constriction and the satellite. Plants with this chromosome combination may be useful in future NOR studies. Duplicate-deficient plants have been recovered from this interchange by E. B. Patterson (Eucarpia, 1973) and utilized in studies on male sterility.

When crossing plants heterozygous for T2-6(5419) or T4-6(4341), two of the NOR-interchanges, with pollen from plants heterozygous for polymitotic (po), Patterson (MGCNL 33:131, 1959) obtained occasional small seed that gave rise to plants with the polymitotic phenotype. The po locus is assumed to be proximal to the NOR since it maps proximally to ragged (rgd), which is proximal to the midpoint of the NOR-heterochromatin, based on tests with TB-6a (R. G. Palmer and E. Dempsey, 1968, MGCNL 42:75-77). One could speculate that the unexpected po plants are not due to the simple transmission of Dp-Df gametes but are the result of a breakage event after the first postmeiotic division that would generate a chromosome deficient for a terminal portion of 6S including the entire NOR. The mechanism could be similar to that described for Neurospora (D. D. Perkins et al., 1972, Genetics 71:s46) and Aspergillus (Lieber 1973, Univ. of Sheffield, Ph.D. Thesis) where certain chromosomes of duplicate-deficient progeny undergo structural modifications. Data presented in Table 2 give no positive evidence for transmission of Dp-Df gametes from T4-6(4341) and mixed evidence for T2-6(5419). Occasional transmission of Dp-Df gametes could have occurred but not in sufficient frequency to result in an abnormal Y:y ratio. Additional evidence has been gained in cooperation with Dr. E. B. Patterson against the chromosome breakage hypothesis to explain po progeny in crosses of heterozygous interchanges with Po/po as pollen parent. Cytological examination of occasional po progeny in crosses involving T3-6(030-8) and T6-7(5181) revealed a heteromorphic chromosome 6 bivalent as expected in a duplication-deficiency heterozygote. No evidence of chromosome breakage was apparent. The po gene must be in the NOR-secondary constriction or the satellite. Since T3-6(030-8) has a break in the NOR-secondary constriction and T6-7(5181) has one in the NOR-heterochromatin, rare transmissions of NOR-deficiencies apparently occur at least for the distal 29% of the NOR-heterochromatin and the site giving rise to the secondary constriction. Study of progeny of these and other maize NOR-interchanges may provide valuable materials for future NOR investigations.

The conclusion we reach from these studies is that the NOR-heterochromatin and at least a large portion of the site giving rise to the secondary constriction are usually necessary for normal gametophytic development and transmission, although occasional transmissions occur of NOR-deficiencies.

R. L. Phillips

Progress in establishing a true-breeding line that will produce "all male-sterile" progeny when crossed on genetic male-sterile plants

I am now assuming that certain of the ms plants among the progeny of ms ms or Ms ms pollinated by X-rayed pollen from a normal stock may have received a treated chromosome with an inactivated Ms allele. When those male steriles are crossed with pollen of a normal inbred, the progeny which received that chromosome through the female would, when selfed, produce only fertile (non-male sterile) progeny. The progeny which received the normal, untreated chromosome carrying ms would segregate 3 fertile: 1 ms when selfed. There are eight lines that have behaved in this manner, indicating that the inactivated Ms allele was transmitted through the female. Plants in those cultures which did not segregate ms were selfed and test crossed on ms as a test to identify plants that might be homozygous for the inactivated allele and also to test transmissibility through the pollen. For three lines which had normal pollen and normal seed set, the progeny from the test crosses of certain plants included ms plants indicating pollen transmission. For one of the three lines, there were 85 ms in a total of 506 plants (17% male steriles), for another line 4 ms in 139 (3% male-steriles), and in the other line 9 ms in 15 (possibly 1:1). Since in these lines pollen and ovule transmission occurs, one would expect to obtain the homozygote for the inactivated Ms allele. Too few

plants have been tested, but crosses for further tests of these and additional lines will be grown in 1976. The limited data suggest that lines with reasonably good pollen transmission can be selected. However, once the homozygote is established, this should be a problem only when transferring it into desirable inbreds.

Germination was low for many of the crosses made in 1974 because of severe frosts the first week in September. Another problem in 1974 and again in 1975 has been that many of the crosses made on the ms stock had very low or no seed set. This may be an example of cross sterility similar to that reported by M. Demerec (1929, Z.I.A.V. 50:281-291).

Similar tests are in progress for ms2, ms8 and ms10. Only those for ms2 have reached the stage where tests for pollen transmission or homozygosity for the inactivated Ms2 allele will be grown in 1976.

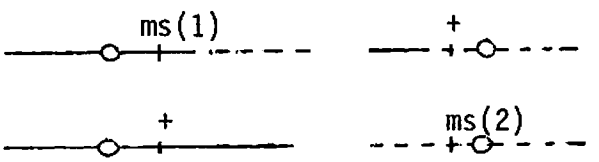
Charles R. Burnham

Other possible methods of producing "all male-sterile" progeny using genetic male sterility

One of the methods proposed for using genetic male steriles in barley for this purpose was an application of the principle involved in the balanced lethal. Plants with two very closely linked recessive male sterile genes in repulsion, when crossed on plants homozygous for both male sterile genes, would produce an "all male-sterile" progeny (Eslick, 1971, Proc. 2nd Internat. Barley Genetics Symp.: 292-297). The cross would be ms(1) ms(1) ms(2) ms(2) x ms(1) +/+ ms(2). With complete linkage the pollen parent could be maintained if grown in isolation.

A modification of this would utilize a chromosomal interchange and two different independent male sterile genes, one closely linked with one of the two breakpoints and present in the interchange chromosome, the other ms gene closely linked with the second breakpoint, but located in the normal chromosome. The cross would be:

ms(1) ms(1) ms(2) ms(2) x



All the progeny would be male sterile, half ms(1) and half ms(2). Only the ms(1) progeny would be interchange heterozygotes. In a species with directed segregation, the degree of sterility would depend on the frequency of crossing over between the centromeres and the interchange breakpoints in both chromosomes.

With complete linkage between each male-sterile gene and the breakpoint, the double heterozygote could be maintained if grown in isolation. One problem remaining would be how to produce progeny all of which would be homozygous for both male sterile genes, which is needed for efficient hybrid seed production. This might be accomplished by using certain types of multiple duplication stocks, one duplication covering one male sterile gene. For one method of producing such multiple duplication stocks, see Burnham, International Maize Symposium, 1975. It is possible that the multiple duplication stock could be used to maintain the heterozygote for both male steriles as well as for producing an all male sterile progeny homozygous for both male steriles. I am presenting this now, hoping that someone can devise workable schemes.

Charles R. Burnham