~~With regard to the pale areas~~, the phenotypes of these two classes of variegated kernels are directly comparable to the phenotypes of the two classes of variegated kernels exhibiting the "1 Spm" and the "3 Spm" patterns that appear following a similar type of cross with plants carrying the class II state of a_2^{m-1}. The pale phenotype with the class I state and the fully pigmented phenotype with the class II state are comparable expressions of the two states of a_2^{m-1} in the absence of Spm or when it is present and in its inactive phase. That the interpretation given above of the Spm constitution in each of the two classes of variegated kernels on the ear of plant 7547A-1, entered in 3 of table 17, is correct is shown by the distribution of Wx and wx among the a_2^{m-1} carrying kernels on the ear of tiller-1 of this plant following testcross type-2: 1 pale Wx : 22 pale wx : 14 variegated Wx : 1 variegated wx. Although there were few kernels on this ear, the distribution of Wx and wx to the pale and variegated kernels leaves no doubt regarding the close linkage of Spm with wx in this plant.

~~The~~ Spm in this plant was in its inactive phase in the cells that gave rise to the first ear of the main stalk. All of the 218 a_2^{m-1} carrying kernels on the ear, produced by testcross type-2, were uniformly pale pigmented; that Spm was in its inactive phase in the cells that

produced the second ear of the main stalk is shown by the kernel types entered in C of table 17. An active Spm appears only in those kernels that received Spm from the pollen parent. However, The two distinct phenotypes among these variegated kernels reveal the presence of the inactive Spm, delivered by the ear bearing parent,, that was closely linked with wx.

Plant 7312-6, under Year 1957, D, table 2, had a constitution similar to that of plant 7312-5, described above. However, Spm in this plant was in its inactive phase in the cells giving rise to all three tested ears. Following testcross type-2, conducted with the ears of two tillers of this plant, only 7 kernels exhibited the presence of Spm in them. Six of these kernels were wx and one was wx. This suggested that the plant was wx +/wx Spm in constitution. Testcross type 1 had been conducted with the first ear of the main stalk of this plant. Only one kernels on the resulting ear showed the presence of Spm in it and it had received the class II state of a_2^{m-1} from the ear bearing parent. In order to obtain better evidence of the location of Spm in plant 7312-6, this kernel was sown in 1958 under culture number 7582A. On the ear of plant 7312-6, three pale colored (class I state of a_2^{m-1}), wx kernels were found ~~in~~ each ~~of~~ having ~~which~~ a small spot of wx, ~~appeared~~, ~~arising~~ ~~from~~ This wx spot arose following spontaneous chromosome breakage resulting in loss of wx in a cell during development of the kernel. The three kernels each with a wx spot were shown

under culture number 7582B. It was expected that the plants derived from them would carry Spm and that it would be linked with wx, and also that Spm would be in its inactive phase at the beginning of plant development. This proved to be true. Testcross types 1 and 3 were conducted with plant 7582A and 7582B-2, and testcross type 3 was conducted with an ear of each of the plants in culture 7582. Plant 7582A, carrying the class II state of a_2^{m-1}, was fully pigmented except for a few small streaks in which no pigment was present. The plants in 7582B likewise were fully pigmented except for some small nonpigmented sectors within which small streaks of deep pigmented appeared. The types of kernels appearing on the testcross ears of these plants in culture 7582 are given in table 18. All tested ears were produced by cells in which Spm was in its inactive phase. However, as testcross type-3 indicates, the inactive Spm in each of these plants was linked with wx.

The plants in culture 7313 were derived from colorless, Bt, wx kernels that showed pigmented spots or specks on an ear of a plant that was A_2 Bt/a_2 bt, Wx/wx when pollen from plant 7109B-1 had been used in making the cross. The types of testcross conducted with these plants in culture 7313, and the results obtained from each, are entered in table 19. The designated constitutions of these plants, entered in D of table 2, are based upon these testcross results. Plant B-4 illustrates one of the

in this study
very few cases in which the Spm number and location was found to differ in different parts of the same plant.

