

# ON *BRAULA CAECA*, NITZSCH, A DIPTEROUS PARASITE OF THE HONEY BEE.

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(With eleven Text-figures.)

## INTRODUCTION.

*Braula caeca* is an aberrant dipteran that is a common parasite of the honey bee in this country and other parts of the world. It is a small, active insect, reddish-brown in colour, and about 2 mm. in length (Fig. 1). In strong hives these so-called bee lice rarely become abundant, but in weak colonies they are sometimes so numerous that hardly a bee is without one or more of the parasites. According to Sharp (1) there is only one species known, and this species is placed in a separate family by itself, the *Braulidae*. This family, together with the *Hippoboscidae* and two small and little-known families, the *Streblidae* and the *Nycteribiidae*, make up the series *Pupipara*. *Braula caeca* is linked with the *Pupipara*, mainly because of the statements of Boise, Packard and others concerning its life-history, but, as will be shown later, these statements are erroneous.

Boise states that a pupa is deposited in the cell in the hive by the side of the young larva of the bee, and appears as the perfect insect in about twenty-one days. Packard says that on the day the larva hatches from the egg it sheds its skin and turns to an oval puparium of a dark brown colour. According to Comstock (2) the mode of reproduction of *Braula* is similar to that of the *Hippoboscidae*. Cowan (3) asserts that the "eggs hatch inside the insect and the larvae are nourished by the secretions from a gland. The pupa is extruded on to the floor-board of the hive, and fourteen days later a perfect insect emerges. The young lice remain on the floor-board until they have the opportunity of climbing on to a passing bee."

## THE EGGS OF *BRAULA CAECA*.

Some time ago Mr. R. H. Harris, Assistant Entomologist, called the present writer's attention to the fact that certain white specks which are often found on the brood combs in the hives are the eggs of some insect or



other. The writer had often noticed these specks in the hives at Cedara, but had failed to detect their true nature until Mr. Harris suggested that they should be mounted in xylol for examination under the microscope. The xylol dissolves the adherent wax from the white specks, clears them, and renders their examination a simple matter.

The eggs measure about  $\cdot 85$  mm.  $\times$   $\cdot 56$  mm. and are dead white in colour (Fig. 2). They are oval in shape, and have on either side a flattened wing-like expansion, marked with a delicate, raised reticulation. They seem to be deposited in a haphazard manner over the brood combs, some being

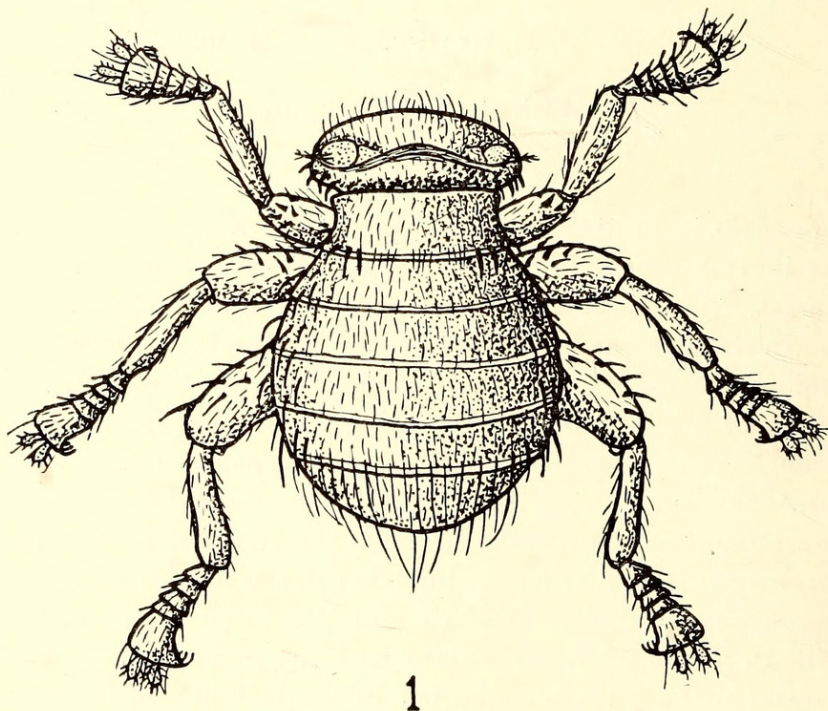


FIG. 1.—*Braula caeca*, Nitzsch.  $\times 25$ .

