

# SOME ADULT AND LARVAL CHARACTERISTICS OF A BRITISH "AUTOGENOUS" STRAIN OF *CULEX PIFIENS* L.

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ABOUT thirty years ago, Dupree and Mitchell, after investigating (at Baton Rouge, U.S.A.) the habits of *Culex pipiens*, stated not only that this species was "an evil biter", but also that "bred specimens which were never allowed to make a meal of blood, mated and laid fertile eggs" (Mitchell, 1907).

Neumann (1912) published an account of experiments in which several generations of *C. pipiens* were reared upon a diet consisting exclusively of sugar solution. During the ensuing seventeen years, no further researches in this direction appear to have been described.

In 1929, independent communications from Roubaud (1929, 1930), de Boissezon (1929) and Huff (1929) directed attention to the fact that certain "strains" of *C. pipiens* are able (a) to breed, under suitable conditions continuously throughout the winter, (b) to mate in a confined space<sup>1</sup>, and (c) to lay fertile eggs without having had a preliminary meal of blood.

Roubaud considered these biological peculiarities to be indicative of a distinct "race" of *C. pipiens*, occurring chiefly in urban areas where large numbers of artificially heated buildings provide suitable winter quarters. Roubaud selected the adjective "autogenous" to distinguish the race in question; the ordinary (blood-egg) race thus becoming the "anautogenous" one. He subsequently (1933) named the two races, respectively, *C. pipiens autogenicus* and *C. pipiens pipiens*.

De Boissezon (1933, 1934), on the other hand, maintains that females of *C. pipiens* (whether town or country bred) exhibit "autogenous" characteristics if the food of the larvae contains a high proportion of iron.

More recently, autogenous strains of *C. pipiens* have been described from Germany, by the late Dr Malcolm MacGregor (1932); and from Greece, Hungary and Malta by Vincent (1933) and Tate and Vincent (1934). Although females of autogenous strains of *C. pipiens* are able to lay eggs without a previous meal of blood, both Roubaud (1930) and Vincent (1933) have independently noted that autogenous females readily bite either men or animals.

In this connection, it is important to note (for reasons which will appear later), that, in a town in France, Legendre (1931, 1932) observed *C. pipiens* breeding freely in flooded cellars, rain-water cisterns and cesspools. These adults had a light-coloured thorax, and the females attacked human beings

<sup>1</sup> This faculty has been termed *stenogamy*, and the absence of it, *eurygamy*.

voraciously. Legendre did not suggest that these adults belonged to an autogenous race, but he referred to the prevalence, in the same district, of a different race of *C. pipiens*, having a dark thorax and breeding in open waters, which did not attack man. It is interesting to compare Legendre's observations with those of Grassi (1923) who noted, some years previously, that, in districts where *C. pipiens* readily attacked human beings, the adults were lighter in colour than those in districts where no such annoyance was experienced.

We are now maintaining, in the laboratory of our Institute, a strain of *C. pipiens* which exhibits all the autogenous characters specified by Roubaud and others. This strain—the first to be recorded in Britain (Marshall and Staley, 1935)—is derived from an egg-raft found, on October 6th last, in an outdoor tank in which a species of *Chara* is being cultivated.

This raft was transferred to a laboratory vessel filled with ditch water, into which fragments of wholemeal bread were introduced from time to time. The eggs hatched after an interval of two days, and the majority of the larvae reached the fourth instar about a fortnight later. The larvae and some of the water were, at the end of October, put into a small breeding jar, which was thereafter kept in close proximity to some heating pipes. Adults commenced to appear on November 12th. None of the females was given a blood meal, but a small egg-raft appeared in the jar in the evening of November 23rd, and a second one on the following morning. Both these rafts (one composed of 38, and the other of 40 eggs) hatched three days later. Up to the time of writing, we have reared four generations of this strain upon a purely vegetarian diet. The adults (like those of the Continental autogenous strains previously mentioned) are decidedly stenogamic, the breeding jars employed providing a mating space of not more than 600 c.c. The Hayling autogenous females also resemble the Continental ones by reason of the readiness with which they attack human beings.

The egg-rafts laid by these autogenous females are much smaller than those laid by anautogenous ones. In the ordinary anautogenous strain of *C. pipiens*, the number of eggs composing the raft usually falls between 150 and 300; whereas, in the Hayling autogenous strain, the number rarely exceeds 110. In 43 rafts of the latter strain, the number of component eggs was found to vary from 37 to 125, with an average of 85.

