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1. Fine structure of meiotic chromosomes in haploid and diploid maize.

Since the finding of a synaptonemal complex in the spermatocytes of crayfish, pigeon, cat, man etc. was reported, it is estimated that from five to eight research communications on this organelle were published annually. Nevertheless, when one reviews these articles and tries to draw a conclusion on the structure and function of this organelle, one encounters a great difficulty. For instance, evidence in support of the role of the synaptonemal complex in chromosome synapsis at meiotic prophase comes from observations of this complex in the microsporocytes of $F_1$ hybrids of Lycopersicon-Solanum, in the spermatocytes of Panorpa, and in the sporocytes of many other higher plants and animals. On the other hand, evidence is available which argues against the idea that the synaptonemal complex plays a role in chromosome synapsis at meiotic prophase. For example, in the spermatocytes of Tipula and Drosophila chromosome pairing is present but no complex was found while in spermatocytes of XO type male insects where the X chromosome appeared as univalent, a synaptonemal complex related with that chromosome was identified. With regard to the postulated role of the complex in crossing over, controversial reports were likewise found. For instance, the absence of this complex in the spermatocytes of Drosophila and in the oocytes of the homozygous mutant C(3)G indicates that the complex plays a role in crossing over. On the contrary, evidence against this idea comes from the lack of the complex in mitoses of Drosophila and in prokaryotes. In view of these conflicting studies, a further investigation of the complex was needed. Therefore, a study of the synaptonemal complex in haploid and diploid maize was commenced a year ago.

The techniques followed throughout the investigation were those of standard light and electron microscopy. The stages of division in the microsporocytes of these plants were determined by the following procedure: One of the three anthers of a single spikelet was fixed in an aceto-alcohol fixative, the other two, in glutaraldehyde. One day later, the

anthers in aceto-alcohol were squashed for light microscopy. The stages of division in the other two anthers were predicted on the basis of findings with the light microscope, because the three anthers of any spikelet are generally synchronized in development.

For diploids, five plants were studied. A synaptonemal complex was found in the microsporocytes of all of them, from zygotene to pachytene. The diameter of the frontal view measured about 1200 A°, the lateral elements measured about 300 A°, the central element, 200 A°, and the areas between the lateral and central elements, 200 A°. For haploid plants, three plants were studied. With the light microscope it was found that at zygotene and pachytene stages all of the chromosomes synapsed nonhomologously. Most of the pairing was of the foldback type. With the electron microscope at the same stages of division synaptonemal complexes were consistently observed in all of the plants examined. These complexes appeared the same as those in the diploids.

Both cytological and genetical evidence indicates that the diploids undergo normal recombination. Evidence of crossing over in haploids was sought by crossing more than 50 haploid plants with pollen from diploid inbreds. Microsporocytes of the $F_1$ hybrids from these crosses were cytologically examined. Theoretically, if there were intrachromosomal crossovers in the haploids, inversions should appear in the $F_1$ hybrids. If there were interchromosomal crossovers, reciprocal translocations should be observed in the $F_1$. However, in more than 200 plants studied during the last eight years, neither inversions nor translocations were found. It seems correct to conclude that there is no, or rare, crossing over in haploids.

From this study the author is led to conclude that the synaptonemal complex is the product of chromosome synapsis, both homologous and nonhomologous, at the meiotic prophase in maize. This complex is not a permanent component of the chromosomes throughout the meiotic division. Because of the presence of this complex in haploid microsporocytes of maize and because of the absence of recombination in haploids, it appears convincing that the existence of this complex does not necessarily lead to crossing over in general.

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