

BIOLOGY AND MORPHOLOGY OF THE IMMATURE  
STAGES OF *MICROCTONUS INDICUS*, NEW  
SPECIES (BRACONIDÆ: HYMENOPTERA)  
A PARASITE OF *PHYLLOTRETA CRUCIFERÆ*  
GOEZE (CHRYSOMELLIDÆ: COLEOPTERA)

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I. INTRODUCTION

THE Braconid subfamily Euphorinæ has not been studied thoroughly so far from the point of view of both taxonomy and biology, but Muesebeck (1936) made an important contribution to our knowledge of this group by revising the Nearctic species. However, nothing is known about the Indian forms as is quite evident from the fact that *Microctonus indicus* n.sp., to be described elsewhere, is the first record of the genus *Microctonus* Wesmael, 1853, from the Indian sub-continent.

*M. indicus* n.sp., like the other known species of the genus, parasitises the adults of a coleopteron: in this case *Phyllotreta cruciferae* Goeze, a pest of various cruciferous vegetables in Delhi and other parts of India.

From the available literature it is seen that so far only four species of the Euphorinæ have been studied as regards their biology. They are: *Microctonus melanopus* Ruthe (Speyer, 1925); *M. vittata* Muesebeck (Smith, 1952); *Perilitus coccinella* Schrank (Ogloblin, 1913; Balduf, 1926) and *P. rutilus* Nees (Jackson, 1928). Of these, the studies by Smith (1952) are indeed noteworthy, being detailed and accurate. The biology of *Microctonus indicus*, however, yielded certain points of interest, as would be clear from the following account.

II. MATERIAL AND METHODS

The parasites were first observed in the field in the middle of April, 1958, in rather small numbers because of high temperature. The entire work was carried out with field collected hosts, which were dissected daily. The immature stages thus obtained were either mounted in a glycerine-water medium to study their structure—especially the tracheal system—or preserved

in Kahle's fluid, which proved to be a very good preservative, for permanent mounts.

Attempts to produce a parasite-free laboratory culture of the host were not successful because of the adverse seasonal conditions prevailing in April-May, during which period these investigations were carried out.

### III. THE BEHAVIOUR OF THE ADULT PARASITE

The behaviour of the parasite with particular reference to oviposition was studied under the binocular microscope by confining a freshly emerged female with a single host in paired petri-dishes. The female parasite evinced a keen interest in the host by vibrating its antennae and moving briskly. The parasite, however, did not actually insert its ovipositor into the host as long as the latter remained motionless at one place: all the while the female remained in a state of 'tension' just behind the host, its abdomen and ovipositor thrust forward between its legs and projecting beyond and under the head, and the antennae vibrating. As soon as the host showed signs of moving off, the ovipositor was thrust still forward and rapid jabs made on the thoracic sternum. The ovipositor was kept inserted only for a short while—about 5 seconds—and rapidly withdrawn. Quite often the parasite was frustrated in its attempts by the host actively repelling the attack by means of its legs or by turning round.

### IV. SEX RATIO

In comparison with *M. vittata* Mues., studied by Smith (1952), a fair proportion of males occur in *M. indicus*. Four males were obtained out of a total number of 40 parasites collected in the field. Furthermore, these males were observed to copulate and were normal in all characters.

### V. PARASITISM IN THE FIELD

Host material, collected from the field during April, 1958, and dissected in the laboratory, revealed that the percentage of parasitism was about 38% during that period.

TABLE I

	10 batches of field collected hosts, with 10 hosts in each batch									
	1	2	3	4	5	6	7	8	9	10
Number of host found parasitised on dissection	3	5	3	4	2	4	5	3	5	4

## VI. SUPER-PARASITISM

Super-parasitism appears to be of common occurrence in this species. A maximum of 3 grubs (2 first instar and 1 early second instar) and 1 egg have been seen in a single host, while the presence of 2 first instar larvæ in one adult beetle was quite frequent.

