The Biology of Homonotus sanguinolentus Fabr. (Hym. Psammocharidae)

By
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Homonotus (Salius) sanguinolentus has hitherto been very little investigated, literature only containing scarce records on its biology comprising partly incomplete observations and partly mere guessings. According to Haupt (1927 p. 350–351) the first record is published by Brischke (1876), who sets forth the supposition that the larva of *Homonotus* is parasitic on spiders.

He found a cocoon between birch-leaves drawn together after the manner of the cross-spider. The space between the leaves was filled with a loose, brown, woolly web, which enclosed a light brown, elliptic cocoon consisting of a papery mass. Next spring a specimen of *Homonotus sanguinolentus* emerged after having cut out a circular lid of the cocoon. He writes amongst others: "Wenn diese Raubwespe zum Larvenfutter, nach Art der Pompiliden, Spinnen u. dergl. wählt, wie kommt die Larve dann in Mannshöhe auf die Birke? Sucht die Wespe etwa die Spinnen auf, um ein Ei auf oder in sie zu legen? Und wenn die Made sich von Spinnen nährt, so müssten Ueberreste der Spinnen zu finden sein, ich fand aber, trotz aufmerksamen Suchens, keine".

In 1880 Brischke again mentions *Homonotus:* "Ich suchte im Spätherbste 1877 und 1878 in den Wäldern bei Zoppot die schneeweissen, seidenartigen, flachen Spinnennester, die ziemlich häufig auf den schon abgefallenen Eichen- und Haselblättern vorkommen, und fand auch fünf Cocons auf denselben Blättern, aus denen im Februar des nächsten Jahres *Goniocryptus annulitarsis* Th. und *titillator* L. in beiden Geschlechtern herauskamen. Bei genauerer Untersuchung dieser Cocons finde ich, dass dieselben denen des *Salius* oder eines *Pompilus* ähnlich sind. ... Meine Vermuthung ist aber die, dass der *Cryptus* Spinnen aufsucht, die, mit der Made eines *Pompilus* besetzt, herumlaufen und diese Made mit einem Ei beschenkt".

In 1888 Brischke published a further information, which, however, does not contain fresh observations.

Ferton (1897 p. 18—19) records on *Wesmaelinius (=Homonotus) sanguinolentus:* "Au point de vue des mœurs il ne diffère pas des pompiles; je l'ai pris en Crau chassant dans une touffe une araignée qui m'échappa. Je l'ai obtenu d'éclosion d'une *Helix aspersa* trouvée à Marseille; l'entrée de la coquille était barricadée avec des brindilles et des mottes de terre, la coque avait la forme d'un ovoïde régulier, elle était faite d'un tissu rigide et épais, rouge brun à l'extérieur, jaune et lisse à l'intérieur."*)

Adlerz (1903 p. 33—34) observed *Homonotus sanguinolentus* as well as other Pompilids straying searching on the ground and making their way into crevices and fissures. In 1903 he observed them in the sandy outskirts of a wood, where now and then they swept across such places where the other Pompilids had their constant residence. Each time they stopped only for a few moments slightly examining the ground. It distinctly appeared from their behaviour that, if they are parasitic on other species, their parasitic habits must be quite different from those of *Ceropales* (E. Nielsen 1932 p. 215). Adlerz (l. c. p. 34) also refers to Peckham's paper from 1898, in which he mentions *Homonotus conicus* Say. Adlerz means to say that from the life-habits of this species certain conclusions may be drawn with respect to the European species. Peckham (p. 53—55) observed *H. conicus* falling upon and paralysing Lycosids after the usual manner of the Pompilids, and subsequently dragging them backwards into its nest by seizing one of the legs of the victims. During the pursuit *Homonotus* never uses its wings but jumps most lively. Peckham means that the spiders treated by this species are not merely paralysed but dead, as several days later he was unable to trace any sign of life in them. However, Adlerz writes that attention ought to be paid to the fact that Peckham, by separating the wasp from its victim and letting it take possession of it again, has caused it to sting the same spider twice. He considers it a premature conclusion to state from the condition of these spiders that the wasp should always kill its victim. (That at any rate *Homonotus sanguinolentus* does not kill *Cheiracanthium carnifex* even after having stung it several times will appear from the observation on page 397—399).

*) This find might indicate, that *Homonotus* was bred from *Cheiracanthium lapidicolens* Simon, which species places its retreat under stones and covers the walls of it externally with earth and pebbles (Simon 1878; E. Nielsen 1932). As no doubt it prefers cavities on the under side of the stone to the flat parts of the stone there is nothing to prevent it from nesting in a snail-shell.

