MAIZE GENETICS COÖPERATION

NEWS LETTER

26

March 17, 1952

Department of Plant Breeding
Cornell University
Ithaca, N. Y.

CONTENTS

I. ANNOUNCEMENTS

1. R. A. Emerson Memorial

A memorial to the late Dr. R. A. Emerson is being planned at Cornell University. The Department of Plant Breeding has decided upon a lighted glass exhibit case in which will be displayed a photograph of Dr. Emerson and changing exhibits of Dr. Emerson's work together with current work of the Department. The cost of this case will be approximately $500. A letter giving complete details will be sent to Dr. Emerson's former students in order to give them an opportunity to contribute. This note is primarily to inform friends of Dr. Emerson's, who were not his students, about the project and to invite their inquiries or contributions. Checks may be made payable to Cornell University and sent to Miss Frances Feehan, Department of Plant Breeding, Cornell University, Ithaca, New York.

2. CORN COÖP - Present Problems and Future Possibilities

A meeting of corn workers was held on the morning of September 12, 1951 at the University of Minnesota (AIBS Meetings) to consider problems in relation to the Corn Coöp. There were 35 in attendance. A summary of the discussions at this meeting, taken largely from notes of E. F. Frolik, and some comments on subsequent developments were prepared for the News Letter by C. R. Burnham. They are as follows:

"The activities and problems of running the Corn Coöp at Cornell were discussed by H. H. Smith. About 220 different genes are at present being preserved and the stocks are replenished every three or four years since no special storage facilities for seed preservation are available. The planting and pollination procedures are handled largely by one graduate assistant. The Department of Plant Breeding furnishes land and labor. Two hundred copies of the News Letter are issued each year and distributed in March to a regular mailing list of about 175. The Coöp has been financed largely through Rockefeller Foundation Grants which in recent years have amounted to $1900 annually. Of this approximately $1500 is for a graduate assistantship, $200 for the News Letter, and $200 for supplies. About 150 letters are answered each year and approximately 350 gene stocks sent out. Clerical services are furnished by the Department of Plant Breeding.

"Various attempts have been made to get increased and permanent support for the Corn Coöp. It was considered that it would be particularly helpful to add a full time technical assistant to give greater continuity to the program and to extend the work into other desirable phases. Much interest was shown but support did not materialize. Consequently, an attempt has been made to maintain the status quo (with some additions) of the stocks, a holding action until more adequate support could be obtained.

"A regional sub-project under provisions of the Research and Marketing Act to cover the Maize Genetics Cooperation activities was drawn up for the Northeastern Region and was approved by the NE

Technical Committee on New Crops for the fiscal years 1948-49, 1949-50 and 1950-51. No 9B-3 funds were made available for this purpose and neither the NE-9 project nor this sub-project was activated. In November 1950 the NE-9 Technical Committee suggested that the Maize Genetics sub-project be written up as a national project but, since it appeared unlikely that approval would be obtained, a compromise measure was adopted of making it a Northcentral and Northeastern inter-regional sub-project. A tentative draft of this sub-project was approved by the Northeastern Directors; was given a vote of confidence, insofar as it fits into the general project on the storage and maintenance of valuable germplasm, by the National Coordinating Committee; and was discussed by the directors of the North Central Region.

"Since money was not in prospect by July 1, 1951 another grant from the Rockefeller Foundation was requested and was received for a two-year period ending July 1, 1953. This is definitely a final grant from this source.

"Considerable discussion followed. Comments were added by M. M. Hoover, Director of the introduction center at Ames, Iowa, under R & M New Crops project funds; and later by D. C. Smith a member of the Technical Committee of the N. C. Region. It was pointed out that the North Central region is the only one in which New Crops Projects has been activated, that the Technical Committee is sympathetic toward the proposed corn genetics program but is limited in what it might do. These projects are set up for the maintenance of stocks; the development of new stocks can not be included. Certain routine things might be handled by the organization at Ames, e.g., sending out of stock lists.

"The importance of adapted stocks for use in different regions was emphasized by several and that the Coöp stocks were not as useful as they might be because of their limited adaptation. In view of this it was suggested that the needs of corn workers in all regions would best be served by a system of regional projects for the maintenance and increase of adapted stocks, but that these would not necessarily replace the present Cornell Coöp project. To the question whether such regional projects might be approved, the answer was that experience with other R & M projects favored regional projects rather than national ones; but that this does not preclude cooperation on a national basis in other ways.

"It was moved, and carried that the group go on record as favoring a regional maintenance program of seed stocks. The need for some kind of coordination was discussed.

"A motion was made and carried that the chairman appoint a committee of 4 to plan a national coordinated program of corn genetics to coordinate all maize genetic work which might develop in different regions. That among other things it make arrangements needed for an annual meeting of corn geneticists and workers at the time of the A.I.B.S. meetings. The meeting adjourned and those from the North Central Region continued in session to consider the problem. After some further discussion, four proposals were made and approved, namely:

1. The maize geneticists of the North Central Region favor the establishment in the area of a project in support of maize genetics research which would have the following objectives among others.
   a) Maintenance of adapted genetic and chromosomal tester stocks.
   b) Development of new combinations of testers.
   c) Determination of linkage relations.
   d) Discovery of new genes.

