LETTERS TO THE EDITORS

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Localization of Chemoreceptivity in Drosophila

THE outbreak of war brought to a standstill a programme of experimental investigations into the genetics of behaviour patterns among Drosophila mutants in the laboratory of the senior author of this note. The end in view was threefold: (*a*) to take advantage of structural modifications of putative receptor organs by mutation as a basis for exploring their functions; (*b*) to gain knowledge of reproductive behaviour requisite to further investigation of assortative mating; (*c*) to standardize the genetic variables affecting behaviour patterns as a basis for inquiries of either type. Recently it has been possible to make a fresh start. The object of this preliminary note is to indicate some positive conclusions about the localization of chemoreceptivity by study of the reactions of mutants with antenna defects or abnormalities, more especially *antennaless*, discovered by Gordon and Sang[1], and *aristapedia*.

The characteristic of the latter is replacement of a normal antenna by a leg-like appendage which, however, bears peg-like organs and other structures of supposedly receptive function present in normal antennæ but not in the normal leg. Full exhibition of the gene *antennaless* leads to complete suppression of both antennæ, partial exhibition to unilateral suppression. By varying the conditions of culture, Gordon and Sang[1] showed how it is possible to obtain genotypically homozygous antennaless individuals with no manifest somatic effect of the gene. Among flies of pure stocks we may therefore distinguish between what they respectively call *antennaless* (A_0) phenotypes, half antennaless (A_1) with unilateral exhibition and wild type antennaless (A_2), the latter being genotypically equivalent to the first two but phenotypically like ordinary flies. It is therefore possible to use as controls flies without antennæ genotypically identical with flies which have them on one side or both sides. Our experiments with these stocks include tests on their phototactic and geotactic reactions, their behaviour in a humidity gradient and their response to solutions containing volatile constituents. This note deals only with results of the last-named class.

As is well known, yeast culture and solutions containing ethyl alcohol acetic acid and various esters exert attraction for *Drosophila melanogaster*. A mixture ('*M*') containing baker's yeast, ethyl alcohol and traces of acetaldehyde, ethyl acetate, methyl acetate and butyric acid attract the flies more strongly than any single constituent. For that reason we have used it for trapping experiments essentially like those of Barrows[2]. The method was to release large numbers of flies in a chamber with traps containing *M* or water ('*W*') as a control. Results of a typical experiment with antennaless stocks are in Table 1, showing the number of flies trapped as a percentage of the number of a given category released. O_r stands for wild type flies of Oregon stock.

Experiments with various mutants having structural defects of the wings leading to defective power of flight conclusively exclude the possibilities that the negative chemoreactivity of the antennaless (A_0) flies is not due to mechanical inability to reach the goal. From this point of view, experiments (Table 2) involving flies ($A-V_g$) homozygous for both the vestigial gene and for antennaless are sufficiently explicit.

TABLE 1.

Solution	Percentage of flies of each class trapped				Total of each group released
	A_0	A_1	A_2	Or	
M	1	31·5	52·5	58·7	400
W	3	8	5	6·7	

TABLE 2.

	$A_0—V_g$	$A_1—V_g$	$A_2—V_g$	
M	4·5	46·4	98·2	112
W	0·0	1·0	0·0	

TABLE 3.

	SS^a	*Y-V-F*	Ft	
M	43·6	61·9	70·0	360
W	3·3	3·6	1·9	

A comparison between the behaviour (Table 3) of mutants, for example, *yellow-vermilion-fork* and *filamentless* (F_t) with normal antennæ and *aristapedia* (SS^a) shows that the macroscopic modification of the antennæ in flies of the last-named type does not eliminate chemoreceptivity, though diminishing it somewhat. The characteristic of the *filamentless* mutant control is absence of filaments ordinarily attached to the egg-case.

We have tested the main conclusions illustrated by such experiments with a new type of olfactometer to be described in a forthcoming publication. This device eliminates air flow, offering flies the choice between an exit leading to a chamber containing the attractive mixture and a control chamber with water. The results substantially confirm those of trapping released flies; but also show that total absence of antennæ does not *entirely* abolish receptivity to vapours.

Since microscopic examination of the leg-like antenna of *aristapedia* reveals the presence of the type of sensilla in the distal joint of the normal antenna, our results point to the conclusion that these organs are the chief olfactory receptors involved in the search for food. However, the peg-like organs of *aristapedia* are not the only morphological differentiæ which they share with a normal antenna in contradistinction to a normal leg; and we are at present investigating the possibility of a more precise identification of the relevant structures by recourse to study of other mutants. Meantime, we have clear-cut evidence that olfactory receptivity of Drosophila, at least with respect to its as yet known chemoreactions, is located almost exclusively in the antennæ.

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[1] Gordon, C., and Sang, J. S., *Proc. Roy. Soc.*, B, **130**, 151 (1941).
[2] Barrows, W. M., *J. Exp. Zool.*, **4**, 515 (1907).