On July 13th, 1905 in the sunny and sandy outskirts of a pine wood Adlerz (1906 p. 1–2) saw a female of *Homonotus* going searching on the ground amongst scrub and heather. She was especially anxious to search at two different spots, where some dead, crumpled leaves were lying, examining the leaves for a long time and trying to force her way into them. In one instance she tried to make stinging movements into the hollowness of a leaf; this leaf appeared to contain a spider's retreat, made after the manner of *C. carnifex*, and enclosing the remains of the dead spider. In the other instance the leaf contained a similar retreat which was empty. – On August 15th at the same locality a *Homonotus* went beneath a stone and after having come up again it continued searching. Under the stone was found a retreat with a quite uninjured young *Cheiracanthium,* on which there was no egg.

It was reserved for Kryger (1910) to withdraw the veil of ignorance from *Homonotus sanguinolentus*. He writes (p. 282–283) as follows: "Its host is the female of *Cheiracanthium carnifex* Fabr. This female spins the tops of some grasses together and in the middle of them arranges a completely enclosed bell in which it lays its eggs and also remains itself until the youngs are hatched. Upon opening one of these bells, I discovered a parasite larva upon the spider, and with further researches I discovered that on some of these females the parasite's egg was attached and upon others a larger or smaller larva. When this spider was attacked either with the parasite's egg or larva, no attempt had been made to lay its own eggs, but it was however quite living, and defended itself when I pulled the nest to pieces. This parasitic larva proved by breeding the next summer to be the larva of *Salius sanguinolentus*. The egg was placed on the spider's abdomen in the hollow between abdomen and thorax."

Kunio Iwata (1932) has given a detailed and very interesting account of the life-habits of a Japanese species, *Homonotus iwatai*. His paper ends with the following summary (p. 317):

"1. *Homonotus iwatai* Yasumatsu is an external parasite of *Chiracanthium rufulum* Kishida. 2. One species of a parasitic Chalcid fly was found to attack this wasp larva. 3. The wasp appears in the field early in July when the spider has constructed its breeding cell by folding the blade of a graminaceous plant and has started to oviposit in it. 4. The larval habits of this wasp are very similar to those of *Psammocharis* (= *Pompilus* auct.). 5. The female wasp intrudes into the breeding cell of the spider, stings the mother spider and deposits an egg on the dorso-proximal portion of the spider's abdomen. This position of the egg has a protective significance. 6. The female wasp either prys open the cell at the seem or cuts a hole through the blade

surface to enter the cell. 7. The wasp's stinging has no effect upon the spinning of the spider, but distincly interferes with the oviposition of the spider, the stung prey invariably ceasing oviposition. 8. The gravid and fertilized female wasp which has emerged at the end of July, has difficulty in finding the host spider in nature by this time of the year. This apparent discrepancy in the life economies of the host and the parasite remains unsolved."

Own investigations on *Homonotus sanguinolentus.*

Independant of existing literature an account will be given in the following of the life-habits of *Homonotus sanguinolentus* which highly deviate from those of the other Pompilids. Firstly its larva lives as a parasite on the spider *(Cheiracanthium carnifex)* that serves as food for it; secondly the wasp does not make any nest for its brood, but simply solves this problem by using the spider's nest as a nest for its own larva. The fact is that *C. carnifex* gathers together blades of grasses, preferably, however, spikelets of the tops of grasses, to form a spacious nest, which it lines with web. It is, however, not confined to grasses, but frequently makes its nest in heather or by folding the green leaves of *Betula, Myrica gale, Lysimachia vulgaris* and other plants. Towards the time of oviposition, when the abdomen of the female is heavy and swoln, another nest is made, which is rather large – 3 to 4 cm. in diameter – and lined with a layer of white web, which is so thick that it is impossible to see through it. Such breeding-nests are very conspicuous, especially in grasses the spikelets of which on high stalks project from the surrounding vegetation, for instance in *Mollinia coerulea, Deschampsia caespitosa, Calamagrostis lanceolata, Holcus lanatus* and *Phragmites communis.*

My investigations took place throughout two years, 1933 and 1934, and were made at Asserbo near Frederiksværk in the month of July. The first year I confined myself merely to collect cocoons for breeding purpose in

order to get a chance to observe the copulation, paralysation and oviposition. However, I was dissatisfied with having not on collecting the cocoons paid attention to facts that might contribute to clear up the problem of *Homonotus*, so in 1934 I renewed my investigations in a more thorough manner.

