E_{10} Esterases. The E_{10} esterases were confined to immature endosperm tissue. Two phenotypes were noted for the E_{10} esterases. Individuals homozygous for E_{10}^A demonstrated a single isozyme which migrated faster than the single isozyme found in E_{10}^B homozygotes. The heterozygote $E_{10}^A/E_{10}^A/E_{10}^B$ demonstrated both isozymes; however, due to the dosage effect the faster isozyme was stronger than the slower isozyme. The heterozygote $E_{10}^A/E_{10}^B/E_{10}^B$ also demonstrated both isozymes, but in this case the slower isozyme was stronger than the faster isozyme. A single locus was postulated.

Ta_1 Transaminases. Two transaminase variants were found to be controlled by a single locus. The symbol Ta_1 was assigned to this locus and two alleles were noted (Ta_1^A and Ta_1^B). Ta_1^A homozygotes showed the faster variant. Heterozygotes demonstrated three isozymes: the faster variant associated with Ta_1^A homozygotes, the slower variant associated with Ta_1^B homozygotes, and a third isozyme intermediate in migration between the two parental types. It was postulated that the functional transaminase isozyme is dimeric in structure and that the intermediate isozyme represents an allodimer or hybrid enzyme containing the two parental type subunits. The faster isozyme would then be composed of two A type subunits, the slower would be composed of two B type subunits, and the hybrid isozyme would contain one of each. The transaminase isozyme migrated towards the anode at pH 8.2.

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1. Studies on the transmission of the B type chromosomes in maize.

Chromosome morphology studies made by Longley and Kato (1965) and Kato (1964) on different Mexican maize varieties have shown that some tend to accumulate a high number of B type chromosomes. Other varieties present very low frequencies of this type of chromosome and still other populations have no B chromosomes.

It is known that B chromosomes cause chromatid non-disjunction in the second mitosis of the microspore, and that on the female side the non-disjunction does not occur at all or very rarely. Also, it is known that the so called "directed fertilization" or "selective fertilization" occurs in plants possessing B chromosomes. Both of these phenomena could be genetically controlled. But the genetics of this control and whether these mechanisms behave differently in different populations is not known.

Therefore, one possible approach in solving the problem, as to why different maize populations differ in relation to B chromosome content, is to find out if either or both of the aforementioned phenomena behave differently in different maize populations. Also, information could be obtained on the nature of the genetic control of these mechanisms.

The present informal report has the intention to present some preliminary data obtained regarding this problem and some ideas developed from them.

During the summer of 1966 at Chapingo several reciprocal crosses between plants having 0B and 1B chromosome were made. Single B chromosome plants were chosen for this purpose because of the convenience in starting the study from the most simple condition. The varieties used were Mexico 210 and Mexico 211 of the race Palomero Toluqueño and Puebla 262 of the race Arrocillo.

These varieties have a low frequency of B chromosomes. Studies with populations having a very high frequency of these type chromosomes are underway.

The seeds obtained from the above crosses were planted at Tepalcingo, Morelos during the winter of 1966-67. Sporocytes were collected from a sample of approximately 50 plants of each cross progeny. The cytological analysis of this material is presented in Table 1.

According to Roman (1947, 1948) B chromosomes undergo nondisjunction of the chromatids during the second mitotic division of the microspore. As a result, 3 types of pollen grains are formed: without B chromosomes; with one B chromosome in both gametes; and with 2B chromosomes in one gamete and the other gamete without any B.

