

Mosquito Larvae. III. The Hairiness Factor Again?

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Larvae attributed to *Tripteroides nepenthis* (Edwards), found in plant pitchers in Malaya, Singapore and Borneo, have a dense covering of stellate setae which, however, is conspicuously less dense in some larvae than in others (Fig. 1). A similar situation, though one involving setae with fewer branches, was noted in *Aedes polynesiensis* Marks and *Ae. pseudoscutellaris* (Theobald) in the Society Islands² by Rosen & Rozeboom¹ and in *Ae. albopictus* (Skuse), in Singapore, by Colless². Hairiness was shown to be associated in both cases with the presence of debris in the tree holes utilized as breeding places. Colless eventually isolated the factor responsible in the form of minute but filterable, non-living, organic particles capable of inducing hairiness in larvae both of *Ae. albopictus* and of *Ae. aegypti* (Linnaeus) when added to the breeding water.

In a previous paper in this series I discussed the possible relation³ between the hairiness factor and the mouthbrush factor studied by McGregor³ in *Opifex* and found also in *Heizmannia* and several subgenera of *Aedes*⁴. Another factor, perhaps more closely related to the present one, was described by Barr⁵ in *Ae. (Ochlerotatus) fitchii* (Felt & Young), this time affecting the number of comb scales. Certain aspects of the situation in *Tripteroides* recall Barr's findings rather strongly. I have accordingly made a quantitative study of the available material (87 larvae from 4 different localities in Malaya, Singapore and Borneo) of *Tr. nepenthis* for comparison. The study is still far from complete but available results so far, based on metathoracic setae 1-13, seem sufficiently interesting to warrant a preliminary note.

Barr was confronted with an apparently continuous series of comb scale numbers, from 10 to 36, in *Ae. fitchii* but concluded, from a bimodality in their frequency distribution, that he was, in fact, faced with two overlapping series. He further deduced that the upper series (from 21-36) arose from a doubling of the comb scale numbers in the lower series (from 10-20). Since, however, no other character was available whereby the two series might be distinguished his interpretation has remained hypothetical.

The two largest dorsal metathoracic setae, 1-T and 5-T, also have a bimodal frequency distribution with respect to numbers of branches in *Tr. nepenthis* and in both of them the branch numbers also appear to form a continuous series. Seta 4-T, on the other hand, shows completely discontinuous variation, being either very small with few branches or very large with many and with no intermediates (Fig. 1). It is thus possible to derive two series of branch numbers for setae 1-T and 5-T associated with small 4-T and large

4-T respectively. When this is done for 1-T it is found that larvae with small 4-T (3-6 branches) all have branch numbers occupying the lower one-third of the range (9-21) while those with large 4-T (12-28 branches) all have branch numbers in the upper two-thirds of the range (22-46). Seta 5-T behaves very similarly though with slightly smaller branch numbers (9-20 and 19-40) and a slight overlap. The correspondence with the upper and lower series postulated by Barr is striking. Moreover, by grouping the numbers in the upper series in pairs and tabulating the even numbers only, as was done by Barr, it is possible to achieve a one-one correspondence between the upper and lower series as shown in Tables I and II.

Table I

Distribution of branch numbers in seta 1-T of *Tr. nepenthis*

		1-T														
		9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
4-T	3-6	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		5	2	11	6	8	12	8	8	6	2	4	-	1	-	-
4-T	12-28	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46
		-	-	2	8	4	6	7	5	14	13	8	1	2	3	1

Table II

Distribution of branch numbers in seta 5-T of *Tr. nepenthis*

		5-T											
		9	10	11	12	13	14	15	16	17	18	19	20
4-T	3-6	9	10	11	12	13	14	15	16	17	18	19	20
		2	-	2	9	7	15	7	10	9	10	3	1
4-T	12-28	18	20	22	24	26	28	30	32	34	36	38	40
		-	1	1	6	6	9	10	13	8	10	9	5

It will be seen that when this is done Barr's hypothesis of a doubling of setal numbers as between the lower and upper series receives support provided it is assumed that a few extreme (and therefore relatively infrequent) values are unrepresented in the available sample. This does not seem an unreasonable assumption. The modes of the two series do not coincide and thus do not support the hypothesis, but the size of the sample is relatively small (147 individual setae for 1-T and 153 for 5-T). On this point further evidence is needed. This does not, however, detract from the strong support given by these figures to Barr's more general hypothesis of a factor operating to produce an increase in numbers of comb scales whether by doubling or otherwise.

Nature of the factor(s) involved.