It was my intention to ascertain the period within which *Homonotus* deposits its egg, and below I state the dates on which in 1933 I found *C. carnifex* infested with eggs of *Homonotus*:

On July 1st: two spiders
" " 5th: six "
" " 6th: six "
" " 7th: six "
" " 8th: two "
" " 9th: seven "
" " 11th: one spider
" " 17th: one "

The collecting of the cocoons took place during the period July 1st to 23rd in one particular locality where *C. carnifex* occurred so abundantly that 50 nests could be opened during half an hour. As each day when at work I collected for 2 to 3 hours it will be understood, that it was a considerable lot of this spider's breeding-nests which were examined, and as moreover I only took the most conspicuous of the nests one can realise in how enormous lots a single species amongst these small animals may occur in a limited locality, if but its situation is fit for the species and the vegetation is exempted from the encroachments of man.

However, on July 3rd, 12th, 13th, 15th, 18th, 19th, 20th, 21st and 22nd no collecting took place in order to prevent that there should be lack of material for the investigations when the egg-laying of *Homonotus* was about to cease. The fact that after July 17th no spider was found with egg of *Homonotus* then implies that for instance after July

20th spiders with eggs of this wasp will only be found as a rare exception. Such an exception is reported by Kryger (1910 p. 283), who found *C. carnifex* with eggs of *Homonotus* as late as on August 15th. — Nor is July 1st a fixed limit for the commencement of the oviposition of *Homonotus*. This appears from the fact that on July 5th I found a nest of *C. carnifex* with a finished cocoon of *Homonotus*. The larva in this cocoon must have been hatched from an egg which was laid in the last half of June. On June 24th, 1934 designer Bülow Hansen found *C. carnifex* with eggs of *Homonotus*.

Homonotus seeks out the spider in its breeding-nest before the latter has laid its eggs. It forces its way into the nest by biting a hole in the silky wall. Inside the nest it paralyses the spider and deposits its egg on the abdomen of the spider quite at the pedicle across the median line of the animal. The delicate larva confines itself to suck blood from the spider, and not until it has nearly become full-sized it kills the host, which in the course of merely a few days it devours entirely leaving only a few remains of cuticle or some pieces of the legs; most frequently, however, only the strongly chitinised ungues of the chelicerae are left; they will almost always be found in those nests where the larvae have made their cocoons. The big lot of food, which as mentioned is taken in within a rather short time, is hardly digested immediately, but presumably the food is in the alimentary canal secured against the decay to which it would have been exposed outside the same. Almost immediately after the feeding period is over the larva begins to spin the supporting threads, which are destined to carry the cocoon and prevent it from touching the walls of the nest.

The space of time elapsing from the hatching of the egg, which takes place after two days, until the spinning of the cocoon begins, seems to vary rather strongly. I myself neglected to make investigations on this point, but

Kryger (1910) states a space of time of 21 days, whereas a breeding made by Bülow Hansen shows a development in only 12 days. I set forth the following dates from his diary regarding this breeding:

"On June 24th I found *C. carnifex* with an egg of *Homonotus*; the length of the egg was 1.$_1$ mm. The egg hatched between June 26th and 27th.

On June 30th the length of the larva was 2.$_5$ mm.
" July 1st the first moult took place.
" " 4th the length of the larva was 5.$_5$ mm.
" " 5th the second (last) moult took place, and the larva killed the spider.
" " 7th the meal ended, and the first threads of the cocoon were spun.
" " 8th the outside layer of the cocoon was finished."

The cause of the different lengths of the periods of development may be explained by the fact that by Kryger the breeding took place in a cool cellar during a summer cooler than that of 1934, whereas by Bülow Hansen it took place on a warm first floor.

It was mentioned above that *Homonotus* preferably oviposits on spiders which themselves are near to oviposit. Although these spiders after being paralysed are still alive for 10 days or a few days more they will never get to deposit their eggs, the paralysation being a hindrance to it. By this fact a lot of organic stuff (the eggs of the spider) is being secured the larva of *Homonotus* in addition to the remaining total mass of organic stuff in the spider. One might perhaps object that the eggs would be secured the larva even if they were deposited by the spider because they would also then always be present in the nest. The fact is, however, that the larva is adapted to feed only on the spider, on the back of which it has entered the world; its helplessness when detached from the spider will disqualify it to seek for food even if the

same is in the narrow nest in form of a heap of eggs slighty covered with web.

Amongst the breeding-nests examined in 1934 there were a few which formed an exception from the above mentioned rule, there being in 10 of these found from 1 to 10 eggs lying unattached in the nest, consequently without any covering of web. This may be explained by supposing that the spider at the time of the visit of the wasp has been so near its oviposition that the tension in its abdomen has caused the eggs to be expelled.

