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# BIOLOGICAL STUDIES OF *BRACHYMERIA LASUS* (WALKER) (HYMENOPTERA : CHALCIDIDAE)

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*Brachymeria lasus* **is a polyphagous parasite attacking the pupal stages of a wide range of pests of crops and vegetables. The adult female lays its eggs one at a time inside the pupae. There are five larval instars. The duration of the development from the egg to adult takes about 10 to 18 days depending upon the weather. Soon after emergence, the female mates. The females live longer than the males. Females predominate on the proportion of sexes. The developmental history, emergence, mating, oviposition, fecundity, nutrition, longevity, sex-ratio and seasonal history of this important species of** *Brachymeria* **are described and discussed.**

## INTRODUCTION

The genus *Brachymeria* includes some of the most widely distributed species in the family Chalcididae and is most commonly represented in India by the species *B. lasus* (Fig. 1). *B. lasus* was first described by WALKER in 1841 from India under the name *Chalcis lasus*. It is cosmopolitan in distribution and is a polyphagous species attacking a wide range of pests of crops and vegetables. Its hosts include pests like cotton boll worm *Platyedra gossypiella* S., teak skeletoniser *Hapalia machaeralis* W., rice skipper *Pelopidas mathias* F., the coconut black headed caterpillar *Nephantis serinopa* M. etc. It was in view of the important role of this species as a natural enemy of many pests that the following studies on the biology of *B. lasus* were undertaken.

## MATERIALS AND METHODS

*Plusia peponis* F., *Sylepta derogata* F. etc. were used as hosts for rearing the parasites in the laboratory. The adults were reared in cages (30 cm x 30 cm x 30 cm) with two opposite sides and top made up of glass and the remaining two opposite sides made up of muslin cloth. In each cage approximately 6 females and 3 to 4 males were placed. Glass test tubes (2.5 cm x 15 cm) with their mouths covered with light muslin cloth or cotton plugs were also used for separately accommodating single pairs of female and male parasites. The adults were fed with honey diluted (50%) with water.

## RESULTS

### *Developmental History*

The eggs (Fig. 2) are laid one at a time and the egg remains freely inside the body-fluids of the host pupa. Duration of different stages varies depending upon weather. The incubation period varies from 20 to 31 hours. The egg is sausage-shaped with an average length of 1 mm and an average width of 0.2 mm. The cephalic end of the egg is somewhat wider with a small button-like process. The chorion is smooth and hyaline. The yolk granules occupy almost the entire length of the egg leaving only a little space at the two ends.

The first instar (Fig. 3) lasts for a period of 21 to 31 hours. It is typically hymenopteriform with well defined head and 13 body segments. The larva measures about 1 to 1.7 mm in length and 0.2 to 0.3 mm in width. The second instar (Fig. 4) lasts for a period of 17 to 28 hours. It measures 1.7 to 2 mm in length and about 0.4 to

