6. Cytological studies of maize-teosinte derivatives.

An intensive study was begun during the year of the maize-teosinte derivatives developed by Mangelsdorf. All of these are the product of crossing varieties of teosinte with the inbred A158, followed by three or more generations of backcrossing to A158 and several generations of selfing. The derivatives, therefore, represent uniform inbred strains of maize in which entire chromosomes or parts of chromosomes from teosinte have been substituted for the corresponding chromosomes or parts of chromosomes from maize.

Before beginning the cytological studies, the derivatives were crossed with an inbred strain of Wilbur's Flint which has knobless chromosomes and which imparts excellent spreading qualities to pachytene smears. In such F_1 hybrids, the individual chromosomes can be much more readily identified than in ordinary F_1 maize-teosinte hybrids.

A cross of A158 with the knobless inbred served as a control. This hybrid is heterozygous for one knob on chromosome 7, contributed by A158. Any knobs other than this or any chromosome irregularities in the hybrids involving the teosinte derivatives can be attributed to teosinte chromosomes.

Knobs. Studies so far completed show that knobs have been introduced into A158 from chromosomes 1, 3, and 9 of Durango teosinte and from chromosome 4 of Nobogame teosinte.

Inversions. Three different inversions were found. One of these, on chromosome 9 of Durango teosinte, has been previously reported. The other two involve chromosome 8 of Durango and chromosome 10 of Nobogame.

The inversion of chromosome 8 is terminal and involves about two-thirds of the short arm of this chromosome. Various configurations formed as a result of this inversion are (a) the two chromosomes forming a loop; (b) one chromosome stretching out, the other folding back to pair with its homologous part in the other member of the pair; (e) one chromosome stretching out, the other folding back on itself in non-homologous pairing.

In 1084 cells studied, the inversion could be detected in only 82 or 7.6 percent, although it was presumably present in all of them.

The inversion in chromosome 10 is equivalent to about one-fourth of its total length and includes the centromere.

Non-homologous pairing. In addition to the cases involving inversion, non-homoloous pairing was observed between chromosome 4 of Nobogame and chromosome 2 of maize. The segment involved was equivalent to the distance between the knob position on chromosome 4 and the distal end. In another cross, chromosome 4 of Florida teosinte was observed to pair with an unidentified chromosome. The length of the segment involved in this association was from the distal end of the long arm to about two chromomeres beyond the knob. A third case of non-homologous pairing, between chromosomes 9 and 10 and involving approximately one-fifth of the long arm, of 10,

occurred in another teosinte derivative which had been outcrossed to a multiple-gene linkage tester.

Asynaptic figures were found in a number of hybrids involving teosinte derivatives. These were sometimes terminal, forming V-shaped configurations and sometimes interstitial, forming loops. The asynaptic segments usually involved not more than three chromomeres. These configurations have involved chromosomes 1, 2, 4, and 7 of Durango teosinte, and chromosomes 1, 3, 7, and 9 of Florida and 1, 4, and 7 of Nobogame.

Summary. The cytological studies so far completed on maize-teosinte derivatives show that chromosomes of teosinte can be transferred to maize, introducing into maize not only knobs, but also inversions, non-homologous pairing, and asynapsis. The chromosomes of teosinte are by no means as completely homologous to those of maize as earlier studies had suggested.

Yu-Chen Ting