus Förster.

Fig. 53. First larval instar; Ms, stomach with contents of undissolved yolk spheres; C, yolk sphere at the orifice of the mouth, $\times$ 188. Fig. 54. The same; orifice of mouth with mandibles, $\times$ 188. Fig. 55. The same, close upon the moult; Ms, stomach with contents of dissolved cells, $\times$ 188.

mouth enables the larva to swallow the big yolk spheres to which the stomach owes its characteristic appearance. The body consists of 7 hairless segments, which at first continue evenly into the caudal outgrowth, and are recognised when the stomach is filled as shown in the figure (fig. 53); the segmentation, however, soon becomes evanescent. The caudal appendage is devoid of spines and is slightly geniculate. The characteristic wriggling and boring motions of the larva implies that it has oblique segmentally arranged muscles. As mentioned above it is peculiar to this instar that a big yolk sphere is seen to be moved to and fro at the orifice of the mouth. As will appear from the description of the larva, it differs in many respects from the larva of *Polynema* and may rather easily be distinguished from the latter, even if only a small part of the larva is to be seen in the contents of the egg. Gradually as the larva fills its stomach and the digestion proceeds, it swells and gets motionless (fig. 55). The swallowing motions are continued longest. The salivary glands are faintly seen to be foreshadowed.

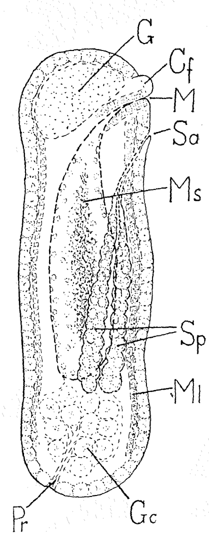


Fig. 56. *Ooctonus heterotomus* Förster. Second larval instar, × 80

Fig. 57. The same. Mandible, × 188.

After about 5 to 6 weeks' development, exclusive of the hibernation, the larva again begins to move, a moult takes place and the larva is transformed into its s e c o n d i n s t a r (fig. 56). The cast cuticle remains often just as in *Polynema* attached at the proctodaeum. Immediately after the moulting it may rather easily be mistaken for the corresponding instar of the larva of Polynema, because the distinguishing characters, typical of the second instar, are not yet developed; though the frontal outgrowth of the second instar is cast, as it were, inside the frontal process of the first instar, it swells after the moulting so as to become finger-shaped, because in contrast to the first instar it is covered with soft integument (cfr. *Polynema*). The body is cylindrical but may be divided into 3 parts: a cephalic part with the process above the mouth, a median part containing the stomach, round which fat-cells appear to be foreshadowed, and a posterior part in which the proctodaeum and the sex-cells are seen; below the mouth is the orifice of the joint duct of the paired salivary glands, which extend as far back as the stomach and are situated below the same. The segmentation of the larva is not defined, but most likely the usual 13 segments in addition to the head are represented; segmental muscles are present. The mandibles, which are exceedingly minute and pale, could not be traced until at a later developmental stage; they are placed far from each other on a level with the second pair of imaginal disks.

In 12 instances I followed the development of this larval instar until the appearance of the imago, and I bred 7 males and 5 females. Through these breedings I learned that the larva, which at first is small enough to take up a transverse position in the egg, in the course of a week sucks the contents of the egg so as to fill up the egg entirely (fig. 58). The yellow colour of the egg is now concentrated in the contents of the stomach of the larva, and its fat-cells are distinctly seen to be white and clear; they are distributed in an inner layer closely round the stomach and an outer one close to the imaginal disks, which are now being foreshadowed and whose position is thus marked out. In the wall of the stomach a number of peculiar blotches are foreshadowed which form protuberances projecting slightly into the body-cavity. A dissection of the larva shows that each blotch is a single cell the contents of which are more or less abundant corresponding to the age of the larva. These „symbiotic“ cells are treated later on p. 85.

Shortly the larva of *Ooctonus,* which hitherto has tumbled unquietly in the egg, commences to stop its movements; however, the peristaltic constrictions of its stomach are continued for a long while. The above mentioned "symbiotic" cells grow and obtain their character-

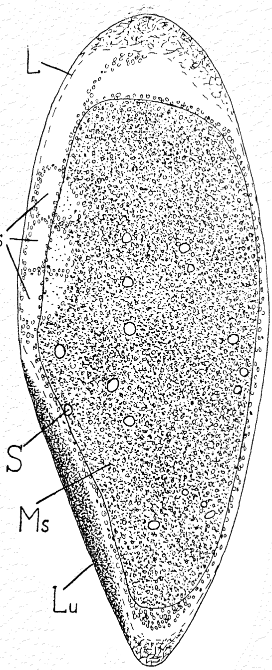


Fig. 58.

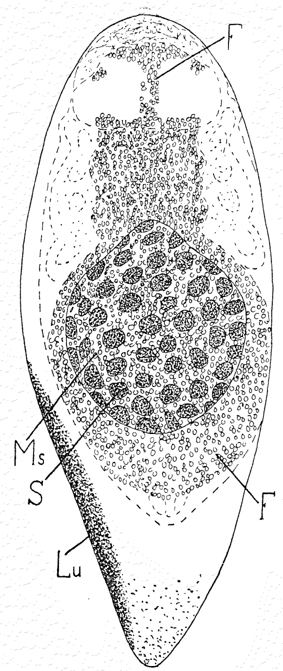


Fig. 59.

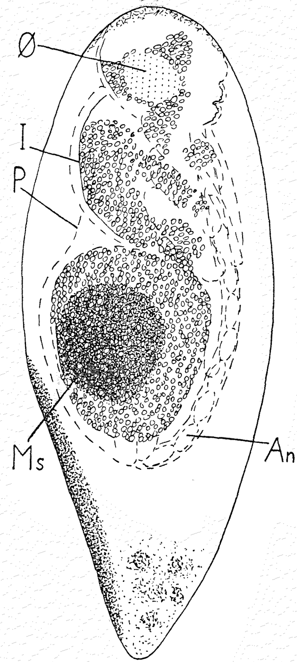


Fig. 60.

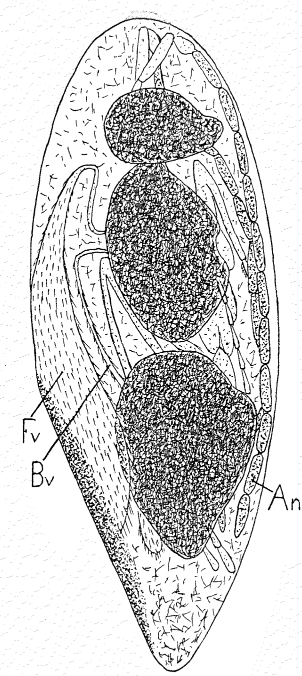


Fig. 61.

Ooctonus heterotomus Förster.

Fig. 58. Host egg with second larval instar, Fig. 59, with pupa (dorsal view), **Fig. 60,** with **foreshadowed imago in the pupa, Fig. 61,** with **male imago** detached, **× 60.**

istic appearance of dark blotches, which by incident light are light yellow and subsequently reddish yellow.

Gradually as the fat-cells and the symbiotic cells increase in size, the stomach is diminished and the pupa is being foreshadowed (fig. 59) about one month after the moult. The closed stomach is now withdrawn to the abdomen, and the "symbiotic" cells appear deep reddish yellow by incident light. After a week the pupal instar is reached, but I was not able to ascertain the moulting; now the imago is seen to be foreshadowed within the pupal integument (fig. 60). The "symbiotic" cells have now joined, forming an extensive reddish yellow blotch within the abdomen. Also when viewed by the aid of a lens the egg appears whitish with a reddish yellow blotch. In the male the long antennae are bent closely round the apex of the abdomen. Reddish "anlages" of eyes, ocelli and mandibles appear; the fat-cells, which gradually disappear, are arranged amongst others in 3 longitudinal streaks on the thorax, and the chitinising commences; the bright vertex is chitinised at last. The wings are seen like sacs down along the body. After a fortnight the imago commences to move and ruptures the pupal integument, the tracheae are filled with air, and the wings, legs and antennae get free (fig. 61). The wings lie bent at the faint point where the subcostal and the marginal veins meet. The host-egg assumes a somewhat cloudy appearance, and in some cases it looks as if the reddish yellow lump of "symbiotic" cells constituting the excrements are evacuated and lie at the apex of the abdomen, whereas in other cases the imago emerges without having expelled excrements. After a period, generally a fortnight, but sometimes varying from one to three weeks, the imago gnaws its way out.

Copulation.

On April 26th I observed the copulation of two recently emerged specimens of *Ooctonus.* The copulation did not take place until after the male had been fed with sugared water. The male, which for an hour had not taken notice of the female, now stopped with strongly vibrating antennae and made preparations for the copulation. Standing on the back of the female he commenced in a peculiar manner to beat her with his antennae and abdomen in a slow rhythm, the number of beats being three a second. After one quarter of a minute the male made himself slide backwards so as to enable the act of copulation to take place; during the same, which lasted half a minute, the male had his dorsal side placed against the underlying surface; his antennae were raised straight up, and his wings trailed backward. At the end of the copulation the male was again beating the female in the same slow rhythm as above mentioned. The whole process, including the preparations, lasted one minute.

Host.

The host-egg—which probably are heteropterous eggs—are found hidden below the sheathing leafs of reed-grass, *Baldingera arundinacea,* where they are cemented to the underlying surface in oblique rows (fig. 160).

On March 25th, 1928 at a shallow pool in Dyrehaven, I found a larva in its second instar, which on account of the presence of "symbiotic" cells and white fat-cells may be referred to the genus *Ooctonus.* In this case the host eggs originated from an *Acocephalus* (fig. 139).

Cycle.

The 12 breedings which are mentioned above all exhibit a larva in its first instar, being about to hibernate. The long time of the larval development, about 3 months exclusive of the time of hibernation, seems to show that there is only one generation a year, whereas the material is too small to show, whether in this case, too, there may be a question of several stocks. From June to during

October *Ooctonus* may be swept very common, especially in meadows in forests.

Stethynium triclavatum Enock.

This species was bred together with *Polynema pusillus* from twigs of *Salix pentandra,* taken in Ryget Forest on January 2nd, 1927; the host eggs were not found, but the host is possibly a Jassid (fig. 142). One male appeared on April 11th, 1927 and one female on April 16th, 1927. The species has hitherto only been found in England, where it was swept on July 28th by Kryger.

Erythmelus goochi Enock.

The female of the genus *Erythmelus* (fig. 62, female; fig. 63, male) is distinguished by having an additional sheath covering the ovipositor outside the ordinary one; the fact is that the base of the ovipositor is not exserted,

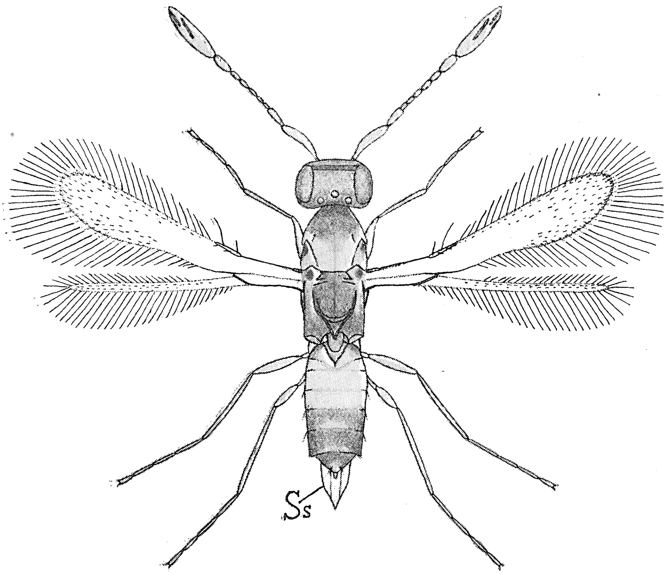


Fig. 62. *Erythmelus goochi* Enock.
Female, × 60. Ss, segmental sheath.

but has been concealed by one (or more) of the ventral segments, which have been shaped so as to form an additional envelopment of the ovipositor*).

Fig. 63. *Erythmelus goochi.* Antenna of male, × 60.

Development.

The number of eggs may be judged from the fact that a female, swept at Birkerød on July 27th, 1924, contained about 70 ovarioles. The ovarial eggs ready for laying were slender and each provided with a pedicel which was $1^1/_2$ times as long as the egg.

The earliest developmental stage of the larva has not been ascertained as such. I thought having found the larva in its first instar, but the larva in question turned out to belong to *Phanurus*, a Proctotrypid which is reared from the same

*) Considering the question of the systematic position of the *Mymaridae* and *Trichogrammidae* I want to draw attention to this type, in which the shape of the abdominal segments mentioned above may be interpreted as a variation of the well known ventral position of the ovipositor in these two groups and in the *Chalcididae*, whereas it can hardly be considered a variation of the "internal" ovipositor occurring in the *Proctotrypidae*. One might hypothetically imagine the differentiation of the last mentioned two groups to have taken place in the way that the base of the ovipositor, issuing as usually from the 8th segment, in the Proctrotrypids is pressed like a telescope into the abdomen, so that in this group such an extreme type as *Inostemma* has arisen in which the basal part of the ovipositor, enclosed in the abdomen, extends like a horn forward over the thorax, whereas in the Chalcidids the base of the ovipositor is pressed towards the under side and by displacing of the basis under a segment has given rise to a type like *Erythmelus*. In *Polynema euchariformis*, too, the ovipositor, which is rolled up in a spiral, is placed ventrally. Besides, in the proctrotrypid subfamily *Scelioninae* the venation of the wings seems to imply a closer relationship of this group to the *Chalcididae* than does that of the other proctotrypid subfamilies, which might indicate a heterogenous origin of the family *Proctotrypidae*.

kind of heteropterous eggs in *Urtica dioeca*, and later investigations were unsuccessful. Thus it is uncertain whether the larva has more than one instar.

The youngest larva (fig. 64) which I found is cylindric, the most characteristic feature of it is its waggling, sideways motions which are performed by powerful lateral segmentally arranged muscles. Laterally the cuticle exhibits segmental folds which allow of a great movability, especially at the middle. At this point of time these folds are clear, without any dark contents. Lateral to the mouth a pair of cuticular outgrowths are present, reminding of those of *Anagrus*, and above them are the powerful mandibles. The sub-mandibular position of the said outgrowths—which in *Anagrus* have been interpreted as antennae—makes against their interpretation as antennae; on comparing them with the larval types described by M a r c h a l I should rather consider them to represent the 1st pair of legs. The stomach is seen to have absorbed a small portion of the contents of the host-egg, and at the apex of the abdomen some bigger cells, the sex cells, are seen.

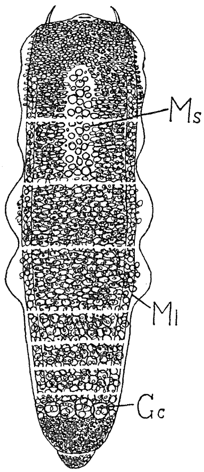


Fig. 64. *Erythmelus goochi* En.
Larval instar, × 80.

The succession of the segments is as follows: a rather big cephalic part, 3 median rather long segments, succeeded by 3 smaller ones, then the genital segment, and finally a small anal segment. The larva absorbs the contents of the host-egg so as to become saclike (fig. 65) on account of the filled and dilated stomach, which is yellowish and devoid of the "symbiotic" cells, characteristic of *Anagrus* and others; anteriorly powerful muscles of the mandibles are present, and the outgrowths below the mandibles are still visible (fig. 66). Clear, white fat-cells are foreshadowed. I followed the development of a single larva from April 9th, 1928 to June 11th, 1928, when a female emerged, proving that the larva in question belongs to *Erythmelus goochi.* Unfortunately I cannot

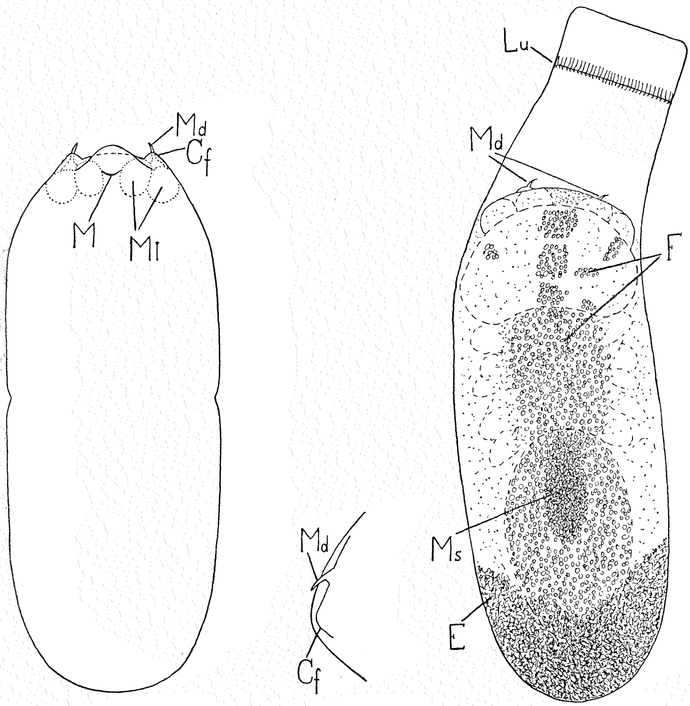


Fig. 65. Fig. 66. Fig 67.

Erythmelus goochi En.

Fig 65. Older larval instar, × 80. Fig. 66. The same; fore end, lateral view, × 80. Fig. 67. Larva with foreshadowed pupa in the host-egg, × 80.

give further informations as to the larva, for instance, of the salivary glands or the like, as I did not pay attention to these facts.

In fig. 67 the pupa is seen to be foreshadowed within the larva, whose mandibles are still in place at the frontal end, and the excrements are evacuated, lying at the apex of the abdomen like a dark calotte, which looks yellowish by incident light.

Copulation.

On June 18th, 1926 I had an opportunity of observing several copulations. The preparations go on quickly, and the male makes himself slide backwards from the back of the female so as to enable the copulation to take place, while, during 10 to 15 seconds, he is hanging with stretched antennae and the wings resting on the underlying surface.

Host.

Erythmelus goochi develops in heteropterous eggs, deposited in *Urtiça dioeca* (fig. 156).

Cycle.

The following breedings in connection with the results of sweepings indicate one generation a year; the occurrence of the species in the open is observed rather sporadically about the end of July. The abrupt culmination of breeding no. 5 was no doubt due to an especially hot breeding-place.

Breedings.

No. 1. On January 10th, 1926 heteropterous eggs were taken in Dyrehaven in nodes of *Urtica dioeca* and separated on moist filter paper.

From February 25th to March 3d	59 heteropterous larvae hatched
From April 25th to May 2nd	7 Phanurus emerged.
On April 18th	3 Erythmelus (females) emerged
On April 21st	5 Erythmelus (2 males, 3 females) emerged
On April 25th	5 Erythmelus (females) emerged
On April 26th	2 Erythmelus (females) emerged
On April 27th	5 Erythmelus (1 male, 4 females) emerged

On April 28th	3 Erythmelus (1 male, 2 females) emerged
On May 1st	10 Erythmelus (3 males, 7 females) emerged
On May 5th	2 Erythmelus (1 male, 1 female) emerged
On May 6th	4 Erythmelus (2 males, 2 females) emerged
On May 7th	4 Erythmelus (3 males, 1 female) emerged
On May 8th	2 Erythmelus (males) emerged
On May 11th	1 Erythmelus (female) emerged
On May 12th	1 Erythmelus (male) emerged
On May 13th	1 Erythmelus (male) emerged
On May 15th	1 Erythmelus (female) emerged
On May 16th	1 Erythmelus (male) emerged.

As no further individuals emerged between May 16th and June 15th, the breeding was considered as concluded, thus presenting a total outcome of *Erythmelus* of 18 males and 32 females.

No. 2. On January 24th, 1926 heteropterous eggs were taken at Springforbi in nodes of *Urtica dioeca*, the nodes were cut off and moistened during the breeding period.

On February 12th	10 heteropterous larvae hatched, and subsequently about 30.
On March 23rd	7 Erythmelus (females) emerged
On March 24th	2 Erythmelus (1 male, 1 female) emerged
On March 27th	8 Erythmelus (4 males, 4 females) emerged
On March 29th	3 Erythmelus (2 males, 1 female) emerged
On March 30th	2 Erythmelus (males) emerged
On March 31st	7 Erythmelus (5 males, 2 females) emerged
On April 6th	1 Erythmelus (male) emerged.

As no further individuals emerged between April 6th and May 14th, the breeding was considered as concluded, presenting a total outcome of *Erythmelus* of 15 males and 15 females.

No. 3. On January 24th, 1926 heteropterous eggs were taken in Dyrehaven from *Urtica dioeca* and separated on filter-paper.

On April 25th	5 Erythmelus (4 males, 1 female) emerged
On May 1st	2 Erythmelus (1 male, 1 female) emerged
On May 18th	3 Erythmelus (males) emerged.