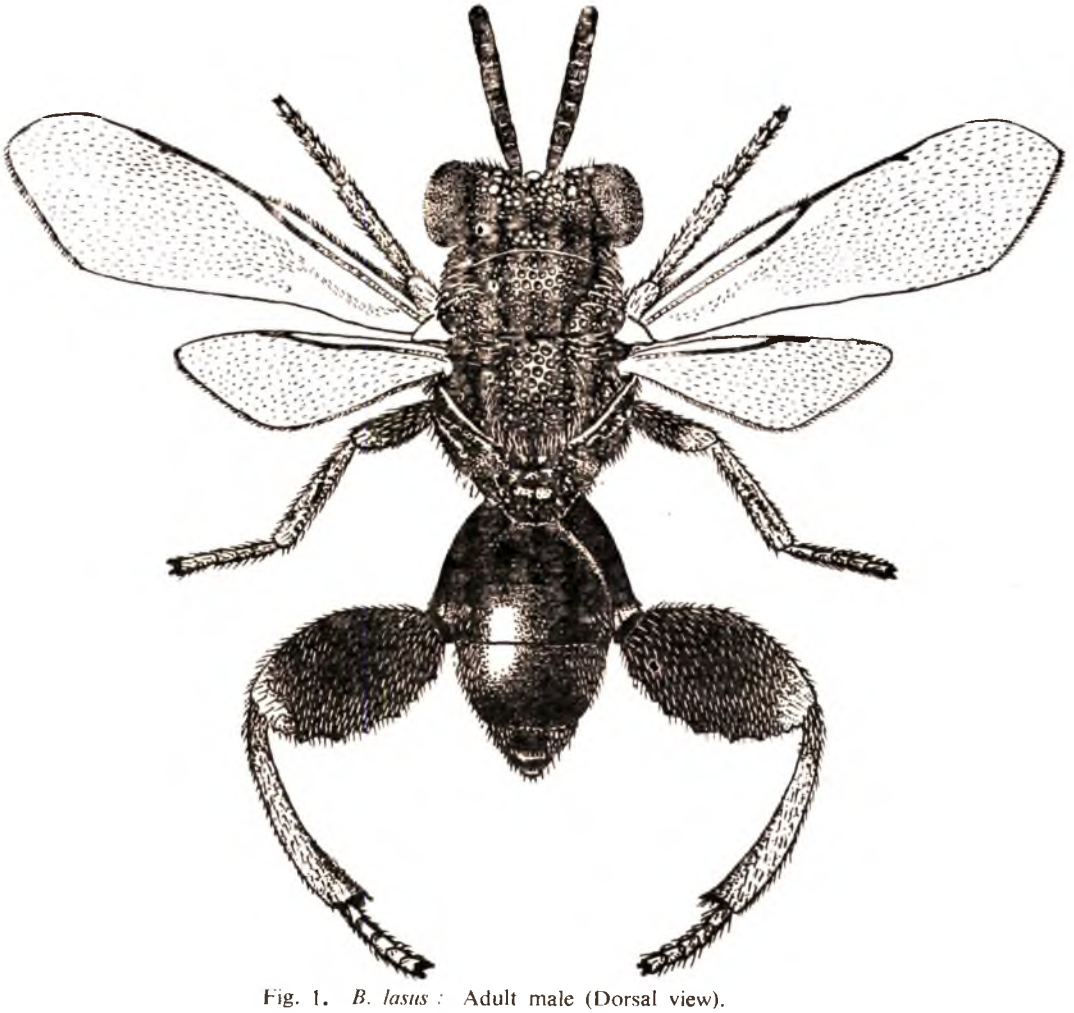


Fig. 1. *B. lasus* : Adult male (Dorsal view).

0.6 mm in width. The third instar (Fig. 5) completes its growth in 20 to 31 hours. It measures 2.6 to 3.5 mm in length and 0.7 to 0.9 mm in width. The fourth instar (Fig. 6) lasts from 22 to 38 hours and measures 3.8 to 5.7mm in length and 1 to 1.8 mm in width. The fifth instar (Fig. 7) is yellowish brown at first and becomes whitish brown later owing to the formation of fatbodies underneath the skin. The duration of the fifth instar varies from 24 to 72 hours. This final instar larva measures 6.6 to 12 mm in length and 2 to 3.5 mm in width.

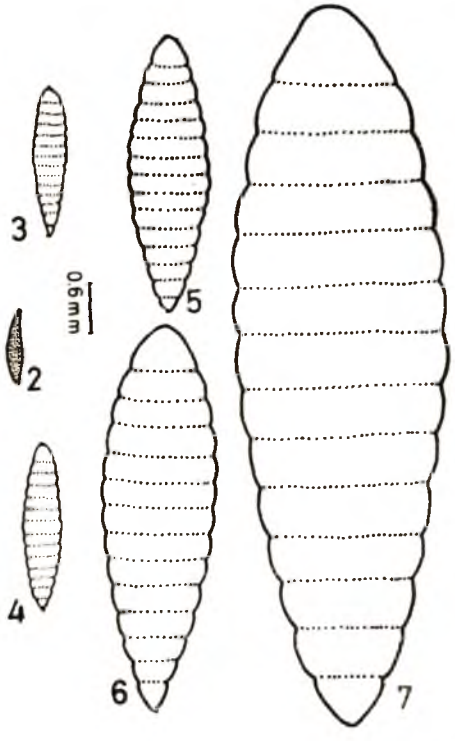
The prepupal stage lasts from 20 to 48 hours from the time the meconia are cast until the last larval skin is shed. The pupa is exarate. The duration of the pupal stage varies from a minimum of 96 hours to a maximum of 144 hours.

*Emergence*

The process of emergence can be conveniently studied under two heads: Primary emergence and Secondary emergence.

*Primary emergence*:– When its development is completed the parasite emerges from its own pupa by shedding the pupal exuvium. About a day or a little earlier than this emergence, very slight movements of the tarsal segments of the leg can be seen

through the pupal covering. The movements become more pronounced later on and within 3 to 5 hours before emergence, irregular slits appear on the pupal covering and this is followed by vigorous movements of the hind legs enabling the insect to get free from the pupal covering. The whole process takes a little less than 5 hours.



