

## CHAPTER VI

LIFE HISTORY OF THE PARASITEAPROSTOCETUS ISRAELI , MANI & KURIAN.

The life history of the parasite was studied in the sugarcane borer - Scirpophaga nivella. F., The host material was reared in fine wire gauze cages in the laboratory. The host pupae were dissected under the binocular microscope to study the various developmental stages of the parasite. The different developmental stages were mounted in Alcohol-glycerine medium and Camera lucida drawings were made. The total period of life cycle was from 14 to 15 days under an average maximum temperature of 87° F and the minimum of 55.9° F with an average humidity of 69.3 per cent.

THE ADULT STAGE | The adult is a minute black Chalcid fly which measures about 2 m.m. in length (Female) and the male being a little smaller in size. The female has a pair of clubbed antennae. The ovipositor is situated on the ventral side of the abdomen. *Vide plates I & II*

MATING OF THE PARASITES. | The parasites are active immediately after emergence from the host pupa.

The male is far more active than the female. It

moves about rapidly in search of its mate. At the approach of the female, the male parasite stands face to face and crosses its antennae with those of the female. After some time of courtship the male parasite mounts on the female and clasps by its 3 pair of legs and mating takes place. The duration of mating may last from 15 to 30 seconds at a time.

OVIPOSITION | The female parasite mounted on the pupa (when the pupa <sup>was</sup> ~~were~~ exposed and provided for oviposition ~~for~~ in the laboratory) rested for a while, located the place for oviposition by its antennae and later raised the abdomen and thrust its ovipositor into the body of the pupa. The ovipositor was kept thrust for some time in the pupal body for the release of the eggs. After this act the ovipositor was retracted. The parasite, later moved about on the pupa for subsequent stabs into the pupal body for oviposition. In the case of borers, lodged inside the sugarcane stubble, the parasite exhibited its unique sense of instinct in locating the borer. It moved about on the stubble of sugarcane and spent most of its time at the orifice prepared by the borer before pupation. The parasite punctured the orifice and entered into the tunnel to oviposit in the host pupa. When the host pupa was found just below the

thinned rind of the sugarcane stubble, the parasite located the position of nearest approach to the pupa and thrust its ovipositor into the thinned rind of the sugarcane stubble and pierced into the pupal body. The ovipositor is strong and long enough to pierce through even the gelatin capsule and reach the host. This was determined on the pupae of *Scirpophaga nivella* F and larvae of *Chilo zonellus* Swinh which were kept in gelatin capsules. The parasite successfully oviposited into the body of the host insects.  
*vide plate III*

The number of eggs laid in the body of the pupa at each time was determined by introducing fresh pupa for oviposition. Each time when the parasite thrust its ovipositor into the body of the pupa and withdrew it, that pupa was removed and a fresh pupa was provided. The pupae which were thus oviposited were dissected under the binocular microscope and the number of eggs lodged were counted. Five parasites each with 10 replications were taken for the study of oviposition at each time. The average of all the 5 parasites was 4.66 eggs with a range of minimum 4.2 to a maximum of 5.0 eggs per stab. The minimum number of eggs laid by any individual was 2 and the maximum was 10. (Vide table on page 39).

TABLE TO ILLUSTRATE THE NO. OF EGGS RELEASED  
BY THE PARASITE INTO THE HOST PUPA AT EACH  
STAB.

Replication No.	<u>Serial No. of Parasite.</u>				
	1.	2.	3.	4.	5.
	No. of eggs laid at each stab.				
1	7	4	4	3	7
2	4	10	2	6	6
3	3	5	3	4	8
4	8	7	5	5	5
5	5	6	5	7	4
6	6	4	4	2	4
7	2	2	4	2	4
8	4	5	6	4	3
9	5	3	4	5	2
10	4	4	7	4	6
<b>Total</b>	48	50	44	42	49
<b>Average per stab</b>	4.8	5.0	4.4	4.2	4.9

Average of all the 5 parasites is 4.66 eggs per stab.

The parasite thrust its ovipositor for oviposition a number of times in the same pupa or chose other pupae if available. Major number of parasites completed oviposition within the first three days of their emergence.

**FECUNDITY OF |**  
**THE PARASITE |**

Fecundity of the parasite was determined by taking observation on the oviposition of 15 parasites. For this observation the female parasites were kept isolated in separate tubes. Host pupae were provided to these parasites every 24 hours. This facilitated the parasite to lay eggs in fresh pupae during the course of 24 hours. The pupae exposed to the parasite were removed after every 24 hours and kept in separate tubes under observation. When the parasites emerged from these pupae, counts were taken and the reproductive capacity of the parasite was arrived at. The observations revealed that the minimum number of parasites reproduced by a single female was ranging from 79 to 156 with an average of 114.6 (Vide table on page 41.)