Table 3 summarizes the behavior ~~of Spm~~ in successive generations of Spm ~~that was~~ derived from plant 7109B-2. ~~As table 1 indicates~~, Spm was in its active phase in the cells that gave rise to the first ear of the main stalk of this plant (table 1) and also in those that gave rise to the ears of tiller-1 and tiller-2. The ear of tiller-1 was self-pollinated and the kernels types appearing on this ear were described earlier (see page). Plants were grown from kernels on the ear of the main stalk of this plant and also from those on the self-pollinated ear of tiller-1.

The plants in culture 7309 A (A, table 3) were derived from kernels that were Bt, and Wx ~~kernels showing~~ and showed spots of pigment in ~~their aleurone layer that were~~ a colorless background. present on the ear of the main stalk of plant 7109B-2. Plants derived from the uniformly pigmented, Bt, Wx class of kernels on this ear were grown under B of culture 7309. None of the plants in ~~B of culture~~ 7309B ~~carried~~ had Spm but each of the nine tested plants in A 7309 ~~of this culture~~ carried it, in these ~~and~~ its position ~~could be~~ was determined in 6 of these 9 plants and in each of these 6 it was linked with wx, ~~in each~~. In only six of the sixteen tested ears of these plants in culture 7309A was Spm fully active in the cells that produced these

ear. Testcross type-2 was conducted with five of these six ears. The phenotypes of the kernels on each of these five ears is entered in table 20. ~~Close~~ Linkage of Spm with wx was expressed by the ratio of kernel types on each ear. Linkage of Spm with wx was also shown by the kernel types of the ears of plants A-6 and A-9 ~~following testcross type-2~~ produced by Testcross type-2. Among the a_2^{m-1} carrying kernels on the ears of plant A-9, 104 were uniformly pigmented (81 Wx : 23 wx), 18 were diffusely-mottled, wx, and 57 had small spots of pigment in a nonpigmented background of which 1 was Wx and 56 were wx. Testcross type-2 produced the kernels on the first ear of the main stalk of plant 7309A-6. Among the a_2^{m-1} carrying kernels on this ear, 244 were uniformly pigmented (127 Wx : 117 wx) and 19 gave evidence of the presence of Spm in each. Among these, 1 was Wx and 18 were wx.

From the evidence given above, it appears that Spm probably occupied the same location in chromosome 9 in both plant 7109B-1 and 7109B-2. However, the phase of activity of Spm in the main stalk of these two sister plants was not the same, and the behavior of Spm in the immediate progeny of each likewise was different. Spm in plants derived from kernels on the main stalk of plant 7109B-1 remained in the previously initiated inactive phase in most parts of the ~~se~~ progeny plants whereas Spm derived from kernels on the ear of the main stalk of plant 7109B-2

from the active

underwent change to the inactive phase early in development in some plants. A comparison of A, table 2 (culture 7456) with A table 3 (culture 7309) makes this evident. No progeny was grown from kernels on the ears of plants in culture 7309. Tests in successive generations were conducted, however, with progeny of Cpm carrying plants derived from kernels on the self-pollinated ear of tiller-1 of plant 7109C-2, as indicated in B, C, and D, of table 3.

Kernels derived from the uniformly pigmented, Bt, Cx class ~~of~~ on the self-pollinated ear of tiller-1 of plant 7109B-2 were sown under culture number 7308A. Bt, Cx kernels showing small spots of pigment in a colorless background were sown under B of culture 7308,

colorless, Bt, wx kernels with specks of pigment in the aleurone layer were grown under D of culture 7308. The plants in D of this culture were derived from totally colorless, bt, wx kernels.

Of the nine tested plants in A of culture 7308, seven had no Spm. Two plants, however, did have Spm (plants 7308A-4 and A-5). The tests conducted with the three fertile ears of plant 7308A-4 were considered earlier, and the kernel types on each were entered in table 7. Plant 7308A-5 was a_2^{m-1} (class II) and Bt and was wx +/wx Spm. Although no fertile ear was obtained from this plant, pollen from it was used in crosses to two plants homozygous for a_2, bt, and wx, and having no Spm. Among the total of 327 kernels on these ears, 198 were uniformly pigmented 10 were diffusely-mottled, and 119 xxxxxxxxxxxxxx had spots of pigment in a colorless background. Knowledge of the xxxxxxxxxxxxxxxxxxxxxxxxxxxx linkage of Spm with wx came from tests of 4 plants derived from the diffusely-mottled class of kernels on one of these ears, and grown under culture number 7554A (Year 1958, B, table 3). Spm was in its inactive phase in most parts of these plants and in the cells that gave rise to all tested ears. From testcross types 2 and 3, it was possible to learn of the presence of Spm in these plants, and of its linkage with wx. (table 21).