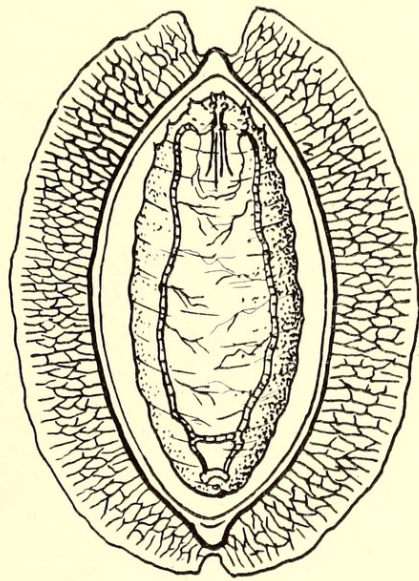
placed on the caps of the cells containing sealed brood, others inside empty cells glued to the sides and bottoms of the cells, and still others on the tops of the partitions between the cells. Some of the eggs were found to contain fully developed embryos (Fig. 2) and their dipterous nature was unmistakably revealed. Thus the writer's attention was turned at once to *Braula caeca*, the only dipterous parasite present in the hives. A number of the lice were caught, and carefully dissected under a binocular dissecting microscope. In three or four of the females examined a fully formed egg was found in the common ovarian duct (Fig. 9, *cod*), and these eggs were obviously identical with those found on the brood combs. The appearance, size, shape and markings were exactly identical, so that there could be no possible doubt as to their identity. The characteristic wings with the



reticulations and peculiar notches at either end make the recognition of the eggs easy and certain.

THE LARVA OF *BRAULA CAECA*.

Having thus established the fact that the bee louse is oviparous and not pupiparous as is so often stated, an endeavour was next made to trace out its life-history. For some time no traces of the immature stages of the parasite could be found in the hives, but finally a neglected hive was found in which the lice were very numerous. This colony had evidently been queenless for some time and was very weak; many laying workers were



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FIG. 2.—Egg of *Braula caeca*.  $\times 70$ .

present, and these had given rise to large numbers of drones. Two of the drones from this hive were very badly infested with the parasites, one carrying no less than eighteen of them and the other twelve. Both of the drones were undersized and both had obviously emerged recently.

A number of the drone larvae were removed from their cells and examined under the lens. In several cases one, and in a few cases two, small dipterous larvae were found lying side by side with the bee larvae. The largest of these dipterous larvae measured about 2 mm. in length (Fig. 3). The buccopharyngeal armature, the tracheal system and the sensory papillae of these larvae were exactly similar to those of the embryos found in the eggs of *Braula caeca* (cf. Figs. 2 and 3), hence there could be no doubt but that these were the larvae of the bee louse. The buccopharyngeal armature is of typical muscoidean form, with well-developed



lateral hooks and a large pharyngeal sclerite, but there is no separate intermediate sclerite (Fig. 6). The tracheal system is well developed, meta-pneustic, but without the hard, horny spiracular plates usually present in muscid larvæ. The larval antennae (Fig. 7, *a*) are small and inconspicuous and of the usual dipterous form. At each end of the larva there are a number of peculiar sensory papillae. Those at the anterior end are long and conspicuous and are armed at the tip with a number of minute blunt cones

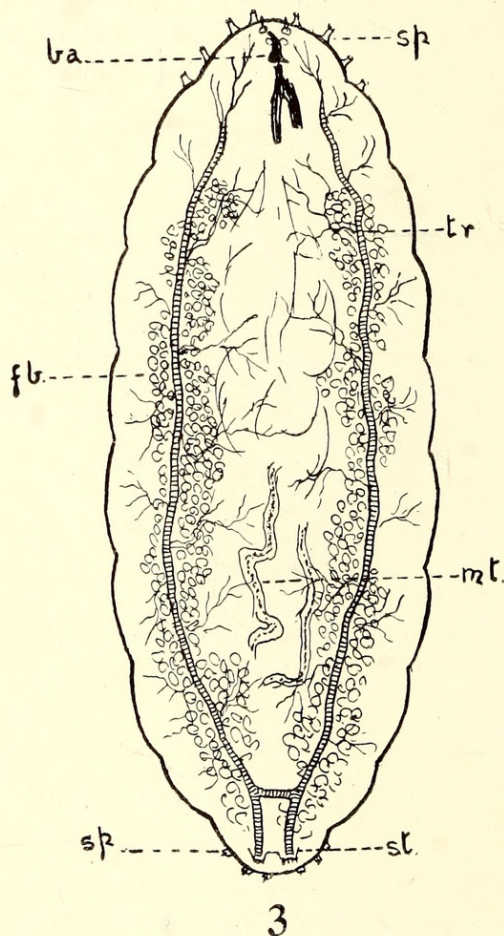


FIG. 3.—Larva of *Braula caeca*.—*sp.* Sensory papillae. *ba.* Buccopharyngeal armature. *tr.* Trachea. *fb.* Fat body. *mt.* Malpighian tube. *st.* Spiracle.  $\times 30$ .

