Since random disjunction from multivalents alone accounts for all of the recessive backcross progeny, it is logical to conclude that bivalents in the "intergeneric" hybrid are rarely or never heterosynaptic.

-- Donald L. Shaver

12. The possible significance of a modified type of autotetraploid meiosis in perennial teosinte.

Meiosis was studied in a clonal derivative of the original collection of E. perennis made by Collins and Kempton in 1922. It was found that at pachynema, pairing was largely multivalent, as in autotetraploid maize. Many exchanges of pairing partners could be found in single cells.

However, a study of the diakinesis stage in 114 completely analysed cells revealed that quadrivalents were formed at a frequency of only .499, while two bivalents were formed at a frequency of .496. In autotetraploid maize, on the other hand, the quadrivalent frequency was .871, and the bivalent frequency was only .106. Since disjunction from bivalents is always regular, E. perennis may be expected to show much greater chromosome stability than autotetraploid maize.

Even more surprising was the fact that the quadrivalents of perennial teosinte were almost always restricted to two of the ten possible types, namely rings and chains of four, which are non-effective pairing (within arms) partner exchange types. Thus, in spite of the fact that exchange of pairing partners is very frequent at pachynema, some mechanism prevents these exchanges from being effective at diakinesis.

Possibly the simplest explanation for such a restriction in chiasma placement would be that the maximal chiasma number per arm in E. perennis is one (Chiasma interference is 100%). If this assumption is allowed, then at diakinesis, all of the chiasmata present can be detected. From cytological data from 110 cells (Shaver, unpublished Ph.D. thesis), it was calculated that the average frequency of chiasma per arm was .89. On the assumption of 100% chiasma interference, then, each chromosome arm takes part in a chiasma at a frequency of .89, and fails to do so at a frequency of .11.

The hypothesis of 100% chiasma interference within arms may be tested to see if it can satisfy the data. The hypothesis predicts ring-of-four formation at a frequency of $.89^4 \times 2/3 = .419$. The observed value was .410. The frequency of arms not taking part in a chiasma would be predicted as .110, while the observed frequency was .119. Hence, for two values, the hypothesis holds very well.

If the secondary hypothesis is made, that failures of chiasma formation are randomly distributed, further predictions can be made.[1] The predicted frequency of chains-of-four is .207 (observed was .067). Trivalent-plus-univalent is predicted at a frequency of .011 (observed was .003). Bivalent-plus-two-univalents is predicted at a frequency of .011 (observed was .001). Two bivalents are predicted at a frequency of .328 (observed was .494). Obviously the secondary hypothesis does not hold, and it seems likely that distribution of chiasma failure is not at random, but rather is directed to give an excess of bivalents at the expense of univalent formation. This localization can be explained by the hypothesis that the apparently strong chiasma interference within chromosome arms extends, to some degree, across the centromere.

It is therefore possible to explain all of the observed differences in meiotic behavior between perennial teosinte and 4N maize by the single hypothesis that chiasma interference is greatly increased in E. perennis, to 100% within arms, and to a lesser extent between arms. This apparently single

[1] The writer is indebted to G. G. Doyle for the method of calculation used here.

change brings a great increase in bivalent formation, and eliminates formation of the more complex types of quadrivalents.

If this change in E. perennis can be considered to be evolutionary in nature, it may be deduced that E. perennis is intermediate along the road from autotetraploidy to functional diploidy. If the goal is merely the attainment of 100% chiasma interference for whole chromosomes, it seems likely that the end result could be an individual whose chromosomes pair randomly at pachynema, but which has only bivalents at diakinesis. Such a quadridiploid would show the 5:1 backcross ratios typical of autotetraploids, but would have perfect chromosome stability.

The finding of a probable inversion in the short arm of chromosome 9 in perennial teosinte (article 8 above) indicates that E. perennis is a recent autotetraploid. The modification in chiasma frequency may therefore relate to a more or less simple genetic system. If simple, it may be amenable to use in improving the fertility of tetraploid maize.

-- Donald L. Shaver

13. Pollen physiology and biochemistry.

A study of pollen biochemistry is in progress. Preliminary results (see MNL 33:23, 1959) suggest that the pollen grain can be considered as a metabolically rich entity, analogous to a microorganism. Relatively small samples of pollen can be used for micro-qualitative and quantitative chemical determinations, as well as for physiological observations. From a knowledge of pollen biochemistry, it may be possible to judiciously employ specific chemical tests to elicit a colored test-reaction, thus affording the possibility of describing pollen phenotypes.

To deal with individual pollen grains, the autonomy of the grains and their contents is required in the test system. This requirement can be met favorably by "plating" pollen on agar-type surfaces. Pollen grains will absorb some chemical test materials from 1-5% agar (Difco certified Bacto-agar), yielding the color test. The use of petri dishes for plating is particularly adapted to rapid counting by using the standard equipment of the bacteriologist. Although aliquots of only dried, non-viable pollen samples have been studied thus far, samples of viable pollen will be tested as the pollen becomes available.

-- D. B. Walden

14. Effect of the abnormal chromosome 10 on chiasma formation and metaphase orientation in T6-9b heterozygotes.

Cytological observations at diakinesis, metaphase I, and quartet stage were made on two T6-9b heterozygotes, sib plants which differed in that one was N 10/N 10 and the other was N 10/abn 10. The break in 9S is proximal to the Wx locus and the break in 6L is between Y and the centromere. A large knob was present on chromosome 9 while the 6^9 chromosome was knobless. The results are tabulated below: