were grown from these kernels, all should possess two normal chromosomes 9. The selection of the C Bz - C bz, Sh - sh, Wx - wx kernels, on the other hand, should give rise to plants with a normal chromosome 9 carrying C sh bz wx ds and a Duplication chromosome 9 with the various constitutions indicated in the supplement to table 8. Because the region between Bz and Wx is the longest, the most frequent of the cross-over classes should be:normal chromosomes 9 with I Ds^1 Sh Bz wx and Duplication chromosomes 9 with C ds sh bz Wx Wx Sh Ds^2 (crossover region 4, supplement to table 8). Crossing over ratios may be determined in regions 2, 3 and 4 by comparing the frequencies of the various classes of I kernels showing variegation. The numbers in the I bz - C bz, sh wx class, (region 2), the I bz - C bz, Sh-sh, wx class (region 3) and the I - C Bz - C bz, Sh-sh, wx class (region 4) are 12 : 3 : 76, respectively. The crossover units for regions I to Sh, Sh to Bz and Bz to Wx in normal chromosomes 9 are approximately 3 : 2 : 21, respectively. The agreement in the two cases in relative frequencies in the several crossover regions is close. No serious disturbance in the relative frequencies of crossing-over in these regions is occurring in the plants that are heterozygous for the duplication.

Moreover to test the projected constitutions of the gametes produced by plants 4628D-10 and 11 (table 8) it would be necessary to grow plants from the various classes of kernels in this table and test the chromosomal and genic constitutions of the chromosome 9 contributed by the male parent. Because the constitutions of the chromosome 9 in the gametes of the mother plant (4306) were probably the same as those produced by the two tested plants of sub-culture D, the probable constitutions of the plants in sub-cultures F to L can be anticipated.

(table 3)

On the self-pollinated ear of plant 4306, the various crossover classes of kernels of the types indicated in table 8 were likewise present. The chromosome 9 constitutions of the examined plants arising from a selected number of such kernels has been given in table 5. The correspondence of chromosome constitution with expectancy on the basis of the selection was confirmed by the cytological analyses. Plants in sub-cultures G and H of culture 4628 should carry two normal chromosomes 9, one with I Ds' Sh Bz wx and one with C ds sh bz wx. These plants should be Ac ac, as the type of variegation observed in the kernels from which they arose would suggest. The plants in sub-culture F should have the same two chromosomes as plants in sub-cultures G and H but these plants could be either Ac Ac or ac ac. The plants in culture I, not examined cytologically, could be expected to have two normal chromosomes 9, one with I Ds' sh bz wx (an I ds sh bz wx chromatid is infrequently produced) and one with C ds sh bz wx. These plants could be Ac Ac or ac ac. The exact genic constitutions of chromosomes 9 in the plants in sub-cultures K and L could not be projected in advance other than to anticipate the presence of the duplication chromosome 9 resulting from a crossover in regions 2 to 5 in the mother plant (or rarely in region 1). Tests of the genic and chromosomal constitutions of these plants will now be given.

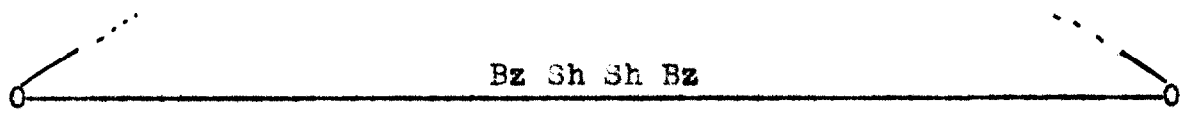
(c) Sub-culture F

By appropriate crosses of plants in sub-cultures F to L, the genic constitutions of the two chromosomes 9 in each tested plant was determined. Plant 4628F-1, known to have two morphologically normal chromosomes 9 because it was examined cytologically, was crossed to two C ds sh bz wx ds ac female plants. The types of kernels

appearing on the two resulting ears are given in table 9. This plant was obviously Ac Ac (allelic positions) in constitution. The supplement to table 9 indicates the types of chromatids that plant 4628F-1 would produce on the basis of the given constitution. The observed ratios of the various classes of kernels on these ears confirms the projected constitution of this plant. The plant had a normal chromosome 9 with I Ds^1 Sh Bz wx and a normal chromosome 9 with C ds sh bz wx. The Ds locus is present just to the right of I. It should be noted that crossing-over between I and Sh is not affected by the presence of this Ds locus (4.9% crossing-over).

