"The New Zealand Glow-worm."

Boletophila (*Arachnocampa*) *luminosa.*

(Extract from the *Annals and Magazine* of *Natural History.* Ser. 9, vol. 17, p. 228, February 1926, and Ser. 9, vol. 18, p. 667, December 1926.)

MR. G. V. HUDSON summarizes results of observations begun by him in January 1885 on New Zealand Glow-worms. He reared flies (both females) from the larvae in 1889 and 1890, description of the fly by Skuse, who named it *Boletophila luminosa,* appearing in *Trans. N.Z. Inst.,* vol. 23, 1890, p. 47. The type-specimen was deposited in the Australian Museum, Sydney, the other being retained in Mr. Hudson's own collection. Another fly, again a female, was reared in September, 1926. Of this specimen, both the imago and pupal skin have been deposited in the British Museum.

Details as regards the web spun by the larvae and the food captured by them were observed by Mr. A. Norris, a pupil of Mr. Hudson's, during the years 1892, 1893, and 1894, and a note sent by him to the *Entomologists' Monthly Magazine* appeared in September 1894, p. 202. This note is as follows:—

"I have observed the larvae in their natural haunts forming their webs, which consist of a kind of mucus, which is discharged from all parts of the body. If you take a larva from its web and put it on the ground, it will stay there until it has discharged enough of this mucus from which to slide out. Wherever it goes it leaves a mark in the same way as the snail. When the larva is making a fresh web, it raises its head and first four or five segments in the air, and reaches round about until it strikes something. It then draws its head back a little way, thus making a very fine thread of mucus. It then passes it to the thick mucus on the first segment, then slides out a little way, and makes another thread on the other side in the same way, fastening each to the thick mucus on the body. When it has made a sufficient number of these braces, it begins to make the strings of beads which hang downwards from these braces by gliding out of the braces, and lowering its head and about half the body. It then works its head and body up and down as if to vomit. You can see the mucus gathering on the body. Then it draws its head right back into the first two segments, as if it were turning inside out. It then catches hold of the mucus on the edge of the segment, and forces it forward. Now the head is out straight, with a large drop of mucus all round it like a drop of water. Then it draws its head gently out of the mucus, thus making a short fine thread from it. It then makes another drop, and another short thread; then a drop, and so on, until it has made several of these pendants of beads, which may vary in length. I have seen them from one inch to four or five inches. I believe in caves, where there is no wind, they reach the length of two feet. At night, when the larva is shining, you can see the reflection of the light for a considerable distance along the main thread or *tube.* When it is in a small

cave, the light also reflects on the pendants of beads, thus lighting up the whole of the cave. I call it the main *tube*, because the larva does not rest on the thread, but glides through it, which can easily be seen when the larva is in the centre of the thread, or tube, and tries to get out through the side. You can see it pushing, and moving its head about as if to break the side of the tube before it gets out.

" It is my belief that the web is formed to entangle insects, which are attracted by the light.

" The following are my reasons. I have frequently found small Diptera, Coleoptera, Lepidoptera, and a great many of the Crustacea entangled in the sticky web of the larva (which is very strong). I have also noticed that several of the Coleoptera, when taken out of the webs, were hollow, showing that the interior had been extracted in some way. When the insects are alive, the larva may be seen smothering them with mucus. On the 17th February, 1894, I saw that one of the larvae had a crustacean in the web. The larva's head was thrust inside the shell of the crustacean, I at once used the lens, and could plainly see the mandibles working, and that the larva was eating the animal. I blew the web gently, when the larva at once stopped eating, but proceeded again. Again I blew, but harder, when it at once retreated, taking the animal part of the way with it. There are frequently fragments of insects to be seen stuck on the rocks at the sides of the webs, as if, when a larva had finished an insect, he turned it out of the web, and was ready for more.

"The ♂ and ♀ can easily be distingushed in the pupa. In the first place, the male is much smaller and not so stout as the ♀, and the end of the ♂ abdomen is very abrupt. On the other hand, the ♀ is much stouter, and the end of the abdomen comes to a point and has two small fans. Both larvae and pupae are luminous, the ♀ being so in all three stages. The ♂ is luminous in the pupa until the last two or three days before it hatches. I have three males, and none of them was luminous in the imago.

"Wellington, N.Z., May 1894."

Mr. Norris also observed that a hymenopterous insect, with an apterous female, *Betyla fulva*, Cameron, is parasitic on the N.Z. glow-worm (See *Trans. N.Z. Inst.*, vol. 25, 1892, p. 164, and the *Entomologists' Monthly Mazagine*, November, 1892.)

During Mr. Hudson's 1926 investigations, the small flies he introduced, mostly Mycetophilidae, half a dozen at a time every three or four days, invariably disappeared, their remains being on several occasions detected in the webs or on the surface of stones close by. Mr. Hudson states: " I have been able to observe the larvae at all hours of the night. The light is, as previously stated, always brighter on dark, warm, damp nights, but it is invariably at its brightest immediately before daybreak. I have noticed this on many occasions. I consider my latest observations absolutely prove that the larvae are carnivorous and that the light attracts, and the web entangles, the small flies on which the larva feeds. There was, in fact, practically nothing else in the tank which could have sustained the larvae during the three and a half months they have been in captivity, and

the speedy disappearance of the numerous flies so frequently introduced further confirms this view."

He has also detected the larva apparently feeding on the pupa: "On several occasions I observed the head of the larva in contact with the pupa, but could not see if it was actually feeding on the same. During the last ten days, however, the pupa has gradually shrivelled up and it is now almost an empty skin, the larva having increased in size during the same interval. It is clear that the larva has fed upon the juices of the pupa, and, from the very close proximity in which we always find the glow-worms in a state of nature, it is practically certain that these cannibalistic habits must at times occur under natural conditions."

He describes the emergence of the fly:—

" September 26th (1926).—Since my note of the 12th instant the pupa referred to has, at irregular intervals, emitted a strong light from its posterior extremity. On the morning of September 24th the perfect fly emerged, a ♀. During emergence the pupa assumes an almost horizontal position, and as the imago protrudes from the pupa its head comes downwards, the thoracic attachment of the pupa acting as a fulcrum. First, the wings are drawn clear, afterwards the legs. In the final stage of emergence the head of the imago is directed downwards, the tail of the pupa pointing slightly upwards, the pupal attachment occupying an intermediate position. When finally clear the imago stands on the pupal skin, with the extremity of its abdomen still within the exuvia, the pupal skin resuming its original vertical position.

"At 4 p.m. on the 24th I detached the exuvia from the rock, and removed it and the perfect insect into a small caterpillar cage. During the ensuing night the anal extremity of the fly was observed to be strongly luminous and apparently continuously so."

Both the larva and the female fly emit the light; the organ emitting it being situated at the posterior end; it is concluded from experiment that the light of the larva is for the purpose of attracting insects; that of the female may be for sexual attraction.

Further details and figures may be seen in the reference above, and in Hudson's *Elementary Manual of New Zealand Entomology*, 1892.