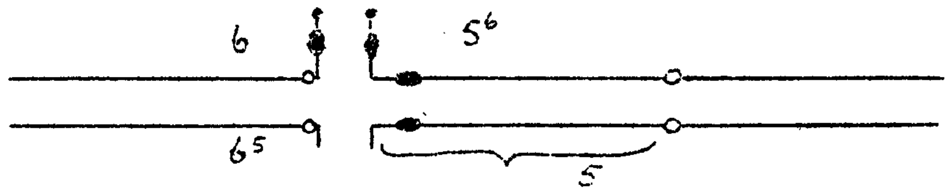
5. <u>Correlation of exchange frequency and crossing over in a translocation heterozygote</u>.



Translocation 5-6c obtained from McClintock was used in the following study. The long interstitial segment indicated by a bracket in the diagram was tested for crossing over cytologically and genetically. The interstitial segment to the left is so short that very little, if any, crossing over occurs in this region.

Exchange frequency in the interstitial segment was determined cytologically from examination of the nucleolar constitution of microspore quartets in two plants heterozygous for the translocation. The types of quartets which occurred with their source and frequency are given in the table below. The values found by Burnham in a more extensive study are also listed.

	Type of quartet	Source	Number	Frequency	Burnham data Number	Burnham data Frequency
1.	1 | 1 1 | 1	nons + alt seg 2 str d + alt seg 4 str d + adj seg	154	13.7	809	19.3
2.	2 | 2 0 | 0	nons + adj seg 2 str d + adj seg 4 str d + alt seg	106	9.4	742	17.9
3.	1 | 2 0 | 1	singles + alt seg singles + adj seg 3 str d + alt seg 3 str d + adj seg	859	76.8	2678	62.8

The genetic data were obtained from sibs of the above 2 plants. Heterozygotes of constitution

$$\frac{\text{T Pr Bt}}{\text{t pr bt}}$$

in which T marks the breakpoint t pr bt and Bt marks the centromere, were used as female parents in backcrosses and the frequency of crossing over in the interstitial segment determined. In a progeny of 1337, 11.4% were crossovers between T and Pr, 32.3% were crossovers between Pr and Bt and 2.2% had exchanges in both regions. The following calculation was made to obtain the expected exchange frequency:

11.4 - 2.2 = 9.2 x 2 = 18.4 single exchange T-Pr
32.3 - 2.2 = 30.1 x 2 = 60.2 single exchange Pr-Bt

2.2 x 4 = 8.8 double exchanges T-Pr-Bt

All of the cells with single exchanges and half of those with double exchanges give rise to type 3 quartets. The expected percent of type 3 quartets is therefore 83. This agrees well with the observed value of 76.8.

Burnham (1950) gives the following frequencies for exchanges in the interstitial region: single exchanges -- 43% double exchanges -- 40% These values are based in part on his quartet data and in part on an assumption of 10% for recovered double crossover strands. Since 2.2% double crossovers were found in the present study, the estimate of 10% seems rather high.

Certain assumptions have been made in calculating the exchange frequency from the genetic data. The double exchanges were considered to ocaur in a ratio of 1 two strand: 2 three strand: 1 four strand. It was assumed that the ratio of alternate to adjacent-1 types of segregation was not altered by the occurrence of interstitial exchanges and remained 1:1 following both single and double exchanges in this region. (Burnham has shown that no or very little adjacent-2 segregation occurs in plants heterozygous for T 5-6a). The agreement of the observed and calculated values for type 3 quartets seems to indicate the validity of these assumptions although an exactly compensating deviation in both ratios would give the same result.

Because of inadequate marking, double crossovers within the Pr-Bt interval were not detected. They would not be expected to be as frequent as the doubles found for the T-Bt region and therefore the map distance from Pr to Bt would not be lengthened by more than 4.4 units. The maximum value for the calculated exchange frequency would then be 87.4.

In a separate test involving the same translocation, a plant of constitution

$$\frac{V_2\ T}{V_2\ t}$$

was pollinated by a v_2 male parent. V_2 is located distal to the break in chromosome 5. No v_2 seedlings were found in a progeny of 303 indicating that there is no transmission through the egg of gametes containing the 5 and 6 chromosomes. These gametes would be deficient for a short terminal segment of 5L and duplicate for most of 6S.