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Ventral spines of femora of legs more strongly developed than in the female. Tibia of second legs beneath with the usual two stout basal spines, with no group of smaller ones distad of them such as found in *oaxacensis*; on the anterior face a double and in part triple series of short stout spines which are typically from thirty to forty in number. Coxae of fourth legs each with a prominent conical apophysis beneath. Coxae of first legs with the usual chitinous hook. The median apophysis (clavis) of the bulb of the male palpus formed almost exactly as in *vertebrata*, the larger lobe not expanded at all distally.

♂.—Length to 14 mm. Length of cephalothorax 7 mm.; width 6 mm. Length of tib. + pat. I, II mm.; of tib. + pat. IV 9.2 mm.

♀.—Length to 15 mm. Length of cephalothorax 7.4 mm.; width 6.2 mm. Length of tib. + pat. I 10.5 mm.; of tib. + pat. IV 10 mm.

Notes on *Gonatopus ombrodes*, a Parasite of Jassids (Hymen., Homop.)*

By C. N. AINSLIE, U. S. Bureau of Entomology.

On July 10, 1910, in Fort Collins, Colorado, a jassid, a female *Cicadula 6-notata*, flew to a lamp by which the writer was seated and attracted attention by her peculiar behavior. She seemed deformed, walked jerkily and was continually flipping her wings. A lens disclosed a small striped sac projecting from or attached to the abdomen between the fourth and fifth segments. This jassid was captured and mounted in balsam for future study.

Since that date a number of leaf hoppers afflicted in a similar manner have been taken in various parts of the middle west and a few adult parasites have been reared from these. The object of the present paper is to offer some facts that have been gathered regarding the habits of these parasites.

The writer is indebted to Mr. S. A. Rohwer, a systematist of the Bureau of Entomology, for a determination of the parasite and for helpful criticisms of this paper, and to Mr. D. M. DeLong of Harrisburg, Pennsylvania, who kindly determined the jassid hosts concerned in this study.

It may be said at the outset that while this parasite may possibly attack jassids more or less promiscuously, regard-

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less of species, no case has come under the observation of the writer in which any other species of jassid than this particular *Cicadula* has been taken with the sac of *Gonatopus ombrodes* attached. Perkins records *G. ombrodes* as reared from *Deltocephalus* sp. at Columbus, Ohio. Farther than this, no data are at present available to the writer regarding the range of victims attacked by this parasite.

The sub-family Dryininae, or Anteoninae, to which the parasite under consideration belongs, is a most interesting Mutilloid group of the Proctotrypidae. This group, recently has been most admirably treated both from a taxonomic and biologic point of view by Mr. F. A. Fenton.* Its members confine their attacks to certain homopterous insects belonging to the Fulgoridae, Jassidae and Membracidae. In most cases the larvae of these parasites live partly within the body of the host and partly within felt-like sacs that project between the abdominal plates of their victims. One most peculiar feature of this group of parasites is the chelate anterior tarsi with which the females of nearly all the species are armed, a character which, according to Ashmead, is found nowhere else among the Hymenoptera. This bit of apparatus, which closely resembles the finger and thumb of man or the opposing claws of raptorial birds, only much more viciously hooked and spined, proves a most successful and formidable weapon when employed in the capture of prey. And it must be borne in mind that this grasping appendage is supplemented by lightning-like activity on the part of its owner, making her more than a match for even the nimble jassids.

Comparatively little attention seems to have been given to this group of insects until recently. In Europe certain species have been given detailed study.

It is not an uncommon thing to find a *Cicadula* carrying two dryinid sacs, one on each side, attached to its abdomen. Usually these sacs are of equal size, indicating that the two eggs were deposited during the same attack. Occasionally one sac is noticeably larger than the other. More than two

*The Ohio Journal of Science, Vol. XVIII, pp. 177, 243 and 285. Numerous figures.

have never been found by the writer on a single individual of this species. It is more than probable that in such cases of double infestation one or both of the guests must perish, since it would be manifestly impossible for one small jassid to afford nourishment sufficient to carry two equally rapacious larvae to maturity. The survival of one larva in such a case would perhaps account satisfactorily for the disappearance of the other.