In order to learn whether these abnormally expelled eggs were fertilised they were in one instance laid aside for possible hatching, and the result was that the eggs became hatched. This fact may contribute to solve the problem whether the eggs are fertilised within the female or in the fluid which precedes the eggs, when they pass the mouth of the oviduct, and the viscidity of which keeps the eggs together until they are covered with web (E. Nielsen 1932, I p. 36, II p. 117, 120, fig. 180). In the present instance only a few eggs were laid, and the egg-laying undoubtedly – although no proof exists of it – occurred without the normal spawning, that is, the eggs did not slide out in a fluid emitted previously, and if this is right the fertilisation of the eggs cannot occur at this stage of the egg-laying but must occur either in the follicles or before the eggs pass the reproductive orifice.

In nine instances the spider had laid the normal number of eggs and covered them with threads as usually. As in 1934 the number of finds of *Homonotus* was 56 the nine instances amount to 16 per cent of the finds. If there had been larvae of *Homonotus* of a fairly advanced growth on the spiders that laid these eggs, it would have been beyond all doubt that the spiders had laid their eggs normally in spite of the paralysation, because all the eggs were fresh-laid. However, in all the instances there was an egg of *Homonotus* on the spider, and as this egg

is hatched after two days, the spider has in all probability laid its egg before receiving the visit of *Homonotus*. This supposition is supported by the fact that in captivity *Homonotus* does not reject a spider, which has laid its eggs, but immediately and without hesitation paralyses it and deposits an egg on it.

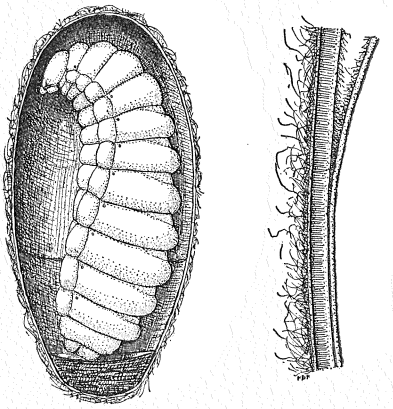

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Fig. 1. Longitudinal cut of the cocoon of *Homonotus*. The larva rests at bottom upon a partition-wall, dividing the cocoon in a compartment for the larva at top and a compartment for the excrements at bottom. Attention is drawn to the dark line dividing the compartment of the larva in a brighter and a darker part.

Fig. 2. The wall of the cocoon. Outermost, on left, the silk-threads are seen, covering a thick, firm and tough layer, $0._{079}$ mm. thick, then there is again silk-threads, and innermost, on right, the second firm, tough layer which is $0._{013}$ mm. thick. Bülow Hansen del.

The cocoon, in which the larva pupates, is brownish and somewhat tapering towards the ends, most towards the posterior end. Of the cocoons measured the largest was $10._5$ mm. in length by $5._1$ mm. in thickness. The dimensions of the other cocoons varied between a maximum of $9._5$ mm. in length by $4._6$ mm. in thickness and a minimum of $7._2$ mm. in length by $3._2$ mm. in thickness. On

all sides the cocoon is kept off the walls of the nest by strong threads of the same colour as the cocoon.

The wall of the cocoon is not equally thick all over. In an average-sized cocoon the thickness of the wall is $0._{092}$ mm. at the middle but merely $0._{066}$ mm. at the ends. The outermost layer consists of silk and is succeeded by a firm and tough layer, which does not consist of web but of a secretion no doubt emitted from the mouth; within this firm layer there is again a layer of silk succeeded by an innermost firm layer, which, however, is far thinner than the first mentioned firm layer (fig. 2). Fig. 1 shows the larva in a cut cocoon; below the median line of the larva a rather sharp line is conspicuous, separating a bright upper from a darker lower part. Next to the bottom the anal segment of the larva is seen resting on a partition-wall, which closes a small compartment containing the excrements.

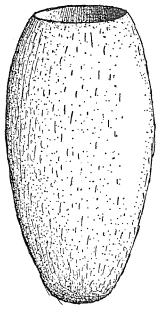

Fig. 3. The cocoon after the wasp has emerged. Bülow Hansen del.

The fact of the many layers of the cocoon gives rise to the question, why the cocoon is so complicated. This question might simply be answered as follows: The larva hibernates in the cocoon, which together with the spider's nest, in which it is enclosed, is all in one with the vegetation, in which the nest is made when autumn and winter begins. It must therefore be considerably water-tight, and its many alternating layers may act as an insulator of heat and may thus in a degree contribute to keep out the cold.

