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ZOOLOGY

The Apparent Genetic Relationship Between Campaniform and Trichoid Sensilla on Drosophila Wings.[1]

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During campaniform sensilla experiments in 1960–61, the authors encountered a wing bristle abnormality in the F_2 and F_3 individuals from white eye x curved wing crosses. These structures either appeared as normal trichoid sensilla in a location normally occupied by campaniform sensilla, or as intermediate structures between the trichoid and campaniform sensilla. Also, additional trichoid sensilla were added on veins not previously occupied by either campaniform or trichoid sensilla. Lees (1941) also described such intermediate structures on the veins of the "hairy" wing mutant of *D. melanogaster*. Lees found the "hairy" wing mutant to have almost twice the normal number of campaniform sensilla. These findings prompted Lees to suggest that the trichoid and campaniform sensilla are homologous structures.

The derivation of the various types of insect sensilla from a single basic type has been previously suggested. Snodgrass (1935) hinted that campaniform sensilla may have lost the bristle with the sockets alone remaining. Waddington (1956), and Lees and Waddington (1942) stated that the basic trichogen cell position was altered in relation to the tormogen cell position by the various genetic effects to produce the bristle mutations. The authors' (1961) investigations support Lees' idea on the homology of the campaniform organs. Continued work in this area has been even more indicative of this homology.

METHODS: The authors developed a procedure which makes it possible to observe the distribution of wing sensilla without sacrificing prospective parents. This was done by isolating Drosophila pupae and allowing them to emerge. As soon as the wings had opened, the left wing was cut off just beyond the axillary sclerites. The tool used for cutting was a razor blade chip mounted in a handle. A fine tweezers was used to hold the wing during the amputation. The wing was then boiled one minute in 95% alcohol, cleared in xylene, and mounted in Piccolyte on a slide, using a coverslip over it.

RESULTS: The curved wing mutant was used for the original parental stock. The experiment originally called for selective matings to produce a high-number campaniform line and a corresponding low line. In both high and low lines, extra campaniform sensilla were observed on the R_1 wing area. However, the high-line displayed a trichoid sensilla quite consistently on R_1, while the low-line displayed it approximately one half of the time. None of the high or low line parents used in these crosses showed these structures; however, a few other curved wing flies from the parental stock had a small number of trichia. The trichoid-displaying flies were then inbred. Once again, as had been encountered in previous years, the trichoid sensilla and intermediate structures were found occupying locations where campaniform organs previously were found. In the absence of a trichoid sensillum, a campaniform organ would again be found at that location. The trichoid sensilla were found to occupy quite predictable positions. In this line, as had been the case in the past, trichoid sensilla did not appear until additional campaniform organs were added, particularly on the R_1 wing area.

Figure 1 shows a comparison of the wing of a "trichoid" fly with the wing of a normal wild type fly. Attention should be directed to those areas which are denoted as being predictable sites for trichoid sensilla.

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F$_2$ generation, a recurrence of extra campaniform sensilla was observed in some cases. Macdowell (1915), who worked with extra bristle inheritance on the thorax of *D. ampulae*, found that the F$_2$ generation exhibited an approximate 3·3:1 ratio of normal to extra bristles. This led him to suggest a simple Mendelian inheritance. The ratio of normal to extra campaniform sensilla in the F$_2$'s in this study was somewhat similar to that of Macdowell. The ratio was 26 normal to 5 extra campaniform sensilla which, when tested with a Chi-square against a 3:1 ratio gave a value of 1.314. This would mean that the variation from the 3:1 hypothetical ratio would be explained 30% of the time by chance alone; well above the 5% critical level.

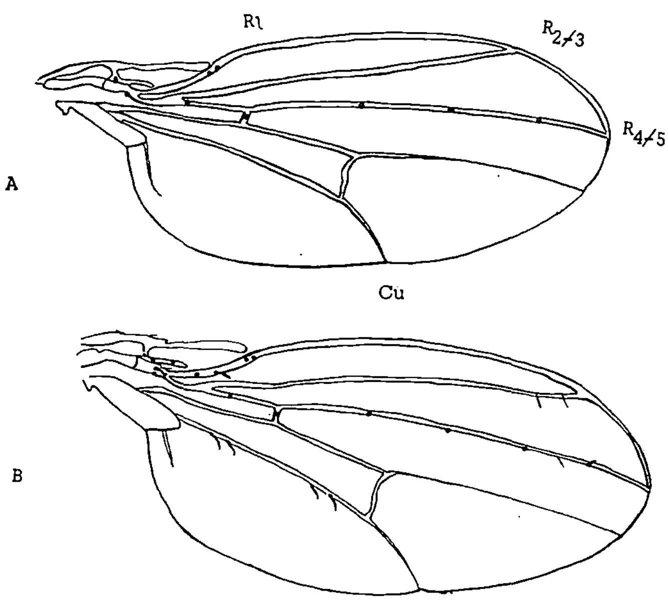

FIGURE I: A comparison of normal wild type fly wing (A) showing campaniform sensilla locations with a hypothetical wing of the "trichoid" type (B) showing all predictable campaniform and trichoid sensilla locations.

Table 1 represents a comparison of wild stock, the parent curved wing stock, and the "trichoid" line.

TABLE 1. Comparison of the sensilla populations of the wild, curved, and "trichoid" stocks.

	R_1	$R_{2/3}$	$R_{4/5}$	C_u
Wild				
campaniform	3	0	4	0
trichoid	0	0	0	0
Curved				
campaniform	3-6	0	4	0
trichoid	0	0-1	0-2	0
"Trichoid"				
campaniform	4-7	0-1	4-6	0-2
trichoid	0-2	0-2	0-3	0-5

Figure 2 represents an enlargement of certain areas of a wing vein showing the various types of sensilla.

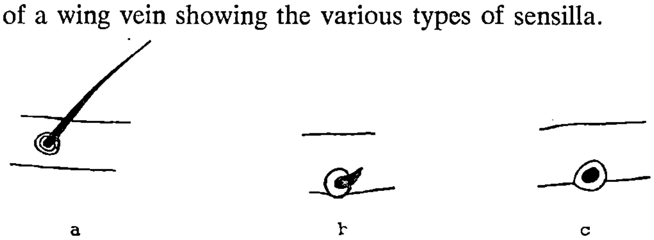

FIGURE II: Sensilla types found on Drosophila wings. a. trichoid, b. intermediate, c. campaniform.

An outcross of the "trichoid" line was made by mating it with the normal wild type fly. All F$_1$'s examined exhibited the normal campaniform distribution of the wild type, and no trichoid sensilla were observed. Among the F$_2$ generation, a recurrence of extra campaniform sensilla was observed in some cases.

SUMMARY AND CONCLUSIONS: Because of the interchangeability of campaniform and trichoid sensilla, it seems quite apparent that the two organs are closely related. The appearance of intermediate structures would seem to make this even more conclusive.

Because the appearance of the F$_1$'s and F$_2$'s of the outcross approximated that of Macdowell, it seems logical to suspect the same inheritance mechanism, i.e., monohybrid-complete dominance. Since an increase in campaniform organs seems necessary before trichia appear, the same trigger mechanism apparently allows the production of both. This trigger mechanism seems to remove an inhibitor of some sort which previously held the sensilla population to that of the normal wild type. When this inhibitor was removed (through selective matings and inbreeding) additional factors seem to be involved in penetrance and/or expressivity. This would account for the variability in the number of trichoid sensilla in the "trichoid" line flies. What these factors are remains unknown.

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