## VII. DESCRIPTION OF IMMATURE STAGES

*The egg.*—The ripe ovarian egg of this species (Fig. 1) conforms to the usual shape of a braconid egg. The cephalic end is bluntly rounded and the caudal end bears a stalk. The dorsal aspect is uniformly convex while the ventral is somewhat concave. The egg is 0.10–0.115 mm. long, this length including the 0.04 mm. long pedicel. The egg appears somewhat translucent.

*First-instar larva.*—A first-instar larva soon after hatching is shown in Fig. 2. In side view, the body is slightly curved; the head somewhat bent downward is brownish, sclerotised, while the rest of the body, composed of 13 segments, is more or less transparent.

The head capsule of the first-instar larva is illustrated in Fig. 3. It is distinctly broader than long; the mandibles (*m*) are long, attenuated, deeply sclerotised—of a darker brown colour than the rest of the headcapsule—their tips crossing each other when retracted. The antenna (*a*) are situated anterior to the mandibles and the lobe-like maxillæ (*mx*) are immediately lateral to the mandibles.

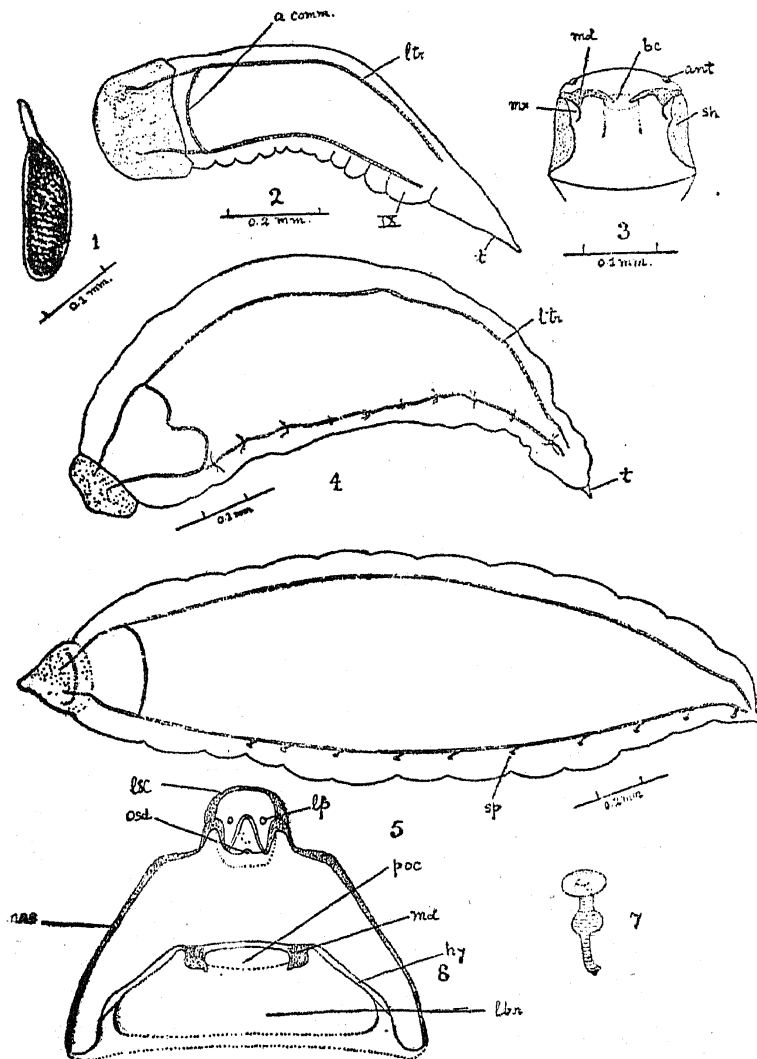
The three thoracic segments are well defined; the first eight abdominal segments are of about equal size, the ninth segment appreciably larger than the preceding one and enlarged on the dorsal aspect because of the globular rectum, while the 10th segment is very much elongated and ends in the 'tail' (*t*).

The tracheal system comprises a pair of thin lateral longitudinal trunks (*lt*) running from the head and extending into the 9th abdominal segment. A dorsal transverse commissure unites the two lateral longitudinal trunks posterior to the head, but there is no caudal commissure.