With the same aleurone genes in chromosome 9, the variegation pattern produced by a Ds locus in this new position is strikingly different from that produced by a Ds locus in its standard location. In this new position, a Ds mutation will give an acentric fragment carrying I and a dicentric chromatid with Sh Bz wx, as shown in the following diagram:

The dicentric chromatid produced by a Ds mutation at this locus will undergo the breakage-fusion-bridge cycle beginning in the anaphase following the Ds mutation. In this first anaphase, the genes Sh and Bz will be located close to the middle of the bridge:



Because the bridge may be broken at any position between the two centromeres, it can be anticipated that some of the breaks in this

Table 9 Cross of 4628F-1

C sh bz ds ac♀ x $\frac{\text{I Ds Sh Bz}}{\text{C ds sh bz}}$ Ac Ac ♂ 4628F-1

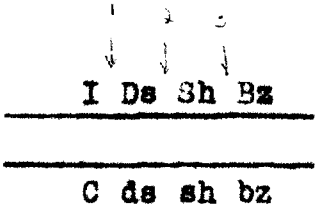
$\frac{\text{I Ds Sh Bz wx}}{\text{C ds sh bz wx}}$

Kernel type	Cross-over region	4368C-4 x 4628F-1	4363-14 x 4628F-1	Totals
I-C Bz-C bz, Sh-sh	non-c.o.	181	89	270
C sh bz	non-c.o. Regions 1&2	153	83	236
I sh	Region 1 Regions 1&3	1	1	2
C Bz-C bz, Sh-sh	Region 1	0	1	1
I bz-C bz, sh	Region 2	8	4	12
C Sh Bz	Region 2	6	6	12
I bz-C bz, Sh-sh	Region 3	10	6	16
C sh Bz	Region 3	2	3	5
I Sh	Regions 1&2	9	0	9*
C bz, Sh-sh	Regions 1&3	1	0	1
I Bz-C bz, sh	Regions 2&3	0	0	0
C Sh bz	Regions 2&3	0	0	0
Totals		371	193	564

* This class is not accurate for showing cross-over regions. It includes (1) losses of Ac and (2) loss, transposition or changes in state of Ds^1.

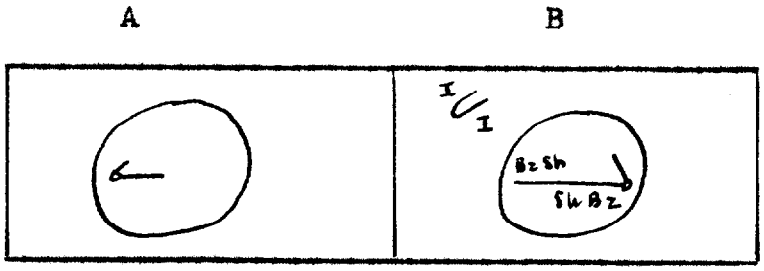
Supplement to Table 9

Chromatids produced by plant 4628F-1



	Chromatid constitutions	Appearance of kernel in table 9
Non-crossovers	I Ds Sh Bz	I-C Bz-C bz, Sh-sh
	C ds sh bz	C sh bz
Cross-overs	I ds sh bz	I sh
Region 1	C Ds Sh Bz	C Bz-C bz, Sh-sh
Cross-overs	I Ds sh bz	I bz-C bz, sh
Region 2	C ds Sh Bz	C Sh Bz
Cross-overs	I Ds Sh bz	I bz-C bz, Sh-sh
Region 3	C ds sh Bz	C sh Bz
Double cross-overs	I ds Sh Bz	I Sh
Regions 1 and 2	C Ds sh bz	C sh bz
Regions 1 and 3	I ds sh Bz	I sh
	C Ds Sh bz	C bz, Sh-sh
Regions 2 and 3	I Ds sh Bz	I Bz-C bz, sh
	C ds Sh bz	C Sh bz

