Translocation heterozygote	N	rgd
$T6\text{-}9_{4778}/N$	287	0
$T4\text{-}6_{4341}/N$	732	1?
$T2\text{-}6_{5419}/N$	713	0
T6-9a/N	465	0

Only one questionable rgd seedling was observed. It was concluded from these results and those obtained with the TB-6a translocation that the rgd locus is not in the portion of 6S distal to the organizer break. However, the location of rgd in the proximal portion of the organizer was not ruled out by these tests.

Reid G. Palmer
Ellen Dempsey

8. Somatic association of homologues induced by abnormal chromosome 10.

It has been postulated that an association of homologous chromosomes is a general phenomenon found throughout the cells of the organism (Feldman et al, PNAS 56: 1192-1199, 1966), and that the intimate synapsis of homologues in meiosis is the extreme condition. Therefore, an effort was made to determine whether or not homologous maize chromosomes associate at random in mitotic cells of the root tips. Since it is known from the investigations of Rhoades and Dempsey (1966) that abnormal chromosome 10 (K10) induces more intimate pairing of the homologous chromosomes in meiotic cells, root tips of plants with and without K10 were examined.

Plants from isogenic W22 stocks carrying 0, 1, or 2 K10 chromosomes were germinated, the root tips collected, and squashes were prepared according to the Feulgen staining technique. The cells were examined to determine the distances between the homologous chromosomes 6 in all three stocks, between each 6 and each K10 in the stocks with one or two K10's, and between the homologous K10 chromosomes in the stock with two K10's. The 6's could be distinguished from the other chromosomes by the terminal satellites and the K10's by the length, extreme arm ratio and the large terminal knob. Cells which were reasonably flat and circular with all twenty chromosomes visible were selected for counting.

The distances between the chromosomes were measured with an ocular micrometer and, to minimize the differences in cell size due to differential squashing, the distance between the two chromosomes in question was divided by the distance between the two chromosomes which were furthest apart in the cell. This gave a corrected value which will henceforth be referred to as distance between the chromosomes.

In order to determine whether the chromosomes were non-randomly associated, the results of the counts were compared with a theoretical distribution. This theoretical distribution is based on the frequencies with which two points will lie at various distances from each other when randomly

distributed in a circle. It is assumed that the two homologous chromosomes, measured from centomere to centromere, can be considered as two points in a circle. According to the work of Lord (Ann. Math. Statistics 25: 794, 1954) the distance, X, between such a pair of points has the probability density function for a circle of diameter 1:

$$f_X(x) = \frac{16x}{\pi}\left[\cos^{-1} x - x(1-x^2)^{\frac{1}{2}}\right]$$

When the distribution is plotted for distances between 0 and 1, a theoretical distribution curve is obtained which has a mean value for X of 0.4527.

Kolmogorov-Smirnov One-Sample or Two-Sample tests of goodness of fit, which take into account both the mean and the shape of the distribution curve, were used to compare the observed measurements with the theoretical distribution.

Table 1 summarizes the data obtained from counts of cells without K10, with one K10 and with two K10's.

Table 1
Mean distance between chromosomes

Class	6-6	6-K10	K10-K10
k10k10	0.439^{+} N = 141	------	-------
K10k10	0.336^{*} N = 74	0.431^{+} N = 113	-------
K10K10	0.315^{*} N = 34	0.404^{+} N = 92	0.445^{+} N = 45

+ = No significant deviation from the theoretical distribution.
* = Deviation from the theoretical distribution is significant above the .01 level.
N = Number of observations.

When the association of the homologous chromosomes 6 was tested in cells from plants not containing K10, the mean distance between the homologues was 0.439. This did not deviate significantly from the expected 0.453 mean of a randomly distributed population. This indicates that during mitotic metaphase in root tip cells the homologous chromosomes are not associated.

Likewise, the mean distance between non-homologous chromosomes, specifically a chromosome 6 and a K10, did not deviate significantly from the value expected for a randomly distributed population. Though this result was anticipated, it is important inasmuch as it strengthens the assumption that

the theoretical distribution actually is a true representation of the distribution of non-associated chromosomes in squashed cells.

When K10 was present in one or two doses, the mean distances between the homologous chromosomes 6 were 0.336 and 0.315, respectively. These means deviated from the random distribution above the .01 level. The values of 0.336 and 0.315 did not differ significantly from each other. The occurrence of a non-random association of the two homologous chromosomes 6 indicates that K10 in some way has initiated or enhanced an attractive force which brings about somatic association of the homologues.

When association between the two K10 chromosomes was investigated no significant deviation from random was observed. This would indicate that the effect of K10 was interchromosomal in nature, affecting only the other homologous chromosomes in the complement. A similar interaction with non-homologous chromosomes has been reported for the effect of K10 on recombination; Rhoades has found that the increase in crossing over induced by K10 in meiotic cells was less in the K10 bivalent than in the other bivalents of the complement.

Since K10 increases the synapsis of meiotic homologues and induces a loose association in mitotic cells, it is possible that both forms of pairing are caused by a single attractive force. This would argue against the hypothesis that both long range and short range pairing forces are operative during meiosis.

Judith Miles

9. The induction of crossing over by B chromosomes.

In the 1960 Maize News Letter I reported that crossing over in the Sh-Wx region was not increased in plants homozygous for a piece of 3L inserted into the short arm of chromosome 9 despite the fact that the length of chromatin separating these flanking markers is approximately twice as great as in a normal chromosome 9. (The chromosome 9 with the inserted segment of 3L was originally designated Dp9 but we have since referred to it as Tp9 since the aberration is more accurately described as a transposition.) In the 1966 Maize News Letter the results of testcrosses of homozygous Tp9 plants heterozygous for the Yg, C, Sh and Wx loci were presented. An unusual feature of the data was the significant increase in recombination for the regions distal to the transposed segment of 3L and the complete, or nearly complete, absence of chiasma interference for double crossovers when one of the regions included the 3L piece. Extensive data from a large number of homozygous Tp9 plants showed no increase in crossing over above the control value for the C-Wx or Sh-Wx regions and the conclusion was reached that crossing over did not occur within the transposed segment of 3L. This conclusion would account for the unchanged recombination in the Sh-Wx region in Tp9 Tp9 and N9 N9 bivalents. Also intelligible are the high coincidence values for those double exchanges where one of the crossover regions is the Sh-Wx interval. The great majority of the exchanges in the Sh-Wx region occur to the right of the inserted piece. Although there is apparently no recombination