Kaufmann, B.P. and H. Gay. University of Michigan, Ann Arbor, Michigan. A single second chromosome carrying both the Cy and Pm markers resulting from crossing over between the In(2LR)SM1 Cy and the In(2LR)Pm second chromosomes of D. melanogaster.

In a study of the mutagenic properties of deoxyribonuclease, we have used the In(2LR)SM1, al^2 Cy cn^2 sp^2/In(2LR)Pm;H/Sb stock (Pm = bw^{V1}) for detection of reciprocal translocations between the second and third chromosomes. When virgin females having these markers are mated with treated males of a wild-type stock, four F_1 phenotypes are usually detected, namely, Cy;H, Cy;Sb, Pm;H and Pm;Sb. (Flies of each type are then tested individually to determine whether a 2;3 reciprocal translocation has been induced.) Occasionally, however, an F_1 fly carries two dominant (or the reciprocal recessive) markers in a single second or third chromosome, as evidenced by the detection of such phenotypes as Cy Pm;H, Cy;H Sb, or Pm;+ +. That these "unusual types" result from crossing over during oogenesis in Cy/Pm;H/Sb mothers has been deduced from cytological analyses of third-instar larval salivary-gland chromosomes of the progeny produced by mating F_1 Cy Pm males with Oregon-R wild-type virgin females. Analysis was restricted to the Cy Pm phenotype, since neither H nor Sb is associated with a gross chromosomal rearrangement.

The In(2LR)SM1 Cy chromosome is essentially metacentric, whereas the In(2LR)Pm chromosome is acrocentric. Sequences of rearranged subdivisions for each of these chromosomes (as reported by Lindsley and Grell, 1968, in Genetic Variations of Drosophila melanogaster) are given below. (The inserted asterisk denotes the approximate position of the centromere.)

21A-22A3/60B-58B1/42A3-58A4/42A2 * 34A1/22D2-33F5/22D1-22B1/60C-60F

21A-21C8/60D1-59E1/40F * 59D4/40F-21D1/60D2-60F

When these chromosomes synapse during meiosis, with their centromeres lying side by side, they should produce two large "inversion loops," separated by an intermediate region (encompassing roughly divisions 34 to 39) in which single exchanges can occur without producing dicentric or ascentric chromatids. Exchanges in the most distal subdivisions of 2L and 2R should also yield balanced, viable products.

Seven F_1 Cy Pm males were tested, but only four of the matings furnished viable progeny. They included in each case both Cy Pm and wild-type individuals. The patterns of banding in the Cy Pm salivary-gland chromosomes obtained from third-instar larvae could be determined by comparison with the band sequences in the normal wild-type second chromosomes of maternal origin. From such comparison we concluded that in the production of the Cy Pm chromosome one exchange had occurred in the 34 to 39 interval (mentioned above) and that another exchange had occurred at the left end in the 59F or 60A region. Diagnosis was based on the following considerations: the Cy Pm chromosome is acrocentric; the short limb often shows the 21EF and 22A subdivisions lying in contact with 60C; the 33F/22D and 40F/59D inversions are present in the long arm; the 42A/58A inversion of SM1 Cy is not included. Thus the tip of the Cy chromosome joins with a small piece of the left limb of Pm to form the short arm of the Cy Pm chromosome, whereas its long arm includes the proximal part of the right limb of Pm and the distal part of the right limb of Cy. The new order appears to be the following (in which X denotes a region of exchange):

21A-22A3/60B6-59F X 59E1/40F * 59D4/40F X 34A1/22D2-33F5/22D1-22B1/60C-60F

This sequence accounts for all the mapped bands, with the possible exception of small deficiencies between 22A3 and 22B1, and between 59D4 and 59E1. But the "deficiencies" may arise from our inability to identify precisely the points of breakage and recombination at these sites rather than from an absence of essential genetic material, since the fertile Cy Pm individuals gave rise to vigorous, fertile Cy Pm and wild-type progeny.

A total of 188 "unusual types" were found among 3453 F_1 flies whose fathers had been exposed to the action of DNAase dissolved in phosphate buffer, and 107 among 2019 flies - serving as controls - whose fathers had been treated with the buffer alone. The frequencies - in each case an overall value close to 5.4 percent, with 0.76 percent of the Cy Pm type - are much higher than those detected in our 1949 study, in which a Cy/Pm, ds^{33k};H/C Sb stock was used in screening for 2;3 reciprocal translocations induced by nitrogen mustard. Only a few "tandem dominants" were observed at that time; subsequent loss of the stock precludes presentation in this note of data about frequencies (and cytological characteristics of unusual types) for comparison with those given above for the SM1 Cy/Pm stock.

This work was supported in part by USPHS Research Grant GM-10499.