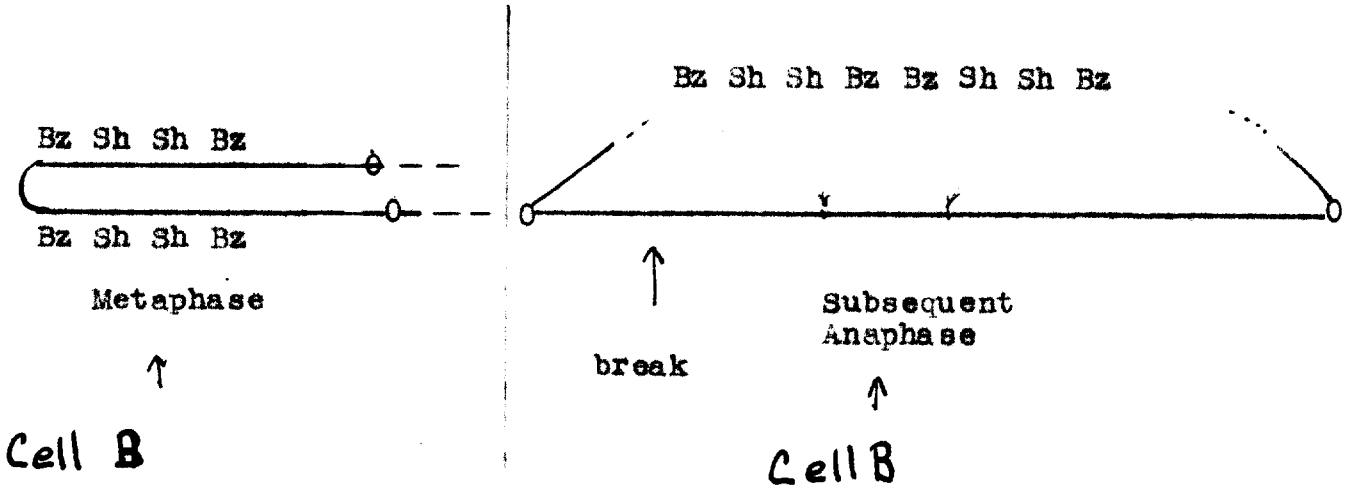
division will occur to one side of this Bz Sh Sh Bz segment instead of within this segment. This would give rise to two daughter cells, one containing no Sh or Bz locus and one containing two Sh and two Bz loci. The I locus, carried by the acentric fragment, would be lost to both daughter cells:



No I, Sh or Bz loci

No I locus; two Sh; two Bz loci

These two sister cells should give rise to two adjacent (twin) sectors in the endosperm, one having a C bz phenotype and one having a C Bz phenotype in which C bz areas appear. These C bz areas would arise from the continuation of the breakage-fusion-bridge cycle in cell B that was initiated by the original Ds mutation:



Twin sectors of the type diagrammed above were present in all of the variegated kernels in table 9.that received an I Ds Sh Bz wx chromosome from the male parent. This variegation pattern is very striking and is strong evidence for the presence of a Ds locus just to the right of the I locus. That this location is correct, is obvious from the genic constitutions and accompanying variegation or lack of variegation in the crossover chromatids recovered from plant 4628F-1 (table 9).

Plant 4628F-2 had the same chromosomal and genic constitution as plant 4628F-1 with respect to the aleurone genes carried by the two chromosomes 9. When crossed to C sh bz wx ds ac female plants, no variegated kernels appeared (table 10-a). When crossed to a C sh bz wx ds,Ac ac plant, again no regular variegated kernels appeared (Table 10-b). From this cross, it may be concluded that plant 4628F-2 has the constitution I Sh Bz wx / C sh bz wx. It does not carry a Ds locus that is regularly producing a dicentric chromatid carrying genes in the short arm of chromosome 9. That a Ds locus may be present was suggested by the presence of a small amount of variegation appearing on a few of the kernels represented in table 10-b. This plant may have a newly transposed Ds locus or a Ds locus with a changed state giving few if any dicentric chromatids (extreme few-late Ds?). These possibilities will be tested this summer.

