THE DEVELOPMENT OF HARPACTICOID COPEPOD, *MACROSETELLA GRACILIS* (DANA.)

THOUGH the typical Harpacticoid nauplii are said to be creepers on the bottom, the nauplii as well as the early copepodite stages of *M. gracilis* (Dana.) were found clinging to floating *Trichodesmium* strands, in the Plankton in September and October. The larvæ of this Copepod were grasping the algal strands considered inimical to living things by some, with the help of the well-developed antennæ or were actively crawling over these.

The eggs which are light yellow in colour and are carried in external brood-sacs, have a diameter varying from 0·06 m.m. to 0·08 m.m.

There are 6 naupliar stages as in all other Copepods. The nauplii are all coloured red owing to the presence of red pigment inside the body. The nauplius eye is present as a red-spot. The length of the nauplius at each of the six stages being 0·102 m.m., 0·130 m.m., 0·168 m.m., 0·205 m.m., 0·302 m.m. and 0·369 m.m., it will be obvious that the growth is uniform and that the increase from one stage to another is more or less mathematically constant obeying Brooks' law.

The progress of differentiation seen in the appendages through the six naupliar stages may be summarised briefly: —

Antennule: Rudimentary. Shows an increase in the number of joints at the 5th stage. *Antenna:* well developed, 2-jointed, the 2nd joint being hinged to a claw. *Mandible:* single lobed with 2 curved setæ. A 3rd seta is added at the 4th stage. Posterior feeler continues to increase in size and complexity from the 1st stage when it is represented by a short bristle.

There are 6 Copepodite stages, the 6th being the adult itself. The number of segments in the body, the size of the body and the number of swimming feet present at different Copepodite stages are given in the table below:—

Stage	I	II	III	IV	V	VI
No. of joints in Metasome	3	3	3	4	4	5
No. of joints in Urosome	1	1	2	3	4	5 ♂ 4 ♀
Length in m.m.	0·484	0·616	0·742	0·922	1·24 ♀ 1·01 ♂	1·4 ♀ 1·1 ♂
No. of swimming feet	2	3	4	5	5	5

The increase in number and complexity of the appendages are briefly summarised thus: — *Antennule:* Prominent, 5-jointed up to the 4th Copepodite stage. Geniculate and 7-jointed in the male and 8-jointed in the female from the 5th stage. *Antenna:* uniramous, 2-jointed in the 1st and 2nd Copepodites and 3-jointed from the 3rd stage onwards. *Mandible:* rudimentary. *1st Maxilla:* rudimentary. *2nd Maxilla:* indistinctly bilobed in the 1st and 2nd stages and 3-lobed from the 4th stage. *Maxilliped:* well developed, 2-jointed, the 2nd joint being hinged to a claw.

PLATE I. Nauplius 3rd stage, under high power (40 × 10)

In the development of *Macrosetella*, the pronounced development of the antenna may be due to its prehensile function.

A full description of the developmental stages is given elsewhere.

The author thanks Dr. C. P. Gnanamuthu, M.A., D.Sc., F.Z.S., Director, University Zoology Laboratory, Madras, for his help and guidance.

University Zoology Lab., Chepauk, Madras, *November* 8, 1948. S. KRISHNASWAMY.

1. Brady, G. S., *Challenger Reports*, **8**, 1873. 2. Giesbreht, *Fauna and flora golfes von Neapel*, **19**, 1893. 3. Wilson, C. B., *Bull. U. S. Nat. Mus.*, No. 158, 1932.

POST-EMBRYONIC DEVELOPMENT OF ANTENNÆ IN APHIDS

Introductory.—The antennæ in adult aphids are usually six jointed (except in a few forms like *Tetranura ulmifoliæ* Baker) with two primary sensoria, one at the apex of seg. v,

and the other at the base of the flagellum. Number of sensoria on seg. iii, iv and v are variable in different species. In all the aphids however, the scape and the pedical are the smallest of the segments.

For the post-embryonic development of antennæ two species from each of the genera *Aphids* and *Macrosiphum* were under observation. The insects were bred in the laboratory on plants grown in pots of convenient size, covered over with lamp chimneys with the mouths capped with fine muslin. The observations on the antennal development were made on the offsprings from the same parents kept under identical conditions.

being sub-equal. The primary sensoria are shifted, one to the apex of seg. v and the other at the base of seg. vi.