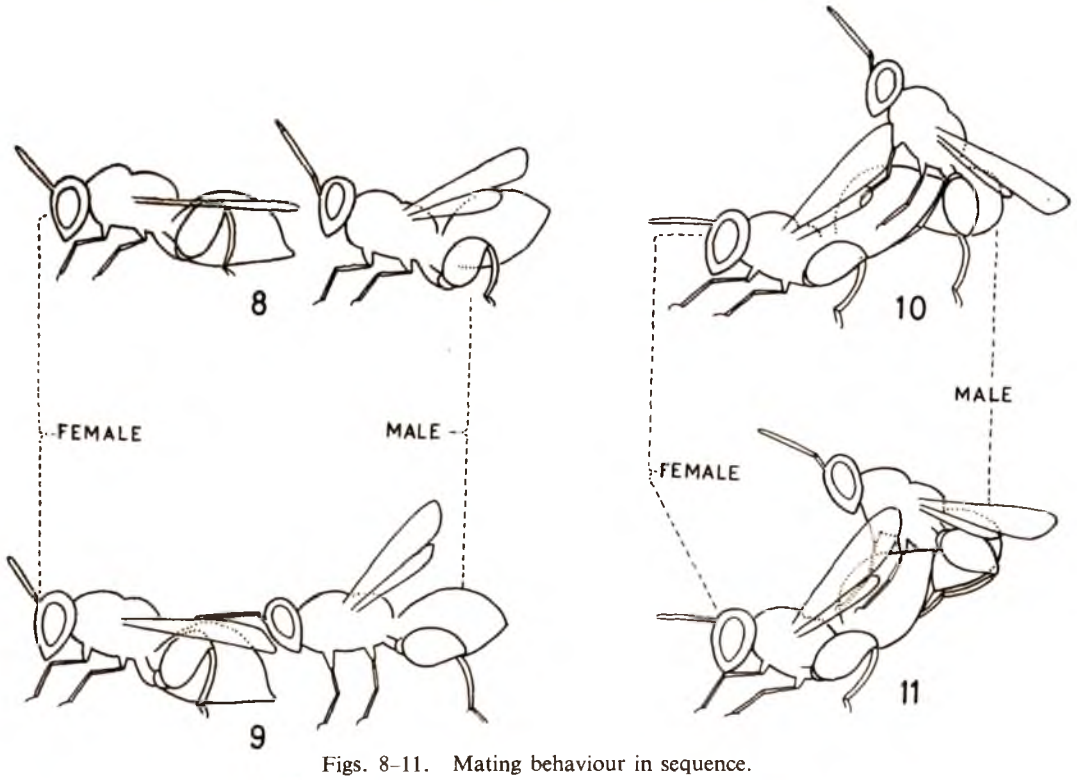

Figs. 2–7. Egg (Fig. 2) and larval stages 1 to 5 (Figs. 3 to 7 respectively). Dorsal view.

*Secondary emergence*:– After the primary emergence the adult usually remains inside the host pupa for about 12 to 24 hours. Then the chalcid gnaws a round hole usually on the anterior dorsal or ventral side of the thoracic segments of the host puparium. Through this hole the adult parasite emerges out. The secondary emergence of the parasite takes place from 10th to 18th day in the case of female. Since the males have relatively shorter developmental period, they emerge earlier than the females.

*Mating behaviour* (Figs. 8–11)

A pre-mating period of 1–3 days was observed for the males. Newly emerged males do not generally show interest in the females. The unmated female is ready for mating soon after her secondary emergence.

After the male locates the female, he chases her, while performing the chasing movements the excited male was found swaying its front part of the body from side to side in a characterstic swinging fashion. While the male chases the female, he may stop moving and direct his antennae toward her. He then continues his swaying movements from side to side and approaches her and places his antennae over her wings which are held folded back over her abdomen. The male then vigorously begins to rock the female to and fro and begins to buzz very briefly with his wings simultaneously with a downward pressure at short intervals. Often a sort of "patting" on the head and thorax of the female is carried out by the male with his antennae and for this purpose he moves over to the side or front of the female before taking up his final position behind the female. He then places his antennae on her folded wings as mentioned earlier. When the male begins to rock the female to and fro and to buzz very briefly with its wings as mentioned above, the female may try to escape. If she sits quiet, a sagging of her body towards the substratum occurs. After about a minute or less, she raises her abdomen and the male lowers his abdomen and at the same time mounts over her abdomen in such a way that ventral part of his abdomen is pressed against the undersurface of that of the female. The penis is now thrust forwards and simultaneously the hypopygium of the female's abdomen opens out to receive the penis which is directed into the female's genital opening. During mating the male's tarsi are variously placed. Those of the pro




Figs. 8–11. Mating behaviour in sequence.