Fig. 3 shows a cocoon from which the wasp has emerged. On emerging the wasp gnaws off a circular lid; however, in this case it must have mistaken the measure and was obliged to gnaw the circle round twice.

A great deal of the facts above described are chiefly based on the investigations in which the collecting of cocoons in 1933 resulted. A record of the particulars of these investigations will be given in the following.

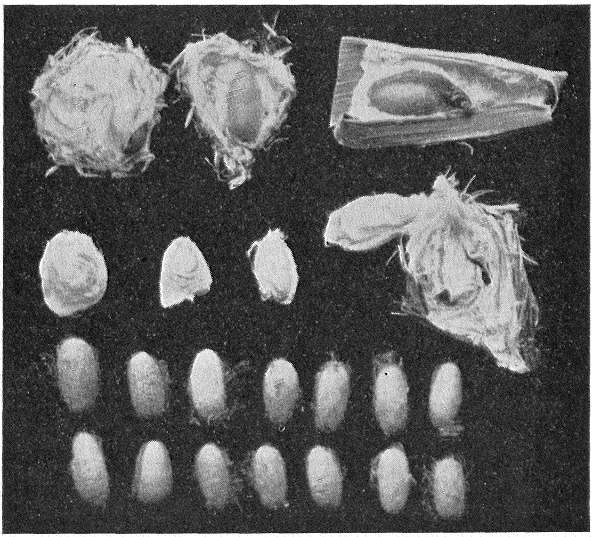

Fig. 4. Cocoons of *Homonotus,* natural size. The first two figures on left in the first row show the cocoons, covered with a white web, which is densest in the figure farthest on left. This is explained by the fact of a *C. carnifex* having taken possession of the nest after the larva had spun its cocoon. In the same row farthest on right an opened nest in a blade of *Phragmites* is seen; here the cocoon appears naturally embedded. – The second row presents cocoons of *Homonotus* densely wrapped in white web, the explanation of which fact must be a similar one to that given above. – The two lowermost rows present 14 cocoons. E. Nielsen phot.

The breeding proceeded successfully, but unfortunately the imagines emerged from the cocoons early in June. They had hibernated in a room in a cock-loft; as this was strongly exposed to the sun the animals were early in May taken down in a not heated room, but as mentioned

they emerged a whole month earlier than expected and also earlier than desirable, because it would be difficult at that time to procure spiders whose egg-laying is approaching, which *Homonotus* requires of the spider to whom it gives its eggs in charge. On June 3rd I therefore went to Asserbo, but in spite of searching anxiously I only found five *C. carnifex* adapted for the purpose, but all of them deposited their eggs in the course of the first two days. On June 5th, when I had one of my school-holidays, the experiments should commence. As regards the copulation, which I wanted to observe, I can only state, that it was impossible for me to discern the sexes as long as the wasps were living, so I could not separate a couple for special observation, but had to let them go amongst each others, and I did not witness any copulation. Still I had two wasps separated in a special tube, one of which I wanted to remove, in which, however, I was not successful, so I put a nest of *C. carnifex* with one of the spiders which unfortunately had laid its eggs into the tube. The wasps at once gnawed their way through the wall of the nest at a spot free of the spikelets, which framed the nest. One of the wasps immediately went to the spider's eggs and began to bite them and suck the contents, whereas the other rushed at the spider paralysing it with its stings. It was impossible to see where the stings hit, because the walls of the nest were dense and intransparent; only through the crevices through which the wasps had forced their way into the nest it was possible by direct incident light to observe a little of the occurrences. The paralysation took place at 12^{25} o'clock and subsequently the wasp placed itself on the spider's abdomen in a bent position down towards one side, whereas the apex of its abdomen was placed at the middle of the spider's abdomen quite at the pedicle. Here the wasp moved the apex of its abdomen to and fro as if it would rub the cuticle asunder; these move-

ments might indicate that a fluid was secreted to attach the egg, which was deposited immediately after the cessation of the movements. Shortly after both wasps left the nest. At 12^{36} o'clock the spider recovered its senses and commenced walking about slowly, but already at 12^{49} o'clock it was as lively as before the wasp entered the nest.

In order to avoid the drawback of the intransparency of the nest and be enabled fully to see what happened

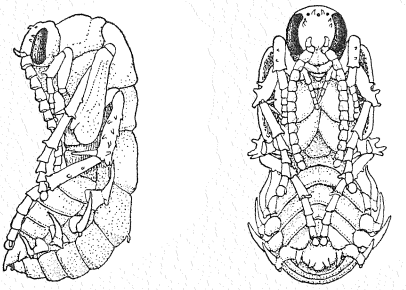

Fig. 5. Pupa of *Homonotus* (lateral and ventral view). Attention is drawn to the spiniform processes laterally, on the hind leg, and on the head. The pupa rests on these processes as well as on those of the abdomen, which prevent it from touching the walls of the cocoon.

