of the corn-grass phenotype by dosage effect. Therefore, $\underline{Cg}$ is apparently distal to the translocation, as would be expected from its map position.

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2. Location of TB-5a with respect to marker loci.

A B-type translocation involving the long arm of chromosome 5 has apparently been separated from the X-ray induced translocation complex, involving chromosomes 5, 6, and a supernumerary, reported in MNL 42:132. Pollen sterility has dropped from the original 60-75% to about 30%. It now seems appropriate to name this translocation, so it is designated TB-5a.

The breakpoint of TB-5a lies between $\underline{v}_3$ and $\underline{bv}_1$, the former being proximal and the latter distal.

Incidental information regarding $\underline{td}$ (thick-tassel dwarf) and $\underline{na}_2$ may be of interest here. Both are proximal to TB-5a and both appear to be closely linked to the translocation. Since $\underline{bv}_1$, $\underline{td}$, and $\underline{na}_2$ plants are all somewhat dwarfed, the stocks were intercrossed to test for allelism; $\underline{Na}_2/\underline{na}_2$ x $\underline{bv}_1$ and $\underline{Td}/\underline{td}$ x $\underline{na}_2$ gave wholly normal progenies. The additional observation that $\underline{na}_2$ and $\underline{td}$ are proximal to TB-5a and that $\underline{bv}_1$ is distal makes it evident that the three represent distinct loci.

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3. Patterns of nucleolar distribution at the quartet stage of meiosis in tetraploids.

There are two nucleolar organizers located on the short arm of chromosome 6 in each microspore of a quartet formed from meiosis in a tetraploid. They each may form a small nucleolus or they may combine to form one large nucleolus. The greater the proximity of the nucleolar organizers, the greater is the probability that they will function together to form only one nucleolus. Consequently, the presence of only one nucleolus indicates that the short arms of chromosome 6 are close together.

There are six major types of patterns possible in a quartet. They are shown in Table 1. The plane of first division is very difficult

to see in tetraploid quartets. If it could be seen clearly, then type 4 could be sub-divided into two classes, one with the two mononucleolate spores on the same side of the plane of first division and one with one mononucleolate spore on each side. In addition, three other types were observed--patterns 7, 8, and 9. These are the result of 3 to 1 disjunctions of the chromosomes 6. Types 7, 8 and 9 were found in 21 out of 2,482 quartets or 0.8% of the cases. It is probable that some 3 to 1 disjunction events gave patterns like those of 1, 2, or 3. However, the error from this source is probably small and will be neglected. Excluding the known 3 to 1 disjunctional types, a total of 2,461 quartets was examined from eight plants. The observed and expected frequencies of the six different patterns are given in Table 1. The formula for determining the expected frequencies is an expansion of the binomial $(m + d)^4$ where m is the frequency of mononucleolate spores and d is the frequency of dinucleolate spores. The values of m and d are .7252 and .2748, respectively.

It is apparent from the data that the relative proximity of the short arms of chromosome 6 tends to be similar in the nuclei derived from a single second metaphase configuration. This is understandable since there probably is very little lateral movement during anaphase or much shifting around of the chromosomes at telophase. Note the low frequencies of types 2 and 4.

Table 1

Patterns of nucleolar distribution at the quartet stage
of tetraploid meiosis

Quartet type	1	2	3	4	5	6	7	8	9

Frequency									
observed no.	1,093	524	432	62	207	143	11	6	4
%	44.4	21.3	17.6	2.5	8.4	5.8			
expected no.	681	1,032	391	195	148	14			
%	27.7	41.9	15.9	7.9	6.0	0.6			
formula	m^4	$4m^3d$	$4m^2d^2$	$2m^2d^2$	$4md^3$	d^4			

The relatively high frequency of type 6 may be the result of there being two bivalents of chromosome 6 at the first metaphase in these cases. If these bivalents are far apart on the first metaphase plate, the two chromosomes 6 will probably be far apart in the first telophase nuclei and all through second division. However, from the high frequency of type 3, we could perhaps say that in mose cases the mirror image spatial relationships of the chromosomes in the two first telophase nuclei are generally lost in the "swing flanking movement" of the chromosomes to form the second metaphase plates which are, of course, 90 degrees off from the plane of the first metaphase plate.

The results are very preliminary. The system is simple but needs definition. Studies will be made to see if the frequency of mononucleolate spores is related to the rate of quadrivalent formation for chromosome 6. Tetraploids heterozygous for an inversion on chromosome 6 should have a higher frequency of dinucleolate spores. Also by correlating the size of the spore after it leaves the quartet with the number of nucleoli, it should be possible to determine the time sequence of nucleolar fusion.

G. G. Doyle

4. Tetraploid gene segregation as studied with a repulsion phase marking system.

This system has been described in previous reports. It allows for the identification of all of the euploid and aneuploid types of tetraploids and the determination of many of the parameters of tetraploid gene segregation such as double reduction, numerical nondisjunction, the relative transmission frequencies of euploid and aneuploid gametes, and the viabilities of aneuploid zygotes and plants.

The gene segregation patterns of three euploid and four aneuploid types are given in Table 2.