The hairiness factor in *Stegomyia* seems to have been clearly shown to be environmental. Colless' experiments also suggest that the wide variation in branch numbers within the series is also at least in part an environmental dosage effect. How far the phenomenon is genetic, and how far, environmental, in *T. nepenthis* requires to be determined experimentally.

Distribution as between the various collection batches (16 in all) is not very helpful. Most of them contain larvae of both kinds and it is not clear whether individual batches are to be ascribed to individual pitchers, individual plants or even groups of plants in a particular locality. Barr observed that in *Ae. fitchii* earlier collections tended to contain a higher proportion of larvae with small numbers of comb scales than later collections from the same breeding place. It thus seems that there is a tendency towards increasing concentration of the causative factor with ageing of the breeding place. This could well apply to tree holes and pitcher plants as well as to ground pools. Thus individual pitchers, even on the same plant, could easily differ in their content of hairiness factor.

Experimental material for comparison is very limited though I hope to remedy this. I have at present only one each of Colless' laboratory reared hairy and non-hairy larvae and none of Rosen & Rozeboom's. The latter figure the thorax of a hairy and a non-hairy larva but their figure is apparently based on *Ae. upolensis* from Samoa rather than on the original *polyne-siensis* material and so cannot be used⁶. Comparison even of this limited material of *albopictus* with that of *Tr. nepenthis* is, however, interesting. (see Table III).

Table III

Nos. of branches in metathoracic setae of two larvae of *Ae. albopictus*

Seta	1	2	3	4	5	6	7	8	9	10	11	12
Non-hairy	3	1	2	3	2	1	4-5	4	1	2	1	1
Hairy	6-7	1	4	6	5	1	4-5	13	1	2-3	1	1

It will be seen that setae 2-T, 6-T, 7-T, 9-T, 10-T and 12-T are apparently unaffected by the hairiness factor. These setae are also unaffected in *Tr. nepenthis*. Apart from this the suggestion of setal doubling in *Ae. albopictus* is quite striking. The only exception among the remaining setae is 8-T which is discussed below. Differences from *Tr. nepenthis* otherwise only affect seta 2-T which is constantly single in both non-hairy and hairy larvae of that species and seta 11-T which is single in both *albopictus* larvae but is single in about 50% of the non-hairy *nepenthis* larvae and double in about 80% of the hairy.

Seta 8-T is interesting since it apparently exhibits tripling in *albopictus*. This seta also behaves differently from the others in *Tr. nepenthis* showing a shifting of the mode in hairy larvae but one falling far short of doubling (Table IV).

Table IV

Distribution of branch numbers in seta 8-T of *Tr. nepenthis*

	8-T											
	4	5	6	7	8	9	10	11	12	13	14	15
4-T												
3-6	2	4	12	10	21	10	10	7	6	-	-	-
4-T												
12-28	-	4	-	1	8	9	11	16	11	10	3	2

In conclusion it is perhaps worth noting that there is no apparent preponderance of even branch numbers in the hairy larvae either of *Ae. albopictus* or *Tr. nepenthis* such as was used by Barr to support his hypothesis of comb scale doubling in *Ae. fitchii*.

Summary and conclusions.

Environmental factors are known or believed to affect larval structures as diverse as mouthbrushes, thoracic and abdominal setae and comb scales in *Opifex*, *Heizmannia*, *Stegomyia*, *Finlaya*, *Diceromyia*, *Aedimorphus*, *Halaedes*, *Ochlerotatus* and, it would seem, *Tripteroides*. They may well be more widespread. They have been found in a variety of breeding places including rock holes, tree holes, bamboos, ground pools and plant pitchers. In the few instances which have been studied they are known or believed to be associated with the presence of particulate matter in the breeding places and to accumulate with ageing of the latter, but these instances are too few to permit of any generalization.

Although hairiness in *Tr. nepenthis* closely resembles that found in *Ae. albopictus* there would appear to be differences in the response of individual setae which suggest that the overall pattern of response may often be taxonomically more significant than the mere numbers of branches per se. Seemingly continuous variation in branch numbers of certain setae in *Tr. nepenthis* has been shown to mask what are essentially distinct, though overlapping or sequential series. This was achieved by correlating the setae in question with another showing discontinuous variation. Correlations between setae have been used in other ways and other contexts for taxonomic purposes⁷ but could probably be profitably employed more often.

