Chadov, B.F. Institute of Cytology and Genetics, Siberian Branch of the USSR Academy of Sciences, Novosibirsk 630090, USSR. Effect of aberrant Y chromosomes on X chromosome nondisjunction.

It is known that structural mutations of X chromosomes and autosomes change considerably the frequency of secondary nondisjunction of X chromosomes. The latter changes with the age of the females, but to a lesser degree.

The effect of aberrant Y chromosomes on the secondary X chromosome nondisjunction was studied in order to obtain some lines contrasting for this character (Chadov 1971). The following Y chromosomes have been used: Y (structurally normal from Berlin wild stock), y^+Y, B^Sy^+Y, $Y^L.sc^{Vl}$, R(Y)L bb^+, R(Y)L, $Y^S.Y^S$, Y^S, $sc^{Vl}.Y^S$. Every Y chromosome was introduced into the genome of y sc^{Vl}In 49 v sc^8/y v (female I), In(1)dl-49+B^{Ml}, y^2 sc w^a v B^{Ml}/y v f (female II), and In(1)dl-49+B^{Ml}, sc v B^{Ml}/sc v f (female III). The females were crossed to yellow males and the frequency of X chromosome nondisjunction in each of 27 stocks was determined (see table).

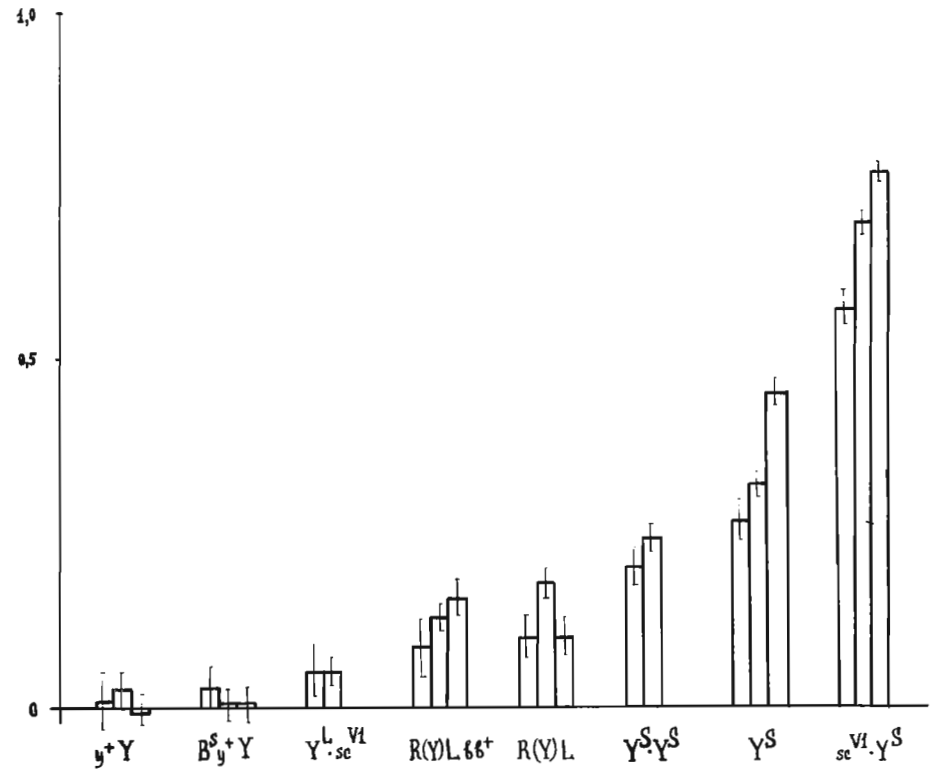
Frequency of secondary nondisjunction (%)

	Female I	Female II	Female III
Y (normal)	54.2 ± 2.2	70.9 ± 2.0	69.6 ± 2.3
y^+Y	53.5 ± 2.2	68.5 ± 1.2	71.7 ± 0.5
B^Sy^+Y	52.8 ± 1.5	70.7 ± 2.0	70.0 ± 2.4
$Y^L.sc^{Vl}$	51.3 ± 1.9	67.2 ± 1.7	---
R(Y)L bb^+	49.9 ± 1.9	59.8 ± 2.0	60.6 ± 2.2
R(Y)L	48.6 ± 1.5	58.5 ± 1.8	62.6 ± 1.9
$Y^S.Y^S$	43.2 ± 1.5	---	52.7 ± 1.5
Y^S	39.6 ± 1.8	48.3 ± 1.6	37.7 ± 1.6
$sc^{Vl}.Y^S$	20.8 ± 1.4	21.8 ± 1.3	15.8 ± 1.3

This table shows that the stocks studied had different frequencies of X nondisjunction. To elucidate to what degree these differences depend on the Y chromosome structure or on the genetic background of the lines, the relative effect of each Y chromosome was determined by the formula

$$\frac{f_o - f_n}{f_n}$$

where f_o stands for nondisjunction frequency in the line containing structurally normal Y chromosome (control) and f_n represents the frequency in the line containing an aberrant Y chromosome. These values determined in each of the three lines for eight Y chromosomes are shown in the histogram. Each Y chromosome is presented as a triad of columns, $Y^L.sc^{Vl}$ and $Y^S.Y^S$ as diads. It is evident that the aberrant Y chromosome effect doesn't depend considerably on the background of the line in which it was determined. The main tendency is that the smaller the Y chromosome size, the smaller is the frequency of X nondisjunction. The Y chromosomes deleted for the long arm ($sc^{Vl}.Y^S$ and Y^S) reduce a control frequency in the greatest degree, followed by $Y^S.Y^S$ chromosome; Y chromosomes deleted for the short arm ($Y^L.sc^{Vl}$, R(Y)L bb^+, R(Y)L) have a lesser effect; and "whole" Y chromosomes (y^+Y and B^Sy^+Y) have the least effect.