2. The group suggests that support be sought from NC-7 funds through the appropriate channels for the germplasm maintenance phases of this project (item a above).

3. The possibilities of support for the other portions of the program from other sources should be explored also.

4. A committee representing the maize geneticists of the North Central area be elected at this meeting and empowered to aid in the organization of the above project and to render such other services as are appropriate.

"A committee of three consisting of J. R. Laughnan (Illinois), Oliver E. Nelson (Purdue), and C. R. Burnham (Minnesota) was elected to aid in the organization of this project. They met at noon (M.M. Rhoades substituted for Laughnan since he was not available). After some discussion, it was the opinion of this committee that Illinois, from the standpoint of its central location, range of adaptation of its stocks, and climate, and that it has leaders and students active in corn genetics research, would be an ideal center for such a project. Rhoades indicated that he would be willing to act as leader of the project if the necessary funds for support could be found and the departments involved and his institution were also interested. Sources of possible support in addition to R & M were also discussed. (Adjourned)"

"A letter from the committee was then sent to Rhoades setting forth the results of the meetings and asking him to ascertain if his institution were interested in the project. Rhoades has informed us that their Agronomy Department and their Associate Director agreed that a maize research center at Illinois is desirable and that they are willing to sponsor a request for 9B-3 Research and Marketing NC-7 funds. A Project Proposal by the Illinois Experiment Station has been written up requesting support for the assembly, increase, and distribution of seed of new introductions, gene stocks, and chromosomal types in maize. This work is to be closely coordinated with the activities of the North Central Primary Introduction Station at Ames, Iowa. The Project is being considered by the North Central Technical Committee and, if approved, calls for each of the Experiment Stations of the North Central Region to make an inventory of its genetic and chromosomal tester strains. From these lists, as complete a collection as possible of the available and desirable

II. REPORTS FROM COOPERATORS

BEAR HYBRIDS CORN COMPANY
DECATUR, ILLINOIS

Amylose content.

After having stabilized a successful waxy hybrid breeding program, our attentions were shifted to the possibilities of altering the amylopectin-amylose ratio of corn in the opposite direction by increasing the amylose content.

An endosperm mutation was found in the Bear Hybrids nursery in 1945 which we believe to be unreported. This gene, which we have tentatively designated as ae, behaves as a simple recessive. In 1950 this gene was crossed with standard corn belt lines. The amylose content, in most cases, was doubled in the F_2 segregates. Slight variations were noted, depending upon the line which was used as recurrent parent in backcrosses. Also of interest are the facts that water soluble polysaccharides remain about the same as in dent hybrids; and when crossed with waxy lines, an appreciable amount of amylose is noted.

Our amylose program at present is concerned with determining the influence of this mutant in various combinations with du, su1, su2, wx, sh, br and fl. In 1951 ae was also crossed with su^{am} and du which J. W. Cameron furnished (California Agricultural Experiment Station). These crosses have all resulted in dent endosperm indicating the separate identity of ae. It should also be noted that these testers from Cameron are similar to the material with which H. H. Kramer (Purdue Agricultural Experiment Station) has been working.

This coming summer we hope to obtain a complete set of double recessives of the various endosperm genes with ae as well as advance some to triple recessive combinations. Work planned for the summer also includes a program to determine the location of this mutant.

M. L. Vineyard and Robert P. Bear

BROOKHAVEN NATIONAL LABORATORY*
UPTON, LONG ISLAND, N.Y.

Biology Department

1. Pseudostarchy.

Sugary seeds from a cross Wx Wx su1 su1 X wx wx Su1 su1

* All research reported in this contribution carried out under the auspices of the U. S. Atomic Energy Commission.

were planted and the F_1 plants selfed. The selfed ears show numerous pseudostarchy kernels, which are probably similar in phenotype to those described by Mangelsdorf (Genetics 1947) and by Cameron (Genetics 1947).

The phenotype of the pseudostarchy kernels varies from those which are chiefly sugary and thus translucent with opaque areas showing starch deposits at the top and near the surface of the endosperm to those which are chiefly smooth and opaque. The latter kernels approach normal starchy in appearance but are readily distinguishable.

Data from selfed ears of four F_1 plants are presented below:

Sugary		Pseudostarchy	
Non-Waxy	Waxy	Non-Waxy	Waxy
1491	81	131	163

From the limited data it appears that this pseudostarchy is controlled by a recessive factor which is linked with waxy on chromosome 9.

E. J. Dollinger

2. Shrunken - 3.

Intercross tests for allelism have been made with shrunkens and brittles isolated from corn introduction received from the Division of Plant Exploration and Introduction in 1949.