(d). Sub-culture G

Plants 4628 G-1, G-2 and G-3 proved to be similar in the chromosomal and genic constitutions of their chromosomes 9. All had a normal chromosome 9 with I Ds Sh Bz wx and a normal chromosome 9 with C ds sh bz wx. All were Ac ac. Table 11-a shows the types of kernels

Table 10-a

C sh bz wx ds ac 9 x 4628F-2 $\frac{\text{I "Ds" Sh Bz}}{\text{C ds sh bz}}$ *

Cross	Kernel types				
	I Sh	I sh	C Sh Bz	C sh Bz	C sh bz
4363-2 x 4628F-2	115	6	6	3	84
4462C-4 x 4628F-2	219	15	23	6	226
4462C-9 x 4628F-2	210	14	12	13	213
Totals	544	35	41	22	523

Total kernels: 1165

* see Text

Table 10-b

C sh bz ds, Ac ac ♀ x 4688F-2 ♂

Kernel types				
I Sh	I sh c.o. region 1	C Sh Bz c.o. Region 1	C sh Bz c.o. region 2	C sh bz
146	8	11	4	173

Total kernels: 342

appearing on the ears following the cross of these plants to C sh bz wx ds ac female plants. The results obtained are similar to those recorded in table 9 with respect to the types and frequencies of the chromatids that were produced by the heterozygous parents. Because of the Ac ac constitution of these plants, the presence of Ds may be detected in only half of the kernels that received a chromosome 9 carrying a Ds locus. The variegation patterns in the kernels having both Ds and Ac are the same as those appearing on the ears from similar crosses involving plant 4628F-1 (see page 13).

In table 11-b, the types of kernels are given that resulted from the cross of two of the 3 plants in sub-culture G to c sh Bz wx ds ac female plants. Crossing over is normal in frequency in the I to Sh segment, as indicated in both tables 11-a and 11-b (5.5% and 3.9%, respectively). Among the 1243 kernels in table 11-b there were only 2 that were C to c variegated. Both kernels carried Sh in the C Ds chromosome. In table 11-a, there were only 3 C Bz - C bz kernels on the ear among the 1461 kernels. All three carried Sh in the C Ds chromosome. The chromatids carrying C Ds Sh Bz wx should represent the cross overs that occurred in region 1,--between I and Ds. These 5 cases in tables 11-a and 11-b, represent approximately one-fourth of the crossovers in this region that are expected to be present on these ears. If it may be assumed that there are 20 cross-overs in the region between I and Ds among the 2704 kernels on these ears, the cross over percent in this region is approximately 0.74. The C variegated kernels on these ears will be planted this summer and the individuals arising from these kernels will be tested for the presence of a Ds locus just to the right of the C locus in order to be

Table 11-a

C sh wx [bz written above] ds ac ♀ x I Ds Sh Bz wx / C ds sh bz wx Ac ac ♂

Kernel type	4367B-2 x 4628G-1	4360A-2 x 4628G-2	4363-1 x 4628G-2	4363-14 x 4628G-2	4462C-8 x 4628G-3	4684-3 x 4628G-3	Totals
I-C Bz-C bz, Sh	107	19	18	38	108	61	351
I Sh	109	26	25	32	106	48	346
C sh bz	202	45	25	53	219	97	641
I sh	7	3	2	4	5	1	22
C Bz-C bz,Sh	0	1	0	1 *	0	1 **	3
C Sh Bz	8	2	2	0	17	6	35
I bz-C bz, sh	8	1	2	2	12	1	26
I bz-C bz, Sh	3	0	1	0	6	2	12
C sh Bz	10	2	0	4	6	3	25
C bz; Sh-sh	0	0	0	0	0	0	0
C Sh bz	0	0	0	0	0	0	0
I-C Bz-C bz,sh	0	0	0	0	0	0	0
Totals	454	99	75	134	479	220	1461

Summary: 757 I : 704 C Crossing-over I to Sh = 5.5%

* [illegible] 1944 [illegible] 4884 [illegible]

** [illegible] " 4885. The kernel had area only of C Bz - C bz, no Ds present. [illegible] due to a spontaneous [illegible] during development of kernel

