

SHORTER ARTICLES AND DISCUSSION

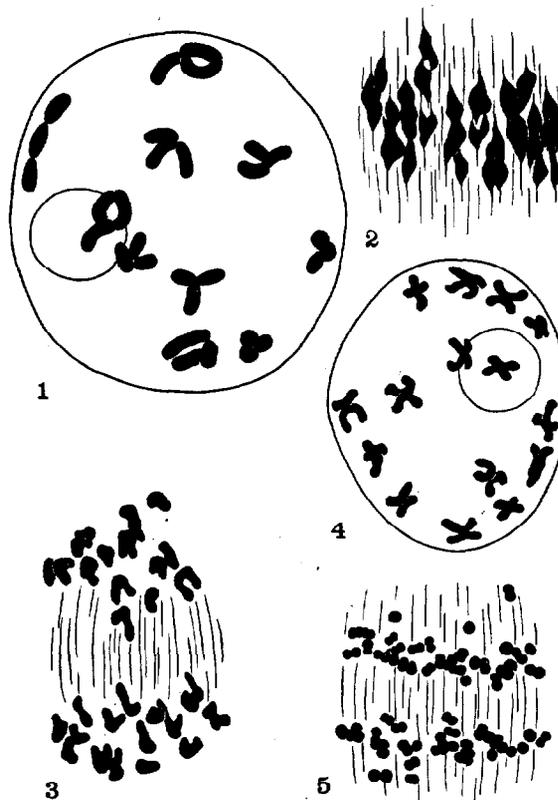
POLYPLOIDY IN ZEA MAYS L.

DURING the course of our investigations on the chromosome numbers in *Zea Mays* a triploid plant has appeared in a culture obtained for cytological and genetical studies from Dr. A. C. Fraser, Cornell University. As compared with the diploid plants of the same culture with their ten pairs of chromosomes, the triploid plant was notably more vigorous; it had a thicker stalk, broader leaves, stouter tillers, larger anthers and distinctly larger microsporocytes. Genetically speaking, the plant appeared to be a dilute sun red with a heterozygous tunicate tassel.

The aceto-carmin method was employed to fix and stain the microsporocytes. Additional material was fixed in other fluids for further study. The history of the chromosome complement was followed from the late prophase of the first meiotic division (*I*) through the second meiotic division (*II*).

On the basis of other evidence not presented here it seems apparent that the basic chromosome number in *Zea* is ten. The plant under discussion possessed thirty chromosomes. At diakinesis these were usually arranged in ten groups of three each, *i.e.*, ten trivalents (Fig. 1). However, in the same preparations a few figures were observed in which the third member of one or more groups appeared unassociated with its homologues. Thus in the same nucleus at diakinesis univalents, bivalents and trivalents were frequently observed.

Fig. 2 illustrates the appearance of the trivalent chromosomes in the metaphase of *I*. (Compare with normal bivalents in Fig. 7.) In early metaphase there are usually ten groups. As in some cases in diakinesis, however, univalents occasionally appeared not clearly associated with any other members of the complement. This suggests a continuous non-association of certain homologues through the late prophase and metaphase. The extra member in each group most frequently appears as if it were united by one end to some point on a normal bivalent, *i.e.*, there is a loose attachment of the third member (see first and last trivalent in Fig. 2). In such a case the third chromosome disjoins from the other two; the latter then pass to opposite poles as usual. In other trivalents of the metaphase complement the three



chromosomes appear to be attached end-to-end with equal closeness. Other modes of association were observed, but whether or not these are characteristic for certain trivalents is not as yet known.

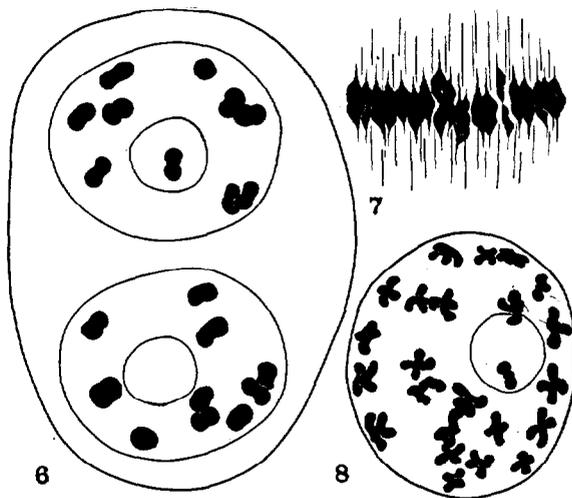
Very early in the anaphase the members of each trivalent appear as three distinct units, and the assortment is apparently a random one. Most frequently, as would be expected, the two anaphase groups show fifteen chromosomes each. However, figures were observed in which the distribution was 14-16, 13-17, and 12-18. In one case the thirty chromosomes were scattered very irregularly between the two poles. It is not known whether this results in the reorganization of one nucleus with the double number of chromosomes, as seems possible from evidence discussed later, or merely indicates a greater delay in the passage of the chromosomes to the two poles.

In the second meiotic division the chromosomes of the prophase are characteristically long and slender, and distinctly X- or

H-shaped (Fig. 4). Here, also, the individual chromosomes are easily distinguishable, sister cells showing most frequently fifteen chromosomes each. Often both mitotic figures were so favorably situated that the number of chromosomes in each anaphase group were countable, so that the number of chromosomes in each microspore of the quartet could be estimated. Occasionally we have observed in one cell, whose size indicates that it is a microsporocyte, a single mitotic figure showing all the characteristics of the anaphase of *II*, but with thirty chromatids in each group (Fig. 5). In case two microspores develop from such a cell, each would contain thirty chromosomes, instead of the usual ten to twenty.

Nothing is known concerning the manner in which triploidy arose in the culture referred to above, but in other cultures the following suggestive phenomena have been observed. In one plant in which many microsporocytes with ten pairs of chromosomes were seen, there were found two binucleate microsporocytes, with ten bivalent chromosomes in each nucleus (Fig. 6), together with a few other microsporocytes showing twenty bivalents in each metaphase of *I* (Fig. 7). In another plant normally showing twelve bivalents in meiosis, cells were observed with twenty-four dyads in the prophase of *II* (Fig. 8), in addition to cells with twenty-four bivalents in the metaphase of *I*. Should viable diploid gametes thus arise, their union with normal haploid gametes would result in a triploid plant.

Since comparatively few cells with the chromosome number thus doubled appear in the anther among normal diploid cells, it



would seem that the former must be due to aberrations occurring in late premeiotic divisions. The occurrence of these various conditions in cells so closely related points strongly toward the conclusion that the stages illustrated in Figs. 6-8 belong to one process responsible for the origin of triploidy, and conceivably of other forms of polyploidy in *Zea Mays*.

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