(Fig. 7, *c*), whilst those at the posterior end are shorter and armed each with a single sensory hair (Fig. 7, *b*).

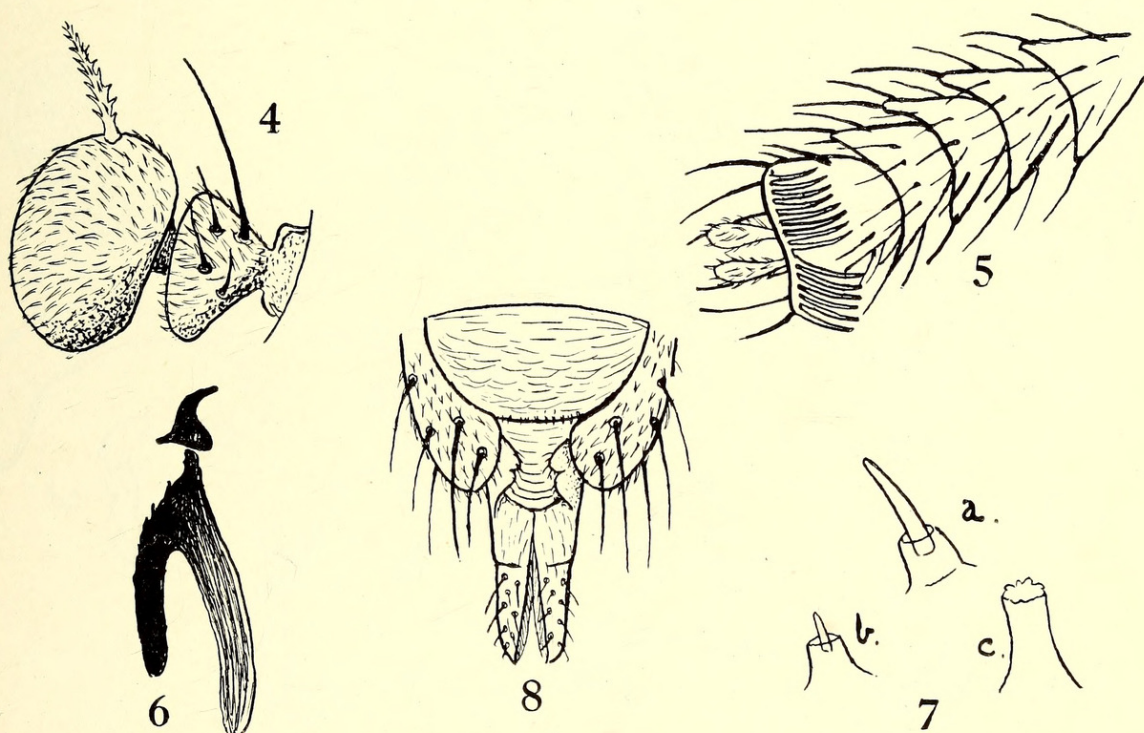
The drone larvae from the cells containing the parasites seemed to be quite normal and healthy. The contents of the alimentary canal of the dipterous larvae were carefully examined and found to consist mainly of pollen, the characteristic pollen grains from the black wattle being especially abundant and easily recognised. The drone larva's stomach was found to contain exactly similar food. Hence there seems little doubt but



that the newly-hatched *Braula* larva makes its way into a cell containing a bee larva, and feeds side by side with it on the food supplied by the nurse bees. Their minute size, white colouring and comparative scarcity in normal hives make their detection very difficult, and would account for their having remained unnoticed hitherto.

#### THE PUPA OF *BRAULA CAECA*.

Six puparia were brought to light after a prolonged search in the hive mentioned above, and all of these were found in sealed cells containing



FIGS. 4-8.—4. Antenna of adult. 5. Tarsus of adult. 6. Buccopharyngeal armature of larva. 7. *a.* Antenna of larva; *b.* Sensory papilla of larva, anal segments; *c.* Sensory papilla of larva, anterior segments. 8. Mouth-parts of adult.