Supplement to table 11-a

C sh bz ds ac ♀ x $\frac{\text{I Ds Sh Bz}}{\text{C ds sh bz}}$ Ac ac ♂

				Frequencies of critical classes
Non-crossover chromatids	I Ds Sh Bz Ac	=	I-C Bz-C bz, Sh-sh	351
	I Ds Sh Bz ac	=	I Sh	
	C ds sh bz Ac and ac	=	C sh bz	
Crossovers	I ds sh bz Ac and ac	=	I sh	
Region 1	C Ds Sh Bz Ac	=	C Bz-C bz, Sh-sh	3
	C Ds Sh Bz ac	=	C Sh Bz	
Crossovers	I Ds sh bz Ac	=	I bz-C bz, sh	26
Region 2	I Ds sh bz ac	=	I sh	
	C ds Sh Bz Ac and ac	=	C Sh Bz	
Crossovers	I Ds Sh bz Ac	=	I bz-C bz, Sh-sh	12
Region 3	I Ds Sh bz ac	=	I Sh	
	C ds sh Bz Ac and ac	=	C sh Bz	25
Double crossovers Regions 1 and 2	I ds Sh Bz Ac and ac	=	I Sh	
	C Ds sh bz Ac and ac	=	C sh bz	
Regions 1 and 3	I ds sh Bz Ac and ac	=	I sh	
	C Ds Sh bz Ac	=	C bz, Sh-sh	0
	C Ds Sh bz ac	=	C Sh bz	0
Regions 2 and 3	I Ds sh Bz Ac	=	I Bz-C bz, sh	0
	I Ds sh Bz ac	=	I sh	
	C ds Sh bz Ac and ac	=	C Sh bz	0

Table 11-b

♀ sh Bz ds ac ♀ x $\frac{\text{I Ds Sh}}{\text{C ds sh}}$ Ac ac ♂

4628C-1 and C-3

Kernel type	Cross-over regions	4353-2 x 4628C-1	4347-22 x 4628C-3	4353-14 x 4628C-3	4347-43 x 4628C-3	Totals
I Sh	Non c.o. Ac and ac Regions 1 & 2 Ac and ac	195	167	147	74	583
C sh	Non c.o. ac and ac Regions 1 & 2 ac	197	157	169	88	611
I sh	Region 1 Ac and ac " 2 Ac and ac	11	6	11	4	32
C-c Sh	Region 1 Ac	1 *	1 **	0	0	2
C Sh	Region 1 ac Region 2 Ac and ac	2	7	2	4	15
C-c sh	Regions 1 and 2 Ac	0	0	0	0	0
	Totals	406	338	329	170	1243

* See summer 1949, culture 4882 = CCShsh

** See summer 1949, culture 4876 = no germination

sure that no event other than Ds mutations were responsible for the appearance of the C Bz - C bz or C to c variegation in these kernels. The presence of the Sh locus in all five of these kernels strongly supports a C Ds Sh constitution that arose from a crossover in region 1.

(e). Sub-culture H

Tests of the genic constitutions of the two normal chromosomes 9 in each of the two plants in sub-culture H are not extensive. Plant 4628H-1 was crossed to a C sh bz wx ds, Ac ac female plant. The types of kernels appearing on the resulting ear are given in table 12-a. The genic constitutions of the chromosomes 9 in this plant are the same as those in plants F-1, G-1, G-2 and G-3 (I Ds^1 Sh Bz wx / C ds sh bz wx). Plant 4628H-1 should be Ac ac from the appearance of the kernel from which it arose. The kernels of the ear should be Ac Ac Ac, Ac Ac ac, Ac ac ac or ac ac ac. The variegation pattern on the kernels coming from this cross indicate the presence of these various Ac constitutions. In the Ac Ac ac kernels, the presence of an I Ds Sh Bz chromosome was detected by the numerous speckles of C Bz phenotype. In the Ac Ac ac kernels carrying an I Ds Sh bz or I Ds sh bz chromosome, the speckles of C bz could not be detected. The color contrast is too faint. In the Ac ac ac kernels, however, the C bz color may be seen for many large sectors of this phenotype are present. Table 12-a does not give satisfactory data, therefore, on the presence or absence of Ds in some of the kernels having an I Ds sh bz wx or an I Ds Sh bz wx chromosome. The variegation pattern in the Ac ac ac kernels that received an I Ds Sh Bz chromosome is like that described for similar crosses involving plant 4628F-1. Crossing over between I and Sh is normal in frequency (3.6%).

