

# **AN ANALYSIS OF THE EFFECTS OF SELECTION**

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An Analysis of the Effects of Selection by A. H. Sturtevant

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**A. H. STURTEVANT**

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By A. H. STURTEVANT



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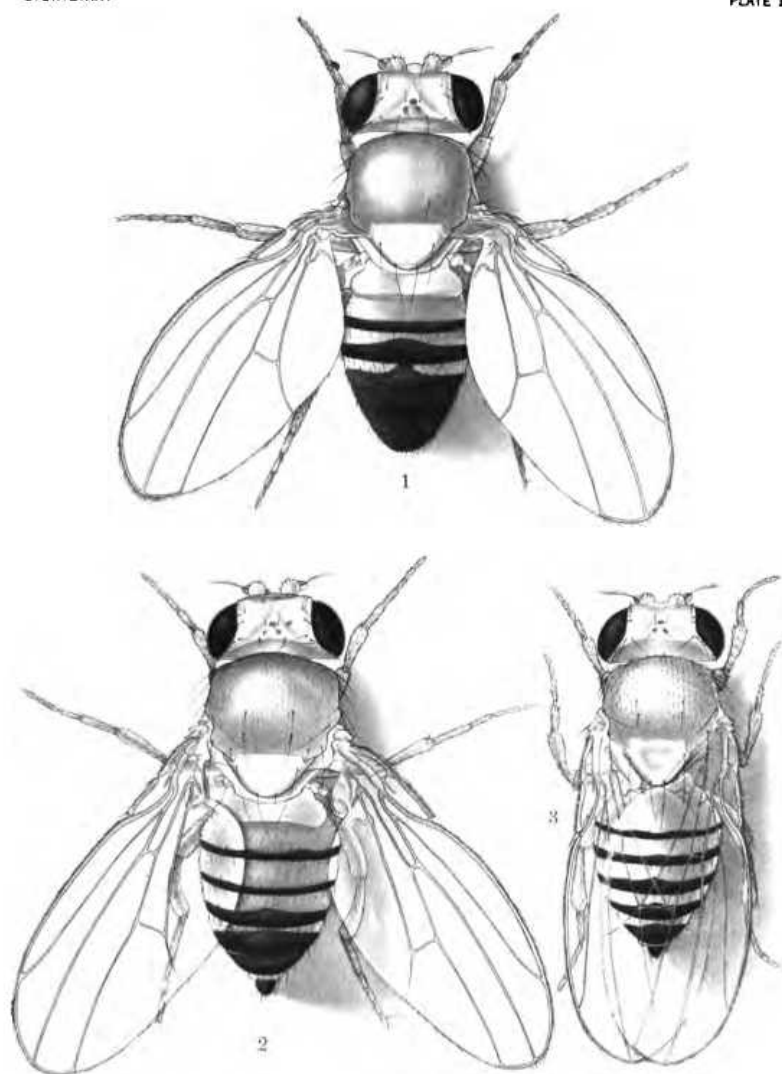
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1. Dichaet male (5-bristled) 2. Extended female. 3. Wild-type female.  
(Drawings by Miss E. M. Wallace.)



## AN ANALYSIS OF THE EFFECTS OF SELECTION.<sup>1</sup>

### INTRODUCTORY SUMMARY.

The present paper describes a series of experiments aimed at determining the causes of the variability in bristle number observed in Dichæt, a mutant race of *Drosophila melanogaster* (*ampelophila*). These experiments are discussed under several headings, as follows:

(a) Selection of plus and of minus variants was carried out. Both plus and minus lines were obtained and were used in the further experiments.

(b) A plus line and a minus line were crossed, and an increase in variability was observed in F<sub>2</sub>.

(c) Linkage tests were made, and by this means it was demonstrated that modifying genes were present in the selected lines.

(d) Evidence against the hypothesis of contamination of allelomorphs was obtained.

(e) This evidence, and that obtained by other investigators, is then utilized in a general discussion of the selection problem, and of the hypothesis of contamination of genes. The conclusions are drawn that selection is usually effective only in isolating genetic differences already present; and that genes are relatively stable, not being contaminated in heterozygotes, and mutating only very rarely.

### DICHÆT.

The mutant character known as Dichæt was discovered by Dr. C. B. Bridges, July 3, 1915. In an experiment involving the sex-linked characters sable, forked, and cleft there appeared a single female that had wings extended and bent backwards near the base, like those of the mutant bent (Muller, 1914b). In addition it was observed that this female had only 2 dorso-central bristles, instead of the 4 usually present. When mated to a male having the mutant character eyeless, this female produced 48 normal offspring and 46 "Dichæt," thus showing the character to be dominant.

Bridges's unpublished data show that the Dichæt gene is in the third chromosome, approximately 5 units to the left of pink.