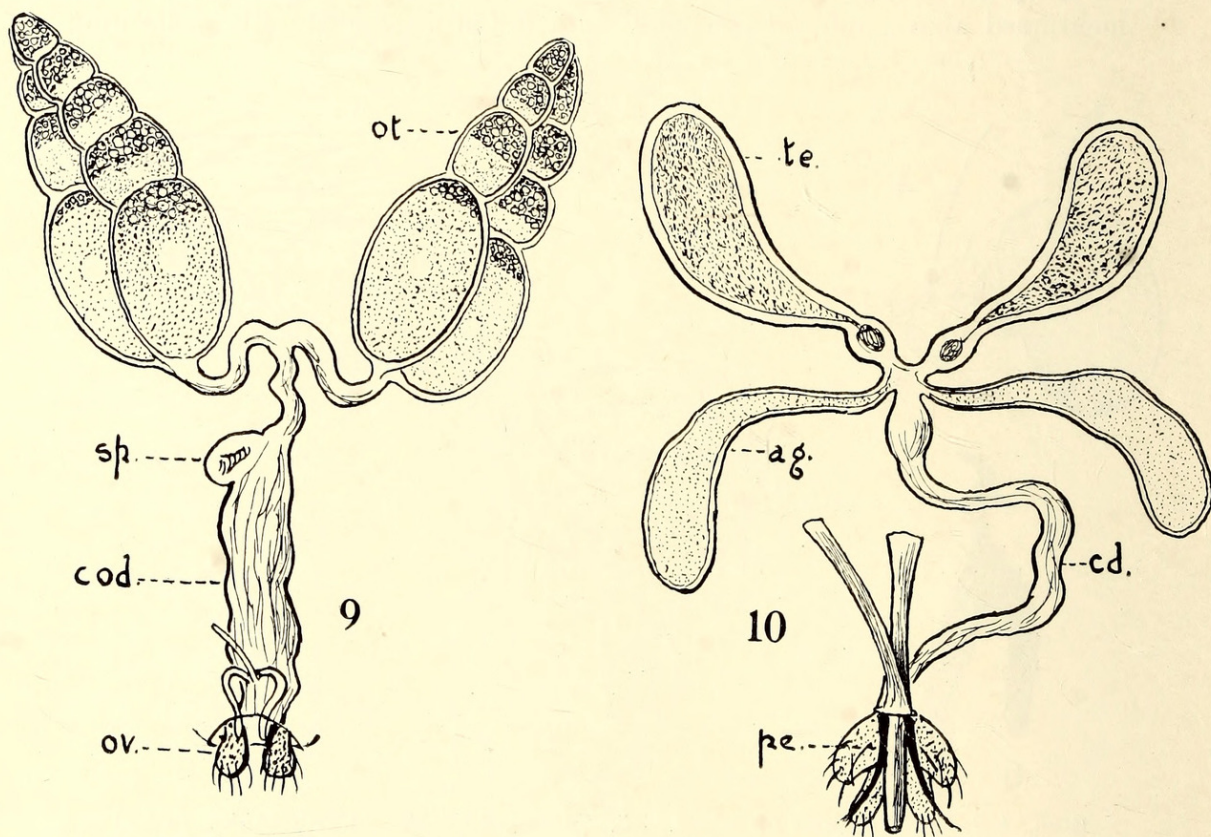
drone pupae. They were white, oval, about one and a-half millimetres in length, and attached to the sides of the cells. The puparium was found to consist of the last larval skin, not modified or thickened in any way, and the *Braula* pupa could be easily discerned inside. The peculiar sensory papillae (Fig. 7, *b* and *c*) and the moulted buccopharyngeal armature (Fig. 6) proved the identity of the puparia and the larvae described above. The adults had already emerged from four of the puparia when found, and these adults, pale yellowish white in colour, had made their way on to the drone pupae inside the cells. The remaining two puparia were kept in order to watch the emergence of the adults, but unfortunately both died soon after their



removal from the hive. The exit hole in the puparium consists of a rough tear and is apparently made by a ptilinum, for a well-marked ptilinal suture can be seen on the head of the adult.

#### THE ADULT BRAULA CAECA.

The antennae of the adult recall both the muscid and the hippoboscoid types (Fig. 4). They are lodged in deep cavities in the front of the head as in true hippoboscids, and remind one strongly of the antennae of *Melophagus*



FIGS. 9-10.—9. Reproductive organs, female. 10. Reproductive organs, male.  
*ot.* Ovarian tubes. *sp.* Spermatheca. *cod.* Common ovarian duct. *ov.* Ovi-  
 positor. *te.* Testis. *ag.* Accessory gland. *cd.* Common ejaculatory duct.  
*pe.* Penis.  $\times 45$ .