No further individuals appeared between May 18th and June 7th, so the breeding was considered as concluded, presenting a total outcome of *Erythmelus* of 8 males and 2 females.

No. 4. On April 1st, 1926 heteropterous eggs were taken from nodes of *Urtica dioeca.*

From April 17th to May 1st	6 heteropterous larvae hatched
On May 31st	1 Phanurus (male) emerged
On May 28th	1 Erythmelus (male) emerged
On June 4th	1 Erythmelus (male) emerged
On June 5th	3 Erythmelus (2 males, 1 female) emerged
On June 7th	2 Erythmelus (females) emerged.

No further individuals emerged between June 7th and 19th, so the breeding was considered concluded, presenting a total outcome of *Erythmelus* of 4 males and 3 females.

No. 5. On April 1st, 1926 heteropterous eggs were taken in Dyrehaven in nodes of *Urtica dioeca.*

From April 17th to May 1st	56 heteropterous larvae hatched
From May 27th to June 1st	16 Phanurus emerged

On May 27th	4 Erythmelus (1 male, 3 females) emerged
On May 28th	3 Erythmelus (females) emerged
On May 29th	3 Erythmelus (1 male, 2 females) emerged
On June 1st	5 Erythmelus (1 male, 4 females) emerged
On June 2nd	6 Erythmelus (3 males, 3 females) emerged
On June 3rd	3 Erythmelus (females) emerged
On June 5th	73 Erythmelus (23 males, 50 females emerged.

No further individuals appeared between June 5th and 19th, so the breeding was considered as concluded, presenting a total outcome of *Erythmelus* of 29 males and 68 females.

No. 6. On May 2nd, 1926 heteropterous eggs were taken in the enclosure of Fortunen in nodes of *Urtica dioeca*.

From May 18th to 21st	14 heteropterous larvae hatched
On June 11th	1 Phanurus emerged
On June 9th	12 Erythmelus (6 males, 6 females) emerged
On June 10th	13 Erythmelus (4 males, 9 females) emerged
On June 11th	19 Erythmelus (9 males, 10 females) emerged
On June 13th	8 Erythmelus (3 males, 5 females) emerged
On June 14th	23 Erythmelus (8 males, 15 females) emerged
On June 15th	5 Erythmelus (3 males, 2 females) emerged
On June 16th	4 Erythmelus (3 males, 1 female) emerged
On June 17th	3 Erythmelus (males) emerged

On June 18th	8 Erythmelus (4 males, 4 females) emerged
On June 19th	1 Erythmelus (male) emerged
On June 20th	5 Erythmelus (1 male, 4 females) emerged
On June 21st	4 Erythmelus (2 males, 2 females) emerged
On June 22nd	3 Erythmelus (2 males, 1 female) emerged
On June 23rd	5 Erythmelus (3 males, 2 females) emerged
On June 24th	2 Erythmelus (1 male, 1 female) emerged
On June 25th	7 Erythmelus (3 males, 4 females) emerged
On June 29th	2 Erythmelus (1 male, 1 female) emerged

No further individuals appeared between June 29th and July 24th, so the breeding was considered as concluded, presenting a total outcome of *Erythmelus* of 57 males and 67 females.

Sweepings.

Erythmelus goochi is swept as follows:

On July 21st, 1924	1 male,	3 females,	in Dyrehaven
On July 27th, 1924		3 females,	in Rude Forest
On August 5th, 1924	1 male,	1 female,	at Langbjerg in the isle of Møen.
On August 7th, 1924		2 females,	—
On August 11th, 1924		1 female,	—
On July 26th, 1927		2 females,	at Skovrød Pond in Rude Forest
On July 29th, 1927		3 females,	in Dyrehaven
On August 5th, 1927		2 females,	at Rø in the isle of Bornholm
On August 6th, 1927		1 female,	at Randkløve in the isle of Bornh.
On August 8th, 1927	1 male,	1 female,	at Østerlars in the isle of Bornholm.

Erythmelus goochi is known from England and Denmark only. It is always swept in forests.

In the breeding-places in Dyrehaven I swept it together with its bigger relative, *Enaesius* Enock, which hardly ought to be referred to a separate genus. Both of them have the above mentioned segmental sheath, which is also known in the strongly deviating genus *Parallelaptera* Enock, but are distinguished from each other by many minute characteristics, for instance by the different length of the tarsi: these are in *Erythmelus* longer than the tibiae, whereas in *Enaesius* this character only applies to the anterior tarsi.

Anagrus incarnatus Haliday.

The genus *Anagrus* includes in my opinion only one species, viz. *incarnatus* Hal., and the species-names *subfuscus, brocheri* etc. are but synonyms to this (cf. Bakkendorf 1925).

Development.

I did not pay any closer attention to this species as regards the developmental facts, which are treated by Ganin (1869) and others. Ganin, however, mentions "eine besondere Erweiterung" of the gut in the apical segment of the larva in its 2nd instar. This dilatation is distinguished histologically from the gut by translucent smaller cells; at this stage of development the gut is as yet closed posteriorly.

Henriksen (1918) writes: "Tarmen er aaben bagtil", and like Ganin he specifies in his drawing a large dilatation behind.

Furthermore Ganin mentions that behind the mouth there is a horseshoe-formed figure, which Henriksen interprets as the orifice of the salivary duct, though he did not see this latter.

In order to investigate these features I took random samples and succeeded in finding larvae which had absorbed some portion of the contents of the host-egg and not yet digested the same; it was therefore easy from the undissolved yolk spheres to ascertain the outlines and extent of the stomach (fig. 68). In the living larva, which was taken out of the egg in a drop of water and deposited below a cover glass, the paired salivary glands were seen ventrally; they extended backward to the large

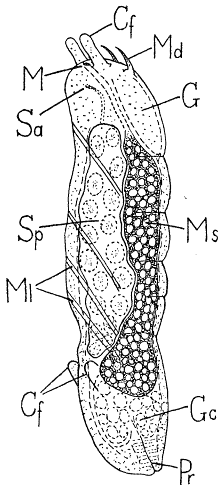


Fig. 68.

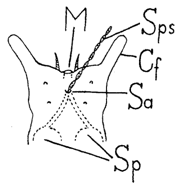


Fig. 69.

Anagrus incarnatus Hal.

Fig. 68. Second larval instar before the marking of the "symbiotic" cells; oblique lateral view; **Cf** cuticular processes of the cephalic and caudal parts, × 94. – Fig. 69. The same, the head end, ventral view, × 94.

apical segment of the larva. At this point of time the salivary glands were strongly dilated and therefore caused the stomach to be displaced towards the dorsal side and made it assume the shape of a rather narrow, irregular channel, which posteriorly had commenced to get dilated. When the larva moved, the contents of the stomach were seen to slide to and fro in the narrow median part of this. The stomach is closed posteriorly and touches a broad accumulation of cells, being no doubt the sex cells, and probably identical with the dilatation of the stomach mentioned by the authors cited above. At apex the proctodaeum is seen to be foreshadowed.

Another larva which was pressed with the cover glass was seen at intervals to emit saliva from the orifice of the salivary duct (fig. 69 Sps).

Further I have to mention the fat-cells, which in the 2nd instar assume a deep red colour and thus cause the red colour of the larva. Even Ganin mentions the red fat-cells which distinguish this larva from several others treated in this paper.

Finally it ought to be mentioned that "symbiotic" cells (figs. 70–72) are developed in the larva; these cells look dark by transmitted light and pale by incident light.

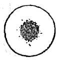


Fig. 70.

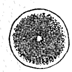


Fig. 71.

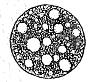


Fig. 72.

"Symbiotic" cells from the wall of the stomach of *Anagrus incarnatus* Hal., showing the increasing number of microorganisms and vacuoles. × 188.

At this point of time the larva has filled its stomach so much, that the same is distended and displaces the other organs. In older larvae I could not find the salivary glands, but the limitation of the stomach behind was seen to be well marked by the "symbiotic" cells on the wall of the stomach. Subsequently the "symbiotic" cells join in a large, dark patch (which is pale by incident light) in the abdomen of the pupa. Later on the stomach opens and its contents are expelled as excrements.

For further informations as to this species I refer to a previous paper of mine (1925), and below I only record a subsequent breeding:

On July 14th, 1929 eggs of a Damsel Fly (Agrionid) were taken on *Nymphaea* at Karensby in the isle of Møen.

From July 14th to 16th a quantity (10 to 20 specimens) of Anagrus emerged.

On July 17th 57 Anagrus (13 males, 44 females) emerged.

On July 18th	154 Anagrus (57 males, 97 females) emerged.
On July 19th	109 Anagrus (40 males, 69 females) 1 Prestwichia (male) emerged.
On July 20th	65 Anagrus (28 males, 37 females) 6 Prestwichia (females) emerged.
On July 21st—22nd	83 Anagrus (29 males, 54 females) 24 Prestwichia (15 males, 9 females) emerged.
On July 23rd	93 Anagrus (29 males, 64 females) 7 Prestwichia (1 male, 6 females) emerged.
On July 24th	36 Anagrus (16 males, 20 females) emerged.
On July 25th	41 Anagrus (7 males, 34 females) 7 Prestwichia (1 male, 6 females) emerged.
On July 26th	25 Anagrus (5 males, 20 females) emerged.
On July 27th	18 Anagrus (12 males, 6 females) emerged.
On July 28th—29th	15 Anagrus (4 males, 11 females) 1 Prestwichia (male) emerged.
On July 30th	58 Anagrus (18 males, 40 females) emerged.
On July 31st	85 Anagrus (20 males, 65 females) emerged.
On August 1st	151 Anagrus (39 males, 112 females) emerged.
On August 2nd	49 Anagrus (7 males, 42 females) emerged.
On August 3rd	6 Anagrus (1 male, 5 females) emerged.
On August 4th—5th	1 Anagrus (female) emerged.

No further individuals appeared between August 5th and 22nd, so the breeding was considered as concluded, presenting a total outcome of *Anagrus* of 325 males and 721 females (and of Prestwichia of 18 males and 28 females).

I also bred *Anagrus* in the spring from *Alnus glutinosa* (eggs of *Typhlocyba*?) (fig. 141) and *Salix pentandra*, and in the autumn from dog's-tail grass, *Cynosurus cristatus* (hemipterous eggs?) (fig. 157). Furthermore J. P. Kryger bred it in the summer from *Typha* and *Phragmites*.

Anaphoidea conotracheli Girault.

The genus *Anaphoidea* was established by Girault (1905). It is distinguished from *Anaphes* Haliday (1833) by the 2-jointed club of the antennae of the female; it seems, however, to be impossible to separate the males of these two genera which are swept commonly in grass all the summer. It is to be expected that the number of species of these two genera, to which in the course of time about 30 species have been referred, will be reduced.

Development.

On May 24th, 1926 in Ryget Forest I swept 5 eggs of a Chrysomelid beetle; their length was 1,5 mm, their width 0,5 mm and they were deep reddish brown and granulated. In one of the eggs parasite larvae in motion could be glimpsed. By tearing this egg 7 full-grown larvae of uniform size were found (fig. 73). They were peculiar disciform with only a slight arching; their body was entirely occupied by a stomach with reddish brown contents of yolk; the stomach was distinctly discernible from the the body-wall by the current constrictions. Imaginal disks were foreshadowed, and fat-cells were present in groups. Mandibles were not observed. The result of the breeding of the larvae is stated below under breeding no. 1.

Copulation.

The copulation, which was stated also to take place between individuals from the same host-egg, lasted about one minute. The male touched the back of the female with his antennae, and standing on her back he initiated the copulation by making himself—as is usually the case —slide backwards, so that his dorsal side got placed against the underlying surface. During the whole act of

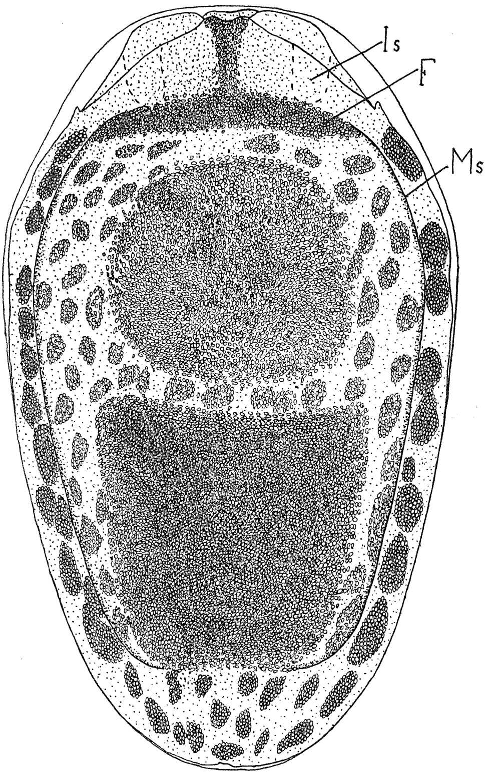


Fig. 73. *Anaphoidea conotracheli* Gir.
Larva, dorsal view; × 114.

copulation the wlngs of the male whirred at intervals of a few seconds.

Oviposition.

On July 24th, 1927 I observed the egg-laying of two specimens of *Anaphoidea* recently emerged from eggs of

Agabus. The ovipositor was held vertically downward and only sunk a short distance down in the egg of an *Agabus,* which besides was not in a fresh condition. The antennae were stretched forward somewhat above the level of the body but were in activity for feeling the egg of the *Agabus* before the egg-laying. The wings were held in a position of rest over the abdomen.

Breedings.

No. 1. On May 24th, 1926 5 eggs of a Chrysomelid were swept in Ryget forest.
On June 4th a chrysomelid larva hatched.
On June 6th 9 Anaphoidea (1 male, 8 females) emerged from one egg.
On June 7th 11 Anaphoidea (3 males, 8 females) emerged from another egg.
Total outcome of *Anaphoidea*: 4 males and 16 females.

No. 2. On June 26th, 1926 at Skovrød Pond, eggs of *Agabus* were taken in *Juncus effusus* from a stem above the water.
On October 4th 1 Anaphoidea (female) emerged.

No. 3. On October 17th, 1926 at Skovrød Pond, eggs of *Agabus* were taken in a *Juncus effusus*-stem above the water.
On February 5th, 1927 10 Anaphoidea (2 males, 8 females) emerged from one egg.
On Februar 24th 2 Anaphoidea (females) emerged from one egg.
On February 25th 2 Anaphoidea (females) emerged from one egg.
On February 26th 2 Anaphoidea (males) emerged from one egg.
Total outcome of *Anaphoidea*: 4 males and 12 females.

According to American investigators, Quaintance (1912), Brooks (1918), and Porter and Alden (1921), the development of *Anaphoidea* (in eggs of *Conotrachelus* on plums etc.) lasts about 10 days, thus causing several generations to be produced during the summer.

Cleruchus pluteus Enock.

Development.

Of the developmental stages in the host-egg I only observed the pupal instar, which has clear, white fat-cells. This latter must also apply to the larva because

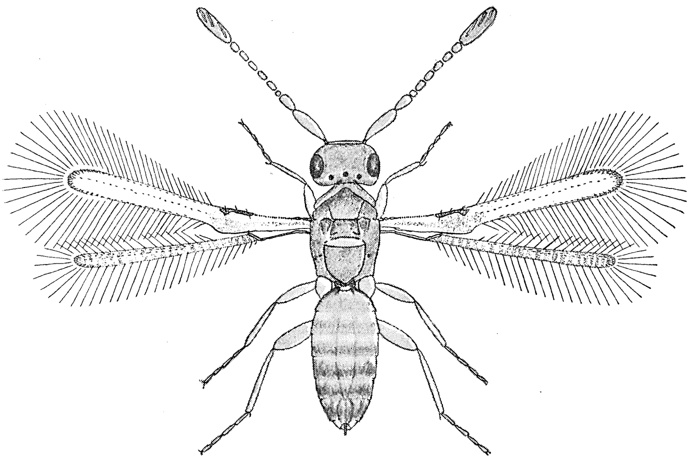


Fig. 74. *Cleruchus pluteus* Enock.
Female, × 54.

the fat-cells make their appearance in the larval stage. The evacuated excrements, which looked yellow by incident light, were so abundant that they partly concealed the pupa.

The imago (fig. 75), lying in the host-egg, has the antennae bent between the scape and the pedicel and the wings bent at the point where the subcostal and the marginal veins meet.

After the emergence the host-egg is left unaltered in shape, showing an open exit hole, and containing the excrements.

Copulation.

In several cases I observed the copulation, which lasted from a half to one minute. On July 13th, 1929 I put a recently emerged female into a test tube with a male, which had remained in the tube for some days. The male seemed immediately to recognise the presence of the female (?smell), and commenced running about vivaciously until he met her. After an introduction of only a few seconds the copulation took place in the usual manner, the male standing on the back of the female; his abdomen was bent somewhat down beneath the apex of the abdomen of the female, as in this species (having a small ovipositor) the genital orifice is situated rather near the apex. The copulation was accompanied by rhytmical beats with the wings, 3 a second, in some cases, however, in a slower rhytm. The female remained passiv. A single male was observed to copulate for the second time after an interval of a few minutes.

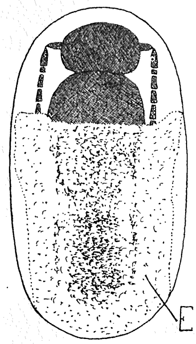


Fig. 75. *Cleruchus pluteus* Enock. Imago in host-egg, × 60.

Host.

It has long been a well known fact amongst collectors that *Cleruchus* may be bred from the leaf-rolls of *Rhynchites betulae* on birch. Through my investigations of *Ophioneurus* I gradually got clear that *Cleruchus* is not a parasite of the eggs of *Rhynchites*. In the leaf-rolls one may rather often find some portions of extraneous eggs, deposited in sheets alongside each other; from these eggs a coleopterous larva emerges, which, however, could not be determined. From these eggs, which apparently are disposed in the leaf-rolls as a chance concealment, *Cleruchus* emerged several times.

Cycle.

Cleruchus seems to have two generations a year. It is swept in the spring, for instance I took 1 male and 4 females at Ryget on May 29th, 1924 and 1 male and 8 females at Frerslev Forest on June 12th, 1927. Then specimens are generally not swept until at the end of July, which seems to be in conformity with the observations from Frerslev Hegn, where the attack was in full swing on June 12th, and the breedings listed below show that the summer generation appears after about 7 weeks.

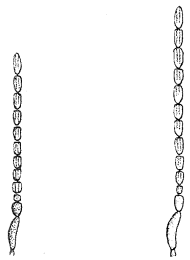


Fig. 76. Fig. 77.

Cleruchus pluteus Enock.
Antenna of male.
Fig. 76. Summer generation.
Fig. 77. Spring generation.
× 60.

While the female (fig. 74) is apparently not varying rather much, the male exhibits a seasonal dimorphism, as the 39 specimens of males which I have hitherto found of the summer generation had 12-jointed antennae (fig. 76), whereas 5 specimens of the spring generation had 13-jointed antennae (fig. 77).

Breedings.

No. 1. On July 17th, 1927 at Frerslev Forest leaf-rolls of *Rhynchites betulae* were taken on birch.

From July 27th to August 3rd	3 Ophioneurus emerged.
On July 23rd	1 Cleruchus (male) emerged.
On July 27th	2 Cleruchus (1 male, 1 female) emerged.
On July 28th	4 Cleruchus (1 male, 3 females) emerged.
On July 30th	15 Cleruchus (8 males, 7 females) emerged.
On July 31st	10 Cleruchus (1 male, 9 females) emerged.

On August 1st 34 Cleruchus (17 males, 17 females) emerged.
On August 2nd 11 Cleruchus (6 males, 5 females) emerged.
On August 3rd 3 Cleruchus (2 males, 1 female) emerged.
Total outcome of Cleruchus: 37 males and 43 females.

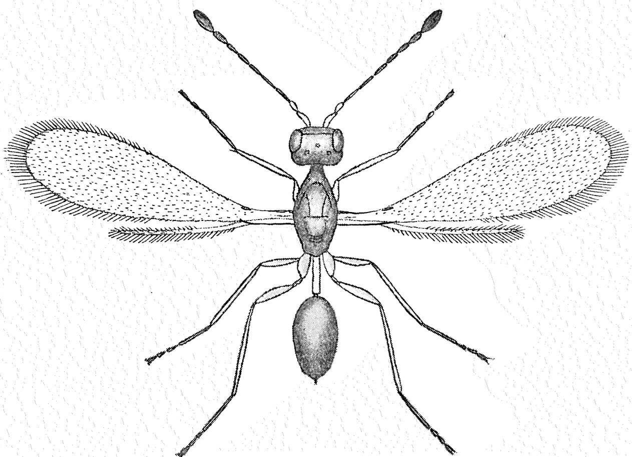


Fig. 78. *Polynema similis* Förster.
Female, × 30.

No. 2. On June 30th, 1929 at Lillerød isolated eggs were taken from egg-portions (not eggs of *Rhynchites betulae*) hidden in the leaf-rolls of *Rhynchites betulae* on birch.
From July 12th to 23rd some coleopterous larvae hatched
On July 13th 4 Cleruchus (females) emerged
On July 23rd 2 Cleruchus (females) emerged.
Total outcome of Cleruchus: 6 females.