The data obtained from the progenies of the crosses 0B x 1B (Table 1) show that only 2 types of pollen grains were formed when the male

Table 1

B type chromosome constitution of the progeny plants of several crosses between plants of OB and 1B Palomero Toluqueño, Arrocillo and Chalqueño

Progeny Tep. 66-67	Type of cross	Plants crossed CH - 66*	No. plants of progeny with				Total plants examined	% plants with B
			OB	1B	2B	3B		
131Y	OB x 1B	5K-14 x 1K-30	35	0	12	0	47	25.53
134Y	"	5K-26 x 1K-23	33	0	15	0	48	31.25
136Y	"	3K x 1K-5	18	0	13	0	31	41.93
144Y	"	7K-1 x 7K-11	36	0	13	0	49	26.53
145Y	"	7K-8 x 7K-9	27	0	22	0	49	44.89
147Y	"	7K-15 x 7K-9	34	0	16	0	50	32.00
148Y	"	5993-18 x 6K-15	34	0	14	0	48	29.16
149Y	"	5993-18 x 7K-11	31	0	13	0	44	29.54
133Y	1B x OB	1K-23 x 5K-26	20	20	0	0	40	50.00
135Y	"	1K-5 x 3K	22	20	0	0	42	47.62
143Y	"	7K-11 x 7K-1	26	24	0	0	50	48.00
146Y	"	7K-9 x 7K-8	21	29	0	0	50	58.00
							548	

* 1K, 3K and 5K plants are Palomero Toluqueño type.

7K plants are Arrocillo type

5993 is a plant of Hidalgo 8 of the Chalqueño type.

parent plant had a single B, i.e., those without B chromosomes and those with 2B in one gamete and without any B in the second gamete. This means that all the microspores having a single B underwent nondisjunction of the B chromosome. This deduction is made because all the progeny plants contained either OB or 2B chromosomes, and none was found with a single B (see Figure 1). These results are in contradiction with those of Roman (1947, 1948). The discrepancy probably resides in the fact that Roman worked with a B chromosome translocated reciprocally with an A chromosome and in the present work only normal B chromosomes were used.

In the case of the crosses 1B x OB (Table 1) again only 2 types of progeny plants were found: (1) without any B and (2) with a single B. This result indicates clearly that in the female parent, B chromosomes behave normally; that is, in all the meiotic divisions of the megasporo-cytes and further mitotic divisions of the megaspores during the formation of the embryo sacs, B chromosomes invariably carry on normal disjunction of their chromatids.

In relation to the crosses of the type, 1B x OB, it can also be said that there is no preferential segregation of the B chromosomes in the megaspore that forms the embryo sac. This should be so since the frequencies of plants with and without B chromosomes appeared to be equal.

The most interesting feature of the present study resides in the frequencies with which the 2B plants appeared in the progenies of the crosses, OB x 1B. The percentage of plants with 2B in these crosses (Table 1) can be grouped into 3 general groups: one group comprises those crosses giving approximately 25% plants with 2B, the second group has approximately 40-45% plants with 2B, and a third group has approximately 30% of the plants with 2B.

The progenies 145Y, 147Y and 148Y (Table 1) suggest the female side may carry a factor which controls the fertilization of the ovules by pollen grains possessing B chromosomes. In other words, progenies 145Y and 147Y were the product of crossing two different female plants by the same male plant, but they gave different frequencies of 2B plants in their progenies, 44.89% and 32.00%, respectively. On the other hand, progenies 148Y and 149Y, which gave the same frequency of 2B plants in their progenies, were the product of crossing the same female plant by two different males.

Under the assumption that there exists a single pair of alleles with an incomplete dominance, say A and A^1, and considering the type of microsporogenesis which has been deduced from the data in Table 1 and shown schematically in Figure 1, two possible mechanisms can be used to explain the results obtained in the crosses OB x 1B:

(1) The pollen tubes formed by all pollen grains (with and without B chromosomes) grow at the same speed in the female stigmatic tissues, penetrating the ovules at random. The female genotype $\underline{AA}$ tends to guide preferentially the 2B gametes of the pollen grains with B chromosomes to fertilize the egg cells and the OB gametes to fertilize the polar nuclei which will produce the endosperm tissues. This would occur in ovules penetrated and fertilized by pollen tubes having B chromosomes. In ovules penetrated by pollen tubes without B chromosomes the fertilization process would be normal. Thus 50% of the progeny would be 2B plants and 50% OB plants. In the case of a female plant with a genotype $\underline{A}^1\underline{A}^1$ the pollen tubes again would grow at the same speed and the fertilization process would be more or less random between 2B and OB gametes. The resulting progenies would be approximately 25% 2B plants and 75% OB plants. In the case of the female plant with $\underline{AA}^1$ genotype the development of the pollen tubes would be normal and the fertilization process would take place in an intermediate fashion in comparison with the females $\underline{AA}$ and $\underline{A}^1\underline{A}^1$.