TABLE TO ILLUSTRATE THE FECUNDITY OF THE

Repli- cation No.	No. of Eggs laid									
	24 hours total.			48 hours total.			72 hours total.			96 h tot
1	62	2	60	25	6	19	21	9	12	-
2	58	5	53	32	5	27	13	5	8	-
3	45	4	41	43	2	41	28	4	24	-
4	63	63	-	32	32	-	22	22	-	-
5	75	75	-	18	18	-	10	10	-	-
6	69	69	-	21	21	-	12	12	-	-
7	82	11	71	22	10	12	15	11	4	-
8	72	7	65	38	12	26	29	14	15	17
9	82	6	76	26	10	16	18	10	8	15
10	67	10	57	28	8	20	34	15	19	23
11	36	4	32	43	2	41	-	-	-	-
12	30	2	28	29	2	27	31	8	23	-
13	44	1	43	40	5	35	25	7	18	-
14	25	22	23	64	9	55	29	4	25	-
15	51	6	45	42	7	35	14	1	13	-

TABLE TO ILLUSTRATE THE FECUNDITY OF THE PARASITE.

No. of Eggs laid												No. of parasites emerged.		
48 hours total.			72 hours total.			96 hours total.			120 hrs total			Total	Male	female
25	6	19	21	9	12	-	-	-	-	-	-	108	17	91
32	5	27	13	5	8	-	-	-	-	-	-	103	15	88
43	2	41	28	4	24	-	-	-	-	-	-	116	10	106
32	32	-	22	22	-	-	-	-	-	-	-	117	117	-
18	18	-	10	10	-	-	-	-	-	-	-	103	103	-
21	21	-	12	12	-	-	-	-	-	-	-	102	102	-
22	10	12	15	11	4	-	-	-	-	-	-	119	32	87
38	12	26	29	14	15	17	10	7	-	-	-	156	43	113
26	10	16	18	10	8	15	10	5	-	-	-	141	36	105
28	8	20	34	15	19	23	13	10	-	-	-	152	46	106
43	2	41	-	-	-	-	-	-	-	-	-	79	6	73
29	2	27	31	8	23	-	-	-	-	-	-	90	12	78
40	5	35	25	7	18	-	-	-	-	-	-	109	13	96
64	9	55	29	4	25	-	-	-	-	-	-	118	15	103
42	7	35	14	1	13	-	-	-	-	-	-	107	14	93
												1720	581	1139

DESCRIPTION OF THE DEVELOPMENTAL STAGES  
OF THE PARASITES

EGG STAGE I The egg is somewhat cylindrical in form, whitish in colour, with a thin smooth chorion. It is about 0.36 m.m. in length and 0.08 m.m. in width with the Cephalic end broader than the posterior end. The egg is centrolecithal. The incubation period ranged from 16 to 20 hours. *Vide plate IV*

LARVAL STAGE I First instar - The newly hatched larva is very tiny and delicate and apodous. The body measures 0.484 mm. in length; 0.146 mm. in width. The width of the head is 0.052 mm. The larva is elongate, oval in general outline, tapers towards the caudal end and more than twice as long as broad. The head appears to be like a small conical projection and the body is simple having neither segmentation nor appendages. The integument is smooth and naked. There does not appear to be any differentiation in the internal organs. During this stage the respiration is by the diffusion of oxygen from the host blood as the larva has not developed spiracles.

The mouth is ventral and appears like a transverse slit. The mouth parts are poorly

developed. The cephalic skeleton at this stage consists of the superior mandibular struts, inverted 'L' shaped mandibles which are weak and a crescent shaped labrum covering the oral aperture. The larva feeds on the host fluid by suction. Moulting occurs within 24 hours. *Vide plate IV*

#### Second instar larva

The larva is slightly oval. The larva exhibits indications of the segmentation in the integument of the body. The head appears to be more rounded than conical. The mandibles look stronger and the foregut is well defined. The other mouth parts are weakly developed. The midgut is enlarged and a darker central portion is visible. During this stage the tracheal strands are developed. There are no spiracles. The respiration appears to be similar to that found in the previous stage. Moulting occurs in about 24 hours.

#### Measurements (average)

Length	0.996 mm.
Width	0.364 mm.
Head	0.098 mm.

*Vide plate IV*

#### Third instar larva.

The larva is elongate, the integument is tougher

than that in the previous stage and the body is found differentiated into segments. The mouth parts are better developed. The mandibles are strong and the struts are well defined. The cephalic skeleton is completely formed. The larvae feed on all the internal tissues of the host. The suctorial activity of the pharynx is clearly visible. The contents of the mid-gut are much denser. At the anal end there is differentiation into clefts - the forerunner of the anus. The spiracles are completely developed. Open tracheal system is seen. This stage lasts for nearly two days.

Measurements (average)

Length 1.156 mm.

Width 0.313 mm.

Head 0.119 mm.

*Vide plate IV*

Fourth instar larva.