Table 12-a

C sh bz wx ds, Ac ac ♀ x $\frac{\text{I Ds Sh Bz wx}}{\text{C ds sh bz wx}}$ Ac ac ♂

4462C-7 4628H-1

Kernel type	Number of kernels
I Sh (not obviously variegated)	104
I-C Bz-C bz, Sh-sh	172
I sh (not obviously variegated)	10*
I bz-C bz, sh	2
I bz-C bz, Sh-sh	1
C Sh Bz (not obviously variegated)	6
C sh Bz	9
C Sh bz	1
C sh bz	220
Total	525

* I Ds sh bz, Ac Ac ac constitutions not distinguishable because color in C bz specks is not deep enough.

Table 12-b

Re ●—+—•— c Sh Bz wx ds / C sh bz wx ds ac ac ♀ x I Ds Sh Bz wx / C ds sh bz wx Ac ac ♂

4365-3 4628H-1

Kernel type	Number of kernels
I Sh	139
I-C Bz-C bz, Sh-sh	68
I sh	4
I bz-C bz, Sh-sh	3
C sh Bz	5
C Bz-C bz, Sh-sh	2 *
C sh bz	103
C Sh Bz	127
C-c Sh Bz	2 **

* See culture 4990 C, summer 1949 { 1 = C Ds Sh Bz wx; 1 = I Ds Sh Bz wx = early loss of I, leaving Sh Bz in C.

** See culture 4890 D, summer 1949 = both C Ds Sh Bz wx

Plant 4628H-1 was also crossed to an ac ac female plant having a rearranged chromosome 9 with c Sh Bz wx ds and a normal chromosome 9 with C sh bz wx ds. The types of kernels appearing on this ear are given in table 12-b. These types and their relative frequencies are expected from the given chromosomes 9 and Ac constitutions of plant H-1.

The constitution of plant 4628H-2 was not examined by outcrossing to appropriate tester plants. Its constitution is very probably the same as that of H-1. This was suggested by a cross of this plant to one having a cm-1 locus. The numerous types of kernels were present on the resulting ear and will not be described.

(f). Sub-culture I.

The two plants in sub-culture I (those arising from I sh wx kernels, table 3) were crossed to a series of tester plants. Plant 4628I-1 had two normal chromosomes 9. Both chromosomes 9 carried C sh bz wx. This constitution suggests that heterofertilization had occurred or that the kernel from which this plant arose had been misclassified. It may have been a C sh bz wx kernel with poor C bz color development. The C bz color in the kernels on the ear of plant 4306 and on the ears in crosses of the plants in culture 4628 is, however, very well developed. Classification for C bz phenotypes are distinct. Plant 4628I-2 had two normal chromosomes 9, one carrying I Ds sh bz wx and one carrying C ds sh bz wx. This plant was ac ac. When crossed to a C sh bz wx ds ac female plant, no variegated kernels appeared on the ear (table 13-a). When crossed to a ~~C Sh Bz~~ recessive wx / C Sh Bz, wx Ac Ac plant, 91 of the 94 kernels ~~receiving an I chromosome~~ were I-C variegated (table 13-b). When crossed to a C Bz / C bz, Ac ac female plant, 109 of the 198 I carrying kernels were either I - C Bz or I bz - C bz

Table 13-a

C sh bz wx ds ac ♀ x $\frac{\text{I Ds sh bz wx}}{\text{C ds sh bz wx}}$ ac ac ♂

4628I-2

Cross	I sh non-variegated	C sh non-variegated
4363-5 x 4628I-2	145	120
4462C-3 x " "		
Totals		

Table 13-b

C Bz / C bz, Ac ac ♀ x 4628I-2 ♂

Cross	I kernels		C kernels
	I, non-variegated	I-C variegated	
4372-3 x 4628I-2	99	109	235

Table 13-c

Re $\frac{\text{c, sh Wx}}{\text{C Sh wx}}$ Bz Bz Ac Ac ♀ x 4628I-2 ♂ I Dc sh bz wx aa cc C dc sh bz wx

Cross	I kernels, Sh wx		C sh Wx	C sh wx	I sh Wx
	Colorless, Sh wx non-variegated	I-C variegated			
4380A-3 x 4628I-2	1	39	44	66	70
4380A-8 x " "	2	53	70	59	51
Totals	3	91	114	125	121

Odds: 1 C sh wx; 1 I sh wx; 1 possible C-c sh Wx *

* see table 4891 [illegible] 1944
No Dc in this kernel.