Testcross type 2 was conducted with 1[illegible] of the ears of these plants and in 9 of them, a few kernels on each ear showed the presence of Spm in them ~~and~~ Among them, linkage of Spm with wx was clearly expressed (A, table 21). The silks of one ear of plant 7554A-3 received pollen from a plant homozygous for a_2, bt, and wx, and also for Spm in its active phase. From the ~~distribution~~ assortment ~~ratio~~ of Wx to wx ~~in~~ Farmers the kernels showing many spots of pigment (one Spm from male parent) to the assortment of Wx + wx among those having only a few specks of pigment (two inactive Spm from female and one active Spm from male) it was ~~obvious~~ evident that the inactive Spm in ~~this~~ plant 7554A-3 was linked with wx.(B, table 21).

The plant used as the pollen parent (plant 7538-1) in the cross that gave rise to the kernel types entered in table 21 B was derived from a kernel on the self-pollinated ear of plant 7308D-2. As described earlier, plant 7308D-2 was homozygous for a_2, bt, and wx. ~~and~~ ~~and~~ It had one Spm was ~~present~~ which was, in its active phase, ~~It was present~~ ~~In~~ ~~the~~ approximately half of the pollen produced by the main tassel of this plant and also ~~in that of~~ each of its three tillers. (Seven) ~~carried an active~~ Spm. (Twenty-one) plants were grown in 1958 from kernels on the self-pollinated ear of plant 7308D-2 under culture number 7538 and for the purpose of obtaining plants that would serve as tester type-3 ~~plants~~. Since neither the appearance of the kernels nor that of the plants derived from them indicated whether or not Spm was present ~~or was absent~~ in ~~them~~ any one, it was not possible to know in advance of a test which of the plants in culture 7538 carried Spm. ~~This could be~~

A large number of crosses were conducted with each of the 21 plants in culture 7538 and with plants carrying either a class I or the class II state of a_2^{m-1} and either having no Spm or having one or more Spm elements in either the inactive or the active phase. The results obtained from these crosses (see Discussion, Table 3) indicated that Spm was present in 13 of the 21 plants in culture 7538. No evidence of its presence was given by the tests conducted with 8 plants. Thus, all crosses conducted with these latter 8 plants were testcross type-2 rather than the desired testcross type-3. Among the 13 plants in culture 7538 in which Spm was present, 7 had one active Spm element (plants -1, -6, -10, -R-2, -R-4) and 6 had two active Spm elements. In five of the latter plants, the Spm element was located in a pair of homologues, most probably chromosome 9, and also most probably at allelic positions in the members of this pair. In one plant, (7538-2) the two Spm elements were not located at allelic positions in a pair of chromosomes. Each Spm element was inherited as if located in one member of each of two different pairs of chromosomes.

The kernel types entered in Table 21 came from a cross in which the pollen parent (7537-1) was homozygous for a_2, bt, and wx, and for Spm in allelic positions in a pair of chromosomes, ~~(plant 7538-1)~~. It will be noted that 26 of the 219 kernels on this ear gave no evidence of the presence of Spm in any one. ~~Such~~ kernels with such a phenotype were to be expected.

A few such kernels appear because the Spm, delivered by the male parent, had entered the inactive phase before fertilization. Others, however, arose from the functioning of a sperm in whose nucleus Spm was absent, the removal of Spm having taken place earlier through the transposition mechanism. Kernels showing no evidence of the presence of Spm in them appeared on nearly all ears produced by crosses of plants having two active Spm elements, apparently located at allelic positions in a pair of homologues. The frequency of appearance of such kernels on ears produced by crosses conducted with 10 such plants is given in table 22. On the ears produced by crosses with plants carrying the class II state of a_2^{m-1}, the number of kernels that showed no Spm in them was always directly correlated with the number of kernels whose phenotypes expressed the presence of more than the expected number of Spm in them: the more frequent the uniformly pigmented kernels on an ear, the more kernels there were that showed a "high Spm dose" pattern of variegation. Examples of this are given in table 22.

