gene[6,7] with a low concentration of HPP in the food, we can expedite the genetic analysis of the *ma-l* locus; (2) by using low concentrations of HPP in food and using the usual genetic selection techniques, it might be possible to select for new mutant alleles at the *lxd* locus, or for leaky mutants at the *ma-l* and *ry* loci; (3) the use of high levels of HPP in the food may facilitate the selection of strains of flies that have very high xanthine dehydrogenase activity. These applications are now being explored.

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E. C. Keller, jun.*
Edward Glassman

Department of Biochemistry
and
The Genetics Curriculum,
School of Medicine,
University of North Carolina,
Chapel Hill.

* U.S. Public Health Service Postdoctoral Fellow (*GM*-10, 296-02): present address, Department of Zoology, University of Maryland, College Park, Maryland.

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Induction of Crossing-over in *Drosophila* Males by Means of Ovarian Extract

The frequency of gene recombination is known to be affected by extrinsic factors or intrinsic ones such as sex. Crossing-over is completely blocked in dipteran males, including those of *Drosophila melanogaster*, and in silkworm females. It is a puzzling problem why sex should have such an influence on crossing-over. Lack of homology between regions of the *X* and *Y* may explain the absence of crossing-over between the sex-chromosomes of the heterogametic sex, but the absence of crossing-over in the autosomes must have a different cause.

All agents that so far have been found to produce crossing-over in *Drosophila* males—irradiation and certain chemicals—cause mutations and chromosomal aberrations as well. In the work recorded here, an attempt has been made to induce crossing-over in males by means of fresh ovarian extracts. Males and females utilized in this work were heterozygous for the second-chromosome markers dumpy (*dp*), black (*b*), cinnabar (*cn*), and brown (*bw*). About 300 ovaries of fertilized females were dissected into 0·3 c.c. of 0·4 per cent saline. The ovaries were then homogenized and centrifuged twice at 3,000 r.p.m. for 15–20 min. The supernatant was filtered and/or directly taken into a microsyringe, and 0·2 µl. was injected into the testis region of males. A portion of the same or a similarly obtained supernatant was boiled before injection. Males injected with 0·4 per cent saline and untreated males served as additional controls. 24 h after injection, each male was individually mated with three virgin females homozygous for *dp b cn bw*, and six broods of three days each were analysed for induced cross-overs in F_1. Presumptive cross-overs were verified by back-crosses to the multiple recessive strain.

Table 1 presents a summary of the results. It will be seen that cross-overs occurred exclusively among the progeny of a proportion of those males that had been injected with fresh ovarian extract.

Table 2 presents an analysis of the progeny from the 25 males that had yielded cross-overs. The overall frequency of crossing-over was 5 per cent. The distribution over the 3 chromosomal regions used did not correspond to the lengths of these regions, and there were great disparities between complementary classes; these unexpected features may, however, be due to the fact that sampling errors were greatly exaggerated by the occurrence of clusters. The brood pattern shows that, as in the experiments by Reddi and Auerbach[1], some of the spermatozoa utilized in brood *B* must have been pre-meiotic or in early meiosis at the time of treatment. The occurrence of some clusters in this brood would suggest the former possibility but, with the few markers used, apparent clusters may equally well have been due to independent cross-overs in several spermatocytes of the same male.

Table 1

Injected with	No. surviving males	No. F_1 tested	No. cross-overs in F_1
—	87	14,472	0
Saline	95	14,043	0
Boiled ovarian extract	69	11,530	0
Fresh ovarian extract	194	29,147	103*

* Among 1,901 progeny of 25 males.

Table 2. Distribution of Cross-overs in the Progeny of 25 Males that had been treated with Ovarian Extract

Brood	Observed phenotypes				*B*	*C*	*D*	*E*	Total
Non cross-overs	+ *dp*	+ *b*	+ *cn*	+ *bw*	897	675	196	108	1,876
Cross-over regions:									
I (*dp* – *b*)	+	*b*	*cn*	*bw*	9	3	6	12	30
II (*b* – *cn*)	*dp*	+	*cn*	*bw*	1	3	–	–	4
III (*cn* – *bw*)	+	+	+	*bw*	13	5	2	–	20
	dp	*b*	*cn*	+	2	3	–	1	6
I and II	*dp*	+	*cn*	*bw*	1	–	–	–	1
	+	*b*	*cn*	+	1	–	–	–	1
I and III	*dp*	+	+	*bw*	7	1	–	–	8
II and III	+	+	*cn*	+	16	12	–	–	28
	dp	*b*	+	*bw*	–	1	–	–	1
	Numbers				50	28	8	13	99
Total cross-overs	per cent				5·5	4	4	11	5

While the details of the observed effect require a more elaborate analysis, the results clearly indicate that fresh ovarian extract contains a factor that induces crossing-over in male germ cells. The ineffectiveness of boiled ovarian extract suggests that this factor is a heat-labile substance.

O. S. Reddi
G. M. Reddy
M. S. Rao

Radiobiological Research Unit,
Osmania University,
Hyderabad,
India.

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Regression of a Phenotypic Value on the Values for the Parents and Grandparents

The problem discussed in this communication was suggested by Dr. Donald Michie in connexion with an investigation, by himself and Mrs. Jean Hayes, of pedigree records in British bloodstock.

Let x be some phenotypic value for some animal, and let x^P be the average of the value for its two parents, and x^G that of its four grandparents. The problem is to find the regression of x on x^P and x^G, that is to find the partial regression coefficients $b_{HG.P}$ and $b_{HP.G}$ such that:

$$E(x|x^P, x^G) = b_{HP.G}x^P + b_{HG.P}x^G.$$

Write :

$$x = w + z,\ x^P = w^P + z^P,\ x^G = w^G + z^G,$$

where the w's are 'environmental values' and the z's are 'genotypic values'. We make the following assumptions, the first of which implies no real loss of generality, and the remainder are natural.

$$E(x) = 0,\ E(w) = E(z) = 0,\ \mathrm{cov}(w,w^P) = \mathrm{cov}(w,w^G) = \mathrm{cov}(w,z) = \mathrm{cov}(w,z^P) = \mathrm{cov}(w,z^G) = 0.$$

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