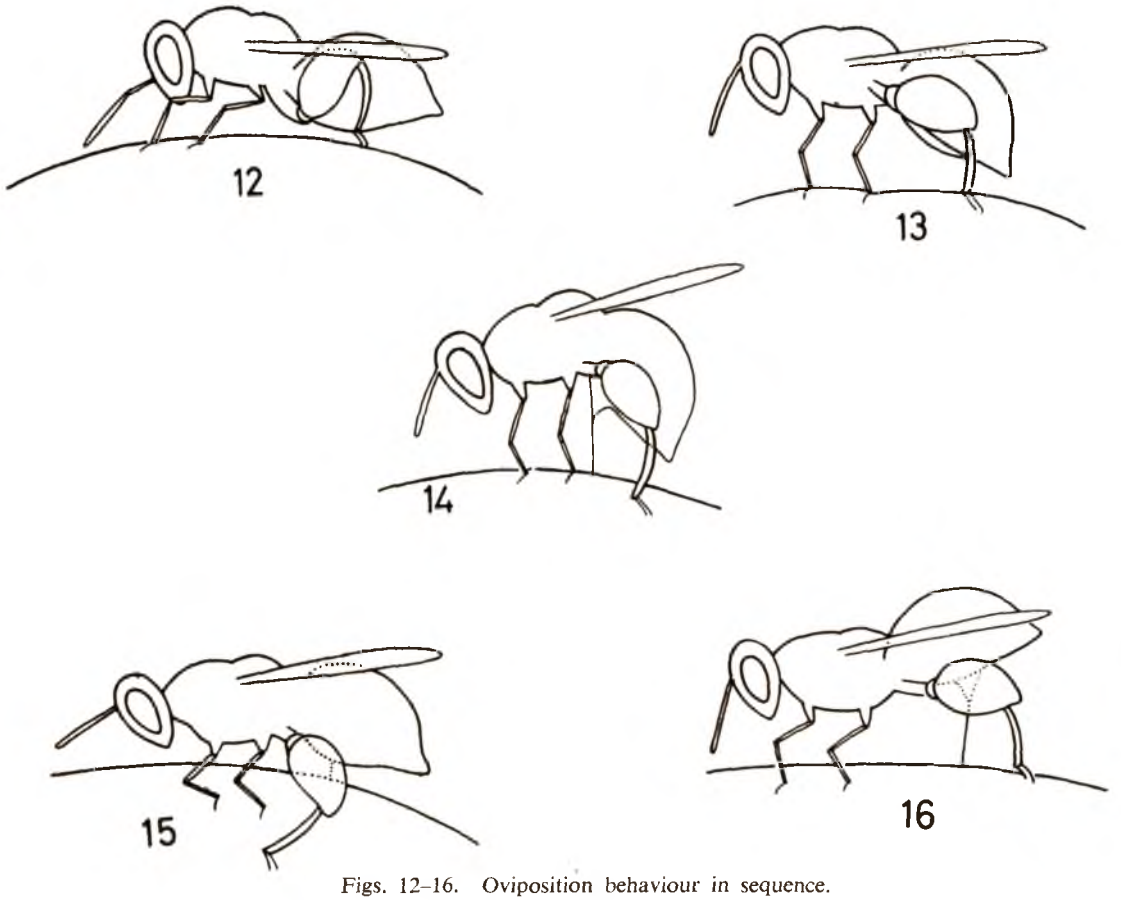
and mesothoracic legs grip some part of the female's wings and abdomen and the metathoracic legs rest on the abdomen of the female or on the substratum. The duration of the act of copulation is about 8 seconds.

Mating usually occurs shortiy after the emergence of the female. The adult females which emerge during the night or early morning hours are usually ready for mating by 9 or 9.30 a.m.