As the first-instar larva grows, its appearance is considerably altered from that described above, inasmuch as the gut gets filled with fat globules which impart a yellowish hue to the body. The 'tail' bends down markedly, and progressively gets shortened. The measurements of the full-grown first-instar larva are: length 0.602–0.606 mm.; width 0.09–0.10 mm.; width of head capsule 0.132–0.134 mm.; 'tail' 0.07–0.08 mm.

*The second-instar larva.*—The second-instar larva (Fig. 4) is somewhat rounded and the segmentation is not so distinct as in the first-instar larva.

The head, in comparison with the rest of the body, is smaller in size than in the first-instar and has lost the sclerotic mandibles and 'shields' of that instar. The body contents are more or less obscured by the fat globules which began appearing in the late first-instar; and the 'tail' is now very much reduced and directed ventrally.



FIGS. 1-7. Fig. 1. Ovarian egg. Fig. 2. First-instar larva: Dorsal view (segmentation shown only on the left side). Fig. 3. Head of first-instar larva: dorsal view. Fig. 4. Second-instar larva: dorsal view. Fig. 5. Mature larva: dorsal view. Fig. 6. Head of mature larva: diagrammatic and much enlarged showing the sclerites. Fig. 7. Abdominal spiracle of mature larva: much enlarged. *a.comm.*, anterior commissure. *ant.*, antennal rudiments; *bc*, bucca; *hy*, hypostoma; *lbr*, labrum; *lp*, rudiment of labial palpi; *lsc*, labial stipital sclerome; *ltr*, lateral longitudinal trunk; *mas*, maxillary sclerome; *md*, rudiments of mandible; *mx*, rudiments of maxilla; *osd*, opening of the silk duet; *poc*, preoral cavity; *sh*, sclerotised head shield; *sp*, spiracle; *t*, tail; IX, IX abdominal segment of first-instar larva.

The tracheal system is well developed in this instar but still not functional inasmuch as the spiracles have not yet been formed. On each side of the body is a lateral longitudinal trunk which extends clearly into the head giving off some short branches; posteriorly the longitudinal trunk runs almost the entire length of the larva, giving off one dorsal and one ventral branch in each of the 10 abdominal segments.

The measurements of the second-instar larva are: length 1.52–1.60 mm.; width 0.30–0.31 mm.; width of the head capsule 0.198–0.201 mm.; 'tail', 0.03–0.04 mm.

*The third-instar larva.*—The third-instar larva (Fig. 5) is the mature larva which emerges out of the host body. It is cylindrical, with cephalic and caudal ends tapering. The head in this instar (Fig. 6) is well developed and sclerotised.

The prothorax is the largest and the meta-thorax the smallest segment of the thorax. The abdomen is distinctly 10-segmented, the 3rd segment being somewhat larger than the others.

The tracheal system is essentially the same as that of the second-instar larva excepting that the spiracles are present in this instar (*i.e.*, the 3rd) and the tracheal system is, therefore, functional. The structure of an abdominal spiracle, its atrium and part of the tracheal trunk is illustrated in Fig. 7. The measurements of the third-instar larva are: length 2.00–2.22 mm.; width 0.399–0.612 mm.; width of head capsule 0.206–0.218 mm.

#### VIII. MODE OF ISSUANCE

The full-fed last instar larva comes out of the host-body in the manner described below:

The egg is deposited in the body in the body cavity in the thoracic region and the larva on hatching out travels down to the abdomen, where—as observed during dissections—the various immature stages are to be found. The larva continues its journey posteriorwards till, when finally mature, it comes to lodge in the peri-anal region. At the time of issuance, the peri-anal tissues are torn through by the pressure exerted by the mature larva, which comes out of the posterior extremity of the host-body, giving the appearance of having made the exit through the rectum if the whole process is not carefully observed.