Testcross evidence of Spm activity in progeny derived from each of the three ears produced by plant 7308A-4 (B, table 3). The types of cross that produced each ear and the kernel phenotypes of the ear are given in table 7. The first ear of the main stalk of this plant was crossed by a sister plant, 7308D-2, which was homozygous for a_2 bt and wx

an

it was considered likely that the Spm

and carried Spm in its active phase, ~~which was considered likely to be~~

was located close to wx in one chromosome

~~closely linked to one of the wx alleles.~~ ~~Three types of~~ Bt, wx kernels

showing pigmented spots in a colorless background were selected from this

ear, and the plants grown from them were given culture number 7570. Those

in A of culture 7570 came from kernels that exhibited many pigmented spots

a number of which were large in area. They were considered to possess

only the Spm element delivered by the male parent (7308-2) and barring

in constitution.

cases of transposition of Spm, should be wx +/wx Spm. Kernels that showed

a number of small spots of pigment in a colorless background were sown

under B of culture 7570. These were considered to have received Spm only

from the female parent (7308-4) and barring transposition, should be

wx Spm/wx + in constitution. ~~The Bt wx kernel on the ear~~ that

exhibited only specks of pigment in a colorless background was ~~grown~~ sown

under J of culture 7570. It was considered to have received Spm from

both parents. Again, barring transposition as a cause of the 3 dose

in this female, the plant varied from

Spm pattern, it should be wx Spm/wx Spm. The constitutions of the

plants in culture 7570, as determined by testcrosses conducted with ~~them~~ each,

are entered in B of table 3 under Year 1958. Ten of the 12 plants had

the expected constitution. In two plants, 7570-7 and -8, a transposed

Spm was present. Spm was in its active phase in the cells that gave

rise to the majority of the ears of the plants in culture 7570 and in this respect, very much resembled that behavior of Spm in the majority of plants in the present culture. Only in the cells that gave rise to 3 of the 34 tested ears was Spm in its inactive phase (first and second ear of main stalk of plant 7570A-1 and first ear, main stalk, of plant 7570A-4).

The types of testcross conducted with the plants in culture 7570 are entered in table 23. The phenotypes of the kernels on ears produced by testcross type-2 is given in A of this table 24-1 and for testcross type-3, in B of the table 24-1. Included in this table are the testcross conducted with the plants that were Wx +/wx Spm, Wx Spm/ wx +, and Wx Spm/wx Spm. The kernels on the first and second ear of the main stalk of plant 7570A-1, and those on the first ear of the main stalk of plant 7570A-4 are not included as only 16 kernels on the ears gave evidence of the presence of Spm in them of which 1 was Wx and 15 were wx. among a total of 100 a_2^{m-1} carrying

On the ears of plant 7570A-7 and A-8 few kernels were produced. However, among those on the ears of plant 7570A-7 no evidence of linkage of Spm with wx appeared. Twenty-one of the a_2^{m-1} carrying kernels were uniformly pigmented (14 Wx : 7 wx) and 36 were variegated (16 Wx : 20 wx). Among the a_2^{m-1} carrying kernels on the ears of plant 7570A-8, 59 were uniformly pigmented (53 Wx : 3 wx) and 132 were variegated (39 Wx : 93 wx).

From the second ear of the main stalk of plant 7308A-4, Bt, Wx kernels showing spots of pigment in a colorless background were selected and grown in 1958 under culture number 7563. A single Spm element was present in each of the 7 tested plants in this culture and it was in its active phase in the cells that gave rise to all 21 tested ears (B, table 3). In 6 of the 7 plants, Spm was linked with Wx but in one plant (7563A-2) it was not linked with Wx. Testcross type-2 was conducted with 19 of the 21 ears and produced the kernel types shown in A of table 25. Testcross type-3 was conducted with an ear of two of the plants that were Wx Spm/wx +. The kernel types on these two ears are entered in B of table 25.

