

AN EFFECT OF TEMPERATURE AND AGE ON CROSSING-OVER
IN THE FIRST CHROMOSOME OF *DROSOPHILA*
*MELANOGASTER*¹

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It has been shown by the work of Bridges² (1915) and Plough³ (1917, 1921), that the percentages of crossing-over in the autosomes of *Drosophila melanogaster* are modifiable by non-genetic conditions such as physiological age and temperature. Later Mavor⁴ (1923), Mavor and Svenson⁵ (1924), and Muller⁶ (1925), gave accounts of experiments in which females were subjected to X-rays, by which treatment the percentage of crossing-over in the X-chromosome and in the autosomes was changed. The results of these investigators all agreed that the influence of the external factors was not a general one, for not all the percentages of any given linkage test changed in a corresponding manner. There has been proven to exist a definite differential susceptibility both between different chromosomes and between regions of the same chromosome. The work of Bridges and Plough showed that there is an effect of age and temperature on the two long, V-shaped second and third chromosomes, but no effect was detected for the rod-shaped X-chromosome. Furthermore they showed that the change in recombination percentages in the autosomes is more pronounced in the central and subcentral regions of these structures. The results of the work with X-rays pointed in the same direction. Muller showed that there is a strong effect of X-raying in the middle region of the autosomes, a less pronounced effect in the adjacent regions, and no detectable effect at all in the more distant regions. Mavor published data on the influence of X-rays on the first chromosome and obtained positive results, but his findings stand alone at present in several respects (cf. also the remarks of Muller⁷).

As suggested by Bridges, the middle region of the autosomes is especially distinguished by one feature from the other parts of the chromosomes, namely that the spindle fibre is attached there. The effect of conditions modifying crossing-over might therefore be different in relation to the attachment point of the spindle fibre.

If this relation between effect on crossing-over and localization of spindle fibre attachment is not a mere coincidence but a causal connection of some kind, one would expect to find an effect of external conditions on crossing-over also in the spindle fibre region of the first chromosome.

Bridges and Plough had not found any significant change in recombina-

tion percentages in their study of the first chromosome. Plough's experiments would have enabled him to find such a difference anywhere between the locus of scute which is at 0.0 + and forked which is at 56.8. After his work was completed, Sturtevant localized a new sex-linked factor, bobbed (*bb*), at the extreme right end of the X-chromosome, thus extending the map to 70 units. Furthermore, Anderson,⁸ Bridges and Anderson,⁹ L. V. Morgan¹⁰ and Sturtevant (unpublished) showed genetically that the *right* end of the map of the X-chromosome corresponds to the point of attachment of the spindle fibre. This region now became the most interesting one in relation to experimental changes of crossing-over, which was not taken into account by the work of Plough.

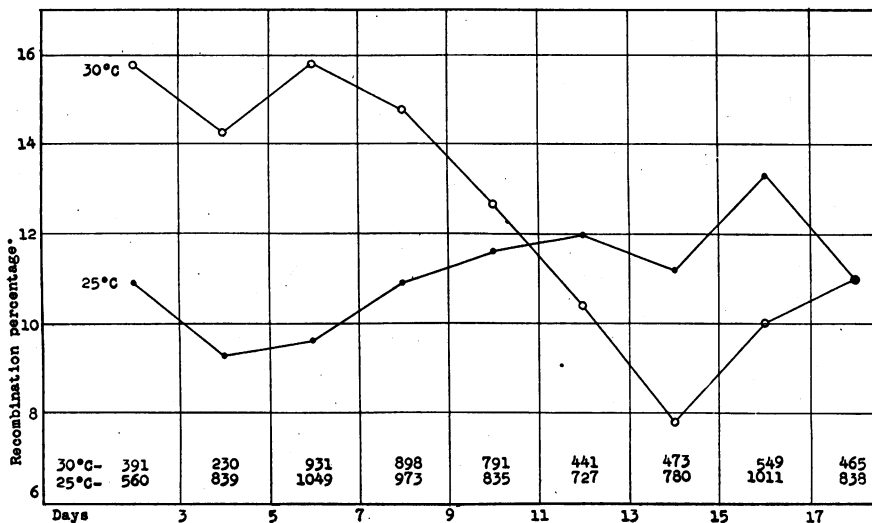


FIGURE 1

Recombination values for the loci Bar-bobbed at 25°C. and 30°C. The numbers above a given abscissa represent the numbers of flies corresponding to the temperatures indicated.

I have recently studied the problem of susceptibility of the first chromosome to external conditions modifying crossing-over by means of extensive experiments with low and high temperatures and with females of different ages in the region from garnet (44.8) to bobbed (70) which is nearest to the spindle fibre attachment. Only results obtained in the Bar-bobbed region are reported here.

Females of the constitution $\frac{B+}{+bb}$ were crossed to *bb* males. Some of the females were kept at a temperature of 25°C. as a control. Others were raised at 30°C. until hatching and were then transferred to 25°C. The newly hatched females, both control and experimental, were all kept for

three days in the first set of vials and then transferred into new vials every second day. The recombination values were determined for each period.

The results are reproduced in figure 1. The curves show two main points:

1. The females which were raised at 30°C. gave a markedly higher recombination percentage during the first three to four periods of transfers than did the control flies. The difference between the curves for recombination at 25°C. and 30°C. for the first 9 days is statistically significant (8.5 times the probable error).

2. Both curves, experiment and control, show a first minimum value at the fourth or fifth day of the age of the female. The difference in the percentage at the third to seventh day of the age of the female as compared with the seventh to thirteenth day is 3.3 times the probable error. This is confirmed by other results.

In biological terms these results mean that there is a difference in recombination percentages in genetically corresponding females which are subjected to different external conditions (age and temperature) in the Barbobbed region of the first chromosome of *Drosophila melanogaster*.

The disappearance of the difference between 25°C. and 30°C. at about the ninth day is in agreement with Plough's observations. He explained this by the fact that the germ cells need about seven days for developing from the early oocyte stage to the ripe egg. He assumed that the temperature produces its effect upon crossing-over at the oogonial stage and does not effect germ cells that are in the oocyte stage. Eggs laid later than seven to eight days after the removal of the female from 30°C. had not yet reached the susceptible oogonial stage at the time they were subjected to the high temperature.

The drop in the experimental curve below the level of the control curve is not statistically significant in the present data.

The results indicate that susceptibility of the process of crossing-over to external conditions is causally connected in some way with the localization of the spindle fibre attachment.

¹ The experiments have been carried out during the summer of 1925 at the Marine Biological Laboratory, Woods Hole, Mass., under a Fellowship from the International Education Board, New York.

² C. B. Bridges, *J. Exp. Zool.*, **19** (1-21).

³ H. H. Plough, *Ibid.*, **24** (147-209); **32** (187-202).

⁴ J. W. Mavor, *Genetics*, **8**, 1923 (355-366).

⁵ J. W. Mavor and H. K. Svenson, *Ibid.*, **9**, 1924 (70-89).

⁶ H. J. Muller, *Ibid.*, **10**, 1925 (470-507).

⁷ H. J. Muller, *Amer. Nat.*, 1926 (192-195).

⁸ E. G. Anderson, *Genetics*, **10**, 1925 (403-417).

⁹ C. B. Bridges and E. G. Anderson, *Ibid.*, **10**, 1925 (418-441).

¹⁰ L. V. Morgan, *Ibid.*, **10**, 1925 (148-178).