The dryinid sac referred to throughout this paper is rather short oval in form, is usually quite symmetrical and when mature measures about one millimeter in its major axis, the minor axis a trifle less. It is light brown in color and is barred transversely by several, three to five, narrow bands of darker brown that give it the appearance of having true segments. It has a dull surface, finely rugulose, projects from behind the second, third or fourth abdominal segment and is found most often on the left side of the abdomen although they occur on either side.

Adult *G. ombrodes* have been both reared and taken with a net. Only a few have been captured in the open and these on lawns where parasitized jassids abounded. It is probable that their activity and watchfulness would ordinarily forbid capture in the open, since they would naturally escape by falling to the ground on any sign of disturbance such as would be produced by the approach of a sweep net. Males are very uncommon and the females must outnumber them at least ten to one, judging from rearing results obtained by the writer.

It has been learned during these studies that in every case it appears to be the female jassids that fall victims to the attacks of the *ombrodes*. This may be due in some measure to the superior agility of the male jassids in eluding the spring of the parasite or because the females, being generally larger, are preferred as hosts because more likely to successfully nourish the young larvae. Nymphs so far as known are free from attack, since only adult females have been taken carrying the sacs.

These parasites are rare during the early summer and only begin to multiply towards autumn. They are seldom seen

before July. One parasitized jassid was taken by the writer June 1, 1915, the earliest date recorded during these observations.

Only the mature larval and the adult stages of the parasite are treated in this paper, since opportunities to acquire information regarding the appearance of the egg, time of incubation and the various instars of the insect have been impossible during the progress of fragmentary studies.

EMERGENCE OF THE LARVA.

August 6, 1914, a series of infested *Cicadula 6-notata*, all females, was captured and placed in a large tube vial with a supply of fresh grass blades. Only those were chosen that bore well-matured sacs as very poor success had been previously had in rearing parasitic larvae in captivity. Even when well supplied with abundant food the jassids would frequently die in the course of a few hours when confined in a cage, and when taken with small sacs would never survive to their maturity.

From this lot thus caged a number of dryinid larvae issued during the first day, wandered a while about the containing vial and finally established themselves on grass blades or in corners where they constructed cocoons. In order to secure more definite data, two jassids with single sacs in an advanced stage were then selected and placed in small shell vials with bits of fresh grass. These vials were kept under constant observation under a binocular with thirty diameter power.

For an hour or more these jassids were very uneasy, constantly on the move, flipping their wings and continually trying to disengage the sacs by kicking at them with their spiny hind tibiae. This nervousness becomes more pronounced as the parasitic larva nears maturity as jassids with small sacs seldom manifest distress in any manner.

At 10 a. m. a perpendicular rent or slit was noticed in the sac attached to one of these prisoners, and the white body of the larva in violent agitation was visible through this rupture. The opening was in the rear or pouch-like end of the sac, at right angles to the brown bands and was plainly

the result of the muscular contortions of the larva within. The membrane composing the sac seemed very tough and leathery but gave way slowly to the compelling force inside. When the delivery first began the jassid seized a grass blade firmly with its feet but soon let go and raced down the tube. It then forced its beak into another blade and with its claws took a firm grip that was never relaxed until death came nearly three hours later. In every case where an emergence has been witnessed, the host has always died during the final act, when the larva leaves its victim. And in each instance life continues with strange persistence to the very farewell move of the destroyer.

The struggles of the larva for freedom continued without cessation for an hour. At 12:15 it became quiet for thirty minutes, possibly for rest, withdrew into the host's body and the rent in the sac nearly closed. At intervals now the jassid moved its legs feebly. At 12:45 the larva again became active and for forty-five minutes labored most strenuously until it gained its entire freedom. Not all larvae are so fortunate for unless conditions are exactly right at this stage emergence is checked and death ensues.

The last few minutes were marked with extraordinary exertion. Peristaltic waves ran cephalad in rapid succession and each one served to propel the body an infinitesimal distance farther out. It will be understood that emergence was backward, for the tapering head was the last thing to appear. Even when finally free it seemed unwilling to leave its happy home for it remained for some little time thrusting its head again and again into the abdominal cavity of the jassid through the remains of the now much tattered sac. After about fifteen minutes of hesitation of this sort it moved away from the dead body of its host and began to travel.

The progress of the larva is peculiar. Its caudal end is first slightly advanced cephalad, then a constriction progresses anteriorly, this being followed in quick sequence by others, all this action tending to propulsion forward. Locomotion is certainly energetic even if not at all rapid.

(To be Continued)