Bülow Hansen del.

when a wasp was let in to a spider, the latter was put into a tube of a diameter of 3 cm. Here it span a retreat simply by spreading a sheet across in the tube and took refuge in the lower part of the tube, the sides of which it covered with a fine, transparent web.

A wasp was now put into the tube; it immediately bit its way through the sheet and rushed at the spider, which it stung on the under side of the cephalothorax. This was done very quickly, and after a few stings the movements of the spider were strongly checked. The wasp now settled on the spider stinging it several times at different spots in the sternum until at last it kept its sting

fixed for several seconds quite at the edge on the left side between the 2nd and 3rd leg. It was then 13^{19} o'clock. At 13^{22} o'clock the wasp left the now totally paralysed spider, cleaning itself by strokings with the hind tarsi. Shortly after it returned to the spider and began to suck at the spot between the 2nd and 3rd leg where the sting was fixed for the longest period. When again it left the spider a big drop of blood appeared at that spot. The wasp did not deposit any egg but energetically rubbed the apex of its abdomen against the spot where the egg should have been deposited, and subsequently went to the upper part of the tube without caring any more for the spider. At 13^{43} o'clock the spider began to move and at 14^{04} o'clock it was eagerly about covering with web the hole bit by the wasp in the sheet.

On June 8th another wasp was put into the tube to the same spider, which previously was paralysed without being infested with eggs of *Homonotus*. The wasp ran about in the upper end of the tube, but avoided approaching the retreat. It was therefore replaced by another wasp, which immediately bit a hole in the web; as, however, the spider from within its refuge tried to bite it, it did not force its way into the retreat. The same took place with a third wasp; the fourth one, however, which was put into the tube, did immediately force its way to the spider, who took to flight pursued by *Homonotus*. The wasp, however, soon caught the spider and clung to its cephalothorax, fixing its sting in the edge of the sternum between the 1st and 2nd leg. The spider immediately became quiet and fell sideways. The wasp now left the spider, trimmed itself and went a little about in the retreat; subsequently it again settled on the spider stinging it once more. Several minutes now elapsed; during which the wasp alternately walked over the spider and about in the retreat trimming itself eagerly. At last it gnawed a hole in the retreat, went outside the same, ran

about a little and then returned to the retreat. For the third time it went to the spider, sucking first juice from its mouth and subsequently stinging it again, the sting being kept fastened for $1^1/_2$ minute. Again it left the spider and ran about in the retreat for several minutes, after which it cut a long slash in the sheet with its mandibles close to the spider; subsequently it commenced to suck the blood oozing from the wound of the last sting. During this the spider began to move its hind legs, which, however, did not seem to annoy the wasp, who again commenced running about in the retreat until finally stopping for stinging the spider for the fifth and last time; the sting was this time kept fastened still longer than the last time. Now the spider did not move any more, the wasp, however, ran about in the retreat for several minutes. Until now 18 minutes had elapsed from the moment the wasp was put into the tube. The wasp now again returned to the spider, ran about on it until at last it settled on the right side of it with the apex of its abdomen somewhat on right to the median line of the spider's abdomen. The wasp now commenced eagerly to rub the cuticle of the spider with the apex of its abdomen continuing to do so for several minutes. At last it became quiet and its egg commenced to slide out, but several seconds elapsed before it was totally out. The wasp now left the spider, who awakened at same moment, stretched its legs and gaped with its chelicerae after the wasp, who ran about in the retreat. Repeatedly the wasp came in front of the spider, and each time the latter catched at it with its chelicerae and each time it looked as if the wasp was caught. Before the wasp left the retreat the spider was able to walk, and as at 13^{21} o'clock the wasp at last had disappeared, the spider began eagerly to make a dense web on the walls of its retreat and to fill out the holes bit by the wasp.

The behaviour of *Homonotus* during its long stays with the spider must be found curious, and this not only

applies to its frequent paralysations but also to its intermediate wanderings inside and outside the retreat. The most curious fact, however, is the placing of the egg on right to the median line in stead of directly across the the same, a diviation from the normal course of proceeding which I never experienced except that single time. In order to understand this anormal behaviour we must pay attention to the fact, that the spot where the egg should normally have been placed previously had been the object of the usual rubbing movements of the abdomen of another wasp without any egg being deposited. I have no doubt but that the wasp was able to trace this; perhaps it got the impression that an egg was actually deposited, and that its own egg should therefore be deposited at

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Plate I.