Cleruchus, which is swept in glades in forests, is hitherto generally rather rarely met with. It is known from Denmark and England.

Polynema similis Förster.

This slender species (fig. 78) was swept on June 2nd, 1929 in a birchforest at Sorte Mose (black bog) near Lillerød.

Polynema fuscipes Haliday.

This big species (fig. 79) was swept on June 6th, 1926 in a meadow in Ryget Forest.

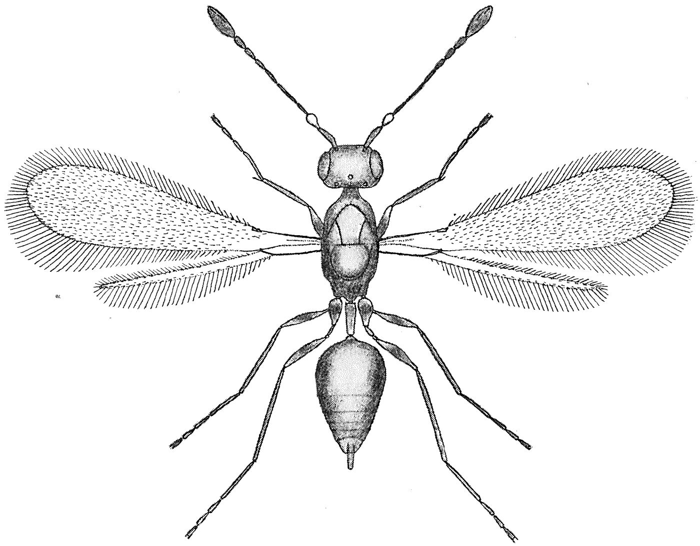


Fig. 79. *Polynema fuscipes* Hal.
Female, × 26.

Polynema pusillus Haliday.

Development.

In about 60 cases I saw larvae in their first instar lying in the host-eggs, generally singly, but also several in the same egg. I did not succeed in carrying out more than one breeding from the first instar (the cyclopoid instar) and two from the second instar, because the technic difficulties of this work during my first period of investigations prevented me from keeping the eggs for more than a few days free of exsiccation, fungi and attacks of bacteria; still in some cases I succeeded in doing so for a period of about a month. An additional difficulty arose from the fact that the host-eggs were thin-shelled and easily crushed on the daily inspection even when disposed under a cover glass of 10 mm. × 10 mm.

Some observations made on the aforesaid breeding

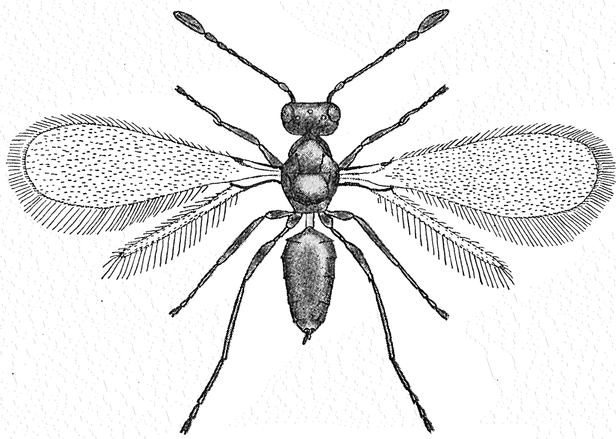


Fig. 80. *Polynema pusillus* Hal.
Female, × 30.

(from the first instar), which commenced on April 22nd, 1928 may be stated. On April 26th the larva was seen to move vivaciously and the segmentally arranged body hairs were easily recognisable. On May 11th the larva was motionless and looked bag-shaped; the frontal process was visible and the stomach appeared to be rather bright by incident light. On May 12th the mandibles of the second instar could be recognised and drawn; the larva was still motionless and occupied half of the length of the egg; on May 13th the larva began to move, on May 15th current constrictions were seen on the stomach, and the larva now occupied the whole of the egg. As late as

May 21st constrictions were seen on the yellow stomach; on May 31st the pupa was foreshadowed, but excrements were not emitted. On June 7th the imago was foreshadowed with reddish eyes; on June 12th the imago was greyish, and on June 14th it was nearly black. On June 28th a female (fig. 80) emerged.

The larva in the first instar (fig. 81) was taken out of the host-egg under water; it consists of a cephalic part, a segmented body part and a stiff caudal appendage. It moves slowly about in the contents of the egg in sickle-like curves. As shown in fig. 82 the cephalic part can be bent strongly against the ventral side, and this also applies to the stiff caudal appendage. This movement seems to be performed by means of muscles along the ventral side and corresponding ones along the dorsal side. The body, which tapers towards apex, has anteriorly a broader region, which seems to consist of two segments and comprises the stomach-cavity lying towards the dorsal side. This region is succeeded by 5 well marked, narrower segments, so that the body no doubt is composed of 7 segments of which the 2nd to the 5th each has a row of hairs around the dorsal half. In a few specimens the number of hairs was twice the usual, consisting of about 20 bristles in a dense row around the dorsum of each segment. In the hind part of the body some bigger cells, the sex cells, were discernible. The long, tapering caudal appendage was slightly geniculate in the middle; it was stiff and provided with one or two teeth at the base; in some cases there was an additional tooth behind these. The head (fig. 83) was provided with a strongly chitinised frontal process below which a protruding mouth cone was seen with strongly chitinised labral and labial sclerites; a muscle bundle is seen extending from the mouth region obliquely backward to the upper side of the head. Under high magnifying powers a pair of hook-shaped mandibles was seen placed in the very orifice of the mouth;

they reminded of the mouth-hooks of a dipterous larva, as from the position in which they are drawn, they could be moved semicircularly behind in a vertical plane and not

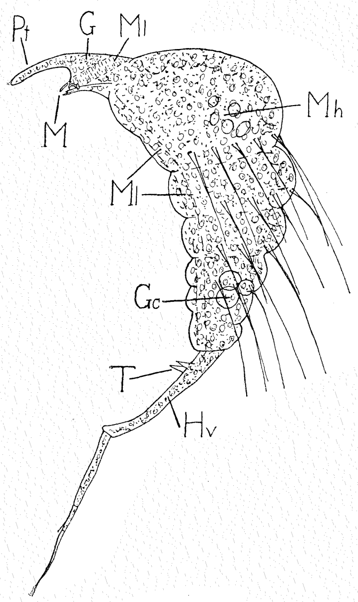


Fig. 81.

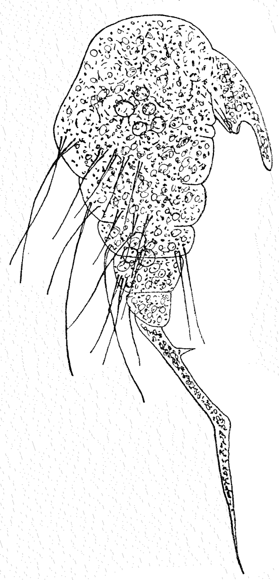


Fig. 82.

Polynema pusillus Hal.
First larval instar, × 188.

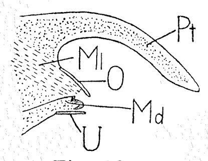


Fig. 83.
Polynema pusillus Hal.
Head, × 425.

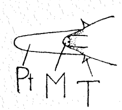


Fig. 84.
Polynema pusillus Hal.
Head, ventral view, × 188.

horizontally towards each other. At the sides of the mouth there was a pair of well chitinised tooth-like outgrowths, which were not, however, discernible unless a specimen was caused to lie exactly on its dorsal side (fig. 84).

Usually the larva hibernates in this instar; the earliest time of finding was in the autumn on October 16th, 1927 and the latest in the spring on June 29th, 1927. The time elapsing from commencement of the growth until moulting is 3 to 4 weeks. Gradually the motion of the larva ceases and simultaneously the larva swells by absorbing food while the next larval instar is foreshadowed, and at the time of moulting the larva has become almost globular (fig. 85). During this period the larva usually did not commence to move until it was irritated by light, heat or mechanical influences during the examination.

On the moulting the cephalic part of the burst larval cuticle is shed backwards and for some time remains adhering to the posterior end until the movements of the new larval instar become powerful again. The cuticle of the second larval instar is so to say cast inside the old one; this may especially be recognised as to the frontal process, which lies clear and empty within the old one while the hypodermic cells have withdrawn farther inwards. The frontal process of the new instar is rather soft and collapses, assuming some chance shape until it is dilated during the growth of the larva, and at last it assumes the shape typical for the second instar. On account of this fact the recognition of the larva is rendered difficult; at first I thought I had to do with several species.

In the course of a few days the larva alters its shape (fig. 86), because it begins to swallow the contents of the egg by which the stomach is increased and dilates the body so as to make the same exhibit an anterior thicker and a posterior slightly thinner region, the latter containing the sex-cells and the proctodaeum. On the surface of the stomach the white fat-cells are now seen to be foreshadowed in rather well marked annular groups. The paired salivary glands are seen on either side of the stomach and their joint opening is seen on the surface somewhat beneath the mouth. The frontal process becomes more and more dilated and gradually almost inrecognisable. The big mandibles of the second instar (fig. 87) are at first merely faintly visible but become gradually more distinct. The larva soon commences to move its body in

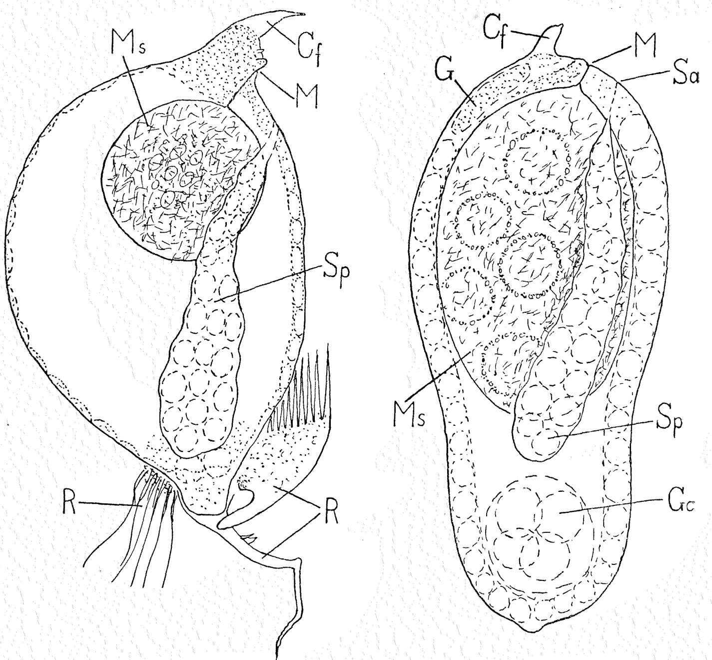


Fig. 85. Fig. 86.

Polynema pusillus Hal.

Second larval instar. Fig. 85, immediately after the moult; remains of cast cuticle present. Fig. 86, at a later time, × 188.

a vivacious, twisting manner by means of the new segmental muscles, which at last mark the usual 13 segments (besides the head). The larva now grows quickly on account of the filling of the stomach; the larva may one day occupy half the lenght of the egg and may on the next day have devoured all the contents ot the egg so as to occupy the whole of it. The stomach becomes yellow and its wall exhibits peristaltic constrictions running to and fro; the fat-cells become bright and white. Gradually as the digestion proceeds the contents of the stomach looks brighter by incident light. Anteriorly to-towards the dorsal side a paired "Anlage" of the brain appears. From the breeding mentioned above it is evident that this instar lasts from 2 to 3 weeks and the remaining part of the development lasts about one month. The excrements, which look very pale by incident light, are not evacuated until after the second instar, supposedly at the transition into the pupal instar. Concerning the pupal instar and the remaining part of the development reference is made to what is set forth about *Polynema ovulorum.*

Fig. 87. *Polynema pusillus* Hal. Second larval instar; mandible. × 188.

Host.

The whole of my material af *Polynema pusillus* originates from homopterous eggs in *Salix pentandra* L. (fig. 142). A Jassid larva, which could not with certainty be determined further, hatched from these eggs. It may belong to *Bythoscopus* Germ. or *Idiocerus* Lew.

Cycle; Breedings.

My investigations of this species were brooken off because the meadow with the shrub of *Salix pentandra* was enclosed and grazed off by young cattle, so there are not many informations about the yearly cycle.

Below the dates of 2 breedings are set forth:

On January 2nd, 1927 at Ryget, twigs of *Salix pentandra* L. were taken.

On January 30th 1 Polynema pusillus (male) emerged
On March 11th 1 Polynema pusillus (male) emerged
On March 14th 1 Polynema pusillus (fem.) emerged
On April 4th 1 Polynema pusillus (fem.) emerged
On April 11th 1 Stethynium triclavatum (male) emerged.

On April 16th 1 Stethynium triclavatum (female) emerged.
On May 9th 1 Polynema pusillus (male) emerged
On May 16th 3 Polynema pusillus (1 male, 2 females) emerged
On May 17th 1 Polynema pusillus (male) emerged.
Total outcome of *Polynema pusillus*: 5 males and 4 females.

From twigs taken on June 6th, 1927 one male of *Polynema pusillus* emerged on June 21st, 1927.

These breedings might indicate that some larvae have already in the autumn reached the second larval instar and therefore emerge early; besides the annual generation of the late-summer some individuals therefore appear at an earlier date. Judging from the long larval development and from comparison with the facts in the other species of *Polynema*, one may only suggest one generation a year.

Polynema atratus Haliday.

I did not follow the larval development of this species (fig. 88) by breeding it, but in the spring of 1929 in the enclosure of Fortunen I found larvae of a *Polynema* in their first and second instar in eggs on aspen, *Populus tremula*. From these eggs the below mentioned breeding originates.

On August 11th, 1929 shoots from the preceding year (1928) were taken from *Populus tremula* with eggs of a *Cicadellid* viz *Idocerus populi*.

On August 13th 1 Polynema atratus (female) emerged
On August 16th { 1 Polynema atratus (female) emerged
1 Lymaenon tremulae (male) emerged }
On August 17th 1 Polynema atratus (female) emerged
On August 19th 1 Polynema atratus (female) emerged
On August 20th 1 Polynema atratus (female) emerged
On August 22nd 1 Lymaenon tremulae (fem.) emerged
On August 23rd 1 Polynema atratus (female) emerged

On August 24th 3 Polynema atratus (females) emerged
On August 27th 2 Lymaenon tremulae (fems.) emerged.

No further individuals appeared between August 27th and September 10th, so the breeding was considered as concluded, presenting a total outcome of *Polynema atratus* of 9 females, (and of *Lymaenon tremulae* of 1 male and 3 females).

On August 7th, 1929 in Præstevangen, two males were swept on aspen, possibly belonging to this species.

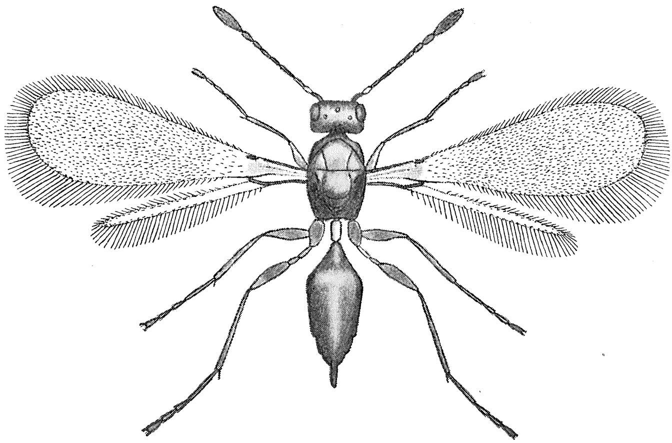


Fig. 88. *Polynema atratus* Hal.
Female, × 30.

The scarce informations of the life habits of the species do not deviate from the facts costumary in the other species of *Polynema*; it seems like its host to have one generation a year.

Polynema atratus develops in eggs of the Cicadellid *Idiocerus populi* in *Populus tremula* (figs. 145—146). The host was met with numerously in the enclosure of Fortunen on growth of aspen. Moreover on August 7th, 1928 I bred a female from eggs of *Idiocerus (?confusus)* in *Salix cinerea* taken at Donse on July 1st, 1928 (figs. 143—144).

Polynema euchariformis Haliday.

Until 1928 I merely knew this species from two specimens taken by Mr. J. P. Kryger in Tisvilde Forest and preserved in Canadian balsam. On September 9th, 1928 in Præstevangen I observed the species (fig. 89) being about to deposit its eggs on the branches of *Salix cinerea* L. The animals, whose number I estimated at

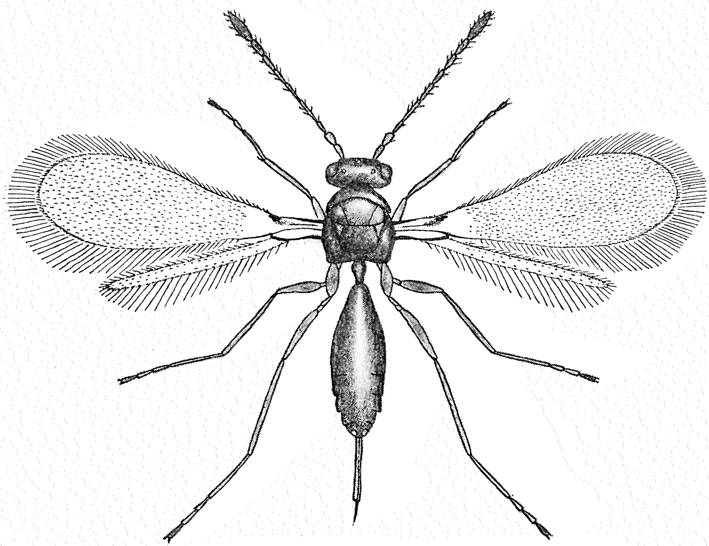


Fig. 89. *Polynema euchariformis* Hal.
Female, × 30.

about 400, were almost exclusively walking on the bark, not on the leaves. Although thus a big number was out, I did not get the species in the sweeping-net that day, nor was it formerly swept in this well investigated locality, where *Salix cinerea* is spread singly amongst the growth of trees and bushes.

Oviposition.

The next day (September 10th) I had the opportunity to observe the oviposition in captivity of some specimens which I had brought home. At first the females are seen running many times to and fro along the crevice where the host eggs are deposited, tapping the bark with the clubs of the antennae; subsequently the female puts the ovipositor in position, feeling its way with the apex and commencing to press it against the host egg so as to cause it to curve backward. Frequently the ovipositor is thrust in full length and remains down from half a minute to several minutes. The wings are kept horizontally while the antennae are first kept down and subsequently somewhat raised.

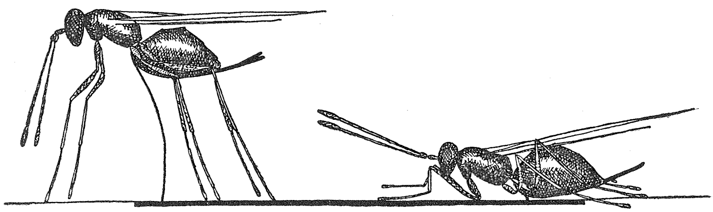


Fig. 90. *Polynema euchariformis* Hal.
2 females during oviposition, × 20.

The size of the Polynema stock.

On Jannary 13th, 1929 the shrub of *Salix cinerea* in question in Præstevangen was measured. It stood isolated from the other shrubs on a small meadow. Its height was 2,5 m. and its measurements across were 2 m. by 3 m. At the base the shrub had 13 branches, the circumference of which varied from 9 to 12 cm., the diameters thus being about 3 to 4 cm. One of the branches which was cut off had 7 annual rings. A closer examination of this branch brought out the following result:

Length of the lowermost shoot...............	0,9 m.
Length of 2nd and 3d shoot (2 branches, each of a length of about 65 cm.).............	1,3 m.
Length of 4th, 5th and 6th shoot (abt. 35 branches)	11,0 m.
Length of the uppermost shoot (numer. branches)	12,5 m.
In total:	25,7 m.

Number of egg-incisions of Cicadellids *(Idiocerus)* made in the summer of 1928:

In the lowermost shoot	105
In the 2nd and 3rd shoots together	129
In the 4th, 5th and 6th shoots together	211
In the uppermost shoots together	0
In total:	445

Number of old egg-incisions made before 1928:

In the lowermost shoot	217
In the 2nd and 3rd shoots together	327
In the 4th, 5th and 6th shoots together	278
In the uppermost shoots	0
In total:	822

From the lowermost shoot 27 fresh egg-incisions were examined, which contained 99 eggs of Cicadellids; 26 of these eggs contained parasites, most of them one, some of them two parasites; all of them were larvae of the cyclopoid type and consequently in their first instar; 15 eggs contained an embryo of a Cicadellid without parasite and 58 eggs were taken out of the incision in such a defective state that they could not be distinctly recognised.