This stage lasts for 2 days and sometimes a little over than 2 days. The larva is fusiform in shape and has a heavily chitinized head and 13 body segments which are clearly visible. The larva is greyish in colour and has dark fecal mass accumulated in its gut. The integument is thick and the anal cleft has deepened affording connection with the hind gut. *Vide plate V*

## Measurements (average)

Length 2.160 mm.

Width 0.549 mm.

Head 0.159 mm.

In this stage, the tracheal system is peripneustic. It consists of two longitudinal trunks. These are connected anteriorly and posteriorly by transverse commissures. Nine pairs of spiracles are present and these are connected to the longitudinal trunks of the trachea. At the junction of the spiracular trachea with the tracheal trunk are the anastomosing trachea which end into small branches - the tracheoles. The head is well differentiated into upper and lower labial lobes. The cephalic skeleton is well formed having a pair of sharp chitinized mandibles, superior mandibular struts affording the articulation of the mandibles on the upper sides. These struts are connected by a semi circular bar - Epistoma on the upper clypeal region. The superior and inferior mandibular struts are connected on each side by the bracket shaped pleurostoma. (Vide plate V & VI)

Fifth instar larva.

In this stage, the larval organs are well developed. There is a complete continuity in the gut from the mouth to the anus. All the internal organs of the host are completely consumed without any exception. The larva passes 2 days in this instar, later rests for a

while leading to the prepupal stage. (Vide plate )

Measurements (average)

Length	2.93 mm.
Width	0.693 mm.
Head	0.204 mm.

APPLICATION OF DYAR'S LAW

There are five instars during the larval stage of the parasite. This has been confirmed by the application of Dyar's law. The head width follows a regular geometrical progression in successive instars. The head-width in the 5 larval instars of *Aprostocetus argyriae*, Mani & Kurian were observed and calculated. The observed number in the series was divided by the one which preceded it and a ratio of increase in each instar was found. The average of these ratios was 1.44.

<u>Calculated widths</u>	<u>Observed widths.</u>
1st instar.	0.052 mm.
2nd instar. $(0.052 \times 1.44) = 0.0748$	0.098 mm.
3rd instar. $(0.0748 \times 1.44) = 0.1078$	0.119 "
4th instar. $(0.1078 \times 1.44) = 0.1552$	0.159 "
5th instar. $(0.1552 \times 1.44) = 0.2235$	0.204 "

It will be seen from the above data that the approximation of the observed to the calculated measurements is sufficiently close to preclude the probability of an ecdysis having been overlooked.

The Pre pupa

The pre pupal stage is marked by the differentiation of the body segments into three distinct regions - the head, thorax and the abdomen. The head having the cephalic structure looks like the head of the 5th instar larva. The thoracic region is demarkated from the broader and bulbous abdomen. The thorax is differentiated into 3 segments. These segments throw out projections which develop into legs. The segmentation of the abdomen is obliterated. The midgut is reduced into a thick band. The faeces which had accumulated in the larval stage are voided off and within 24 hours the prepupa goes into the pupal stage. (Vide plate ix) This stage is reached normally on the 10th day where the duration of the entire life cycle of the parasite lasts 14 days.

The pupa

The pupal stage lasts for 4 days. The pupa lies free inside the host's pupal case. The pupa is of Coarctate type.

Measurements (average)

Length	1.718 mm.
Width	0.550 mm.

It is in this stage that all the future adult organs are developed. In the cephalic region, the

compound eyes, the ocelli and the antennae are developed. The mouth parts - labrum, maxillae, mandibles and the labium are formed.

In the thoracic region the 3 pairs of legs are fully formed. The thorax throws out lateral tergal expansions or paranota and these develop into wings. The 1st abdominal segment coalesces with the meta thoracic segment. The 2nd abdominal segment connects the thorax and the abdomen.

In the abdomen all the internal organs, such as the digestive, excretory and the genital organs are gradually formed.

#### Male genitalia

In the male (pupa developing into male) the ~~the~~ external genitalia comprises the penis, a pair of inner processes or parameres and a pair of claspers. The 9th abdominal segment bears the external genitalia.

#### Female genitalia

In the female (pupa developing into female) the 8th and the 9th abdominal segments carry the external genitalia. The ovipositor is composed of three pairs of components whose shafts are termed

valves. Each valve is associated with a basal plate or valvifer. These valvifers are derived from the limb bases of the 8th and 9th segments. The median outgrowths of the limb bases of the 8th segment give rise to the anterior or ventral valves. The median outgrowths of the limb bases of the 9th segment give off the posterior or inner valves. The drawn out or modified limb bases of the 9th segment give rise to the lateral or dorsal valves. The lateral valves are quite separate and ensheath the functional ovipositor or terebra when not in use. The posterior valves are united to form a guide or median stylit. The anterior valves articulate with the posterior valves by a ridge and groove device. Thus forming a channel which serves for the passing down of the eggs. (Vide plates XIX)

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