Fig. 1. *Cheiracanthium carnifex* with an egg of *Homonotus sanguinolentus*. Attention is drawn to the fact of the egg being placed in front on the abdomen.

„ 2. The egg of *Homonotus* (natural size: 1.$_1$ mm.)

„ 3. The larva on July 14th. Attention is drawn to the distinctly marked head. (This figure is not a developmental continuation of figs. 1 and 2; the larva from the egg in these figures died at an early stage.)

„ 4. The larva from fig. 3 on July 22nd. It has now killed the spider. Below the larva its cast cuticles are seen. On comparing this figure with fig. 3 it will appear, that the mouth of the larva in both figures is attached to the same spot on the spider; during the growth the larva is pushing its body backwards in contradiction to the larva of *Polysphincta,* whose body during the growth is constantly pushed forwards, because behind it is attached to its host by processes, which are sunk in the "saddle" below it (E. Nielsen 1923).

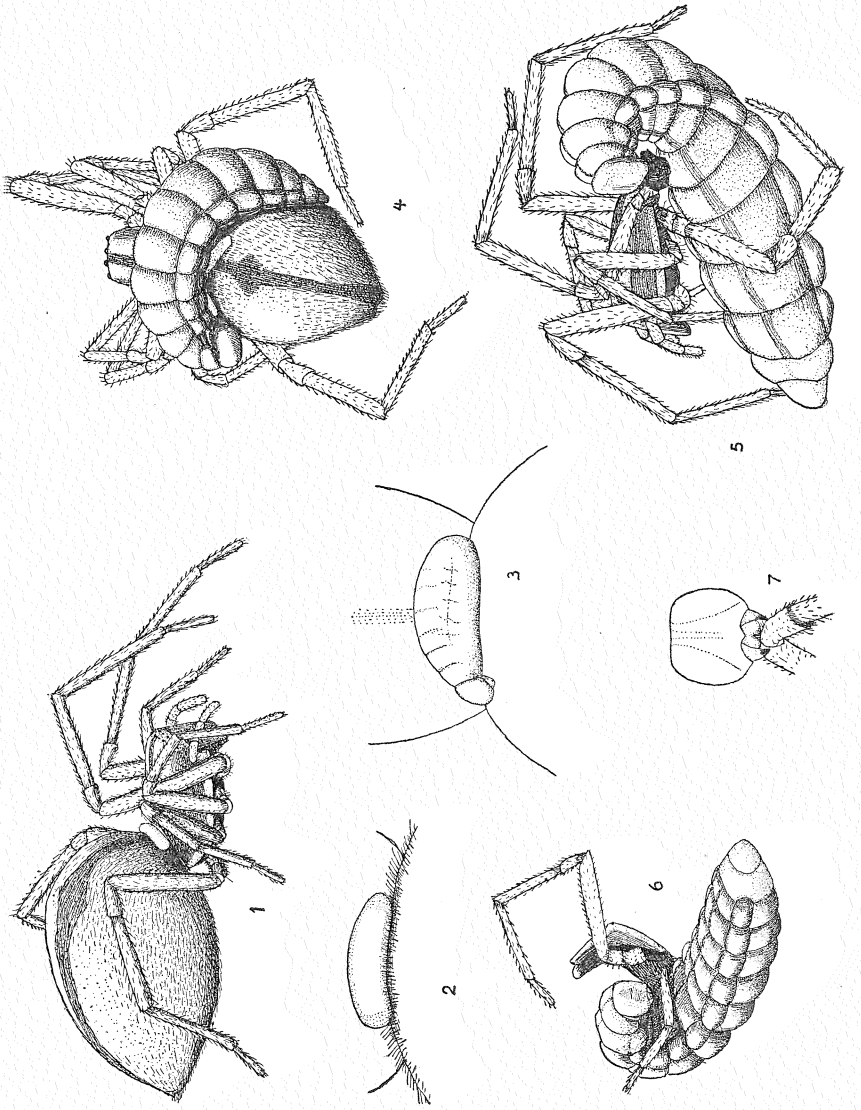
„ 5. The same larva on July 23rd. On comparing this figure with fig. 4 it will be seen how much food the larva has been able to consume during 24 hours; the whole abdomen of the spider has been devoured.

„ 6. At a later point of time on the date the larva had only left a few limbs and the head of the spider.

„ 7. The head of the larva about to devour a leg.