Our observations are in conformity with those of Bhargav (1947) that the pedical does not divide in *Aphididæ*. Sexena (1946) however, remarks that an increase in the antennal segments is brought about by the division of the pedical. This, however, does not hold good in *Aphididæ* where the seg. iii divides by two successive devisions and thus ultimately the antenna becomes 6 segmented.

Genus Macrosiphum.—The antennæ in the 1st instar nymph is 5 segmented, segments i and ii being sub-equal and the last being the

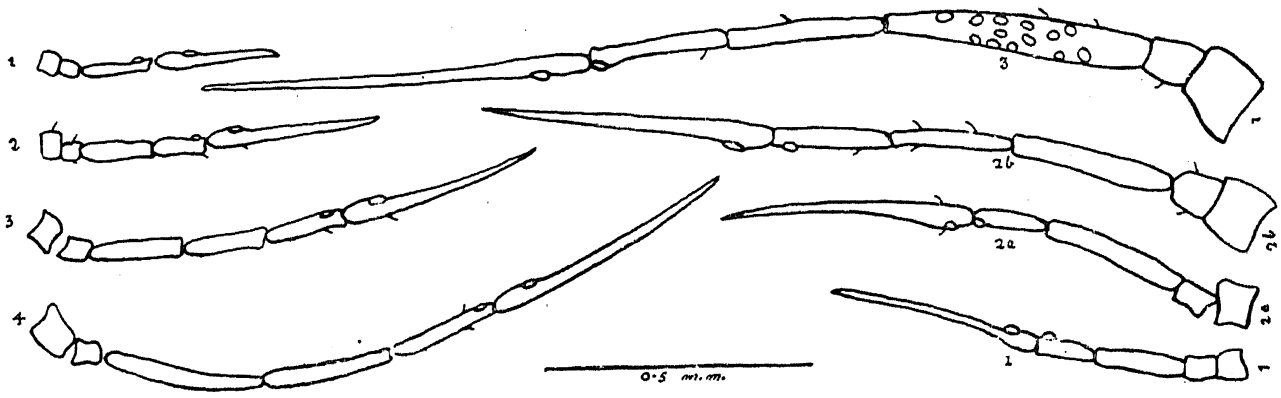

PLATE I. Antennal Developement in Aphids

Genus Aphis.—On the first day of hatching the antenna is only 4 segmented, the scape and pedical are sub-equal, the last segment the longest. Primary sensoria are present, one at the apex of seg. iii, and the other near the major constriction of the flagellum. Just before the first moult, seg. iii shows a little constriction. In the second instar the antenna continues to grow showing a clear demarcation within the seg. iii. Thus the antenna is now 5 segmented, the primary sensoria previously on seg. iii is now shifted at the apex of seg. iv, and the other as usual, placed at the base of the flagellum. The flagellum in the second instar is relatively longer than in the first instar. Similarly, seg. iii has grown longer than in the previous instar. In the beginning of the third instar there are still 5 antennal segments, seg. i and ii being equal, iii longer than iv and the flagellum of the terminal segment being the longest. The primary sensoria are situated on the apex of seg. iv and the other at the base of seg. v. Prior to the next moulting however, a constriction again appears in seg. iii, thus making in all 6 segments. During the 4th instar, segments iii, iv, v and vi continue to elongate, the first two segments longest. Primary sensoria are located, one at the apex of seg. iv, and the other compound sensorium at the major constriction of the flagellum. In the beginning of the second instar seg. ii is slightly longer than seg. i, segments iii and iv continue to elongate, and the flagellum is the longest. Seg. iii becomes uniformly thick, and a slight constriction appears. The primary sensoria are situated, one at the apex of seg. v (original iv) and the other at the base of the flagellum. Prior to second moulting, segmentation in seg. iii becomes more marked and the antenna becomes 6 segmented. During the third instar all the individual segments continue to grow, seg. iv and v are sub-equal, seg. iii longer than iv, and flagellum again the longest. The position of primary sensoria is the same as in the previous instar. In the 4th instar, seg. iii attains normal length and is longer than seg. iv or v. The individual segments continue to grow to attain their normal lengths.

Obviously the segment iii divides but only once in this case.

Summary.—Unlike in the genus *Aphis* there are 5 segments in the antenna of freshly born *Macrosiphum* nymph. The clevage in seg. ii

is seen just in the beginning of the second instar, yet only 5 antennal segments are made out. However, the segmentation at the end of the same instar is completed and thus 6 segments are made out. The lengths of antennal segments after the division and just in the beginning of third instar are given below. The individual segments continue to grow in different instars until normal proportinate lengths are attained in their adult stage. Thus, in the third instar the number of antennal segments in *Macrosiphum* nymphs are six.