(2) The second possibility is that the female genotype controls the development of the pollen tubes and has no influence on the fertilization process; in other words, the fertilization is at random.

The pollen tubes with B chromosomes would grow at a higher rate of speed than those without B chromosomes in stigmatic tissues of $\underline{AA}$ genotype plants. Therefore, the pollen tubes with B chromosomes would reach the ovules first. Fertilization by OB and 2B gametic nuclei would be at random, resulting in 50% of the progenies being 2B plants.

In the stigmas of $\underline{A}^1\underline{A}^1$ plants the growth rate of the pollen tubes with and without B chromosomes would be the same. Since 25% of the gametic nuclei have 2B chromosomes and fertilization is at random, 25% of the progeny would be 2B plants.

Microsporocyte

Meiotic division I

Meiotic division II

Mitosis I
of microspore

Mitosis II
of microspore

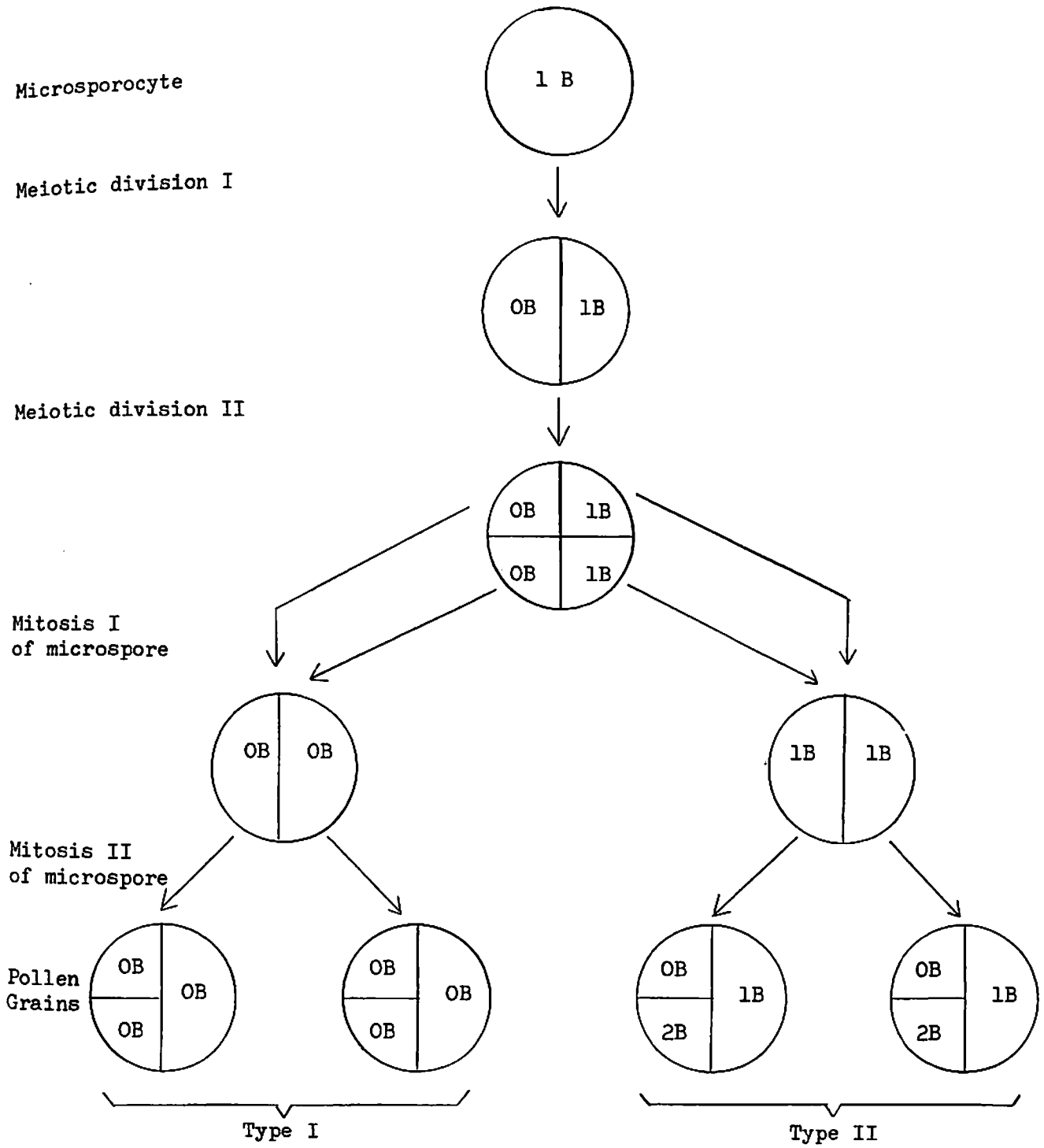Pollen
Grains

Type I

Type II

Figure 1. Diagram showing the type of microsporogenesis carried on by plants
with a single B chromosome. This scheme was deduced from the data
presented in Table 1.

In female plants with the $\underline{AA}^1$ genotype the growth rate of the pollen tubes with and without B chromosomes would be intermediate between that in female plants with $\underline{AA}$ or $\underline{A}^1\underline{A}^1$ genotypes. Assuming fertilization is at random, the frequency of 2B plants in the progeny would be intermediate, i.e., between 25% and 50% expected in $\underline{AA}$ and $\underline{A}^1\underline{A}^1$ genotype plants.