As each egg-incision thus contained about 4 eggs and the shrub had 13 branches, the number of eggs in the whole of the shrub from the first 6 years may be estimated at about 42744, and the number of fresh eggs from 1928 at about 23140. Of the latter at least 25 per cent were infested, that is, about 5785 parasites were about to hibernate.

Development.

Of the material from January 13th, 1929 breeding of 3 larvae was accomplished in the course of 4 months. The imagines were about to emerge on May 17th, one of them on May 28th, but besides they perished as they were drowned on emerging. It was ascertained that the development in all its main features is the same as that described under *Polynema pusillus* and *ovulorum*. Fig. 91 shows a larva in its first instar. A single tooth is seen on the geniculate caudal appendage; it seems to sit closer to the base than in *ovulorum*, so in this respect *euchariformis* seems to approach *pusillus*. The stomach has re-

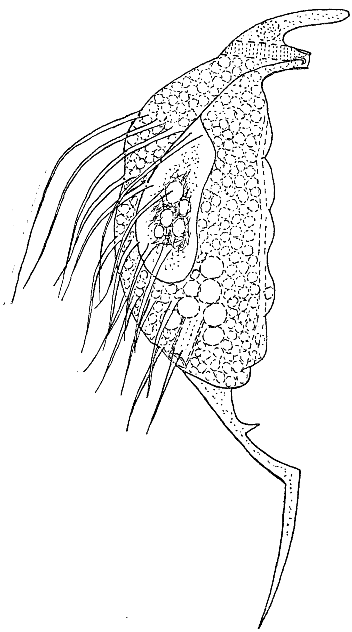


Fig. 91.

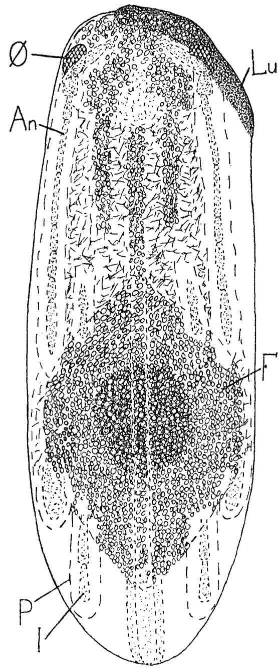


Fig. 92.

Polynema euchariformis Hal.

Fig. 91. First larval instar, × 188. – Fig. 92. Pupa with foreshadowed imago within the host-egg, × 60.

ceived some nourishment and is therefore more visible. In the second instar the bright, white fat-cells were observed. The food, however, seemed to be more perfectly assimilated; no calotte was formed and only once I saw the evacuated excrements being like faint shadows. It is also a conspicuous fact that the pupa is compressed and lies with its head pressed close against the one end and its ovipositor close against the opposite end of the egg. It is likely to imagine that the strange, compressed shape of the imago is caused by lack of space and by the development of the ovipositor. As is probably the case in the other species of *Polynema* the wings lie bent at the faint point between the subcostal and the marginal veins.

Breedings; Cycle.

On July 21st, 1929 an egg was brought home and bred on August 6th, 1929. On August 7th, 1929 one of the remaining 12 branches of the *Salix*-shrub was sawn to pieces, and moistened rags were wrapped round them during the breeding period; the breeding gave the following result:

On August 10th 6 Polynema euchariformis (females) emerged

On August 12th 7 Polynema euchariformis (females) emerged

On August 13th 11 Polynema euchariformis (females) emerged

On August 14th 10 Polynema euchariformis (females) emerged

On August 15th 11 Polynema euchariformis (females) emerged

On August 16th 15 Polynema euchariformis (females) emerged

On August 17th 14 Polynema euchariformis (females) emerged

On August 18th 20 Polynema euchariformis (females) emerged

On August 19th 20 Polynema euchariformis (females) emerged

On August 20th 12 Polynema euchariformis (females) emerged

On August 21st 16 Polynema euchariformis (females) emerged

On August 22nd 10 Polynema euchariformis (females) emerged

On August 23rd	11	Polynema euchariformis (females) emerged
On August 24th	12	Polynema euchariformis (females) emerged
On August 26th	9	Polynema euchariformis (females) emerged
On August 27th	11 1	Polynema euchariformis (females) Lymaenon tremulae (female) — emerged
On August 28th	5	Polynema euchariformis (females) emerged
On August 29th	5	Polynema euchariformis (females) emerged
On August 30th	4	Polynema euchariformis (females) emerged
On August 31st	2 1	Polynema euchariformis (females) Lymaenon tremulae (female) — emerged
On September 2nd	2 1	Polynema euchariformis (females) Lymaenon tremulae (female) — emerged
On September 5th	2	Lymaenon tremulae (females) emerged
On September 12th	1	Lymaenon tremulae (female) emerged
On September 16th	2	Lymaenon tremulae (females) emerged.

No further individuals of *Polynema euchariformis* appeared between September 16th and 24th, so the breeding was considered as concluded, presenting a total outcome of *Polynema euchariformis* of 213 females (and of *Lymaenon tremulae* of 8 females).

On September 8th, 1929 in Præstevangen the egg-laying was in full swing; the number of individuals perhaps somewhat exceeded that of the preceding year. By means of a tuft of wadding the animals were removed from one of the branches, the number of animals turned out to be 91 *Polynema euchariformis* (females) and 2 *Ly-*

maenon tremulae (females). From this result one may judge that about 1000 individuals were present on the 11 branches of the shrub. A Cicadellid, which was determined as *Idiocerus confusus* Flor, was about to deposite its eggs. On September 22nd, 1929 although the weather was sleety, still one female of *Polynema euchariformis* was seen to be active and another one rested on the under side of a leaf.

From the above mentioned breedings and random samples as also from the long larval development it will appear, that *Polynema euchariformis* has absolutely not more than one generation a year.

Already on September 9th, 1928 when more than half a hundred individuals were collected, it was a striking fact that all of them were females. During the above investigations I had paid attention to this fact and it clearly appears that the reproduction of the said stock is parthenogenetic.

Host.

As mentioned above the host belongs to the genus *Idiocerus*, and with some doubt it has been referred to the species *confusus* Flor. I knew beforehand another species of *Idiocerus*, viz *populi* L., which species deposits its eggs (figs. 145—146) in the shoots of *Populus tremula*, while the species in question, which originates in *Salix cinerea* (figs. 143—144), as shown from the observations on January 13th, 1929, only deposits its eggs in the older branches. The shape of the egg goes, however, to show that it, too, belongs to the genus *Idiocerus*.

Polynema longula Förster.

Of this species (fig. 93) only one male has been bred. This male emerged from a big heteropterous egg, which due to the parasite was whitish; the egg was taken in *Juncus effusus* L. on December 26th, 1928 at a flat pool in Dyrehaven. The imago emerged on May 17th, 1929. In the following some observations from the breeding are set forth. During the first months only a dark patch, signifying the contents of the larva's gut was visible. On March 4th the larva was seen to move; on March 10th current constrictions on the stomach appeared, indicating the second instar of the larva; on March 12th white fat-cells and 4 imaginal disks at the head were seen; on

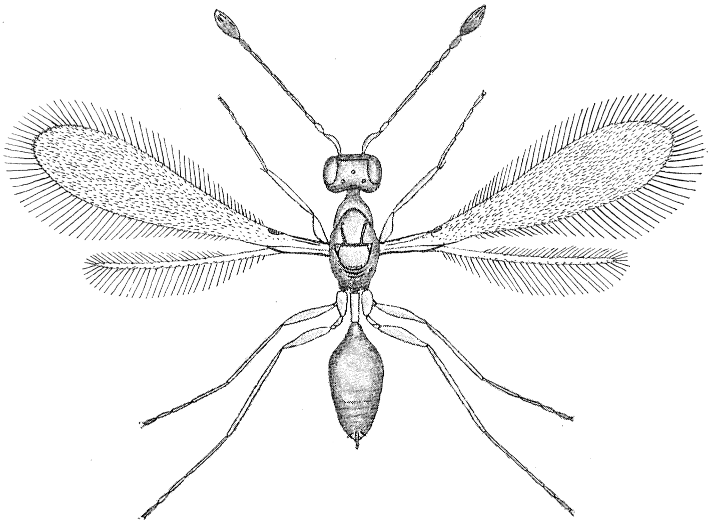


Fig. 93. *Polynema longula* Förster.
Female, × 23.

March 16th the larva filled the egg; on March 25th it was motionless; on March 31st a dark (pale by incident light) excremental patch at the posterior end of the larva was visible; on April 4th the transformation into pupa had taken place and the imago was foreshadowed within the pupa; on May 3rd the wing-buds were seen; on May 5th the last moult had taken place and the imago moved in the host egg; on May 17th it had gnawed a hole in the egg, but it died on emerging.

As it appears from these notes, the development does not seem to deviate from that described under *Polynema pusillus* and *ovulorum*, except that it is of a somewhat longer duration; the fact, too, that the insect is frequently swept in the middle of August, might indicate that this species has only one stock and one annual generation. It is frequently swept in damp meadows.

On August 18th, 1927 I observed the copulation of a pair of individuals, swept in the echo-valley in Bornholm; the copulation lasted a quarter of an hour and besides proceeded as described under *Polynema ovulorum*.

Host.

Polynema longula develops in eggs in *Juncus effusus*, deposited by an undetermined heteropterous insect (figs. 149—151, 164 E).

Polynema fumipennis Haliday.

I only bred this species (fig. 94) once from an egg of *Acocephalus*, taken in *Juncus effusus* at a flat pool in Dyrehaven. It was the same kind of eggs (figs. 139, 164 J) from which I used to breed *Polynema ovulorum*; the developmental facts of *Polynema fumipennis* seem hardly to deviate from that of *ovulorum*. The breeding was commenced on March 25th, 1928; on April 7th the segmentally arranged hairs of the cyclopoid first instar were observed; on May 8th the larva had assumed its second instar, entirely filling the egg; on May 24th the pupa and the evacuated excrements were seen; on June 1st the imago was foreshadowed and on June 29th a female of *fumipennis* emerged. Before the emergence the imago was seen to be enclosed in a darkish fluid, while the fluid around the pupa of *ovulorum* is rather bright. As the emerged specimen was a small one, it may have been a chance breeding and possibly the normal host egg may prove to be an other, bigger one.

The specification of sweepings set forth below, indicates in connection with the above mentioned breeding that the species has only one generation a year and only one stock.

On August 22nd, 1921 at Sandvig in Bornholm 1 female was swept,

On September 10th, 1922 in Dyrehaven 1 female was swept,

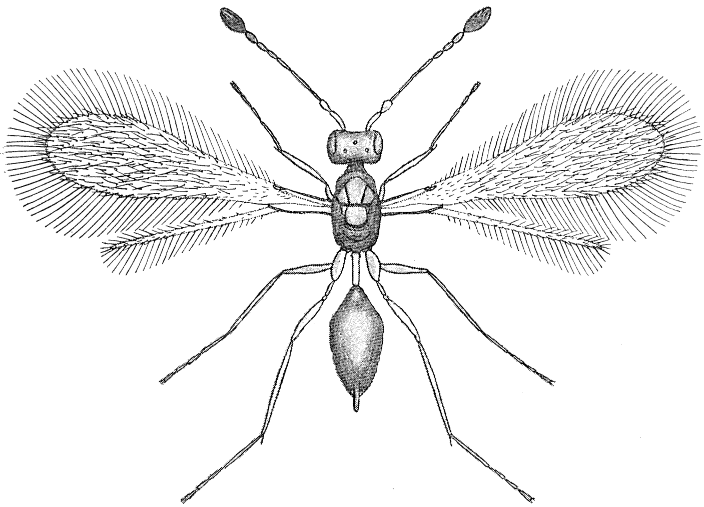


Fig. 94. *Polynema fumipennis* Hal.
Female. × 26.

On August 6th, 1924 at the lighthouse of Hellehavn 2 males were swept,

On August 13th, 1924 at the same place 8 males and 1 female were swept,

On September 14th, 1924 in Præstevangen 1 male was swept,

On August 20th, 1925 at Karensby in Møen 1 female was swept,

On August 8th, 1927 at Østerlars in Bornholm 1 female was swept,

On September 4th, 1927 at Skovrøddam, Holte 1 male was swept.

Polynema ovulorum Haliday.

D e v e l o p m e n t.

In 4 cases I succeeded in following the development of this species from the first larval instar to the emergence of the imago (fig. 95). On March 25th, 1928 at a flat pool in Dyrehaven 4 eggs of *Acocephalus* were collected from *Juncus*, and the first examination of them took place on April 6th. In 3 of the above mentioned cases

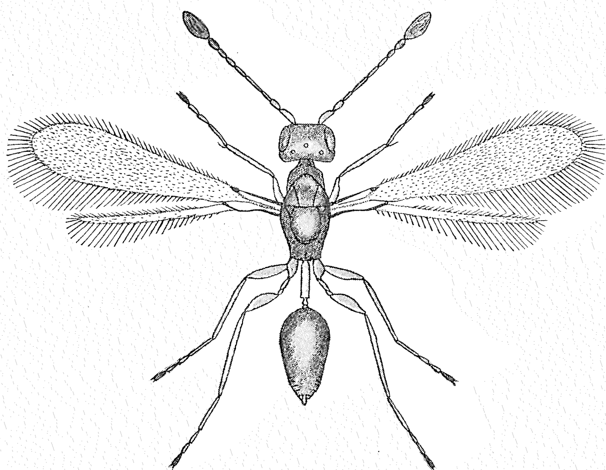


Fig. 95. *Polynema ovulorum* Hal.
Female, × 30.

the larvae were stated to be in their first instar, and the imagines emerged on July 2nd, 5th and 10th, 1928 respectively. The 4th larva was stated to have assumed its second instar, but distinct remains of the cuticle of the first instar were still adhering to it; the imago emerged on May 12th, 1928.

The larva in its f i r s t i n s t a r seemed in all essentials to agree with that of *Polynema pusillus*, except that as a rule it seems to have only one caudal tooth (fig. 96) which latter is placed somewhat more distant from the caudal base than in *pusillus*. Besides, concerning this instar as well as the subsequent moult reference is made to the particulars set forth concerning *Polynema pusillus*.

After the moult the larva in its second instar soon commences to make wriggling movements in the egg-mass; it swallows the contents of the egg in the course of a few days, so as to cause the yellowish stomach to fill the greater part of the body (fig. 97). The larva is now faintly segmented; there are 13 segments besides the big head; the 3 thoracic segments are greater than the succeeding ones. On the under side of the head the orifice of the salivary duct opens; the salivary glands have now attained the maximum of their development; they are so strongly distended that especially posteriorly they partly displace the stomach. Gradually as the running, peristaltic constrictions on the stomach decrease the imaginal disks are foreshadowed and the fat-cells grow and become more numerous. At last the larva lies quite quiescent in the translucent host-egg (fig. 98), which latter now besides the parasite larva only contains some few remains of the first instar of the same. In the head of the larva 2 pairs of imaginal disks are seen to be foreshadowed; the mandibles are now hardly visible, only their tips are seen to project from the posterior pair of imaginal disks. On the under side 3 further pairs of imaginal disks are seen in the thoracic part, and one pair is seen near the apex of the abdomen, being the "Anlage" of the reproductive organs. The thoracic imaginal disks are rather complicated, comprising "Anlage" of wings as well as of legs. The bright, white fat-cells fill the space outside the imaginal disks and seem to be distributed in an outer and an inner layer. The darkish stomach, which looks whitish yellow

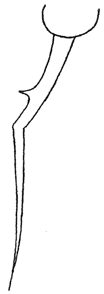


Fig. 96. *Polynema ovulorum* Hal. First larval instar, caudal appendage, × 188.

by incident light, is faintly seen; its extent gradually decreases, it becomes displaced towards the dorsal side, having its greatest extent posteriorly (fig. 99).

In the course of about 3 weeks the digestion has come to an end, the pupa is foreshadowed and a moult takes

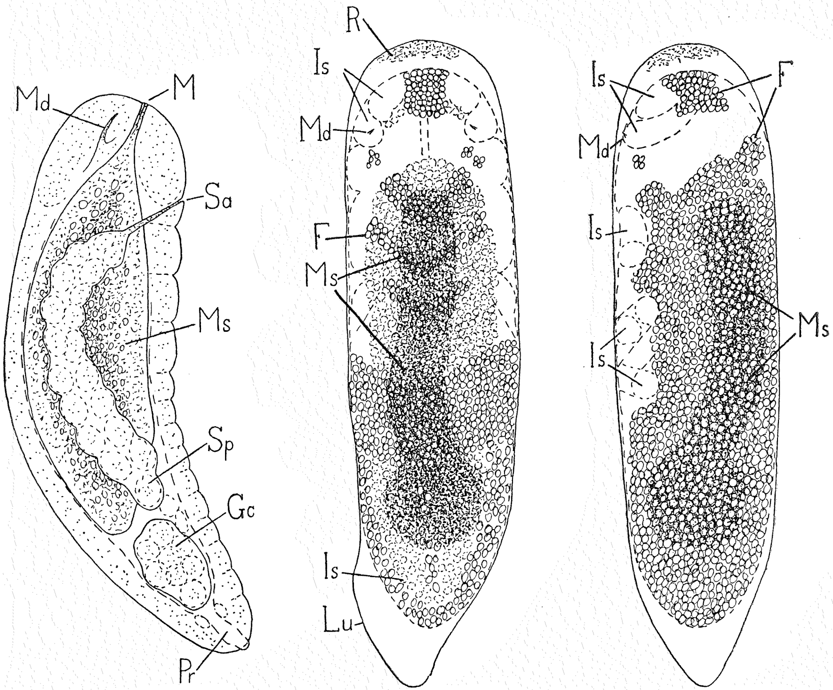


Fig. 97. Fig. 98. Fig. 99.

Polynema ovulorum Hal.

Fig. 97, second larval instar, × 80. Fig. 98, somewhat older larva within the host egg, × 60. Fig. 99, lateral view of the larva shown in fig. 98, × 60.

place; simultaneously the stomach opens posteriorly and the excrements are evacuated, forming a dark calotte around the apex of the abdomen (fig. 100). By incident light the excrements look quite whitish; the white excremental patch is easily visible by the aid of a lens and imparts to the egg a characteristic appearance. However, a small rest of the excrements usually remains in the abdomen. The shape of the pupa recalls in a degree the shape of the imago; still the abdomen is not petiolate and the wings, the legs and the antennae appear as sac-like outgrowths. 4 to 5 days after the moult the imago is fore-

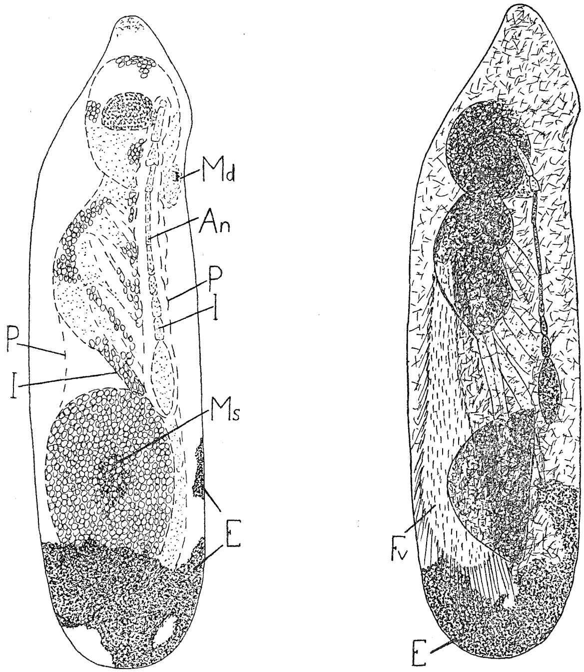


Fig. 100. Fig. 101.

Polynema ovulorum Hal.

Fig. 100, pupa with foreshadowed imago within the host-egg, × 60. Fig. 101, Female imago lying detached in the host egg, × 60.

shadowed in the pupa (fig. 100); it is faintly segmented, has faintly reddish yellow eyes and its abdomen is petiolate. The fat-cells commence to decrease, but still they are found inside the whole abdominal surface, and generally forming 3 longitudinal streaks on the thorax. Conspicuous is the high, clear vertex, which is not dark chitinised until just before the emergence. The 3-toothed mandibles become quickly visible and the eyes become highly reddish, while the chitin of the body day to day gets darker and that of the legs yellowish. By the aid of a lens the red eyes and the dark body may be disstinctly seen.

When 3 to 6 weeks after the last moult the imago has been entirely chitinised, it commences to move and sheds the pupal cuticle (fig. 101). In most cases amongst 12 breedings, which I inspected at few days' intervals, the pupal instar lasted 4 to 5 weeks. During the pupal stage the host egg is exhausted of moisture, especially when care is taken that the egg is not being too exposed to moist surroundings; the tracheae become filled with air and may be recognised within the legs and the antennae. The imago now wriggles uneasily in the egg and in a few days after it merely seems to await a favourable opportunity to emerge, for instance an irritation caused by heat, light or the like. In one case I observed an imago, which during the escaping spent one quarter of an hour in gnawing a hole in the egg-shell and one minute in creeping out. I bred a total of 9 females and 6 males. By feeding the imago with sugared water and keeping it in a humid atmosphere it may be kept alive until one month.

