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## COMPLEMENTARY FACTORS FOR EYE COLOR IN DROSOPHILA

Bridges ('19) and Bridges and Morgan ('23) have described the effects of a large number of combinations of factors on eye color in *Drosophila*. They found many cases in which the effects are not simply cumulative. Such cases furnish interesting laboratory material. A considerable number of crosses between different recessive eye colors were made by members of the class in genetics at the University of Chicago in the fall quarter of 1931. Doubtless all have been made before as only familiar mutations were used but as I have not found any published reference to certain of the most striking results, it may not be superfluous to call attention to them. Six members of the class (L. E. Alexander, D. M. Crooks, Mary Talbot, J. A. Miller, Grace Townsend, and C. A. Cohn) made the cross between brown eye and scarlet. The red eyed  $F_1$  flies produced an  $F_2$ , which in the aggregate included 919 red, 302 scarlet, 327 brown, and 89 white, each divided approximately equally into males and females. It appears that scarlet and brown, which individually produce relatively slight, though qualitatively different effect on eye color, produce white as the double recessive. Mr. Crooks and Mr. Alexander tested this conclusion by mating the new white with brown stock, obtaining only brown; with scarlet stock, obtaining only scarlet and with ordinary sex-linked white in which case the daughters (at least) were red-eyed.

The effects of the scarlet gene are very nearly if not quite the same as those of the sex linked gene vermilion. The eye colors are indistinguishable unless a tendency of scarlet to darken more with age, noted by Bridges and Morgan, is characteristic. Both have very light ocelli, those of scarlet being described as white and those of vermilion as having a barely detectable tinge of yellow. There is a marked contrast with the brownish red ocelli of red eyed and brown eyed flies. Bridges and Morgan state that the double recessive scarlet vermilion shows no cumulative dilution effect being a vermilion "indistinguishable from both single recessives." The simplest physiological hypothesis for accounting for such cases (of which they give many other examples from eye colors of *Drosophila*) seems to be that the recessives represent complete inactivation of two genes which are solely responsible each for carrying through a different link in the same chain reaction.

Failure of either link or both would cause complete absence of the end product of the postulated reaction. In the present case, it must be assumed that this reaction product is not itself necessary for eye pigmentation since its failure leaves the rather intensely colored vermilion (or scarlet) eye.

The absence of pigment in the double recessive scarlet brown indicates that the type allelomorph of brown is solely responsible for an essential link in the complementary pigmentation process implied above. If these deductions are correct both pigmentation processes should also fail in the double recessive vermilion brown, which, therefore, should also be white. This turns out to be the case. Mr. Crooks mated a brown female with a vermilion male. The  $F_2$  from the red eyed  $F_1$  flies consisted of 76 females (54 red: 22 brown) and 79 males (23 red: 7 brown: 34 vermilion: 15 *white*).

The apparently "disproportionate" effect of the double recessive and the qualitative differences between brown and the others present some difficulty but it may be that the two postulated reaction products act primarily on the same otherwise limited process, on which the failure of either has thus only a slight effect but that they differ in effect on a secondary qualitatively different pigmentation process. In this connection, the recognition by Johannsen ('24) of two distinct pigments, wine red and yellow, which varied to some extent independently in the different eye colors is of interest.

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#### LITERATURE CITED

- Bridges, C.B.  
1919. *Jour. Exper. Zool.* 28: 337-384.
- Bridges, C. B. and T. H. Morgan  
1923. Carnegie Institution of Washington Publ. No. 327.
- Johannsen, O. A.  
1924. *Journ. Morph.* 39: 337-345.