Bülow Hansen del.

Plate I.



another spot. The repeated paralysations may be interpreted as a sign of uncertainty in the wasp as to whether it would actually do give its egg in charge to this spider; in connection with the intermediate wanderings they indicate a hesitation in *Homonotus* until at last it conquered every doubt and deposited its egg. It was my intention to repeat the trials on the egg-laying of *Homonotus* with the animals bred in 1934. I was, however, compelled to give it up, because the wasps did not commence emerging until on June 30th, and already on July 1st I went to Sweden, where I did not succeed in finding any *C. carnifex*.

Some few further observations will be reported in the following.

On July 7th I found a nest of *C. carnifex*, in which the spider lay killed by a sting in its abdomen by *Zaglyptus varipes* (E. Nielsen 1935 p. 213); but besides being infested with eggs of this ichneumon fly it carried a larva of *Homonotus* on its abdomen. This larva took the brother's share of the food and on July 14th it had entirely devoured the same. As it is hardly probable that *Homonotus* would use a dead spider as food for its larvae it must be this wasp that first laid egg on the spider; shortly after this the spider has then been killed by *Zaglyptus*.

On the same day I found a spider who, being not killed, had a wound from a sting on its abdomen; it carried a larva of *Homonotus*.

On July 9th I again found a spider, who had died from a wound on its abdomen; the nest did not contain larvae of *Zaglyptus*, but a rather big larva of *Homonotus*.

J. C. Nielsen (1907) mentions in his description of *Homonotus*, that the male is quite black and that the thorax of the female is most frequently black and red. However, all the specimens in the Zoological Museum at Copenhagen are black without any trace of red on the

thorax. This also applies to all the specimens which I bred from the material collected in 1933 and 1934. As the specimens of the Zoological Museum as well as my own ones originate from North-Sealand it might be supposed that in the said region there is a stock of *Homonotus*, whose females have a quite black thorax.

The length of the wasps bred in 1933 varied in 15 females from $6._2$ to 8 mm.; a single female measured $8._4$ mm., another one 9 mm. The length of the males varied in 8 specimens from $6._8$ to 8 mm.

Finally I want to render my very best thanks to the drawer Mr. Helge Bülow Hansen for the interest he took in my investigations partly by drawing the necessary figures and partly by permitting me to make use of some few of his own observations.

Copenhagen, November 1935.

Litterature cited.

Adlerz, G., 1903. Lefnadsförhållanden och instinkter inom familjerna *Pompilidæ* och *Sphegidæ*. I. Vet.-Akad. Hdl. Sthlm. Bd. 37 No. 5.

– 1906. Lefnadsförhållanden etc. II. ibid. Bd. 42 No. 1.

Brischke, G. A., 1876. Cocons von *Salius sanguinolentus*. Kraatz's Ent. Monatsbl. Bd. I. p. 12.

– 1880. *[Salius sanguinolentus.]* Ent. Nachr. Bd. VI. p. 27.

– 1888. Hymenoptera aculeata der Provinzen West- und Ostpreussen. Schr. Ges. Danzig. p. 85–107.

Ferton, Ch., 1897. Nouvelles observations sur l'instinct des Pompilides. Act. Soc. Linn. Bordeaux. T. 52. p. 3–34.

Haupt, H., 1927. Monographie der *Psammocharidae (Pompilidae)* von Mittel-, Nord- und Osteuropa. Beih. Deutsch. Ent. Zeitschr.

Iwata, Kunio, 1932. Biology of *Homonotus iwatai* Yasumatsu (Hymenoptera, Psammocharidæ). Contr. Ent. Lab. Kyoto Imp. Univ. No. 21. p. 305–17.

Kryger, J. P., 1910. Notes and observations on some parasites on spiders' eggs. Ent. Medd. II. R. 3. Bd. p. 280–85.

Nielsen, J. C., 1907. Gravehvepse og Gedehamse. "Danmarks Fauna" Bd. 2.

Nielsen, E., 1923. Contributions to the life history of the pimpline spider parasites *(Polysphincta, Zaglyptus, Tromatobia)*. Ent. Medd. Bd. 14. p. 137–205.

– 1932. The Biology of Spiders. Vol. I–II. Cph.

– 1935. A third supplementary note upon the life histories of the Polysphinctas. Ent. Medd. Bd. 19. p. 191–215.

Peckham, G. and E., 1898. On the instincts and habits of the solitary wasps. Wisc. Geol. and Nat. Hist. Surv. Bull. no. 2. Scient. Ser. No. 1.

Simon, E., 1878. Les Arachnides de France. T. IV. Paris.