Copulation.

I observed the copulation a few times; the one time the male had emerged 11 days ago and the female was 3 days of age. At the meeting with the female the wings of the male began to whir and he tried to start the copulation from her dorsal side. The copulation was brought about after a few minutes (fig. 102) and lasted 10 minutes, which, however, no doubt must be interpreted in the way that the real copulation lasted but short time and that afterwards the male was merely conveyed by the female.

Host.

The breedings above mentioned originate from at least 50 eggs of cicadellids, deposited in *Juncus effusus*. It seems to be a jassid, which with some doubt is referred to the genus *Acocephalus* Germ. (figs. 139, 164 J).

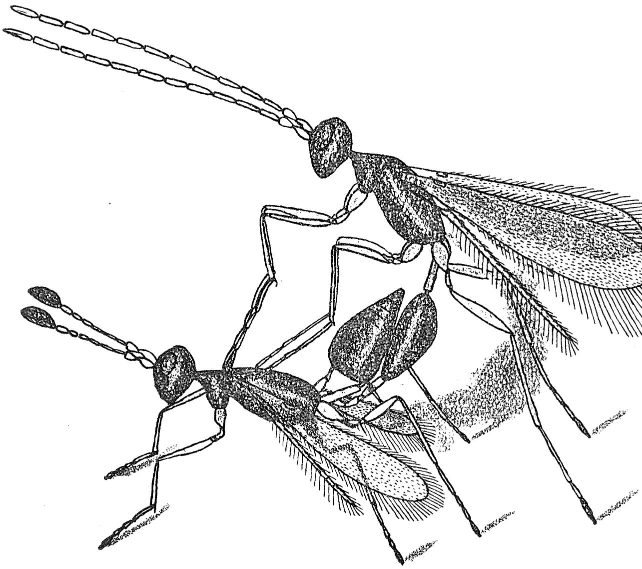


Fig. 102. *Polynema ovulorum* Hal.
Copulating pair, × 30.

Besides, from the egg of a heteropterous insect, placed in *Juncus* (figs. 155, 164 G) and taken on December 29th, 1926 I bred a male on April 26th, 1927.

Cycle.

As will appear from the breedings first mentioned, *Polynema ovulorum* has only one annual generation. Larvae in their first instar, which have hibernated, have still to undergo about 3 months' development — in the aforesaid breedings from April 6th to the beginning of July—, and the whole of the summer is spent for that purpose. On adding the preceding embryonic development the cycle is completed. The imago is, however, very commonly swept not only in the autumn but during all the summer; the reason of this fact is no doubt that there are several stocks. When examining the host-eggs one finds already in the autumn larvae which have attained the second larval or even the pupal instar. It seems as if the development is stopped by the cold in one of the intervals of rest, and that the hibernation takes place chiefly at 3 different stages of the larval development. Those whose development is most advanced emerge first and thus 3 stocks are established during the summer; possibly the development of some individuals which have been especially favoured by sun and heat is accelerated, so that they emerge earlier than others which have hibernated in a younger instar. The stock which is swept at the end of August seems to be the most numerous and to be identical with that which in my breedings emerged early in July.

Polynema microptera n. sp.

This new species may be characterised in the following way:

Polynema microptera n. sp.

Female. Body brownish with darker abdomen. Petiole and legs pale yellow with darker terminal joint of the legs; scape and pedicel pale yellow, funicle and club darker towards apex; the area of the wings strongly reduced. Concerning the dimensions reference is made to fig. 103. Mesopostphragma is reduced, extending only to base of propodeum. Length of body 0,7 mm. Ovipositor short, 0,2 mm. long, not reaching base of abdomen (fig. 104 g).

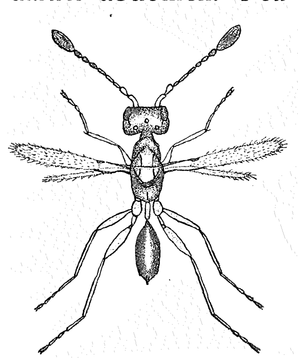


Fig. 103. *Polynema microptera* n. sp. Female, × 30.

This Mymarid which is closely related to *Polynema ovulorum*, is smaller than the latter and besides distinguished by the reduced wings and shorter proximal joints of the antennal funicle.

It is generally swept late in the autumn, for instance in Dyrehaven on August 31st and October 28th, 1923.

The genus Polynema. Table of species.

I have tried to decide which of characters are primitive and which specialised, and in the following tables the most primitive character is mentioned first in order to establish a table corresponding to the natural evolution. For instance it is a fact that the primitive insect groups have slender, multijointed antennae and many veins in the wings. In general it may therefore be inferred that fewer joints and fewer veins are the result of a reduction within a group—and not vice versa. The reductions seem to be prevailing at apical parts and areas, and where a flexion or elbowing takes place. Thus Rimsky-Korsakof (1925) draws attention to the reduction of the apical part of the wing in *Caraphractus reductus* as compared with *Caraphractus cinctus*. The presence of anelli and the occurrence of types with a petiolate abdomen are within the chalcidids likewise well-known phenomena which may be mentioned in this connection.

As far as the antennae are concerned the reduction of the apical part is sometimes combined with another sort of altering. In the Mymarids the males as a rule have long, filiform antennae, whereas the females have a few joints less, but at the same time the female antennae are thickened towards the apex, to form a club consisting of one or a few joints. This shape of the antennae of the female enables her to move them more quickly during the constant search for the host-eggs, and is most probably evolved as an adjustment for this purpose.

The advantage obtained by forming the table in accordance with the above said principle would thus be, that the table, after the settling of the questions about the investigated details, could only be set up in one way corresponding to the natural relationship.

It should be remarked that only the most conspicuous of the species of *Polynema* are embodied in the table. Specimens of *Polynema* are usually caught in great numbers during the summer on each excursion; however, as the species are very much alike, I was not, before beginning my breedings, much interested in ascertaining, which species I got, and no doubt more Danish species may be recognised besides those mentioned in the table. Still I suppose, that the species, which it comprises, represent the greater part of the material generally swept.

Key for determination of the species of Polynema treated above.

1 (2) Female: 1st joint of the funicle more than $1^1/_2$ times as long as the pedicel and as long as 2nd joint of the funicle; species delicate; length 1,1 mm.; legs, petiole and base of antennae pale .... *similis*

2 (1) Female: 1st joint of the funicle as long as the pedicel; 2nd joint of the funicle $1^1/_2$ to 2 times as long as the 1st joint.

3 (10) Legs dark; male: scape and pedicel dark; female: club slender.

4 (9) Female: Ovipositor not projecting far (figs. 104 a – i).

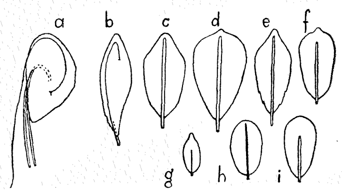


Fig. 104. Abdomen with ovipositor of:
a *Polynema euchariformis,* b *P. longula,* both seen laterally;
c *P. fumipennis,* d *P. fuscipes,* e *P. atratus,*
f *P. pusillus,* g *P. microptera,* h *P. similis,*
i *P. ovulorum,* c—i seen ventrally. × 20.

5 (6) Female: 2nd joint of the funicle $1^1/_2$ times as long as the 1st joint; species larger, length 1,5 mm......... *fuscipes*

6 (5) Female: 2nd joint of the funicle twice as long as the 1st joint; male: antennae $2^1/_2$ to 3 times as long as the thorax (figs. 105 a – e); smaller species.

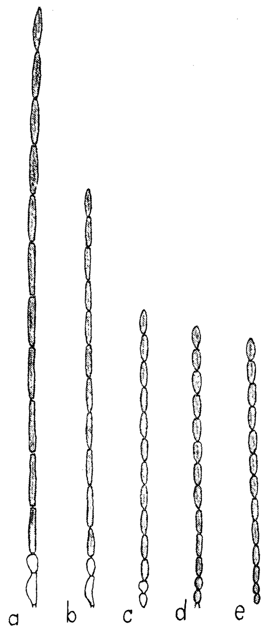


Fig. 105. Antenna of male of:
a *Polynema longula,* b *P. fumipennis,* c *P. ovulorum,*
d *P. pusillus,* e *P. atratus.* × 30.

7 (8) Broader; scutellum rather large; fore wings with a hairless spot at base; ovipositor delicate, hardly projecting; abdomen broad at base; male and female: length 1 mm. *pusillus*

8 (7) More slender; scutellum rather small. Male: scape and pedicel shorter; female: ovipositor commencing at base of the abdomen, distinctly projecting; abdomen narrow at base. Male: length 1 mm., female: length 1,2 mm.... *atratus*

9 (4) Ovipositor projecting as far as half of the length of the abdomen, internally rolled up in a ring; head and thorax short, compressed; abdomen high and narrow; parthenogenetic female: length 1,4 mm................ *euchariformis*

10 (3) Legs pale; male: scape and pedicel pale; female: club rather broad and stout.
11 (14) Male: antennae 4 times as long as the thorax; scape twice as long as the pedicel. Female: 2nd joint of the funicle twice as long as the 1st joint. Species larger.
12 (13) Area of wings with normal pubescence. Male: 1st joint of the funicle twice as long as the pedicel. Length of male 1,4 mm., of female 1,7 mm. . . . . *longula*
13 (12) Area of wings with long pubescence. Male: 1st joint of the funicle $1^1/_2$ times as long as the pedicel. Length of male 1,2 mm., of female 1,3 mm. . . . . *fumipennis*
14 (11) Male: antennae 3 times as long as the thorax; scape as long as the pedicel. Female: 2nd joint of the funicle $1^3/_4$ to $1^1/_2$ times as long as the 1st joint. Species smaller.
15 (16) Wings normal; female: 2nd joint of funicle $1^3/_4$ times as long as the 1st joint; club hardly twice as long as the 2nd joint of the funicle; length of male 1 mm., of female 1,1 mm. . . . . *ovulorum*
16 (15) Wing areas reduced; female: 2nd joint of the funicle $1^1/_2$ times as long as the 1st joint; club almost 3 times as long as the 2nd joint of the funicle. Length of female 0,7 mm. . . . . *microptera*

Corresponding key from a biological point of view.

All species mentioned have only one annual generation. Host eggs unknown: *similis* (spring stock, in localities with birch and heather), *fuscipes* (summer stock, in meadows in woods), *microptera* (late autumnal stock together with *ovulorum*).

1 (6) Parasitic on host-egg in the bark of shrubs and trees (willow and aspen).
2 (5) Bisexual.
3 (4) Host: eggs of a Cicadellid (?*Bythoscopus*) deposited below the buds of *Salix pentandra*); 1 (?perhaps 2) stocks *pusillus*
4 (3) Host: eggs of *Idiocerus (?populi)*, deposited in the shoots of aspen *(Populus tremula)*; 1 annual stock . . . . *atratus*
5 (2) Parthenogenetic. Host: eggs of *Idiocerus (confusus)* in older branches of sallow *(Salix cinerea)*. . . . . . . *euchariformis*
6 (1) Parasitic on host-eggs in low plants *(Juncus)*.
7 (10) 1 annual stock.

8 (9) Bred from a heteropterous egg in *Juncus* .... *longula*
9 (8) Bred from the egg of a Cicadellid (*Acocephalus*) in *Juncus* .... *fumipennis*
10 (7) 3 annual stocks (but only 1 annual generation) in eggs of a Cicadellid *(Acocephalus)* .... *ovulorum*

(?)**Mymar pulchellus** Curtis.

On August 31st, 1927 some small eggs were found in the stalks of dog's tail-grass, *Cynosurus cristatus* L., growing on a dry grass-grown slope in Dyrehaven. They were probably heteropterous eggs (fig. 157). On September 9th a larva in its first instar was taken out of the host-egg (fig. 106). It may possibly belong to the well-known species *Mymar pulchellus*, as this species occurs and may be swept in the same locality. As, however, there is a possibility of a mistake—the larva might be a *Polynema* larva in transition to the second instar—I may note, that there seems to be a difference in the shape of the caudal appendage and in the number of segments between this larva and the larvae of *Polynema*.

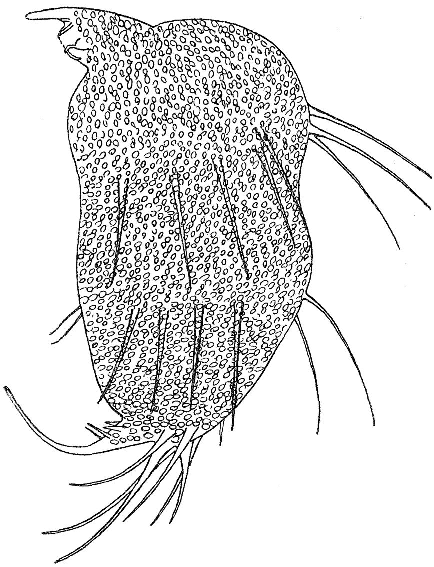


Fig. 106. *?Mymar pulchellus* Curt.
First larval instar, × 282.

A Synopsis of the known larvae of the genera of the family Mymaridae.

Group I.

Second instar: Cylindrical with 2 cephalic outgrowths (1st pair of legs) laterally below the mouth.

First instar (of *Anagrus*): Bag-shaped with clumsy cephalic and caudal parts.

Anagrus.

Second instar: Cephalic outgrowths fingershaped. Pairy ventral outgrowths from the hind body present. Oblique muscles, winding motions and shortening of the ventral surface. Fat cells deep red. Stomach with whitish symbiotic cells. Long, pairy salivary glands opening behind the mouth. The excrements are evacuated by the pupa (or imago?).

First instar: Bag-shaped, with separate, clumsy cephalic and caudal parts (Ganin 1869).

Erythmelus.

Second instar: Cephalic outgrowths very small. No outgrowths from the hind body. Clear white fat-cells. —Stomach yellowish, without symbiotic cells. Lateral muscles, waggling sideways motions. The excrements are evacuated before the pupal stage.

First instar: ?

Caraphractus.

Second instar: Cephalic outgrowths very small. No outgrowths from the hind body. Clear white fat-cells. —Stomach with whitish symbiotic cells. Winding motions (oblique muscles?). The excrements are evacuated by the imago (Rimsky-Korsakof 1925)[1].

First instar: ?

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1) Rimsky-Korsakof (l. c.) mentions that the salivary glands of the larva of *Caraphractus* are small and globular. I should rather believe that the salivary glands are long just as in other My-

Group II.

Second instar: Cylindrical, with a single outgrowth (frontal process) above the mouth, or without outgrowths.

First instar: Cephalic part with frontal process; a slender, stiff and tapering caudal appendage present.

Polynema.

Second instar: Clear white fat-cells. Stomach yellow, without symbiotic cells. Long pairy salivary glands, opening behind the mouth. Larva very movable. Excrements are evacuated at the transition to the pupal stage.

First instar: Body segmentally haired. Frontal process rather long. Mouth small, mandibles parallel. Caudal appendage with tooth. — Body with 7 segments. Caudal appendage geniculate. Sickle-shaped motions.

(?) *Mymar.*

Second instar: ?

First instar: Like Polynema, but body apparently 2-segmented, and caudal appendage curved.

Alaptus.

Second instar: Stomach without symbiotic cells. Yellow fat-cells, arranged in groups. Excrements are evacuated before the transition to the pupal stage.

First instar: Body unhaired. Frontal process small. Mouth great, mandibles directed mediad. Caudal appendage without tooth. – Rather small. Frontal process and caudal appendage small. (Motions?).

Lymaenon.

Second instar: Stomach with symbiotic cells. Long pairy salivary glands, opening behind the mouth. –

---

marids (perhaps in all egg-parasites?); in Rimsky-Korsakof's figure (l. c. fig. 12) a clear area is shown along the stomach, reminding of the long salivary glands of other larvae.

Yellow fat cells. The symbiotic cells become deep yellow. Mandibles close together. Pupa lying in a yellow (excremental) fluid.

First instar: Body unhaired. Frontal process small. Mouth great, mandibles directed mediad. Caudal appendage without tooth. — Rather big. Frontal process and caudal appendage well-sized. Wriggling and boring motions. Caudal appendage straight.

Ooctonus.

Second instar: Stomach with symbiotic cells. Long pairy salivary glands, opening behind the mouth. — Clear white fat-cells. The symbiotic cells become reddish yellow. Mandibles apart from each other. The excrements are evacuated by the pupa (or imago?).

First instar: Like Lymaenon, but caudal appendage is geniculate.

Anaphoidea.

Second instar: Body disciform without outgrowths. Fat cells present in groups.

First instar: ?

Cleruchus.

(It is only stated that the second instar has clear white fat-cells).

Trichogrammidae.

Ophioneurus signatus Ratzeburg.

This trimerous Chalcidoid (fig. 107) is easily distinguished by the blackish grey stigma of the wing, the radius of which is running at a right angle to the anterior margin of the wing. It may be distinguished from some of its allies by having the club and the funicle fused, so that the antennae consist of scape, pedicel, ring joint and a 6-jointed club; moreover the pubescence of the wings is rather distinctly arranged in rows.

Kryger (1918) includes 3 species in the genus *Ophioneurus*. Of these species I had for examination the type specimen of *Ophioneurus danicus* Kr. belonging to the Zoological Museum of Copenhagen. In spite of the funicle and club of antenna being fused I am of the opinion that, on account of the other characters of the wings and the body, it must be referred to the genus *Oligosita* Hal. — With respect to *Ophioneurus germanicus*, described

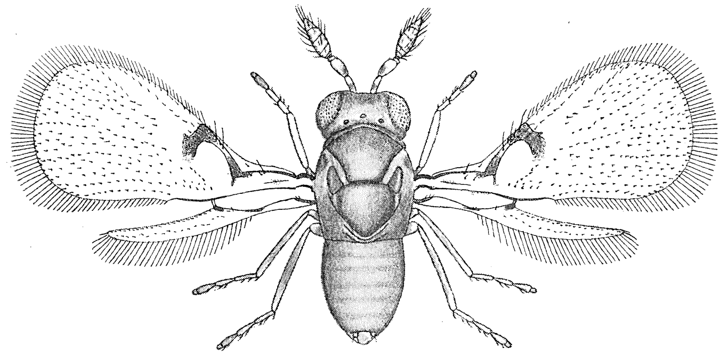


Fig. 107. *Ophioneurus signatus* Ratz.
Male, × 52.

by Girault (1914) by the name of *Lathromerella germanica,* the following characters, viz. the yellow colour of the scutellum and the other dorsal regions, together with the long marginal hairs, the length of which is up to $^1/_3$ of the width of the wing, seem to show that the species in question cannot be referred to *Ophioneurus.* — The only species left within the genus is then *Ophioneurus signatus* described (1852) by Ratzeburg. It is known from England (Kryger), Germany and Denmark (including Bornholm).

Ganin (1869) records that he has bred an *Ophioneurus sp.* from eggs of *Pieris brassicae*; the species must according to the somewhat diagrammatic figure be referred to *Trichogramma evanescens* Westw. It is worth noting that Ganin mentions the salivary glands to be half the length of the larva and draws them accordingly, while Silvestri (1909) does not mention salivary glands in *Oophthora semblidis* Aur. (= *Trichogramma evanescens*). This also applies to Gatenby's investigations (1917) of *Trichogramma evanescens*.

After the completion of the present paper I had an opportunity of becoming acquainted with a little known paper of F. de Filippo (1861); it presents itself as a correction (concerning his having mistaken the head for the apex of abdomen) of a preceding paper (1852) which I do not know. His figures of the larva of *Ophioneurus*, which no doubt is identical with *signatus*, are fairly well in accordance with mine, and even Filippo observed the closed gut, the two larval instars etc.

Development.

I did not succeed in following the development of the larva fully up to the emerging of the imago, but in several cases I followed the transition from the first to the second instar and from the second instar even to the imaginal stage, so that I have no doubt about its identity.

On June 5th, 1927 in Frerslev Forest I found on birch some leaves rolled up by the weevil *Rhynchites betulae*. In each of 3 of the eggs of *Rhynchites* I found a larva in its first instar (fig. 108). One of the larvae moved vivaciously in the egg-mass; its movements were jerky and turning. The next morning the movements ceased gradually and the larva kept quiet just like the two others. The larva was conical, if anything, and had a stiff caudal appendage. The body was divided in 3 regions: an anterior rostriform one with the mouth orifice at the tip, a median one containing the stomach which lay towards the dorsal side, and a posterior thinner region divided in 5 segments, a character found in many larvae of the cyclopoid type. On the dorsal side of the last segment a long, stout spine was present, which assists in the forward motion. The preceding segments and the anterior part of the under side of the body was provided with segmentally arranged hairs, and on the under side of the caudal appendage there was a stout tooth. Gradually the stomach swelled to some extent so as to reach

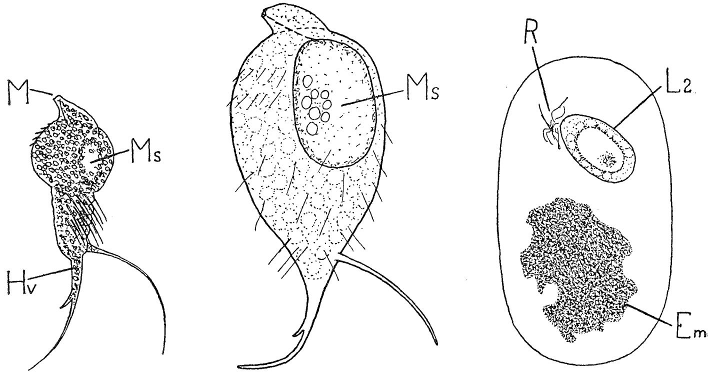


Fig. 108. Fig. 109. Fig. 110.