Other explanations may be developed but these presented are worthy of consideration as working hypotheses since they can be tested experimentally.

The failure of the OB x 1B crosses (Table 1) to give exactly 50% 2B progeny is probably due to the presence of environmental or genetic modifier factors.

Some experimental studies regarding these two working hypotheses have been started during 1968.

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1. Further evidence for sister-strand crossing over in maize.

Schwartz (Genetics 38:251, 1953) presented evidence that sister-strand crossing over is a general phenomenon in meiotic cells of maize. Essentially that work has been repeated here using plants heterozygous for a ring and its homologous rod chromosome 10.

The ring chromosome 10 was derived from a long derivative of abnormal chromosome 10. Figure 1 gives a diagramatic representation of the formation of the ring following a crossover between 10L and a second 10L fragment attached to the short arm of the chromosome. The knob is a large portion of the abnormal chromosome 10 knob.
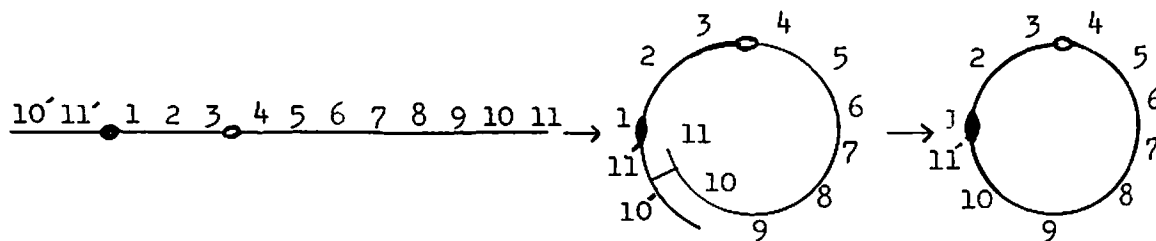

Figure 1. Diagramatic representation of the formation of ring 10.