Hitherto, as will have been noted, the separation of autogenous and anautogenous strains of *C. pipiens* has been effected exclusively by reference to certain biological characteristics exhibited by the adults. Roubaud and Toumanoff (1930) considered the two strains to be morphologically identical; and, so far as we are aware, no evidence to the contrary has yet been submitted.

In order to discover whether any morphological peculiarities distinguish our Hayling autogenous material, it was first of all necessary to obtain some uniformly anautogenous material with which to contrast it. A few larvae of *C. pipiens*, collected in November last, which had developed into adults with obvious anautogenous characteristics, were available for purposes of com-

parison; and through the kindness of Dr Tate a large number of adults and larvae of a known anautogenous strain of this species were obtained from Cambridge.

The results of comparing (i) the Hayling autogenous, (ii) the Hayling anautogenous, and (iii) the Cambridge anautogenous specimens of *C. pipiens* indicate, in our opinion, that not only the adults (of both sexes) but also the larvae of our autogenous strain possess definite diagnostic characteristics. The adults (of both sexes) are separable from those of the anautogenous strains examined by having (a) a light-coloured thorax, and (b) a larger average number of hairs on the lobes of the ninth tergite. The data on which the latter statement is based are summarised in Table I.

Table I. *Chaetotaxy of lobes of ninth tergite in autogenous and anautogenous strains of Culex pipiens L.*

	Autogenous (Hayling)		Anautogenous			
			(Hayling)		(Cambridge)	
	♂	♀	♂	♀	♂	♀
Number of cases examined	100	78	24	24	151	80
Average number of hairs on a lobe	13.3	12.9	8.8	8.0	8.2	8.8

In male adults, an additional diagnostic indication (c) is provided by the relative length of the maxillary palp. In the Hayling autogenous strain, the combined length of the first four segments of the palp does not exceed the overall length of the proboscis: whereas, in anautogenous males, the reverse is the case. If the overall length of the proboscis be taken as 100, then the combined length of the first four palp segments varies from 92 to 100 in the Hayling autogenous strain, and from 101 to 109 in both the Hayling and the Cambridge anautogenous strains<sup>1</sup>.

It is probable that males of the Hayling autogenous and anautogenous strains are also separable by hypopygial differences: the first division of the mesosome appearing to be broader and more deeply pigmented in the former strain. Further investigations in this direction are now in progress.

Fourth instar larvae of the Hayling autogenous strain differ from those of the anautogenous strains examined in having (d) a larger average number of branches in each of the four siphonal tufts, and (e) a considerably lower siphonal index.

Data regarding the siphonal chaetotaxy of (i) the Hayling autogenous strain, (ii) the Hayling anautogenous strain, and (iii) the Cambridge anautogenous strain are summarised and compared in Table II. These figures show that, in the specimens examined, tufts with more than three branches were found chiefly, and tufts with more than four branches exclusively, on larvae of the Hayling autogenous strain.

<sup>1</sup> In the Greek autogenous strain the combined length of the first four palp segments of the male varies from 86/100 to 92/100 of the overall length of the proboscis.

Table II. *Siphonal chaetotaxy of autogenous and anautogenous strains of Culex pipiens L. (fourth instar)*

NOTE. The figures in the first column indicate the number of branches in one or other of the four siphonal tufts; and those in the remaining columns the number of occasions on which each particular number of branches was recorded. The Roman numerals denote the four tufts, the one nearest to the base of the siphon coming first.

Number of branches	Hayling autogenous				Hayling anautogenous				Cambridge anautogenous			
	i	ii	iii	iv	i	ii	iii	iv	i	ii	iii	iv
1	—	—	—	—	—	—	2	—	—	—	—	—
2	5	3	10	9	33	32	34	18	60	77	84	71
3	28	29	69	64	10	10	3	21	61	45	25	61
4	45	47	17	24	1	—	—	2	4	3	1	—
5	19	16	3	3	—	—	—	—	—	—	—	—
6	4	5	1	—	—	—	—	—	—	—	—	—
7	—	1	2	—	—	—	—	—	—	—	—	—
8	1	—	—	—	—	—	—	—	—	—	—	—
Total number of cases examined	102	101	102	100	44	42	39	41	125	125	110	132
Average number of branches	4.0	3.9	3.2	3.2	2.3	2.5	2.0	2.6	2.5	2.3	2.2	2.5

On comparing Tables I and II, it will be noted that the average number of hairs recorded in the former, and the average numbers of tuft branches recorded in the latter, amount to about half as much again in the autogenous strain as in the anautogenous ones.

