2. Transmission of a specific class of deficiency gametes.

The female transmission of a specific class of duplication-deficiency gametes has been detected during the course of an experiment designed to test the effect of proximity of a translocation breakpoint upon mutation of R to r. A series of six translocations involving the long arm of chromosome 10 were used in this test. The six reciprocal translocations, the position of their breakpoints, and the genetic maps of the resulting translocated tenth chromosomes are listed in the table below.

Translocation	Breakpoints	Genetic Map
T6-10a	6L 0.75; 10L 0.15	T 10.6 g 12.0 R
T1-10e (B98)	1L 0.16; 10L 0.31	T 7.6 g 15.7 R
T4-10b	4L 0.15; 10L 0.60	T 4.3 g 13.6 R
T1-10d (a84)	1L 0.50; 10L 0.68	T 2.1 g 7.9 R
T2-10 (5651)	2S 0.71; 10L 0.62	g 0.3 T 4.2 R
T5-10 (4384)	5L 0.13; 10L 0.79	g 0.0 T 2.3 R
NONE (control)		g 17.0 R

The map distances given above represent values obtained through the female side from crosses $\underline{T} + \underline{R}^{r}/\underline{N}\ \underline{g}\ \underline{R}^{g} \times \underline{N}\ \underline{g}\ \underline{r}^{g}$. The order agrees with that established from $\underline{N}\ \underline{g}\ \underline{r}^{g} \times \underline{T} + \underline{R}^{r}/\underline{N}\ \underline{g}\ \underline{r}^{g}$ crosses, where the translocation heterozygote was used as male parent. The order in T5-10 (4384) is known from the latter crosses to be g T R, the recombination values obtained in that case being 2.4% for region I and 6.7% for region II. As can be seen from the above table, the breakpoint in 10L lies proximal to g in four of the six translocations. In two of them, namely in T2-10 (5651) and T5-10 (4384), the breakpoint occurs between g and R.

Colorless seeds were selected from crosses $\underline{T} + \underline{R}^{r}/\underline{N}\ \underline{g}\ \underline{R}^{g} \times \underline{N}\ \underline{g}\ \underline{r}^{g}$, germinated, and the resulting seedlings scored for coleoptile color. The selections were then transplanted to the field where they were grown to maturity for further testing. In testcrosses utilizing translocation heterozygotes with the breakpoint in 10L proximal to g, the frequency of colorless seeds was low, though variable among the different translocations, and in the order of magnitude expected from mutation of R to r. An approximately equal number of red and green seedlings was obtained from these seeds. In crosses involving translocation heterozygotes

having the breakpoint in 10L between g and R, an unexpectedly large number of colorless seeds was found. Upon germination, only a small minority produced the red seedling color expected from R^r to r^r mutation. A large majority gave green seedlings. Samples of 15 green seedlings from each of the two crosses were grown to maturity. These plants were well developed and normal in appearance, somewhat late in pollen shedding, and in general, smaller than the sib plants obtained from red seedlings. Some developed yellow stripes in the lower leaves. Pollen examination revealed two classes of pollen grains segregating in equal numbers: one class consisting of large, normal appearing grains, and the other class consisting of smaller, though well-filled grains. The ears in these plants were partially sterile.

Apparently, plants heterozygous for T2-10 (5651) and T5-10 (4384) produce a large number of functioning duplication-deficiency megaspores. Deficient in these female gametes is the distal end of 10L, a chromosome segment including R but not g. The behavior of these duplication-deficiency gametes in transmission closely parallels the behavior of a haplo-viable deficiency reported by Stadler (Missouri A.E.S.R.B. 204, 1933). This X-ray induced deficiency of the distal one fifth of the long arm of chromosome 10 also covered R but not g. Furthermore, the general appearance of the aneuploid plants obtained from translocation heterozygotes matches Stadler's description of his deficiency heterozygous plants.

On the other hand, plants heterozygous for any of the other four translocations do not produce functioning duplication-deficiency gametes. The breakpoint in 10L in these translocations lies proximal to g, the closest one mapping 2.1 units proximal to g. It would appear, therefore, from this evidence that a chromosomal region which extends short distances proximally and distally to g, but which definitely excludes R, contains a gene or genes which are essential for normal female gametophyte development.

Confirmatory evidence comes from the transmission behavior of 10^B in $10/10^B$ hemizygotes. 10^B is one of the two members of a reciprocal translocation between chromosome 10 and a B chromosome, in which the breakpoint in 10L is proximal to g. Gametes receiving only 10^B, and therefore deficient for g, are non-functional through the female.

A note might be added regarding the physical location of the genes g and R in the long arm of chromosome 10, with the reservation that the variable position of the center of a translocation cross makes these placements very tentative. As can be seen from the table, a translocation breakpoint in the long arm of chromosome 10 occurring between 10L 0.60 and 10L 0.80 may be either proximal or distal to g, but is always proximal to R. Breakpoints proximal to 10L 0.60 are always proximal to g. Thus, g would be placed in the sub-terminal one-fifth and R in the terminal one-fifth of the long arm of chromosome 10. This placement of R agrees with Stadler's.

An examination of the genetic map of the long arm of chromosome 10 reveals that g lies in the proximal one-fifth of the arm and R approximately midway between the centromere and the distal end. To reconcile the genetic map with the physical map one can postulate a very high frequency of recombination in the distal two-fifths of the long arm of chromosome 10 relative to that in the remainder of the arm. The possibility of localized high recombination in the terminal segment of 10L agrees well with previous findings in maize and differs markedly from findings in Drosophila, where the frequency of recombination increases towards the center of the chromosome arm.

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3. Use of a partial trisomic in a half-tetrad analysis.

A cytogenetic system was sought for the recovery of reciprocal products of crossovers in the R region of chromosome 10. Such a system, ideally, would be disomic, of such a nature to permit recovery following a single exchange, and be efficient in terms of its yield of reciprocal products. As a preliminary to study of R intralocus crossovers, an investigation involving the g-R and R-M^{st} segments was performed utilizing the following heterozygote: