Ives, P.T. Amherst College, Amherst, Massachusetts. Residual lethality in induced rearrangements and the chromosomal distribution of ♂ crossovers.

Two-day old virgin ♂♂ (Oregon-R/T(2;3)bw;h) after exposure to 1 or 2 kr of X-rays were mated individually and exhaustively (each to 6 new ♀♀ daily) to sets of vg bw;se or Cy bw sp^2;TM3 Sb Ser/T(2;3)bw;gl ♀♀, the latter to set up a test by which I could eliminate any ♂ that carried a pre-treatment lethal in either + chromosome, the former to lead to a T(2;3) test of treated +;+ pairs of chromosomes in sperm from proven lethal-free ♂♂ by the test mating of +;+/vg bw; se ♂ x T(2;3)vg sp^2;se ♀♀. T's involving the Y chromosome were discarded. Each T(2;3)+;+ and several of its sibling non-T +;+ pairs were tested for lethals starting with their ♂♂ x Cy bw sp^2;TM3 Sb Ser/T(2;3)bw;gl ♀♀. A lethal in either + chromosome or from the (rare) interaction between the +;+ members of a non-T pair, was sufficient to score a pair of non-T +;+ chromosomes as a lethal in just the same way that such a lethal must score a pair of T-linked +;+ chromosomes. The difference in frequency of lethality in those two kinds of pairs of chromosomes is a direct measure of the residual lethality (due to the rearrangement itself) in T's. Similar groups of sibling non-T lines (sometimes the same ♂♂ as used in the above lethal tests) were also tested for inversions (In's) using al cl b c sp^2 and scoring their F_2 for reduced crossing over (< 1/2 normal) in one or more regions. Residual lethality for In's was then calculated using the chromosome 2 lethal frequencies from the tests of non-T's or from appropriate SM5 tests in series which had no parallel T and non-T lethal tests. In a separate experiment, after a similarly built-in lethal screening test for both starting chromosomes, crossover (CO) chromosomes from the days 7-10 sperm broods of 1kr treated Oregon-R/al cl b c sp^2 ♂ x al cl b c sp^2 stock ♀♀ were tested for lethality (using b Bl/SM5 al lt^v sp^2) along with samples of both kinds of sibling non-crossover (non-CO) chromosomes. The data from these experiments are given in the accompanying table. T's in the sperm of day 1 after treatment, and in days 5 and 6 sperm (which showed similar characteristics), and in both the 1 and 2 kr series, show a very similar rate of residual lethality, ranging from 40.4 to 41.9%. In's from the different days and treatments, although smaller in number, have the same order of residual lethality, 44.9 to 48.9%. Days 7 and 8 sperm show equivalent CO and lethal characteristics and their data are pooled here. Their residual lethality was 39.4%, but only 2 of the 4 broken ends of the homologous pair of chromosomes is recovered in each CO chromosome. All 4 broken ends are recovered in T's and In's. Thus, per broken end, residual lethality is

RESIDUAL LETHALITY IN X-RAY INDUCED REARRANGEMENTS

A. In Reciprocal 2;3 Translocations

Day	Dose	T's	le	%	Non-T's	le	%	Resid. %
1	1 kr	74	41	55.4	1016	137	13.5	41.9
1	2 kr	65	42	64.6	600	134	22.3	42.3
5+6	1 kr	314	198	63.1	2249	512	22.7	40.4

B. In Chromosome 2 Inversions

Day	Dose	In's	le	%	Non-In	le	%	Resid. %
1	2 kr	17	10	58.8	323	45	13.9	44.9
5+6	1 kr	89	52	58.4	1544	194	12.6	46.8
5+6	2 kr	26	19	73.1	351	85	24.2	48.9

C. In Male Crossovers, after 1 kr

Day	Flies	CO	%	CO	le	%	+	le	%
7+8	68,028	869	1.28	212	110	51.9	1367	171	12.5
9	37,716	373	.99	142	23	16.2	309	10	3.2
10	80,821	524	.65	199	17	8.5	1454	43	3.0