TABLE I

Measurements of antennal segments in Aphids during different instars

Instars	Antennal segments	*Aphis fabæ*	APHIDS *Aphis* spp.	APHIDS *Macrosiphum jacaeae*	APHIDS *Macrosiphum pisi*	Remarks
		Average measurements in m.m.				
I	i	0·03	0·03	0·04	0·04	In each case averages are derived from antennal measurements of 6 nymphs bred under observation
	ii	0·04	0·03	0·04	0·04	
	iii	0·16	0·15	0·16	0·22	
	iv	0·26	0·23	0·12	0·22	
	v	..	..	0·41	0·57	
	vi	..	.	..	..	
II	i	0·04	0·04	0·04	0·06	*Aphis*: seg. iii shows clear division, spliting it into two. *Macrosiphum*: seg. iii uniformly swollen and a slight cleavage could be noticed.
	ii	0·04	0·04	0·06	0·08	
	iii	0·13	0·15	0·27	0·34	
	iv	0·08	0·09	0·15	0·28	
	v	0·32	0·32	0·49	0·69	
	vi	..	..	..	..	
III	i	0·04	0·04	0·09	0·08	*Aphis*: Seg. iii shows thickening at base, cleavage is seen in seg. iii, seg.v now becomes vi. In *Macrosiph* as well the full compliment of six segments is observed in this instar.
	ii	0·04	0·04	0·08	0·09	
	iii	0·13	0·18	0·28	0·33	
	iv	0·08	0·16	0·22	0·36	
	v	0·09	0·15	0·22	0·35	
	vi	0·37	0·41	0·57	0·91	
IV	i	0·09	0·06	0·09	0·13	
	ii	0·08	0·06	0·09	0·08	
	iii	0·36	0·29	0·53	1·13	
	iv	0·33	0·22	0·28	0·78	
	v	0·25	0·22	0·28	0·71	
	vi	0·58	0·50	0·77	1·35	

The difference between antennal developments in the two different genera, namely *Aphis* and *Macrosiphum*, were not noticed by Bhargava (1947).

Entomological Laboratory, K. N. TREHAN.
College of Agriculture, H. L. KULKARNY.
Poona 5,
November 19, 1948.

1. Bhargava, "Post-embryonic development of antennæ of Aphids." *Curr. Sci.*, 1947, **8**, 258. 2. Sexena, S. S., "Post-embryonic development of antennæ of *Begrada pita* Fab.," *Curr. Sci.*, 1946, **20**, 194.

DIMORPHISM IN STAMENS OF *CROTOLARIA JUNCEA*

IN the course of our studies on anthesis of crop plants, an interesting type of dimorphism in stamens was observed in *Crotolaria juncea*.

The inflorescence is a raceme with the number of flowers ranging from 14 to 22 with an average of 16. The number of days taken from the bud initiation to flower opening is on an average 20. The flower remains open for a day. The flower is typically papillionaceous, the only interesting feature being the dimorphic stamens. The androecium consists of 10 stamens, 5 of which have round anthers and 5 linear anthers, arranged alternately on a ring.

TABLE I

Lengths of the dimorphic stamens during the development of the flower-bud in Crotolaria juncea

Developmental stages of flower-bud	Age in days	* Length in cm. of the stamens with linear anthers	* Length in cm. of the stamens with round anthers	Difference in length of stamens of the two types	Remarks
1	5	0·40	0·05	−0·35	Equal growth
2	6	0·50	0·05	−0·45	
3	7	0·55	0·10	−0·45	
4	8	0·52	0·10	−0·45	
5	9	0·60	0·15	−0·45	
6	10	0·65	0·15	−0·50	
7	11	—	—	—	
8	12	0·80	0·14	−0·66	Growth rapid in stamens with linear anthers
9	13	0·80	0·20	−0·60	Equal growth rate
10	14	0·87	0·30	−0·57	
11	15	0·95	0·30	−0·55	
12	16	1·20	0·60	−0·60	
13	17	1·30	0·80	−0·50	Growth more rapid in stamens with round anthers
14	18	1·25	1·00	−0·25	
15	19	1·20	1·30	+0·10	
16 (Open flower)	20	1·30	1·50	+0·20	

* *The length is measured from the base of the staminal ring to the tip of the anthers.* Each figure is an average of five observations.