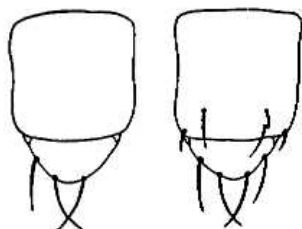
The data published by Muller (1916) give the locus as 9.7 from sepia (the locus farthest to the left of those as yet discovered), and 11.0 from spineless, on the right. My own (unpublished) data give:

$$\text{Sepia Dichæt, } \frac{204}{1369} = 14.9 \text{ p. ct.} \quad \text{Dichæt spineless, } \frac{122}{931} = 13.1 \text{ p. ct.}$$

<sup>1</sup>I am indebted to Mr. J. W. Gowen for much advice and assistance in connection with the statistical treatment of the present problem. He has done a part of the actual calculations, but is not responsible for any arithmetical slips, as I have myself done all the checking.

The averages, roughly weighted according to number of individuals, are: sepia Dichæt, 13; Dichæt spineless, 12. This agrees with the data of Bridges on the position of Dichæt with reference to pink, since that locus is about 8 to the left of spineless.

Bridges also found that homozygous Dichæts are not produced. The gene, like that of the yellow mouse, acts as a lethal when homozygous. The result is that when Dichæts are mated together they produce two heterozygous Dichæts to one not-Dichæt. This discovery has been verified by the experiments described in this paper, and by other experiments carried out by Muller and by the author.



FIGS. 1 and 2.—Two types of bristle distribution in Dichæts—a "3" and a "7." Small post-alars are present in fig. 2. These are never counted in the totals.

TABLE 1.

Culture No.	No. of bristles.				Total.
	3	4	5	6	
881	..	9	20	27	56
882	1	23	29	30	83
883	..	9	11	11	31
900	..	32	22	13	67
2715	..	7	15	3	25
	1	80	97	84	262

2 and 7 bristles have also been observed in unselected stocks.

As shown in plate 1, fig. 1, the wings of Dichæt flies are held out from the body and are bent back near the base. The number of dorso-central bristles (on the dorsum of the thorax) on the original female was 2 instead of 4, as is usually the case in the normal fly (plate 1, figs. 1 and 3). This has since been found to be a variable character.

The number of dorso-centrals varies from 0 to 4, and sometimes one or more of the scutellars may be missing. In addition, the anterior post-alars above and just behind the wing-base are reduced or absent. Plate 1, figure 1, and text-figures 1 and 2 show some common types. The work reported in this paper has consisted in selecting for a high and for a low total of scutellar and dorso-central bristles. Counts from five unselected cultures gave the results as shown in table 1.

The normal flies occasionally show variations in bristle number, but these are much rarer than in the case of Dichæt. MacDowell (1915) has given some data on the frequency of these variations, and has also reported on very extensive selection experiments with them (1915, 1917). These experiments will be referred to below.

I have made bristle counts on a few unselected not-Dichæt stocks, with the results shown in table 2.

The normal flies have 8 dorso-central and scutellar bristles in most cases, while the Dichæts range from 1 to 8. But the 8-bristled Dichæts are still distinguishable from normals, even when their wings are not

unfolded enough so that they can be separated on that basis. This is because the anterior pair of dorso-centrals never, so far as I have observed, becomes as large as the corresponding pair in normal flies. The anterior post-alars are also reduced in 8-bristled *Dichæta*. This

TABLE 2.

Stock.	6		7		8		9		10		Total.
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	
Wild:											
Falmouth, Massachusetts.	0	0	0	1	186	118	11	2	0	0	318
Berkeley, California.	0	0	0	0	95	104	0	0	0	0	199
Mitchell, South Dakota.	0	0	0	0	228	213	4	1	0	0	444
Amity, Oregon.	0	0	0	0	59	51	1	1	0	0	112
Sydney, Australia.	0	0	0	0	16	21	0	1	0	0	38
Pink band.	0	0	1	5	103	99	1	0	0	0	200
Black.	0	0	0	0	28	38	0	0	0	0	64
Ebony.	0	0	0	0	80	92	0	0	0	0	172
Blistered.	0	0	0	0	114	67	0	0	0	0	181
White.	0	0	0	0	74	77	2	0	0	0	153

separability is a matter of some importance, since, because of the lethal effect of *Dichæt*, any *Dichæt* culture may produce normal flies. However, the spread wings can be and are used for the separation in all but the rather rare instances of failure to expand properly.

## SEXUAL DIMORPHISM.

Calculations show that there is a slight but significant sexual dimorphism in bristle number in the *Dichæt* races. Random selection of plus and of minus selected cultures gave the totals shown in table 3.

TABLE 3.

	Bristle number.								Total.
	1	2	3	4	5	6	7	8	
Plus ♀			4	490	608	1,702	81	6	2,951
Plus ♂	3	25		436	694	1,527	53	8	2,736
Minus ♀	5	17		1,517	712	424	7		2,682
Minus ♂	1	39	177	1,190	615	332	2		2,356

These distributions give the statistical constants shown in table 4.

The first three columns show that there is a slight difference in the means, the females being higher in both cases. In the case of the plus series the difference is doubtfully significant; in the minus series it is larger and certainly significant. The last column gives the chance