*ovinus*. The mouth-parts (Fig. 8) are peculiar, and do not resemble closely those of the muscid or the hippoboscoid flies; the task of making out the different parts is too involved for the present writer to attempt it. The foot also seems to be unique among the *Diptera*, for the tarsus is armed with two well-developed chitinous combs instead of the two simple claws usual among the *Diptera* (Fig. 5).

The alimentary canal is of the usual type found among the higher *Diptera*. A narrow oesophagus leads to a small proventriculus (Fig. 11), behind which the canal branches, one branch leading into a large, thin-walled



crop, and the other to the chylific ventricle. There are four Malpighian tubes, uniting to form a single pair just before entering the small intestine. The rectal ampulla is large, conspicuous, and furnished with four typical rectal glands, well supplied with trachea. This part of the alimentary canal is strongly reminiscent of that of *Hippobosca*.

The reproductive organs are shown in Figs. 9 and 10 and need little description. There are two ovarian tubules on either side closely applied one to the other. The follicles consist of groups of nurse-cells with a developing ovum posterior to them; the nurse-cells get smaller and the ovum larger as the egg approaches maturity. There is only one spermatheca,

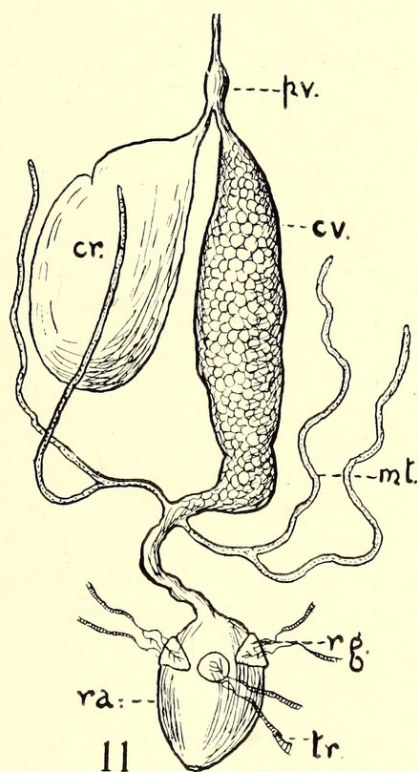


FIG. 11.—Alimentary canal of adult. *pv.* Proventriculus. *cr.* Crop. *cv.* Chylific ventricle. *mt.* Malpighian tubes. *rg.* Rectal glands. *ra.* Rectal ampulla. *tr.* Trachea.  $\times 40$ .

closely applied to the side of the common ovarian duct—not three as in the true muscids.

The testes are comparatively large sac-like bodies, and there is one pair of accessory glands filled with a white granular fluid. The penis is large and conspicuous and is armed with a pair of strongly chitinised curved spines.

Our knowledge of the feeding habits of the adult is very scanty, and the following, quoted from A. I. Root (4), is perhaps the most authoritative statement so far put forward:

“When the louse wishes to feed it goes to the bee’s mouth, where the



motions of its feet, armed with bent claws, produce a tickling sensation perhaps disagreeable to its host, but at least provoking some movement of the buccal organs, which slightly open and release a small drop of honey, which the louse at once licks up."

Although the present writer has never witnessed the feeding of these lice, he has been able to prove that their food consists of honey. In the study of the anatomy of this insect several individuals were dissected which had the crop distended with a colourless fluid, and when this fluid was applied to the tongue it was proved unmistakably to be honey. No solid matter was ever found in the intestine.

#### SUMMARY AND CONCLUSIONS.

1. *Braula caeca* is oviparous, not pupiparous as was hitherto supposed.
2. The eggs are deposited on the brood combs in the hives, hatch out into typical muscid larvae which make their way into cells containing young bee larvae.
3. The larvae feed on food supplied to the brood by the nurse bees, and beyond robbing the bee larvae of a little of their food do no harm.
4. The larvae pupate inside the cells beside the bee pupae; they emerge before the bees do and make their way at once on to the bodies of their hosts.
5. The adults feed on honey, probably supplied to them by their hosts.
6. Although *Braula* is not pupiparous, it shows many marked resemblances to the *Hippoboscidae*, and the family *Braulidae* should probably be placed between the *Muscidae* and the *Hippoboscidae*, not between the latter and the *Streblidae* as at present.

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