Ophioneurus signatus Ratz.

Fig. 108. First larval instar, × 188. Fig. 109. Older first larval instar, × 188. Fig. 110. Second larval instar with remainder of cuticle of first instar within the host egg, × 80.

somewhat down into the narrow posterior region; now the whole body became dilated causing the segmentation to be evanescent (fig. 109). On June 10th the 3 larvae had moulted and assumed their 2nd instar. The cast cuticle was seen to lie at the apex of the abdomen. Shortly after the development ceased on account of an error incurred in keeping the larvae (vaseline was used for the isolation). I also found this instar in 1928 and 1929. It is easiest found early in June when the weevil has just commenced to make its rolls, which generally contain 2 or 3 eggs, each of which is disposed in a small pocket-like cleft below the epiderm of the leaf.

During the movements of the larva in its first instar a bright region is formed around it, so that at the time of moult it often happens to lie in a bright fluid, while the embryo of the beetle is concentrated in a shapeless mass (fig. 110). After the moult the larva has in its second instar become totally bag-shaped and somewhat wider anteriorly (fig. 111). Anteriorly the mouth and the

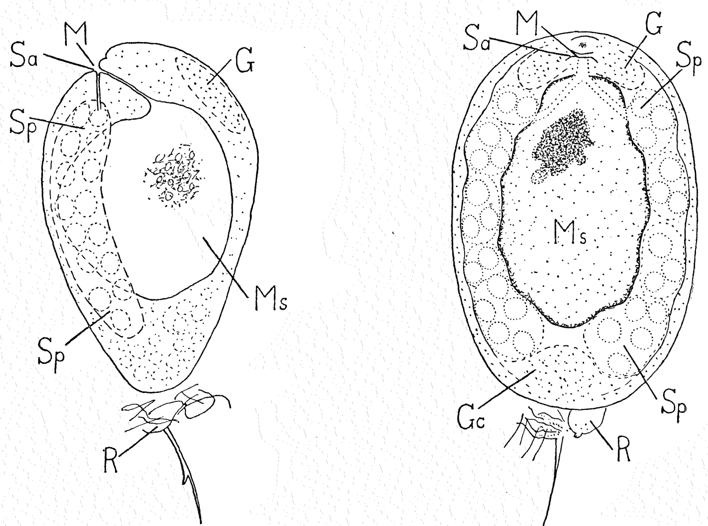


Fig. 111. Fig. 112.

Ophioneurus signatus Ratzeburg.

Fig. 111, second larval instar, lateral view; Fig. 112, ventral view, × 188.

oesophagus are seen, the latter leading to the stomach (mid gut) which is closed behind. Above the orifice of the mouth there is a soft lip for imbibing purpose, while I could not see the mandibles until later on. On the labium, just inside the mouth, the joint duct of the paired salivary glands opens; the salivary glands extend alongside the stomach and nearly attains the posterior end of the body (fig. 112). I did not follow their development, but I suppose that they are foreshadowed already in the first instar. Above the anterior part of the gut two granulated lobate bodies are seen situated near the dorsal wall; no doubt they may be interpreted as the brain. At the apex of the abdomen the cast cuticle is adhering. Some of the muscles may be seen to contract, and they appear to be arranged segmentally.

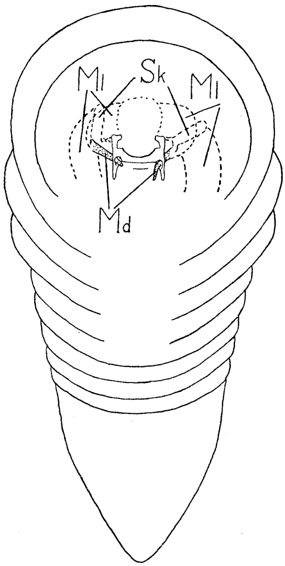


Fig. 113. *Ophioneurus signatus* Ratzeburg.
Second larval instar, taken out of the host-egg, × 188.

Later on I succeeded in taking out of the host-egg a somewhat bigger larva, which after being taken out appeared to be distinctly segmented (fig. 113). The head is succeeded by 3 broader thoracic and 5 a little narrower abdominal segments, and finally a rather long posterior region, which latter perhaps includes several segments. The two mandibles which now could be discovered were moved alternately; their bases are so deeply invaginated in the head that only the tips are projecting from the surface, each tip through a hole in a sclerit, which latter is connected with the corresponding one on the other side through a transverse rodlike sclerit. To the side of the handle-like base of the mandible a contractor muscle was attached, extending caudad in the body; another muscle (retractor) was attached in prolongation of the mandible and running closer to the under side forward and somewhat mediad.

The larva lying in the host-egg soon after the moult absorbs the remainder of the egg-mass, so that in the course of a few days it fills up the egg. Now and then it swallows and moves, which is most easily observed at the time when the last remains of the yolk is passing around it. On rolling the egg below a cover-glass we observe a characteristic figure just beneath the surface of the larva; this figure signifies the salivary glands which now have been pressed quite flat by the stomach (fig. 114); below the mouth the salivary duct is seen, which bifurcates at a short distance from the mouth, and each branch widens suddenly to form the salivary gland, which pre-

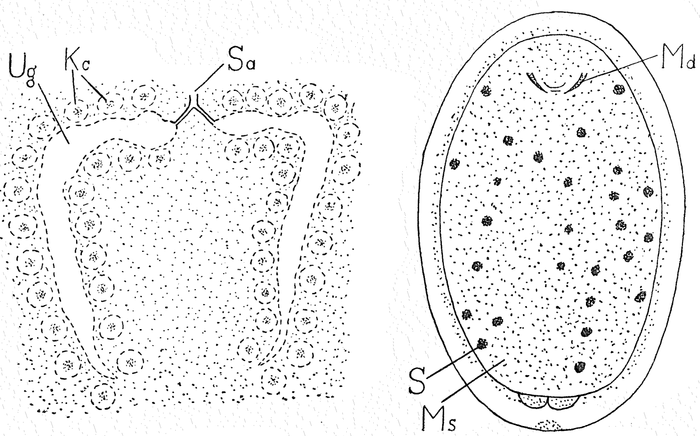


Fig. 114. Fig. 115.

Ophioneurus signatus Ratzeburg.

Fig. 114, second larval instar. Salivary glands, somewhat pressed, × 94.
Fig. 115, older second larval instar, slightly pressed, × 80.

sents itself as a bright channel, tapering terminally and outlined by two rows of big cells; the two glands turn at first sideways and are then rather suddenly bent and point backward, extending nearly to the apex of the abdomen.

Now the movements cease totally, fat-cells are foreshadowed and "symbiotic" cells appear as dark patches on the wall of the stomach (fig. 115); by incident light the patches look whitish. Simultaneously the host-egg assumes a granulate, yellowish grey appearance and becomes intransparent, so that the transition into pupa and imago cannot be observed. This opaqueness seems partly to be due to delicate water-drops adhering to the inner side of the egg-shell, as the air no doubt has penetrated this latter. After the expiration of about 3 weeks the egg becomes darkish in consequence of the chitinisation of the imago, and a few days later the imago emerges.

After emergence the imago is seen running about with folded up wings, and not until several hours after the emergence the wings are unfolded and fit for flight. It may furthermore be noted that the empty shell of the host-egg keeps its yellowish grey colour and does not collapse after the wasp has forced its way out.

Copulation.

On July 8th, 1928 3 fresh emerged males were brought together with a female, which had been fed with sugared water and had been put together with a male since a few days. The males introduced the copulation by applying themselves on the back of the female, and after performing some peculiar rocking movements sideways they caused themselves to slide backwards, taking up an oblique position below the female, after which the copulation took place, lasting in each case 10 to 15 seconds. After the copulation the male roamed about for a short while, while the female passed the ovipositor to and fro between the sheaths and shed a small portion of fluid from the apex of the ovipositor. The ovipositor was protruded as far from the sheath as the length of the latter.

The males made attemps to copulate *inter se.*

Host.

As mentioned above the host is a weevil, *Rhynchites betulae,* which deposits its eggs in rolled up leaves of birch and sometimes of alder. As the wasp seems only to be swept where the said host occurs, it must be supposed to be monophagous.

Cycle.

According to the information on hand *Ophioneurus signatus* has apparently 3 generations a year, viz. one in the winter, one in June, and one in July. Some of my breedings are specified below. The attack in Frerslev Forest in 1927 took place from June 5th to June 12th, and the imagines emerged about June 30th to July 4th, i. e. about a month later. The next brood from the same locality emerged after the expiration of another month, viz. about August 1st; then the breeding ceased, although I could still find fresh larvae of the parasite; so at this rather early point of time at which the host, too, ceases to lay eggs, the hibernation of *Ophioneurus* commences. Kryger (1918) gives the result of his extensive breedings of the June-generation, culminating on June 26th; he also swept specimens of this species in September, which specimens may have been representatives of the hibernating generation, appearing at a too early time.

Breedings.

No. 1. On June 12th, 1927 in Frerslev Forest leaf rolls of *Rhynchites betulae* ware taken on birch.

On June 23rd	5 eggs were isolated on filter-paper
On June 30th	2 Ophioneurus (1 male, 1 female) emerged
On July 1st	1 Ophioneurus (female) emerged
On July 2nd	1 Ophioneurus (male) emerged
On July 4th	1 Ophioneurus (male) emerged.
Total outcome:	3 males and 2 females.

No. 2. On July 17th, 1927 in Frerslev Forest leaf-rolls of *Rhynchites betulae* were taken on birch.

On July 27th	1 Ophioneurus (female) emerged
On July 28th	1 Ophioneurus (female) emerged
On August 3rd	1 Ophioneurus (male) emerged
Total outcome:	1 male and 2 females.

No. 3. On June 23rd, 1928 in Frerslev Forest leaf-rolls of *Rhynchites betulae* were taken on birch.

On July 6th 2 Ophioneurus (1 male, 1 female) emerged

On July 8th 3 Ophioneurus (males) emerged

On July 9th 4 Ophioneurus (2 males, 2 females) emerged

On July 10th 4 Ophioneurus (females) emerged

On July 14th 1 Ophioneurus (female) emerged.

Total outcome: 6 males and 8 females.

No. 4. On July 26th, 1927 in Rude Forest leaf-rolls of *Rhynchites betulae* were taken on birch.

On July 27th 1 Ophioneurus (female) emerged.

Sweepings.

On June 8th, 1924 in Frerslev Forest, 1 female,

On June 12th, 1927 in Frerslev Forest, 1 male, 1 female,

On July 17th, 1927 in Frerslev Forest, 1 female,

On July 24th, 1927 at Sandkroen near Frederiksværk, 3 males,

On August 5th, 1928 in Rø plantation in Bornholm, 1 female.

Chaetostricha pulchra Kryger.

Kryger (1918) describes as belonging to the genus *Chaetostricha* Walk. 4 species, viz. *werneri* Kr., *schlicki* Kr., *dimidiata* Hal. and *pulchra* Kr., of which, at the Zoological Museum of Copenhagen, I had the opportunity to re-examine the original material of *C. werneri* Kr. and *C. schlicki* Kr. In these two species I was unable to ascertain the longitudinal lines on the abdomen, which Kryger emphasise as a main character for the genus. *C. dimidiata* Hal. is very difficult to identify, but the dark colour on the basal half of the wing suggests some relation to *Lathromeris scutellaris* Först. At any rate these 3 species are so different from the 4th species, *pulchra* Kr. that the latter can hardly be placed together with the 3 others.

in the same genus; as however, the characters of *pulchra* are in full accordance with Kryger's diagnosis of *Chaetostricha* I consider this latter to be the genus name to be reserved for *pulchra* Kr.

Chaetostricha is at once distinguished from *Brachista* —no doubt its closest relative—by the yellow colour and the dark transverse bands on the abdomen, moreover by the rather long marginal hairs, and in the male by the

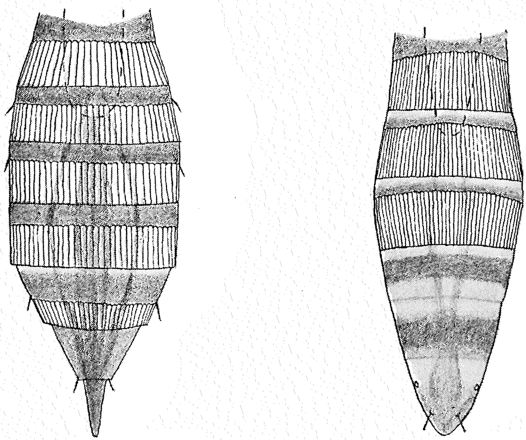


Fig. 116. Fig. 117.

Chaetostricha pulchra Kryger.

Fig. 116, abdomen of average sized female, × 90.
Fig. 117, abdomen of male, × 90.

yellow, indistinctly bounded patch on the fore wings, whereas *Brachista* appears black and has short marginal hairs on the fore wings. Common to both genera is the striped margin of the abdominal segments, which character is not present in *Oligosita, Prestwichia* and other trimerous chalcidids. The colour of *Oligosita* to some degree resembles that of *Chaetostricha* except that its abdomen is without the transverse bands characteristic to the latter. The dark-coloured *Prestwichia* can hardly be confounded with it.

The aforesaid 4 genera possess only one, more or less distinctly marked, funicular joint in the antenna, whereas in the other Trichogrammids the funicle is generally 2-jointed (if this is not the case and the joints of the antennae fuse, the hairs on the wing surface are arranged in distinct rows, or there are short marginal hairs on the fore wing).

The longitudinally striped hind margin of the abdominal segments is in the female of *Chaetostricha pulchra* present on 5, and in the male on 3 segments (figs. 116, 117). The female of *pulchra* is besides larger (average length of female 1,0 mm., of male 0,9 mm.) and has darker markings.

Development.

A female of *pulchra* taken on August 2nd, 1925 in the enclosure of Fortunen, contained about 20 eggs in her ovary. Their pedicel was hardly half as long as the broader main part of the egg.

A few times I found eggs of *pulchra* deposited in the eggs of *Tettigonia,* placed within these latter near the tip (fig. 118).

The following statements of the larval development are based upon breedings partly from egg to full-grown larva, and partly from larva to imago, so that there can hardly be any doubt about the identity of the observed instars. The smallest larval instar which I saw and which I think justified in referring to *pulchra* was from eggs of *Tettigonia viridis* in *Juncus effusus* L. taken on August 19th, 1928 in Præstevangen near Hillerød. It looked as if the larva had not yet absorbed any food; it was bag-shaped and the orifice of the mouth and the proctodaeum were foreshadowed (fig. 119); a darker region was visible (pale by incident

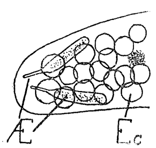


Fig. 118. *Chaetostricha pulchra* Kryger. 2 eggs deposited in the host-egg. Ec, cells of the host-embryo. × 40.

light), apparently lying in the cavity of the body. The larva was somewhat flattened and broader posteriorly. On another larva (fig. 120) the mouth and oesophagus were seen, leading to a minute stomach-cavity. This larva lay motionless. However, another, somewhat older larva, taken on September 8th, 1928 moved vivaciously in the egg-mass and advanced rather quickly within this by incessantly altering the shape of its body. It quickly swal-

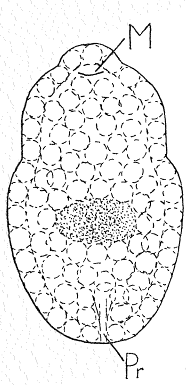


Fig. 119.

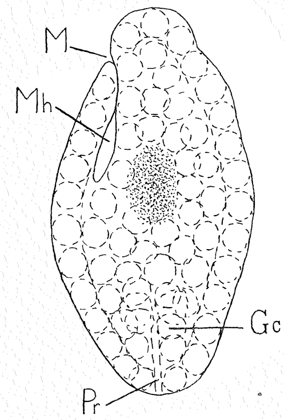


Fig. 120.

Chaetostricha pulchra Kryger.

Fig. 119, freshly hatched larva, seen ventrally; Fig. 120, seen laterally, × 188.

lowed the contents of the egg, and its body became dilated (fig. 121). This state of movability no doubt lasts a few hours only; when the larva has again come down into quietness it continues swallowing food, so that the wall of the body becomes still more dilated and its cells flattened (fig. 122). Below the mouth a pair of mandibles are seen (figs. 123, 124) each of which is provided with a minute tooth on either side at base. It is, however, very difficult to discover the mandibles on account of their minuteness and pale colour. Gradually the larva assumes the shape of a vesicle (fig. 125) with only a minute protuberance projecting above the mouth. The larva is now seen freely suspended in the yolk (fig. 126).

The length of this period of the development is 3 to 4 days; the larva then continues absorbing the egg-mass, which in the course of a fortnight in August was entirely

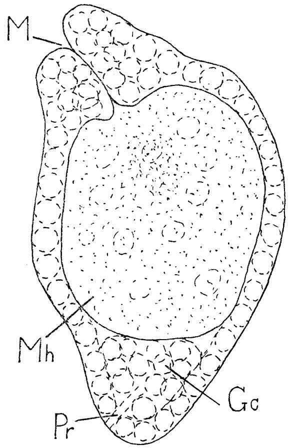
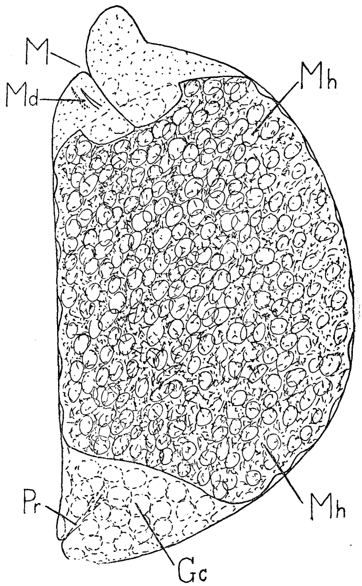
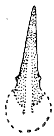


Fig. 121.





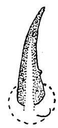


Fig. 123. Fig. 124. Fig. 122.

Chaetostricha pulchra Kryger.

Fig. 121, somewhat older, mobile larva, × 188. Fig. 122, still older larva, × 188. Fig. 123, Mandible of the latter, × 455. Fig. 124, the same, lateral view, × 455.

devoured. Usually two full-grown larvae are found in each egg (fig. 126); rarely 3 to 4 larva or a single larva is found in an egg. When the two larvae have attained to occupy the whole space of the egg, their meeting terminal parts are flattened (fig. 127) and they pass each other somewhat, so that the host-egg seems to be divided in two parts, separated by an oblique circular line (fig. 128). On the wall of the stomach dark points are now foreshadowed (fig. 129), which by incident light look whitish. They are "symbiotic" cells like those mentioned p. 120. Also yellowish fat-cells commence to appear, and two v-shaped bright regions become recognisable, one behind the mouth and another near the apex of the abdomen; they may be interpreted as salivary glands and rudiments of the reproductive organs respectively. The infested host-eggs now assume a greyish appearance and become intransparent; they, however, keep a faint shine. At this time, about a month after the infesting took place, the further development of the parasite stops, and the larva is going to hibernate and may still be found late in the next spring. In this stage the larva is difficult to take out of the host-egg, because it adheres to the

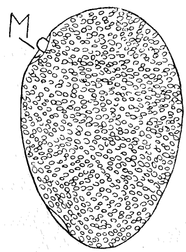


Fig. 125. *Chaetostricha pulchra* Kryger.
Older larva submitted to a slight pressure. × 40.

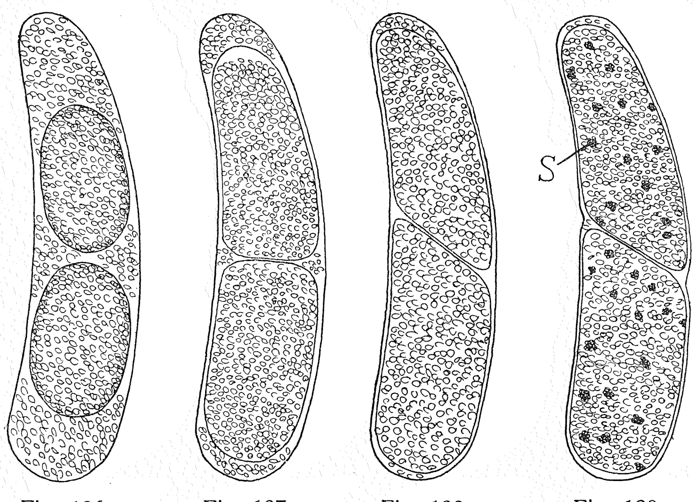


Fig. 126. Fig. 127. Fig. 128. Fig. 129.