The + indicates non-crossovers. Resid. % in Day 7+8 is 39.4

much higher in CO's than in T's or In's at the time when it is at a maximum. In days 9 and 10, especially in day 10 sperm (whose clusters of crossovers were rare and small, in contrast to the situation in days 11 and 12 sperm) there was a sharp decrease in lethality in both CO and non-CO chromosomes (as well as a modest but clear decrease in frequency of recovered CO's) and residual lethality decreased to 13.0% in day 9 and to 5.5% in day 10 CO's. Residual lethality in T's and In's is presumably a position effect of the changed gene order. In ♂ CO's (homologous T's?) is it a result of possibly unequal crossovers producing chromosomes with small deficiencies or duplications, especially in days 7 and 8 where the chromosomes did not replicate before entering meiosis? Was the decrease in residual lethality in days 9 and 10 due to a repair of both lethals and rearrangements in cells whose chromosomes did replicate at least once more before meiosis, or to a loss of many days 9 and 10 cells with lethals and lethal-bearing crossovers during the subsequent replication? These questions are not answered in these data. (Minutes were relatively frequent in days 7 and 8 CO, and half the days 7 and 8 CO ♂♂ were sterile. Less than 10% of our T's and In's did not produce enough descendants for an adequate homozygous lethal test, which started, however, with several ♂♂ in each case.) Tests of a random sample of days 7-10 CO chromosomes showed no T associated with any one of them. Induced crossing over in ♂♂ appears first and very consistently in day 7 sperm (at 25° C) after radiation if the ♂ mates exhaustively (daily) during days 1-6. In another experiment 101 crossovers induced by 1 kr in al lt stw^3 sp^2/net b cn bw ♂♂ distributed themselves 17 in the net-b region, 31 in b-lt, 21 in lt-stw, 2 in stw-cn, 28 in cn-bw, and 2 in bw-sp. (The matings were treated ♂ x al lt stw^3 sp^2 ♀♀, and each F_1 CO x net b cn bw.) Compared to the linkage map distances those numbers are significantly high in both euchromatic b-lt and heterochromatic lt-stw and are low in euchromatic net-b and cn-bw.

This work, done in 1963-1970, was supported in turn by AEC Contract AT (30-1) 2467, NIH Grant T01-GM306, and NSF Grant GB-5680, and I am indebted to Mrs. Lucy Casey, Mrs. Virginia White, Miss Elinor Ives, and Miss Hildreth Spooner for assistance in it. Related studies from other laboratories, especially those of Bateman, Hannah-Alava, G. and A. Olivieri, and Puro, have been reported in Mutation Research during this time. Sobel's note in DIS 48:117 is perhaps the latest reference.

Široký, J. and J.K. Benedík. J.E. Purkyně University, Brno, Czechoslovakia. The changes of viability in a cage population.

The changes of the viability in the natural population during one year affected by the second chromosome were studied. The population was established on November 1st and all the time it was kept in the population cage at 25°C temperature, without light, and under a constant food condition.

The viability was tested by the Cy-method. Three tests for viability were done during the one-year period. The first in November 1970, the second in May 1971, and the third in November 1971. The modification of the Cy-method was used making possible the study of the viability of both chromosomes in each male. The results of the tests are compiled in the Table.

	% of detrimentals	% of supervitals
November 1970	34.00	12.04
May 1971	28.95	9.87
November 1971	2.01	1.34

The results suggested that the frequencies of both the detrimentals and the supervitals decreased continually. The difference between this finding and the results of some other authors (Cetl, unpubl., Mukai, 1969) occurred, but these authors studied only single second chromosome lines. In their experiments the percentage of all detrimentals, especially lethals, significantly raised to the 20th or 75th generations, respectively. The situation in our experiment was rather different. The whole population, and not only the single chromosomal lines, was studied and so the natural selection connected with the competition may overlap the mutation rate in this case.

References: Mukai, T. 1969, Genetics 61:479-495.