*Oviposition* (Figs. 12–16)

*B. lasus* is a pupal parasite. As a rule the length of preoviposition period of *B. lasus* is 2 to 5 days. Preliminary to oviposition the parasite makes a thorough examination of the host pupa by means of its antennae. At times during this investigation she may move away from the host, as though dissatisfied, perhaps to return again immediately. Finally after these preliminary processes of examination, she locates a suitable site, usually on the thoracic region of the host, for the penetration of her ovipositor. Females sometimes compete for the same host, the larger or stronger repulsing the other by using her hind legs; two females simultaneously ovipositing on the same host pupa is not an uncommon occurrence.

When the host pupa is removed from its cocoon (which is often silken and thin in the case of *Plusia peponis* and *Sylepta derogata*) and given to the female, after determining the suitable site on the host for oviposition she bends her abdomen in such a way that the tip of the ovipositor touches the spot selected for penetration for her oviposition. Once the ovipositor is in position, the body is straightened and simultaneously the ovipositor pierces the host pupa. The parasite now takes a firm grip with her powerful hind legs on the host. During this position the wings are held folded and the antennae




Figs. 12–16. Oviposition behaviour in sequence.

remain mostly motionless. The pupa writhes and rolls in an attempt to dislodge its attacker, but the parasite firmly braced, shows remarkable ability to hold on to its host until the act of oviposition is over. The 99.7% confidence limits of the population mean value of the duration of oviposition are found to be (in seconds) 55.6 ± 3.8.

When the host pupa is provided with a silken cocoon (as in the case of *Plusia piponis*), after locating a suitable spot for oviposition, the female makes a hole in the silken cocoon with the help of its mandibles, forelegs and antennae. When a small aperture is made, the antennae are inserted through this hole as if to feel the presence of the host pupa inside. The female then withdraws the antennae, moves itself a short distance forwards so that the ventral part of its abdomen is above the prepared hole in the silken cocoon. She then inserts the ovipositor through the hole for effecting oviposition. But, in case the host pupa writhes and rolls violently she withdraws her ovipositor without ovipositing and then inserts her hind legs into the silken cocoon through the hole so as to grasp the pupa firmly. After doing so she inserts her ovipositor into the same hole and oviposits as described earlier. Rarely the parasite may fail to thrust its ovipositor into the host as the ovipositor may slip on the host's cuticle

due to the violent wriggling movements of the host. In such cases the parasite may choose another site for oviposition or may abandon the pupa after a few attempts.

Once oviposition is completed, the female pulls up her abdomen, straightens her legs and withdraws the ovipositor into its sheath. She now spends a little time cleaning her antennae, head or abdomen by means of her legs.

Often after oviposition the female sucks up the fluids oozing out of the host pupa through the puncture made by her for oviposition.

On a few occasions females have been seen ovipositing on pupae of *Sylepta derogata* by thrusting the ovipositor across the silken cocoon without making a hole in it as described earlier.

*Fecundity*

The female lays only a single egg as a reult of each act of ovipositon. Usually 3 to 6 eggs are laid by a female during the course of a day. The maximum number of eggs laid in a day is 8. The maximum number of eggs laid at a stretch is 5 and in most cases 3 to 4 only. After ovipositing 3 to 5 times, the female has been observed taking a period of rest for about 10 minutes or more before starting the process again.

The number of eggs a female is capable of laying during her life time could not be defenitely ascertained due to difficulties in having a constant supply of host pupae. However, when supplied with enough fresh pupae every day one female laid 131 eggs within her life span of 43 days and another 61 eggs within a short life span of 20 days. This is approximately 3 eggs per day in each case. The average life span of a female is about 53 days and at the rate of 3 eggs per day a female may be capable of laying about 159 eggs in its life. However the maximum realization of this potential will also depend on many other factors like climate, individual variations, availability of hosts etc.

*Parthenogenesis*

The parthenogenesis in *B. lasus* is arrhenotokous and virgin females produced only males. Mated females produced both male and female progeny. The males produced by virgin females were all found to be normal and fertile.

*Nutrition*

Adults take sugary fluids like honey, nectar, etc.. and occasionally feed on the body juices of their hosts. In the laboratory they were fed with honey diluted to 50% with water. In nature, as in other chalcids, *B. lasus* feeds on extrafloral nectaries, honeydew, etc. Thus the adults can be observed during the morning hours in bright sunshine, on the extrafloral nectaries of several plants, particularly of *Cassia tora*. In confinement, the females have often been observed feeding on the host fluids oozing out from the oviposition puncture. Occasionally the female parasites were seen stinging the host pupae exclusively for feeding on their body fluids.

*Longevity*

Usually the females of *B. lasus* have been found to live for a longer period than the males. Though no wide variation in the life span of adults was observed during different seasons of the year in the South Malabar, the adult life span was comparatively a little shorter during the summer months than during the other periods of the year.