Chaetostricha pulchra Kryger.
Successive developmental stages of 2 larvae in one host-egg. × 40.

shell of the latter. As will appear from the above statement no moult seems to take place in the larval stage.

The pupa is foreshadowed in the larva during the spring, but the "Anlage" was not observed, as the egg-shell is intransparent. The pupae remain during the summer in the infested eggs still present in the one year old stems of *Juncus*. The latest dates at which I saw the pupae were on July 18th, 1926 at Ryget, and on July 30th, 1926 in Kelstrup plantation in Sleswick.

The imago emerges early in August; in 1927, however, it emerged later, as 20 specimens from Ekkodalen, Bornholm, emerged in the last half of the same month. The shell of the host-egg does not collapse after the parasite has gnawed its way out, such as is the case in *Anagrus*. The excrements are left within the egg.

Copulation.

On June 11th, 1926 the copulation of bred individuals was obserwed twice. The male introduces the copulation by thrusting at the female with its antennae; as soon as she becomes quiet the male tries to come behind her, while at the same time he taps her wings with his antennae. From a small distance he bends the abdomen along his under side so as to make it project in front of the head, and in this position he approaches the female (fig. 130) until the apices of their abdomens touch each other, and the copulation, which lasts half a minute, takes place. The abdomen of the male is stretched considerably, almost reaching double its original length.

When two males (their sex easily recognised by the yellow wingpatch) encountered, they performed a sort of "cock fight", each of them trying to come behind the other. The result was frequently that one of them took up a mating position.

On comparing the copulation of this species with that of *Ophioneurus* or of the Mymarids one will recognise an important difference, the introducing position on the back of the female has been given up and the female is not taken hold of during the copulation.

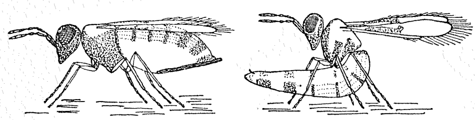


Fig. 130. *Chaetostricha pulchra* Kryger.
Male and female in position for copulation. × 20.

Oviposition.

On September 10th, 1928 I succeeded in observing the egg-laying (fig. 131). The female moves her antennae slowly and cautiously along the egg-slit of *Tettigonia* and advances somewhat; when having orientated herself as to the direction, she retires a few steps and then without turning she walks a few steps sideways so as to get entirely free of the egg-slit; then the ovipositor is put in position and bored down full length in the course of 2 to 3 minutes. After a boring she sometimes advances parallel to the egg-slit, searching with the antennae and then boring the ovipositor down again; now and then she goes again to the egg-slit for orientating herself in the same manner as before.

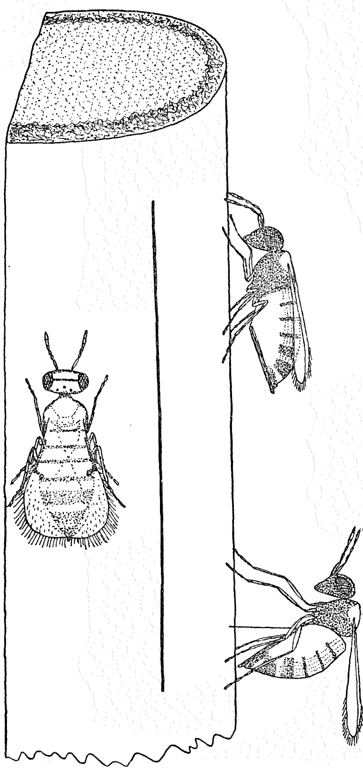


Fig. 131. *Chaetostricha pulchra* Kr.
3 females during oviposition. × 20.

This mode of procedure corresponds to the fact that the eggs of *Tettigonia* are as a rule thrust somewhat obliquely and so deeply that their tips are not lying immediately below the egg-slit.

Host.

As far as I know *Ch. pulchra* was bred the first time by the author in 1925. In contradistinction to its competitor, *Anagrus incarnatus* Hal., it seems to be monophagous, as it was found infesting only eggs of *Tettigonia viridis* (figs. 138, 164 D) in *Juncus effusus* L. and it is swept in corresponding localities. It was never found in the large material of eggs of *Conomelus limbatus* which I had before me for my investigations of the said species of *Anagrus*.

Cycle.

To judge from my hatchings and sweepings *Ch. pulchra* seems to have only one generation a year. The fact is that the imago is not swept in the spring and the summer in the localities where at a certain time of the late-summer it may be swept rather abundantly; it was thus swept on August 24th, 1924 at Ryget Forest (where Mr. Kryger called my attention to it), on August 3rd, 1926 (12 females) at Søgaard Lake in Sleswick, on August 22nd and 28th, 1926 in Præstevangen near Hillerød, on September 3rd, 1923 near Fortunen (1 specimen creeping on *Juncus*), on August 28th, 1927 (5 females) at Ryget, on September 10th, 1927 (3 females) in Præstevangen, and on September 15th, 1927 (1 female) at Fortunen. During the remainder of the year infested host-eggs may easily be found, thus in the summer in the dead, one year old stems of *Juncus*, until the emerging commences early in August.

Besides it will be seen from the breeding no. 1 below that from February 8th it required being kept more than 3 months in room temperature for the development, and breeding no. 2 required $1^{1}/_{2}$ months from the date of finding, May 17th. Breeding no. 4 from July 18th together with no. 3 form supplements to this picture.

Ch. pulchra thus seems to require much heat for its development in this country, and 2 females which I swept on October 3rd, 1926 in Præstevangen near Hillerød must no doubt be considered as lingerers, which perhaps on account of a colder place in the shade have emerged later than the majority of the specimens. I may also note that I kept a specimen alive in captivity for more than a fortnight.

Breedings.

No. 1. On February 8th, 1925 at Springforbi I took eggs of *Tettigonia viridis* from *Juncus effusus* and isolated them.

On May 17th 1 Chaetostricha pulchra emerged
On May 18th 2 Chaetostricha pulchra emerged
On May 19th 2 Chaetostricha pulchra emerged
On May 20th 1 Chaetostricha pulchra emerged
On May 21st 2 Chaetostricha pulchra emerged.
Total outcome: 8 specimens.

No. 2. On May 17th, 1925 at Ryget I took about 70 infested eggs of *Tettigonia viridis* from *Juncus effusus* and isolated them on moist filter-paper.

On June 27th 7 Chaetostricha pulchra (males) emerged
On June 28th 1 Chaetostricha pulchra (male) emerged
On June 29th 5 Chaetostricha pulchra (4 males, 1 female) emerged
On July 1st 2 Chaetostricha pulchra (1 male, 1 female) emerged
On July 2nd 2 Chaetostricha pulchra (females) emerged
On July 3rd 19 Chaetostricha pulchra (7 males, 12 females) emerged

On July 4th 6 Chaetostricha pulchra (1 male, 5 females) emerged.

No further individuals appeared between July 4th and September 27th, so the breeding was considered as concluded, presenting a total outcome of *Chaetostricha pulchra* of 21 males and 21 females.

No. 3. On April 2nd, 1926 at Springforbi I took eggs of *Tettigonia viridis* containing larvae of *Ch. pulchra* and isolated them on filter-paper.

On June 7th 1 Chaetostricha pulchra (female) emerged

On June 8th 2 Chaetostricha pulchra (1 male, 1 female) emerged

On June 9th 2 Chaetostricha pulchra (males) emerged

On June 10th 26 Chaetostricha pulchra (12 males, 14 females) emerged

On June 11th 12 Chaetostricha pulchra (10 males, 2 females) emerged

On June 12th 10 Chaetostricha pulchra (6 males, 4 females) emerged

On June 14th 3 Chaetostricha pulchra (1 male, 2 females) emerged

On June 15th 1 Chaetostricha pulchra (female) emerged

On June 16th 3 Chaetostricha pulchra (2 males, 1 female) emerged

No further individuals appeared between June 16th and 25th, so the breeding was considered as concluded, presenting a total outcome of *Chaetostricha pulchra* of 34 males and 26 females.

No. 4. On July 18th, 1926 at Ryget I took pupae of *Chaetostricha pulchra* in eggs of *Tettigonia viridis*. The imagines emerged early in August.

Sweepings.

I have had the opportunity to examine Kryger's original material of swept Danish specimens of *Chaeto-*

stricha pulchra, preserved in the Zoological Museum of Copenhagen.

The material included 93 specimens, all females. 26 dates of capture from 1906 to 1918 were stated. 86 of the specimens proved to be captured during 21 days in the period from August 1st to 15th, whereas the remaining

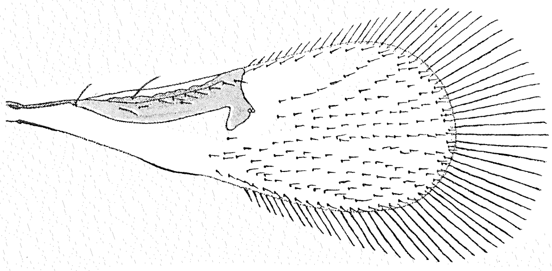


Fig. 132. *Chaetostricha pulchra* Kryger.
Forewing of male. × 90.

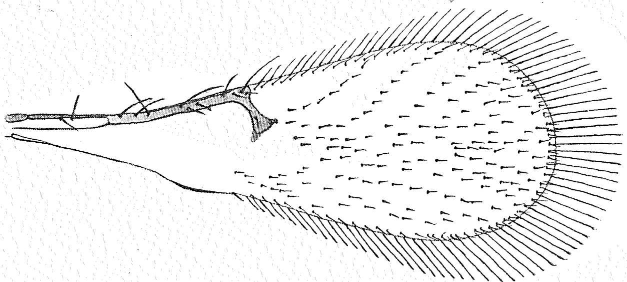


Fig. 133. *Chaetostricha pulchra* Kryger.
Fore wing of female. × 90.

7 specimens were taken on July 12th, 27th, 29th, August 30th, and September 11th, respectively. These dates seem to agree very well with the above statements as to the time of emerging.

Distribution.

Chaetostricha pulchra and its host, *Tettigonia viridis* are distributed all over Denmark and are common in all meadows in forests with *Juncus effusus* L.; as such localities, however, are generally isolated from each other the occurrence of the species is somewhat local.

According to kind information received from Mr. Kryger it is found also in England and Poland.

Sexual dimorphism.

It appears from the rather large bred material which was at my disposal that the enlargement of the marginal vein into an indistinctly bounded yellow patch is characteristic of the male (fig. 132), whereas in the female the said vein is normal (fig. 133). I was unable amongst the females of the material belonging to the Zoological Museum of Copenhagen to find any with wings like that drawn by Kryger (1918, fig. 16 A), whereas amongst the material a single male was present which seemed to agree with the said figure.

Variation.

The bred individuals vary considerably in size, for instance in breeding no. 3 the length of the body varies from 0,5 to 1,1 mm. and the other measures vary proportionally with this. The male figured in fig. 134 having short antennal clubs with 1 and 2 joints respectively must no doubt be interpreted as a pygmy specimen, owing its minuteness to want of food during the larval period. Very small larvae are frequently seen lying besides big ones; these small larvae have been behind in their development and have not succeeded in being filled with yolk.

It is remarkable that in the pygmy specimen of *Ch. pulchra* above mentioned the 3 terminal joints of the antennae, which normally (figs. 135—136) constitute the club, in the one antenna are fused to one and in the other antennae to two joints. Moreover the club is strongly shortened, whereas other alterations of this specimen are not considerable. It may be supposed that the alteration of the club in question has taken place in the pupal instar.

Previously I collected some males of *Anagrus incarnatus* likewise distinguished by having misshaped antennae, in which especially the first and the second of the four ter-

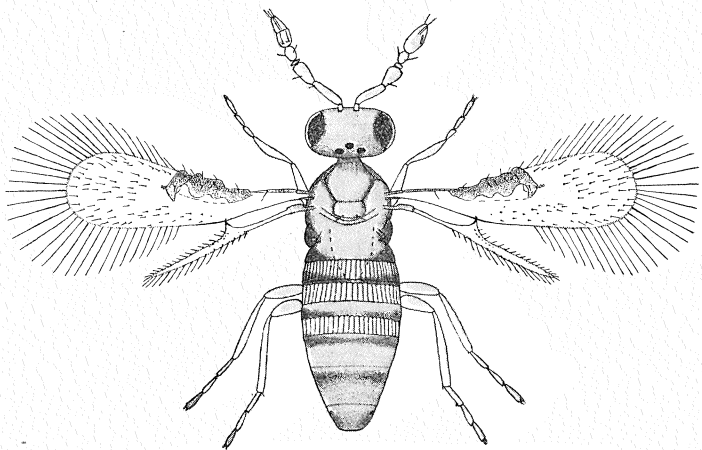


Fig. 134. *Chaetostricha pulchra* Kryger.
Male, pygmy specimen; the one antennal club 2-, the other 1-jointed. × 85.

Fig. 135.

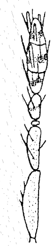


Fig. 136.

Chaetostricha pulchra Kryger.
Fig. 135, antenna of average sized male, × 90.
Fig. 136, antenna of female, × 90.

minal joints show a tendency to fuse into one deformed joint. Most likely such deformities may be caused when the development takes place in small host-eggs; the antennae of the male, which in contradistinction to those of the female are longer than the body, in the pupal instar lie bent just at that point. The fact that the animal is quite soft when the first »Anlages« of the pupa are seen also applies to *Ch. pulchra.* The joints of the antennae may therefore be imagined to behave like drops tending to assume a globular shape; the median antennal joints, however, are held in position by the adjacent joints, and thus gain a certain resisting power which the terminal joints lack. When the animal owing to want of food is below a certain size, the possibility that an inner contractive power tends to reduce just the apex of the antennae is prevalent. That the antennal joints of these minute animals may be considered as vesicular is best seen, when sometimes mounted specimens become exsiccated and shrunk.

This pygmy specimen thus shows that characters of the apex of the antennae must be judged with a certain degree of caution and always in comparison with the other characteristics of the animal.

Oligosita nudipennis Kryger.

Of this species I am able to present the following breedings from twigs of *Alnus glutinosa* containing eggs of a cicadellid, *Typhlocyba sp.*, taken on March 28th, 1926 at Kobberdammene near Bagsværd.

From April 10th to 13th	several cicadellid larvae hatched
On June 1st	2 Oligosita nudipennis (males) emerged
On June 4th	1 Oligosita nudipennis (male) emerged
On June 6th	1 Oligosita nudipennis (male) emerged
On June 7th	2 Oligosita nudipennis (females) emerged
On June 12th	1 Oligosita nudipennis (female) emerged
On June 15th	3 Oligosita nudipennis (females) emerged

Total outcome: 4 males and 6 females.

According to the sweepings there seems to be one generation a year, which emerges in August.

The eggs of the host, *Typhlocyba* (fig. 141) were very difficult to remove from the wood of the twigs, and the larva of *Oligosita* was not found. Other species of *Oligosita* occur in a lot of different host eggs which are not dependent on alder, and which most probably may present a material better adopted for studying the morphology of the *Oligosita* larva.

A Synopsis of the known larvae of the genera of the family Trichogrammidae.

Ophioneurus.

Second instar: Bag-shaped. Bright fat cells? Stomach with whitish "symbiotic" cells. Long paired salivary glands, opening in the mouth on the labium. One larva fills the host-egg.

First instar: Cephalic region rostriform with the mouth at the tip. Caudal appendage stiff, with a ventral tooth. Segmentally arranged hairs. A long dorsal spine on last segment. Jerky, turning movements.

The deserted host egg yellowish grey, intransparent.

Poropoea.

(5 larval instars have been described by Silvestri, but as he has only seen 1 moult, only 2 instars may be recognised here—as in *Ophioneurus.*)

Second instar: Bag-shaped. One larva in each host egg (Silvestri 1916).

First instar: Like *Ophioneurus*, but no dorsal spine on last segment (Silvestri 1916).

The deserted egg yellowish grey, intransparent (Stollwerk 1857).

Chaetostricha.

Only one larval instar: Bag-shaped. Yellowish fat-cells. Stomach with whitish "symbiotic" cells. Generally two, obliquely lying larvae in each host-egg. The young larva moving vivaciously.

The deserted host egg yellowish grey, intransparent.

Trichogramma.

Only one larval instar: Bag-shaped, long salivary glands (Ganin 1869). Generally several larvae in each host-egg (Kryger 1918). The young larva moving (Gatenby 1917).

Prestwichia.

Only one larval instar: Bag-shaped. Salivary glands open somewhat behind the mouth. Excrements evacuated at the transition into pupa. Generally several larvae in each host egg (Henriksen 1918).

Symbiotic cells in Mymarid and Trichogrammid larvae.

During my investigations of the second larval instar of *Ooctonus heterotomus* I observed in the wall of the stomach a number of peculiar blotches, which formed protuberances projecting slightly into the body-cavity. The blotches were dark, but appeared pale by incident light. A dissection of a larva showed that each blotch was a single cell, the contents of which was somewhat different corresponding to the age of the larva.

As I had not got much material of this species, I took, in January 1930, random samples of second instar larvae of *Anagrus incarnatus* and *Chaetostricha pulchra*, both of which possess similar cells. At an early time of the second instar each of the cells in question is seen to contain a lump of oval bodies, which may be particles of excretional nature or rather microorganisms; these bodies are in vivacious motion in the central part of the cell, the wall of which is distinctly recognisable (fig. 70). Subsequently the number of these bodies increases (fig. 71) and in the middle of the cell vesicles (vacuoles) arise, the contents of which may be guessed to consist of some gas. Gradually the cell increases in size and many vacuoles arise (fig. 72), while at the same time the motion of the supposed microorganisms almost ceases, and the wall of the cell is now hardly to be discerned from the contents. At this time the cells obtain the characteristic appearance of dark blotches, which by incident light are whitish*) (in *Ooctonus* and *Lymaenon*, which also possess such cells, however yellow), and, except in *Lymaenon*, they become later on more intensively coloured, thus in *Ooctonus* reddish yellow.

Such blotches in larvae of egg-parasites are, as far as I know, only mentioned by Rimsky-Korsakof (1925) and Ganin (1869). The former has made a drawing of them in the larva of *Caraphractus*; he terms them concrements which are afterwards removed through the anus. Ganin writes as to *Anagrus* ("Polynema sp." Ganin) about "eine Menge von besonderen kugeligen schwarzen und ganz undurchsichtigen Ablagerungen in Folge dessen die Durchsichtigkeit des Larvenkörpers mehr und mehr abnimmt". Rimsky-Korsakof mentions the effect of incident light, which is not mentioned by Ganin.

In the present paper the normal presence of these cells is stated within several genera, viz. besides *Caraphractus* and *Anagrus* mentioned above, also in *Lymaenon*, *Ooctonus*, *Ophioneurus* and *Chaetostricha***). Contrarywise the cells seem to be absent in the larvae of *Erythmelus*, *Polynema* and *Alaptus*, which genera are for the rest the most fully treated here. Some of the observations are recapitulated below in order to give some reasons for the use of the term "symbiotic cells" for them.

In *Lymaenon effusi* the "symbiotic cells" are followed from their appearing at the beginning of the second instar; they were light yellowish (by incident light) and became most intensively coloured before the moulting into pupa. At this latter time the dark yellowish fat-cells had

*) The whitish colour disappears in larvae killed by treatment with hot water.

**) and also in the Chalcidid *Anellaria*.

their culmination, but these might be observed some time before as well as after the "symbiotic cells". During the culmination time of the fat cells and "symbiotic cells" a yellow colouring of the fluid surrounding the larva was observed, and afterwards, as the fat cells and the "symbiotic cells" decreased, the fluid became deeply yellow, and at last it dries up, when the pupa has moulted into imago.

In *Ooctonus heterotomus* the "symbiotic cells" are followed likewise from their appearing at the beginning of the second larval instar. Their light yellowish colour becomes afterwards reddish yellow, and the cells join after the moult in a dark reddish-yellow lump within the abdomen of the pupa. This lump which constitutes the excrements seems in some cases to be quitted by the imago in the host egg. The fat cells, which are clear whitish, are to be seen as in *Lymaenon* before and after the "symbiotic cells". They have their culmination towards the end of the larval instar and afterwards they decrease as usual.

In *Anagrus incarnatus* the "symbiotic cells" are seen to be whitish and join in a whitish lump in the abdomen of the pupa, while the fat-cells get a deeply red colour.

In *Ophioneurus signatus* the "symbiotic cells" are likewise observed to be whitish, and the fat-cells seem to be clear whitish.

In *Chaetostricha pulchra*, which has but one larval instar, the "symbiotic cells" are followed from their appearing at the moment when the larva has swallowed the contents of the host egg, until the time when they become whitish (and the fat-cells yellowish).