Thus, the data obtained strongly suggest that the secondary X nondisjunction is a result of X-Y pairing and the frequency of this pairing depends on a correspondence of X and Y sizes, in agreement with Grell's rule for nonhomolog pairing (Grell 1964).

References: Chadov, B.F. 1971, Genetica (Rus) 7(2):117-127; Chadov, B.F. and S.N. Davidova 1971, Genetica (Rus) 7(5):87-94; Grell, R.F. 1964, Proc. Nat. Acad. Sci. USA 52:226-232.

Chadov, B.F. and E.V. Chadova. Institute of Cytology and Genetics, Siberian Branch of the USSR Academy of Sciences, Novosibirsk 630090, USSR. Nonhomologous pairing and spontaneous interchange in D. melanogaster males.

It may be concluded from Moore's cytological data that nonhomolog pairing takes place in mitosis of D. melanogaster males (Moore 1971). Inasmuch as nonhomolog pairing is usually accompanied by spontaneous interchanges in D. females (Chadov 1975, 1977), it was supposed that nonhomologous pairing and interchanges between C(2L) and C(2R), C(2L) and Y, C(2L) and X chromosomes took place in mitotically divisioned spermatogonial cells of sc^8·Y/y;C(2L)RM, b pr;C(2R)RM,cn males bearing autosomal compounds C(2L)RM, b pr and C(2R)RM,cn. The appearance of chromosomes 2L·2R,b pr cn with the standard order of genes was expected as a result of interchanges between the compounds in their centromeric regions, and the appearance of half-translocations Y·2L,b pr or X·2L,b pr, containing arm 2L with b and pr genes, as a result of interchanges C(2L)-Y and C(2L)-X.

In experiments the males mentioned above were mated to C(1)DX,y;b j pr cn/T(Y;2)C and C(1)DX,y;+/T(Y;2)C females. These females produce several types of gametes: some of them are euploid and complementary to sperm cells with new arising chromosome 2L·2R,b pr cn; others are aneuploid and complementary to sperm cells with half-translocations Y·2L or X·2L. The progeny of females in three crosses constituted 225 individuals. Judging by phenotypes, 156 individuals contained chromosomes 2L·2R and 12 individuals, half-translocations bearing arm 2L. As the subsequent analysis showed, some of the 225 individuals were sterile, 123 individuals contained chromosome 2L·2R,b pr cn and 5 individuals, half-translocation Y^S·2L,b pr. 35 individuals arose from sperm and egg cells with nondisjunctional autosomes 2. The progeny with interchanged chromosomes arose in clusters. The data obtained have shown that in spermatogonial cells of Drosophila males nonhomologous pairing and interchanges take place.

References: Chadov, B.F. 1975, Genetica (Rus) 11(1):80-100; _____ 1977, DIS 52:79; _____ and E.V. Chadova 1977, Genetica (Rus) 13:477-489; Moore, C.M. 1971, Genetica (Ned) 42:445-456.

Chadov, B.F. Institute of Cytology and Genetics, Siberian Branch of the USSR Academy of Sciences, Novosibirsk 630090, USSR. Nonhomologous X-2 pairing in females containing structurally normal X chromosomes.

Phenomena of nonhomolog pairing usually arise in genotypes in which a conjugation of no less than two chromosome pairs was purposely disturbed or some supernumerary chromosomes were introduced into the genome. One may suppose, however, that the nonhomolog pairing is not restricted to the above mentioned range of genotypes, but can take place in any genotype, if two nonhomologs don't conjugate for some reason. I have observed two cases when chromosomes, whose conjugation was not purposely disturbed, participated in nonhomologous pairing.

(1) Females with structurally normal X chromosomes and heterozygous SM1, al^2 Cy cn^2 sp^2 inversion were tested for formation of oocytes aneuploid for autosomes 2 and X's (Chadov et al. 1970). In mating with C(2L)RM,b pr;C(2R)RM,cn males they produced progeny arising from the following oocytes:

Oocyte type	XX	XX22	2-2	0	X22	X
Number	20	-	41	-	39	63

Double aneuploid oocytes, i.e., oocytes aneuploid both for the X's and autosomes 2, constituted 55% of all oocytes. The double aneuploid oocytes were of two types only: XX and 2-2. Based on these data, it may be supposed that X-2 pairing takes place and X and 2 disjoin after the nonhomologous pairing. If X-2 pairing did not take place and autosomes 2 and the X's were distributed independently, the double aneuploid oocytes would rarely arise and four types of such gametes instead of the two types observed would be formed.