#### IX. DEVELOPMENT PERIOD

The parasite was observed to take 10–12 days to complete its development within the host and 3–4 days for pupation outside at room temperature

varying from 86° to 96° F. and 60% R.H. The first-instar period lasted for 5-6 days, the second-instar for 3-4 days and the third-instar for about 2 days at the above temperature and humidity.

#### X. DISCUSSION

*Microctonus indicus*, new species, is a parasite of adults of *Phyllotreta cruciferae* Goeze, a pest of various vegetables in Delhi and other parts of India.

The manner in which the female parasite attacks the host has been described and it seems to agree with the description of the process as given by Smith (1952) in the case of *M. vittatae* and by workers on the other species of *Microctonus*. It also agrees with *M. vittatae* in that the region selected for oviposition is invariably the thorax. But in this species, the parasite eggs have been found in any of the three thoracic segments whereas in *M. vittatae*, according to Smith (1952), the anterior part of the prothorax is most often selected. Also, as in *M. vittatae*, superparasitism was of common occurrence, at least in the field-collected host material. The maximum number of parasites found in one host was 4 (3 grubs and 1 egg) of which only 1 (an early first-instar larva) was alive, the others having apparently been killed either in combat or by the toxic secretions of the 'survivor'.

In our opinion, there are only three instars in the immature stages of this parasite, viz., the first-instar, the second-instar and the third-instar larva. Smith (1952), however, described as many as 5 instars in *M. vittatae*. As far as we could gather from a careful perusal of his work, what he regards as third-instar is really the advanced second-instar and his fourth-instar is an early form of the third-instar larva. Further, Smith (*t.c.*: 328) himself, while commenting on the inapplicability of Dyar's law to the immature stages of *M. vittatae*, makes the following remark: "It is obvious that for the species Dyar's principle fails to apply, whether the correct number of instars present be 4 or 5."

In the occurrence of males, *M. indicus* n.sp. resembles *M. pusillae* Mues. and *M. morimi* Ferr. and differs from *M. vittatae*. In the last-named species, Smith (1952) obtained only 1 male out of 612 imagines during two consecutive years, and remarked that reproduction in *M. vittatae* seemed to be entirely thelytokous. Now, in *M. indicus* the males were morphologically quite normal and copulation was observed frequently, both in the field and in the laboratory. We, therefore, believe that the males of *M. indicus* are fully functional.

The general structure of the head of the mature larva of *M. indicus* agrees closely with that of *M. vittatae* though differing in the relative proportions of

the components (Fig. 6). In this species, too, the tentorial hypostome (*hy*) is internal and unpigmented: actually it is of a very light colour as compared to the other chitinous parts, *viz.*, the maxillary and the labiostipital scleromes.

By studying the mode of issuance of the mature larva, we are able to confirm the view expressed by Smith (1952) (*t.c.*: 337) that emergence occurs by means of the tearing of the membranous tissues around the anus—between the pygidium and its parallel ventral sclerite, to be more exact. Speyer (1925) stated that the mature larva comes out of the anus and Clausen (1940) in his remarks on the process of emergence in the Euphorinæ (*t.c.*: 33) stated that the larva cuts a hole through the thin membrane between two abdominal segments. However, Clausen (*t.c.*: 33) also made the following statement: "In some instances it has been reported that the emergence is through the anal opening, but it was more probably through an incision in the membrane nearby." The latter remark of Clausen's is quite correct except for the term 'incision' since the final instar larva does not have the mandibles fit for cutting the tissues or making 'incisions' in them. Speyer's view, that the emergence takes place through the anus, seems to have been based on an erroneous observation, for, as explained in the description of the process of issuance in *M. indicus*, the mature larva does give the appearance of making its exit out of the anus if the whole process is not carefully observed.

#### XI. SUMMARY

*Microctonus indicus*, new species, is a braconid parasite of the adults of *Phyllotreta crucifera* attacking various vegetables in Delhi and other places in India. This is the first record of the genus *Microctonus* Wesmael from the Indian sub-continent. The biology and behaviour of the adult parasite has been briefly described and discussed in this paper and the immature stages have also been described.

#### XII. ACKNOWLEDGEMENT

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\* Not seen in the original.





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