In the first instance, the presence of these cells in some genera and the absence in other rather nearly allied genera are facts indicating that the cells in question are in a degree specialised. Further it must be noticed that they are placed in the wall of the stomach, and that they contain bodies guessed to be microorganisms. The activity of these latter and the production of gas in the cell culminate at the same time as the larval digestion.

Moreover it may be noted that the change of colour of the symbiotic cells and of the fat-cells (as well as of the probably excretory fluid surrounding the larva of *Lymaenon*) during the period of digestion indicate that the cells are taking part in the metabolic process.

The reasons given above appear to me to be sufficient for justifying the placing of these cells amongst those termed "symbiotic", but at the same time I must call attention to the fact that further investigations, e. g. histological, are necessary for solving the question.

Host-Eggs.

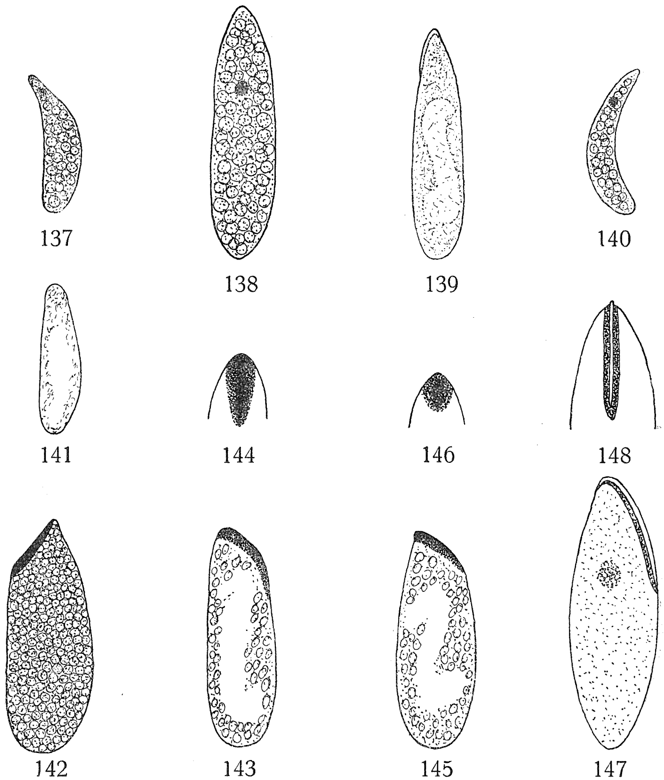
The material of host-eggs, from which I bred or took out the parasites treated above, chiefly consists of cicadellid and heteropterous eggs, found hibernating.

A. Cicadellid eggs.

In *Juncus effusus* L.

1. *Tettigonia viridis* L. The big eggs (fig. 138) of this cicadellid are found thrust in through slits of a length of 5 to 10 mm. which sometimes go through the sheath of the stem (fig. 164 D). The eggs are deposited in a row beside each other and are thrust in obliquely in the stem; they are, like those of the next two species, usually found in the lower part of the stem. — This cicadellid is host of *Chaetostricha pulchra* Kr. (pag. 104) and of *Anagrus incarnatus* Hal. (Bakkendorf 1925).

2. *Conomelus limbatus* Fabr. The rather small eggs (fig. 137) of this species are found abundantly in the lower part of the sheath of the stem. The eggs are thrust in through a small hole, few specimens together and arranged fan-shaped (fig. 164 A). – This cicadellid is a host of *Anellaria conomeli* n. sp. (pag. 8) and of *Anagrus incarnatus* (Bakkendorf 1925). The eggs which are attacked by *Anel-*



Cicadellid eggs. × 20.

Fig. 137. Egg of *Conomelus limbatus* F.
Fig. 138. Egg of *Tettigonia viridis* L.
Fig. 139. Egg of *Acocephalus sp.*
Fig. 140. Egg of *Liburnia sp.*
Fig. 141. Egg of *Typhlocyba sp.*
Fig. 142. Egg of *Jassid sp.*
Fig. 143. Egg of *Idiocerus ?confusus* Fl.
Fig. 144. The same; cover, seen from front edge.
Fig. 145. Egg of *Idiocerus populi* L.
Fig. 146. The same; cover, seen from front edge.
Fig. 147. Egg of *Aphrophora salicis* D. G.
Fig. 148. The same; cover, seen from front edge.

laria generally display a dark patch round the hole made by the animal, presumably caused by the juice flowing out of the bitten egg (fig. 164 B).

3. *Liburnia sp.* The eggs (fig. 140) of this species are of the same size as those of the preceding species, but are thrust in through a short slit of a length of 1 mm. in a file containing 2—6 specimens (fig. 164 C). – The species is a host of *Anagrus incarnatus* (Bakkendorf 1925).

4. *Acocephalus sp.* The eggs of the present cicadellid (figs. 139, 164 J) are found thrust in towards the middle of the pith of *Juncus effusus.* The are found singly or a few together, placed at broken stems, at the tip of the stem or at the inflorences. Obviously it is not easy for the cicadellid in question, as in the case of *Conomelus* with its movable spurs, to hold on during the egg-laying. The larvae were fed with *Juncus*, however, I only succeeded in forwarding the development to the second instar. It seems to be a jassid; with some doubt it is referred to the genus *Acocephalus* Germ. The eggs are faintly yellowish with a clear region, which is elongated during the development of the embryo. The eggs are found during a rather long part of the summer in the dry stems, but I have got no further records as to this point. — This species is a host of *Lymaenon effusi* (pag. 23), *?Ooctonus heterotomus* (pag. 34), *Polynema fumipennis* (pag. 79) and *Polynema ovulorum* (pag. 81). When the egg is infested by *Polynema ovulorum* it assumes an easily recognisable whitish appearance, which, however, is not observable until some time after the hatching of the 1st instar larva.

In *Salix pentandra* L.

5. *Jassidae sp.* Below the buds of the shoots of *Salix pentandra* one or two eggs (fig. 142) are thrust in transversely, and the opening of the hole is closed with some black substance. On the outside of the bark a minute

protuberance shows where the egg was deposited. By the aid of a pin the exceedingly thin flake of the bark covering the compressed eggs, could be removed, and the eggs could be loosened. My material was taken during the winters between 1926 and 1928 from a shrub of *Salix* which stood rather isolated on a low boggy meadow at Ryget forest. On June 1st, 1927 a jassid larva, which could not with certainty be determined further, hatched from the eggs. It may belong to *Bythoscopus* Germ. or *Idiocerus* Lew. Quite sure, during summer a great amount of *Empoasca smaragdula* Fall. was present in the locality; but I do not think the eggs and larvae belonged to it; the hatched larva seemed far from being identical with this species, which possibly could be imagined to originate from some bright eggs of the *Typhlocyba*-type, of which a few were found thrust in lengthwise in the twigs. — This species is a host of *Polynema pusillus* Hal. (pag. 62) and probably of *Stethynium triclavatum* Enock (pag. 42).

On *Salix cinerea* L.

6. *Idiocerus ?confusus* Flor. The eggs in question (figs. 143—144) are deposited in *Salix cinerea* in the older branches. I was first inclined to believe that they might belong to another genus than the eggs found in the shoots of *Populus tremula* and determined to be *Idiocerus populi*; I guessed it to be the genus *Aphrophora*. However, afterwards I had an opportunity to see the eggs of *Aphrophora salicis* D. G. (figs. 147—148) being deposited in captivity (on paper, singly); they are much larger than and totally different from *Idiocerus populi* and the present species, which on the other hand agree so much *inter se* that this latter may be determined to be an *Idiocerus*, and most probably *confusus* Flor. – The species is a host of *Lymaenon tremulae* (pag. 30), *Polynema atratus* (pag. 69), and *Polynema euchariformis* (pag. 71).

On *Populus tremula* L.

7. *Idiocerus populi* L. The eggs of this species (figs. 145—146) are deposited in the shoots of *Populus tremula*. The eggs of this and the preceding species of *Idiocerus* agree mutually, except that the eggs of *confusus* are closed with a somewhat longer, black cover than those of *populi*, in accordance with the fact that the eggs of the former are thrust in more obliquely than those of *populi*, which species generally splits the thin twigs in the middle. — This species is a host of *Lymaenon tremulae* (pag. 30) and *Polynema atratus* (pag. 69).

In *Alnus glutinosa* (L.) Gärtn.

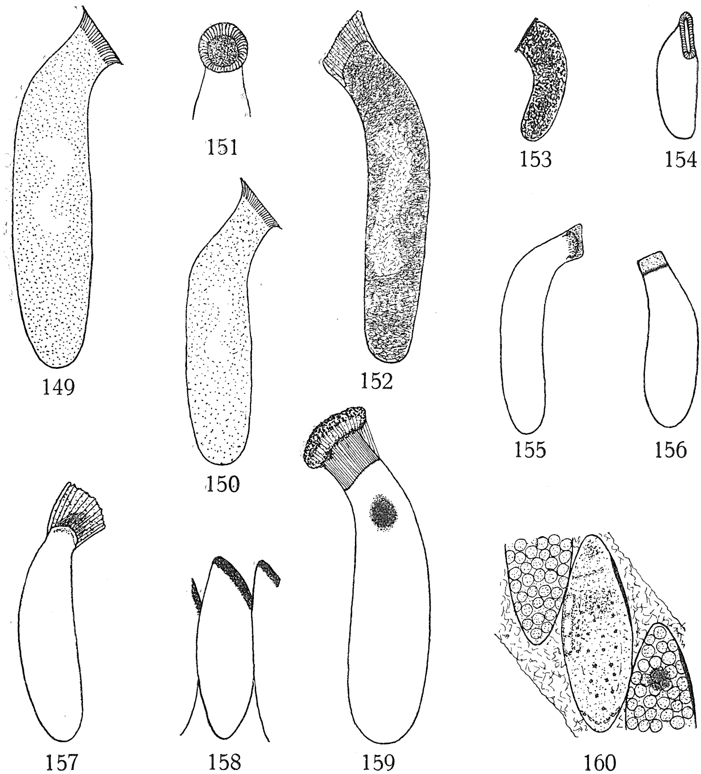
8. *Typhlocyba sp.* The eggs (fig. 141) of this cicadellid, which was determined by breeding it from larva to imago, are found thrust in singly in the one year old shoots of alder, which therefore sometimes appear to be densely provided with minute holes. The species is a host of *Oligosita nudipennis* Kryger (pag. 118) and *Anagrus incarnatus* (pag. 51).

B. Heteropterous eggs.

In *Juncus effusus* L.

9. *Heteroptera sp. 1.* The rather big eggs of this bug (figs. 149—151, 164 E) are found only in small numbers, but they vary very considerably in size. Towards its end the egg shows a neck-like elongation, which is cut off obliquely; before hatching red patches indicating the eyes of the bug embryo shine through. — It is the host of *Polynema longula* (pag. 77).

10. *Heteroptera sp. 2.* The eggs of this bug (figs. 155, 164 G) are fairly frequently found thrust in singly in *Juncus effusus*. They are deposited lengthwise in grooves beneath the bark with the flat, strongly curved pedicel of the egg placed in the hole which is hardly visible on the outside. The eggs are yellow but turn high-red before



Heteropterous eggs. × 20.

Fig. 149. Egg of a bug (sp. 1) from *Juncus effusus.*
Fig. 150. The same.
Fig. 151. The same; cover, seen from front edge.
Fig. 152. Egg of a bug (sp. 5) from an undetermined species of grass.
Fig. 153. Egg of a bug (sp. 3) from *Juncus effusus.*
Fig. 154. The same, oblique lateral view.
Fig. 155. Egg of a bug (sp. 2) from *Juncus effusus.*
Fig. 156. Egg of a bug (sp. 4) from *Urtica dioeca.*
Fig. 157. Egg of a bug (?) from *Cynosurus cristatus.*
Fig. 158. Eggs of bug (?) from *Baldingera arundinacea.*
Fig. 159. Egg of another bug (?) from *Baldingera arundinacea.*
Fig. 160. Eggs of still another bug (?) from *Baldingera arundinacea*; the egg in the middle with a parasite larva.

the larva hatches; the fresh emerged bug, which I did not succeed in determining, has the same high-red colour. This species is the (normal?) host of *Polynema ovulorum* (pag. 81).

11. *Heteroptera sp. 3.* The eggs of this species are minute and short with curved pedicel (figs. 153—154, 164 F). They are high yellow and before the hatching of the larva the eyes are seen as red patches. The eggs are pressed fast in the grooves beneath the bark. The hole is hardly visible on the outside. I found these eggs numerously, but not infested by parasites.

In *Urtica dioeca* L.

12. *Heteroptera sp. 4.* The eggs of this species (fig. 156) have a roundish pedicel. They were found deposited in the soft parts, especially in the nodes of the stalks of *Urtica dioeca.* The eggs may be easily found in dead stalks by scraping off the humid, decaying exterior layer with a pin; the eggs then appear as white particles. From the eggs a heteropterous larva was hatched, but I was unable to determine it. — It is a host of *Phanurus angustatus* Th. (p. 3) and *Erythmelus goochi* Enock (pag. 42).

In an undetermined species of grass.

13. *Heteroptera sp. 5.* On December 18th, 1927 in Ryget Forest a single egg of this species with a flat pedicel (fig. 152) was found in the stem of a grass. A bug larva was hatched.

In *Cynosurus cristatus* L.

14. (?) *Heteroptera sp.* Some few eggs (fig. 157) with a flattened, fan-shaped pedicel were found inserted in the stem of dog's tail grass, but they were not bred. They serve as a host of *Anagrus incarnatus* (pag. 51) and of (?) *Mymar pulchellus* (pag. 92).

In *Baldingera arundinacea* L.

15. (?) *Heteroptera sp.* These eggs (fig. 160) are found hidden below the sheathing leaves of the reed-grass; they

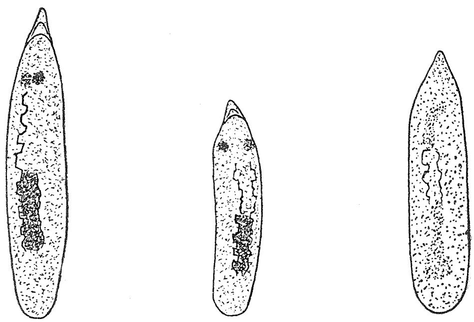
are cemented to the underlying surface in oblique rows and are yellowish and rather opaque; one may, however, succeed in seeing their contents fairly well when the egg is pressed in water rather hard between two object slides, which on account of the thick shell of the host egg may be done without injuring the egg. The larva hatched from the egg, but I was unable to determine it; it does not seem to be a cicadellid, but may be a psyllid or—most probably—a bug. It is a host of *Lymaenon sulphuripes* (pag. 29) and *Ooctonus heterotomus* Förster (pag. 34).

16. (?)*Heteroptera sp.* These eggs (fig. 158), which are like those of the preceding species, but have the black cover closer to the apex, were found in small numbers under similar circumstances as the preceding species.

17. (?)*Heteroptera sp.* A single egg of the type shown in fig. 159 was found in a stem of reed-grass.

C. Odonate eggs.

18. *Lestes sp.* The eggs of a damsel fly, presumably *Lestes sp.*, are figured in figs. 161—162. They vary somewhat in size. They are stuck in in the stems of *Juncus effusus* above the water (fig. 164 H); a single projecting dry stem at the water's edge contained several hundred



161 162 163

Odonate eggs. × 20.
Figs. 161—162. Eggs of *Lestes sp.*
Fig. 163. Egg of *Aeschna grandis.*

eggs. The frayed holes are easily visible on the outside. The eggs hibernate in the stem, and the hatching took place the next year. — A host of an undetermined Chalcidid (pag. 15).

19. *Agrionidae sp.* Eggs from *Nymphaea.* A host of *Anagrus incarnatus* (pag. 51). — For further hosts of *Anagrus incarnatus* see Bakkendorf 1925.

20. *Aeschna grandis* L. I had a portion of the eggs (fig. 163) of this species, deposited in a fragment of *Scirpus lacuster* L., left at my disposal by Mr. J. P. Kryger, who on September 29th, 1929 witnessed the egg-laying of this dragon-fly.

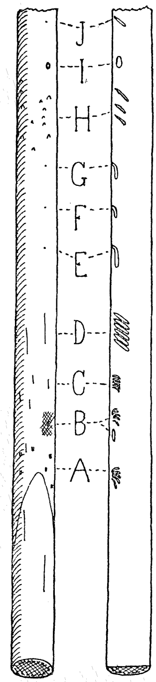


Fig. 164. The manner of depositing the eggs in stems of *Juncus effusus* (the one to the right longitudinally cut through)- A *Conomelus limbatus.* B The same, infested with larva of *Anellaria.* C *Liburnia sp.* D *Tettigonia viridis.* E, F, G *Heteroptera sp.* H *Lestes sp.*, I *Agabus sp.*, J *Acocephalus sp.* $\times 1^1/_2$.

D. Psocid eggs.

21. *Pterodela pedicularia* L. *et alii.* The psocid eggs are deposited by groups, covered by a small, white web, they are laid on leaves of different plants; I got parasites from psocid eggs found on oak-leaves, beech-leaves, leaves of *Baldingera arundinacea* and *Archangelica sativa.* In one case I succeeded in breeding the psocid larva from oak-leaves, feeding them with the greenish cover of lichens on the oak-twigs. The bred imago was determined to be *Pterodela pedicularia* L. (as the veins of the wings were somewhat varying the determination was rather difficult). Psocid eggs are hosts of *Alaptus minimus* (Hal., Walk.) (pag. 17).

Other psocid eggs, which were deposited as dark crusts on branches of alder, *Alnus glutinosa*, proved to be the host of *Alaptus fusculus* (Hal.) Walk. (pag. 17).

E. Beetle eggs.

22. *Agabus sp.* The eggs of this water-bettle (fig. 164 I) were found inserted in stems of *Juncus effusus* above the water and functioned as a host of *Anaphoidea conotracheli* Gir. (pag. 55).

23. *Chrysomelidae sp.* Host of *Anaphoidea conotracheli* Gir. (pag. 55).

24. *Rhynchites betulae.* The eggs are deposited in rolled up leaves of birch and sometimes of alder. As the weevil seems to prefer sheltered and sunny localities, most of the leaf-rolls are generally found at such places where growth of birch stands sheltered. — A host of an undetermined chalcidid (pag. 16) and of *Ophioneurus signatus* (pag. 95).

25. Coleopterous eggs in leaf-rolls of *Rhynchites betulae* on birch were the host-eggs of *Cleruchus pluteus* Enock (pag. 58). The coleopterous larva was hatched, but it could not be determined.

Technics.

The host eggs were taken out of the plant by different modes of procedure, for instance by unravelling the wood by aid of a pin *(Salix)*, by scraping on the rubbed stems *(Urtica)* or by removing the bark as a whole *(Juncus)*; subsequently the eggs were deposited for breeding. The further mode of procedure best adapted for giving satisfactory result was to dispose the eggs singly on a fragment of moist filter paper, which is pressed fast at the middle of a glass-tube (52×10 mm.) with a few drops of water at the bottom. The tube and its contents ought to be sterilised and the tube closed with a cork before the eggs are disposed in it. On the daily inspection the egg was taken out by means of a soft brush and applied on a small object slide. A cover glass was lowered down upon the egg (when the eggs had a rather thick shell an object slide was used), and by the aid of the brush a drop of sterilised water was applied. Even rather dark eggs could by being rolled and pressed with the top glass make their contents become visible under the microscope, and as it is important to ascertain the contents of the egg at as early a stage as possible, one must disregard the fact that some of the eggs are crushed by this mode of procedure. The flat eggs from the ligneous plants were more resistant of being rolled, when for about one day they had absorbed moisture and had swollen, but on the other hand the larvae were then not easy to find in the egg-mass. After the investigation of each egg the brush and the water had to be sterilised again in order to prevent infection from rotten eggs, if any. In order to identify the species some of the breedings were to be carried through to the imaginal stage, and in these cases the tubes could remain for 5 to 6 days without inspection, and the only thing necessary was then to tilt the tube so as to cause the drop at the bottom to run to the paper and moisten it.

Explanation of the lettering of the figures.

A anellus, An antenna, B base of ovipositor, Bv hind wing, C yolk spheres, Cf cephalic process, E excrements, Ec cells of the host embryo, Em rest of embryo, F fat cells, Fl fat-body, Fv fore-wing, G brain, Gc reproductive cells, H cephalic part, Hv caudal appendage, I imago, Is imaginal disks, Kc glandular cells, L larval cuticle, Lu cover of host egg, L_2 second larval instar, M mouth, Md mandibles, Mh stomach cavity, Ml muscles, Ms stomach, O labrum, P pupal cuticle, Pe pedicellus, Pr proctodaeum, Pt frontal process, P_2 mesopostphragma, R remains of cuticle of first larval instar, R_2 remains of cuticle of second larval instar, S symbiotic cells, Sa orifice of salivary duct, Sc scapus, Sk shaft, Sp salivary glands, Sps secretion of salivary gland, Ss segmental sheath, T tooth, U labium, Ug salivary duct, V yellowish fluid, Æ egg, Ø eyes.

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