As regards the diagnostic evidence provided by the siphonal index, the examination of 155 larvae of the Hayling autogenous strain showed the average value of the index (as well as its actual value in 58 cases) to be 4.0. In 142 cases the value of the index fell within the limits of 3.7 and 4.3. In 104 larvae of the Cambridge anautogenous strain, the average value of the index (as well as its actual value in 40 cases) was 4.8. In 84 of these cases the index fell within the limits of 4.6 and 5.3. In larvae of the Hayling anautogenous strain, the average value of the index was 5.3: this figure was obtained, however, by examining 20 specimens only<sup>1</sup>.

As previously mentioned, the egg-rafts of Hayling autogenous females are composed of much fewer eggs than those of anautogenous ones; the number rarely exceeding 110 in the former case, and usually falling between 150 and 300 in the latter one. For information which enables eggs to be classified individually we are indebted to Dr Tate, who recently pointed out to us that eggs laid by English anautogenous females are more slender than those laid

<sup>1</sup> It seems probable that both the autogenous and anautogenous groups of *C. pipiens* are doomed to progressive subdivision. Roubaud, for instance, has described (in addition to his stenogamic, autogenous *C. pipiens autogenicus* and his eurygamic, anautogenous *C. pipiens pipiens*) a stenogamic, anautogenous *C. pipiens berbericus*, having a somewhat shorter siphon than *C. pipiens pipiens*. The siphonal index of *C. pipiens berbericus* is said to be "about 4.5", while that of the Cambridge anautogenous specimens averages 4.8. It may also be mentioned that although the larvae of the Hayling and of the Greek autogenous strains have the same siphonal index (namely 4.0) they differ from one another in certain respects. For one thing, a large proportion of the larvae of the Greek strain have only three pairs of siphonal tufts.

by descendants of Continental autogenous ones. To ascertain whether eggs of the Hayling autogenous strain could be recognised by this means, measurements of 60 of these eggs were compared with those of a similar number of eggs assumed (on account of being taken from rafts composed of more than 200 eggs) to be of anautogenous origin: the ratio of greatest breadth to overall length being computed in each case. It was found that, in the autogenous eggs, the average value of the ratio (as well as its actual value in 32 cases) was 0.24; whereas, in the anautogenous eggs, the average value of the ratio (as well as its actual value in 43 cases) was 0.22.

In the Hayling autogenous strain, as will be remembered, the females have a light-coloured thorax, and readily attack man. In the latter respect they resemble the autogenous females independently investigated by Mitchell (1907), Roubaud (1930) and Vincent (1933): while in both respects they resemble the "cellar-breeding" strain described by Legendre (1931, 1932). In this connection it may be of interest to refer to the fact that, in Britain, where *C. pipiens* is generally regarded as being a "man-ignoring" species, well-authenticated instances of its causing widespread annoyance in urban areas are occasionally recorded. Shute, for example (1933), refers to an invasion, by bloodthirsty females of *C. pipiens*, of certain private hotels in the Charing Cross district, as well as to the occurrence of similar incidents in the residential parts of Plumstead, Hull, Harwich and Epsom. In yet another case (which came under the personal notice of the authors some years ago) a large hotel in Westminster became seriously infested with man-biting females of the above species. A few female adults collected on that occasion were preserved, and an examination of the ninth tergites shows the average number of hairs per lobe to be 12.0; a fact which appears to indicate that the adults are of autogenous origin<sup>1</sup>.

We suggest that, in all the above-mentioned cases of indoor annoyance, the offending females of *C. pipiens* very probably belonged to the (or a) British autogenous strain—a strain which may prove to be identical with the cellar-breeding one described by Legendre.

#### SUMMARY

1. A strain of *Culex pipiens* which is autogenous and stenogamic has been found at Hayling Island, England, and compared with British anautogenous strains.
2. Definite characteristics in adults of both sexes and in larvae have been found which separate the autogenous from the anautogenous British strains of *C. pipiens*.
3. The autogenous strain differs from the anautogenous strains in (a) the

<sup>1</sup> A similar inference is perhaps permissible in respect of two small batches of females captured while attacking the occupants of houses in Ventimiglia (Italy) and in Senlis (France); the average number of hairs per lobe being 11.8 in the former batch and 13.0 in the latter one. All these Italian and French adults (as well as the adults from the hotel in London) have a light-coloured thorax.

lighter colour of the thorax of the adults; (b) the greater average number of hairs on the ninth tergite of the adults; (c) the relative shortness of the male palps in comparison with the proboscis; (d) the larger average number of branches in each of the four siphonal tufts of the fourth instar larvae; (e) the lower siphonal index of the fourth instar larvae; and (f) the greater width of the egg relatively to its length.

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