Two considerations combine to suggest that hairiness in *Tr. nepenthis* is environmental in origin. One is the qualitative resemblance to the hairiness experimentally induced in *Ae. albopictus* and *aegypti* and in *Ae. poly-nesiensis*. The other is the striking quantitative resemblance to the pattern of variation observed by Barr in comb scale numbers in *Ae. fitchii* and plausibly attributed by him to an environmental factor. Nevertheless the possibility that hairiness has become genetically fixed in *nepenthis* will have to be borne in mind as the study of this species continues. Hairiness appears to have become genetically fixed in species such as *Ae. (Stegomyia) horrescens*⁶ and *Ae. (Finlaya) echinus*⁸ and is found in isolated species in otherwise non-hairy genera such as *Culex*⁹ and *Uranotaenia*¹⁰. On the other hand it appears to be quite labile in several species of the *Ae. scutellaris* complex⁶ and in some african *Stegomyia* in which it has been noted by several observers, including myself, though not perhaps recorded in the literature.

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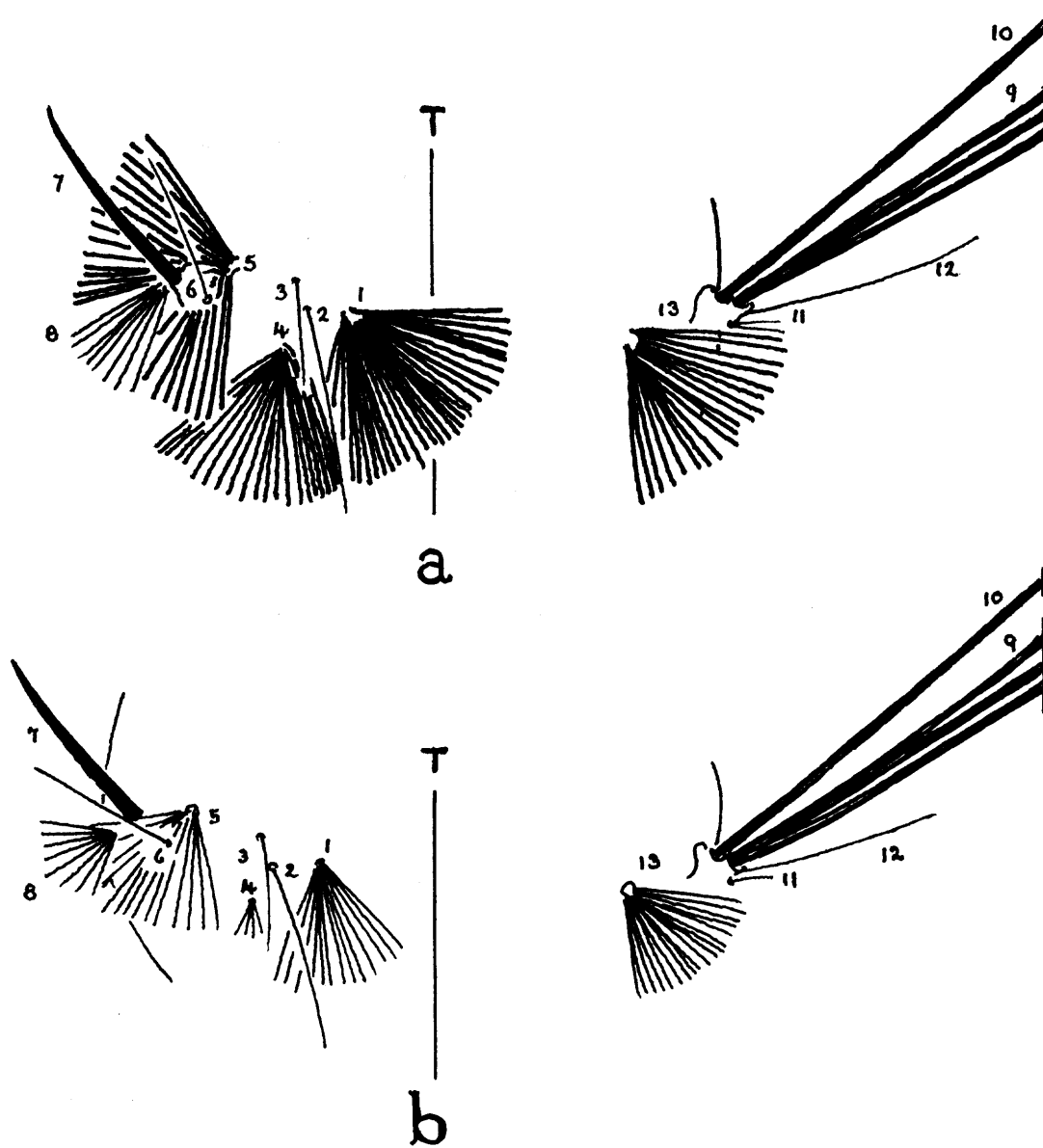


Fig. 1. Metathorax of a. Hairy and b. Non-hairy Larvae of *Tripteroides nepenthis*.