published) saw regular pairing in the oögonial cells of homozygous c3G flies; and finally, (4) Dr. Jack Schultz permits me to quote him as having observed regular pairing in the salivary glands and in the endomitotic nerve cells of the ovary of homozygous c3G animals.

By themselves, however, these former results are not decisive, since in (1) and (2) they could have been attributed to special X-ray effects and since regular pairing in (3) and (4) does not necessarily signify crossing-over. Only some data on autosomal somatic crossing in untreated males (7) are of similar significance as the data reported here, which give evidence of mitotic crossing-over in untreated females homozygous for c3G.

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Linkage and Crossing-over Between Black Pigmentation and Susceptibility to Induced Fibrosarcoma in Mice[1]

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Evidence has been published which indicates that germinal mutations have been induced in mice by chemical means. These germinal changes occurred in mice whose parents and grandparents had been injected subcutaneously with methylcholanthrene for a number of generations. More recently it has been determined that one of these germinal mutations (recessive brown pigmentation to dominant black pigmentation) has also apparently involved the genetic mechanism which determines, in part, susceptibility to fibrosarcoma induced at the site of methylcholanthrene injection. Thus, the black mutants possess a tremendously enhanced susceptibility to fibrosarcoma above the susceptibility possessed by mice of their ancestry or even their brown litter mates. Further unpublished evidence has shown that of the mice of the 15 inbred strains developed by the author and tested for susceptibility to fibrosarcoma, all, irrespective of genetic origin or relationship, that possess the black gene show a higher susceptibility to induced fibrosarcoma than any mouse of any of the strains possessing the brown gene. Thus, a linkage experiment is clearly indicated.

The F_1 from a cross between the original brown ancestral stock (NHO descent) and the black mutants possess the susceptibility of the black mutants (dominant inheritance). The F_1 generation consisted of 76 mice, all showing the dominant black. In the backcross generation to the recessive brown stock, 235 mice have been obtained and tested for susceptibility to induced fibrosarcoma. Of these, 121 were black and 114 brown (expected on Mendelian theory, a 1:1 ratio). The black backcross mice retain the susceptibility of the black mutants and the F_1's, whereas the brown backcross show the low susceptibility of the ancestral brown stock. Thus, linkage between black hair color and susceptibility to induced fibrosarcoma has been demonstrated.

The late survivors of the F_1 (that is, those mice living beyond 75 per cent of the total F_1's) show some degree of resistance, since it takes a longer time for them to develop fibrosarcoma at the site of injection. Therefore, if this tendency to greater resistance to fibrosarcoma is due to the loss of the hypothetical high susceptibility "gene" through the process of crossing-over, it ought to be possible to demonstrate this by the investigation of their descendants. This has been done, and when mice of one subline (of three separate ones tested) of the black mutant derivatives, suspected of possessing low susceptibility to induced fibrosarcoma even though they were black, were outcrossed to the ancestral brown stock, the F_1's (255 mice) showed the fibrosarcoma susceptibility of the resistant brown stock mice. A new black subline derived from these resistant F_1 black mice continued to show the low susceptibility of the brown mice.

The present evidence would indicate that on the "black" chromosome there is a gene that determines high susceptibility to induced fibrosarcoma; on the "brown" chromosome, a gene that determines low susceptibility or resistance to the same induced neoplasm. In the data reported here it appears that the process of crossing-over has occurred between the black gene and the S^{fs} (susceptibility to induced fibrosarcoma) gene. Thus, the evidence is accumulating that the intrinsic or genetic nature of resistance and susceptibility to induced fibrosarcomas is beginning to be indicated; that is, a mouse develops a fibrosarcoma following the subcutaneous injection of methylcholanthrene because it has a peculiar configuration in its genetic constitution determined by genes which apparently obey the same laws of Mendelian heredity (linkage and crossing-over) as the genes that determine hair pigmentation, etc. One of the genes, the S^{fs}, is on the same chromosome that carries the gene for black pigmentation.

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