Table 13-d

c / c, Ac Ac ♀ x 4628 I-2 ♂

Cross	I kernels	C kernels	
		C-c variegated	C, non-variegated
4354-5 x 4628I-2	42	1	70
4354-6 x " "	108	0	100
Totals	150	1	170

variegated (table 13-b). This plant was also crossed to a c / c, Ac Ac female plant. Among the 171 C kernels on the ear, only 1 appeared to be C - c variegated (table 13-d). This latter kernel showed only very late Ds mutations--a uniform pattern of c specks--characteristic of Ds mutational responses to two doses of this particular Ac locus. The evidence from all of the crosses indicate the correctness of the given constitution of plant 4628I-2.

The constitutions of the plants in sub-cultures F, G, H and I, that arose from the I carrying class of crossover chromatids on the self-pollinated ear of plant 4306 (table 3), are those expected from the given constitution of this parent plant. A summary review of the constitutions of these plants is given in table 18. The reciprocal crossover classes, those carrying the duplication and having a C locus instead of an I locus, should be represented in sub-cultures K and L. The genetic analysis of these latter plants has given the final evidence that is required to substantiate the projected nature of the event that brought about the transposition of the Ds locus.

(g). Sub-culture K

The constitution of plant 4628K-1 (Duplication chromosome 9 with C ds sh bz Wx Wx Bz Sh Ds^2 / normal chromosome 9 with C ds sh bz wx ds, Ac Ac) was determined by the types of kernels appearing on the ear when this plant was crossed to a C sh bz ds ac female plant (table 14-a). All but three of the C Sh Bz Wx kernels were C Bz - C bz, Sh-sh, Wx-wx variegated. In these kernels, there were no extensive wx sectors regularly appearing in the C Bz areas. Also, all bz areas were wx and where sh could be recognized, all were sh. This type of variegation would indicate that only one Ds locus was present and that it must be located to the right of the duplicated segment.

Table 14-a

C sh bz wx ds ac ♀ x $\frac{\text{C ds sh bz Wx Wx Bz Sh Ds}^2}{\text{C ds sh bz wx ds}}$ Ac Ac ♂

4462C-3 4628K-1

♂: Duplication chromosome 9			♂: Normal chromosome 9	
C Sh Bz Wx not obviously variegated	C Bz-C bz, Sh-sh Wx-wx	C Sh* bz wx	C sh bz Wx	C sh bz wx
3	134	2	8+	323**

* Sh is possibly, not positive = sh 10/20/47

\+ 1 of these is very dark in bz color

** 6 of these have very dark bz color

Var [illegible] 4892 F [illegible]

Duplication chromosome C ds sh bz Wx Wx Bz Sh Ds^2

Normal chromosome C ds sh bz wx

Cross-overs: Duplication: C ds sh bz wx Wx Bz Sh Ds^2

Normal chromosome: C ds sh bz Wx ds

see note above

Normal chromosome class (minus 2 uncertain C Sh bz wx kernels): 331

Crossovers : 2.4%

Table 14-b

Re $\frac{\text{c Sh Bz wx ds}}{\text{C ds sh bz wx ds}}$ ac ac ♀ x 4628K-1 ♂

4365-1

♀ chromosome: C sh bz wx ds				♀ chromosome: c Sh Bz wx ds		
♂ Duplication chromosome 9		♂ normal chromosome 9		♂ Dupl.chr.9	♂ nor. chr.9	Odds
C Sh Bz Wx	C Bz-C bz, Sh-sh,	C sh bz Wx	C sh bz wx	C-c, Sh Bz	C Sh Bz wx	
Non-variegated	Wx-wx			Wx-wx		
5	56	1	150	65	122	2 broken C wx ♀ / C Sh Bz Wx Ds ♂ *

* To be expected from crossing over involving Re chromosome ♀ and normal chromosome ♀ in ♀ parent