Diluted honey (50%) was given as food for the adults reared in the laboratory for the survival was maximum in such honey fed individuals. The life span of 200 such females varied within the range of 21 to

95 days. The distribution of life span is diagramatically represented in Fig. 17. The 99.7% confidence limits of the population mean value are found to be (in days) 53.3±3.8. Under similar conditions the life span of 200 males varied within a range of 15 to 62 days. The distribution of life span is diagramatically represented in

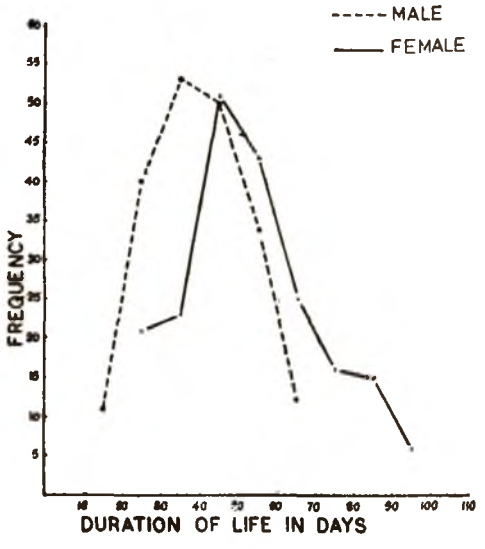



Fig. 17. Frequency polygon showing the distribution of 200 males and 200 females according to their life span (in days).

Fig. 17. The 99.7% confidence limits of the population mean value are found to be (in days) 39.6±2.8.

*Sex ratio*

Females predominated in the proportion of sexes both in the laboratory-reared individuals and in specimens collected in the field. Out of the total 556 individuals reared in the laboratory during 1970 and 1971, there were 332 females and 224 males. The average sex ratio has been found to be 100 females for 67.5 males. However individuals resulting from parthenogenetic reproduction and individuals from smaller hosts were not included in this sex ratio since virgin females gave rise to only males and smaller hosts tended to produce a high proportion of males. The average sex ratio of adults collected from the field was 100 females for 53 males.

*Seasonal history*

In the South Malabar (Kerala) adults of *B. lasus* were found occurring throughout the year (1970 and 1971). Their numbers were found maximum during the colder months (especially in September & October). During the remaining part of the year, their numbers were considerably reduced, especially during the monsoon months.

## DISCUSSION

In *Brachymeria fonscolombei* (D.) according to PARKER (1924) there is a distinct peduncle at the anterior end of the egg. SYCHEVSKAYA (1966) also noted a distinct peduncle at the anterior end of the egg of *B. minuta* (L.) and at the tip of this peduncle six rounded and shiny projections by which the egg is fixed to the internal tissue of the host. But in the case of *B. lasus* no such peduncle with or without projections is seen for the eggs. DOWDEN (1935) noted that the egg of *B. compsilurae* (C.) has a membrane enveloping the chorion but no such membrane could be observed in the case of *B. lasus*.

The first instar larva of *B. lasus* is hymenopteriform. In certain species of *Brachymeria* like *B. compsilurae* (DOWDEN, 1935), *B. fonscolombei* (PARKER, 1924), *B. minuta* (SYCHEVSKAYA, 1966) etc., instead of hymenopteriform first instar larva, a caudate type first instar larva exists. The larval instars of *B. intermedia* (N.) (DOWDEN, 1935) and *B. lasus* resemble very closely.

*B. fonscolombei* (D.) manifested no preference for any particular portion of the host for oviposition (ROBERTS, 1933). *B. lasus* was found to give preference to the thoracic

region of the host for oviposition. This is probably because the thoracic region of the pupa is not involved in the writhing movements and also because it is more spacious for oviposition than the tail region of the host pupa. It may be that in the case of *B. fonscolombei* there is no preferred site for oviposition since the host is the larval stage.

*B. lasus* takes two kinds of nourishment, namely naturally occurring sugary liquids and the body juices of their hosts. *B. lasus* female licks the fluid exuding from its victim's body at the site of penetration of her sting. Such feeding ensures adequate quantities of proteins in addition to the carbohydrates derived from the feeding of honeydew or naturally occurring sugary fluids. It is now well known that such proteinaceous food helps the optimum egg laying capacity.

Because of weather conditions favouring development throughout the year individuals of *B. lasus* are found at all seasons of the year in the South Malabar area where this investigation was carried out.

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