The ear of the tiller of plant 7308A-4 had been used in a cross with a plant that was homozygous for a_2, bt, and wx and had no Spm. Bt, Wx kernles on this ear that had spots of pigment in a nonpigmented background were sown in 1958 under culture number 7546. Among the 12 tested plants in this culture, one was Wx/Wx and had one Spm. The remaining 11 plants were wx/wx and in 10 of these, one Spm was present and it was linked with wx in each plant. ~~The remaining plant~~ One wx/wx plant had two Spm elements, neither of which was linked with wx nor with one another. Spm was in its active phase in all but one of the 25 tested ears of plants in culture 7546. Testcross type-2 was conducted with 20 of the 26 ears and testcross

type-3 was conducted with 6 of them (second ear, main stalk of plants -1,-2, -5, -7, -9, and -12). The types of kernels on the ears of these plants are entered in A, B, and C of table 26. In B and C of this table, linkage of Spm, contributed by the 7546 parent, with wx is exhibited not only by the ratios of kernels types within the Wx and wx classes, but also by the pattern of pigmented spots in those having Spm. The majority of wx kernels exhibited the "1 Spm" pattern and the majority of the wx kernel exhibited the "high dose Spm" pattern.

Spm in plant 7308A-4, derived from tiller-1 of plant 7109B-2, and in the progeny of plant 7308A-4 (plants in cultures 7570B, 7570C, 7563, 7546) exhibited a long duration of the active phase. This could be seen in the plants themselves in that they showed relatively few large sectors in which Spm was in its inactive phase. Among the ears produced by the plants in these cultures, only one (first ear, main stalk of plant 7546-2) was derived from cells in which an early occurring change of Spm, from active to inactive, had occurred during development of the plant. The long duration of the activephase of Spm likewise characterized its behavior in other plants in culture 7308, as shown in B of table 3. However, as was pointed out earlier, if selection is made of kernels on an ear that have in them an Spm that has recently

entered the inactive phase, then the duration of this inactive phase may be examined in the progeny as was done with the plants in culture 7554A, each of which was derived from such a kernel.

The results obtained from tests conducted with plants in B and C of culture 7308 may be described briefly. Testcross type-2 was conducted with 7 of the 9 ears produced by plants in B of culture 7308. Testcross type-1 was conducted with two ears (first ear, main stalk, plants B-1 and B-3). Testcross type-1 was conducted with the ears of all plants in C of culture 7308. The kernel types appearing on all ears, except that of the first ear of the main stalk of plant 7308B-1, are entered in table 27. The first ear of the main stalk of plant 7308B-1 had 146 bt kernels of which 95 were uniformly pigmented, 37 were colorless with many small specks of color, and 14 were totally colorless. In addition, there were 151 bt kernels. Seven of these were uniformly pigmented and one had small specks of pigment in a colorless background. No pigment was detected in the remaining 143 bt kernels.

The Bpm designations given to the plants in 7308B and C are based on the kernels entered in table 27. In the plants that were homozygous for a_2^{m-1} and Bt, some kernels appeared that showed no pigment spots. Tests of plants derived from such kernels have shown that the endosperms

of such kernels have high doses of Spm, six or more being present in some of them. In table 27, it will be noted that the proportion of such kernels is greatest on the ears of those plants that have two or more Spm in them. The ear of plant 7308S-2 is conspicuous in this respect. No tests of its progeny were conducted however.

Tests were conducted with the progeny of plant 7308S-6. On the basis of the kernel types on the ears of this plant, three Spm elements were presumedly considered to be present in it. Two of them occupied allelic positions in a pair of homologues. It would be expected that each would be located close to wx in each chromosome 9. The additional Spm was inherited independently of these two. From the first ear of the main talk of plant 7308S-6, Bt, Wx kernels showing only a few specks of pigment in a colorless background (high dose Spm pattern) were sown under culture number 7573A. Other Bt, Wx kernels showing many small spots of pigment in a colorless background (2 Spm pattern) were sown under B of culture 7573. The constitution of the tested plants in this culture, with respect to Spm number, location, and activity, is indicated in B table 3 under Year 1958.