Plant introduction P. I. 177621 was found to segregate for bt1 (Mangelsdorf, 1926) on chromosome 5.

P. I. 167993 was found to segregate for sh1 (Hutchison, 1921) on chromosome 9.

A new recessive shrunken (sh_3) was discovered. It is non-allelic to sh1 or sh_2, but very similar to sh_2 in appearance. Further tests are in progress to determine linkage relationships.

David L. Matthews

3. Growth of corn endosperm tissue in vitro.

Corn endosperm tissue excised from fresh corn grains has been grown as a tissue culture of unlimited growth on an artificial medium by LaRue since 1948. New stock cultures of corn endosperm tissue have been obtained at this laboratory during the summer of 1951 from a number of Dr. Singleton's corn varieties. The endosperm tissue of var. Black Mexican, excised ten days after pollination, has shown the best growth. The friable, undifferentiated tissue masses have undergone several sub-cultures, and continue to produce

the anthocyanin pigmentation which is found in the aleurone layer of the endosperm of this strain of corn.

Elizabeth A. Pieczur
Sturtevant

4. Genetic diversity in foreign corn.

Maize stocks obtained from the U. S. Plant Introduction Garden in Glenn Dale, Maryland have been grown for three years at the Brookhaven Laboratory. Our main interest in growing these stocks was to look for new hereditary characters to add to the present "genetic pool" of corn stocks. One new, and perhaps very useful character, shrunken 3, has been isolated and described in this News Letter by David L. Matthews. Also at least one, and perhaps two cyto-sterile types have been isolated. One of these P. I. 171892 was also observed to be cyto-sterile by D. F. Jones. The other P. I. 168055 produced a progeny all male sterile from a sib pollination ms x +. It is presumed to be cyto-sterile. These two cyto-steriles came from places about 150 miles apart in a part of the country with topography similar to the great plains area of this country. The two may or may not be the same cyto-sterile.

The material from Turkey was extremely diverse in type, ranging all the way from very early plants to rather late dents. All matured well on Long Island. Not only was there extreme diversity in type but selfed ears of many of the progenies were segregating for seedling characters. Of a total of 81 selfed progenies grown in 1950, there were 27 segregating for either albino, virescent, yellow green or zebra stripe. The genetics of these characters has not been determined but seed has been sent to the Plant Introduction Garden, Glenn Dale, Maryland and can be obtained from John L. Creech, Regional Coordinator for the Northeastern area.

W. R. Singleton

5. A temporary mounting medium for determining pollen abortion percentages.

Percentages of normal and aborted pollen grains are frequently determined from temporary mounts of pollen from one or more anthers. Randomly selected areas of small size are usually counted because of the labor involved and for accuracy the distribution of the grains must be reasonably uniform.

Media commonly used for pollen abortion percentage counts have been water or 70 percent ethyl alcohol in which I_2 and KI were dissolved for staining purposes. Preparations made with water or alcohol are not wholly satisfactory since they dry out quickly and

as the aborted pollen grains are lighter in weight than the normal grains they tend to be unevenly distributed. The use of high viscosity liquids has been suggested (Valleau). Pittenger and Frolik reported that the addition of 1 percent agar to the mounting medium aided in obtaining uniform dispersion. However, agar does not seem entirely satisfactory because it contains starches and stains with iodine. Glycerine seemed to inhibit the absorption of stain by the starch in the pollen grains.

The addition of gelatin to an aqueous I_2 + KI solution was found to provide the desired viscosity for uniform distribution of the normal and aborted pollen grains and to resist the drying of the preparations. The medium is prepared by adding about 2 grams of gelatin to a solution composed of 1 gram of KI and 1/4 gram of I_2 in 100 ml. of water. The mixture is then heated to dissolve the gelatin. This gelatin medium will solidify, but not very rapidly, at room temperature and warming once during a day is usually all that is necessary to keep the medium in the liquid phase. Unlike the agar method, it is not necessary to warm the slides before using them. A drop of medium is placed on the slide; an anther is placed in the drop and dissected to force out the pollen grains. After the debris has been removed, the drop is stirred to distribute the pollen grains and covered with a cover-slip. Usually it is unnecessary to apply pressure to obtain a uniformly thin film. The medium soon gels and the pollen grains are held in place. Unsealed mounts have not dried out after a full day's exposure to average laboratory atmosphere.

Calvin F. Konzak

CALIFORNIA INSTITUTE OF TECHNOLOGY AND
UNITED STATES DEPARTMENT OF AGRICULTURE
PASADENA 4, CALIFORNIA

1. Linkage relations of some translocations in Chromosomes 2 and 9.

In the course of studies on linkage relations of chromosome translocations in maize, data have been gathered on the genetic locations of translocations which on the basis of cytological observation were placed in the short arms of either Chromosome 2 or 9. Translocations involving Chromosome 2 were placed with relation to the genes lg$_1$, gl$_2$, B, sk$_1$, and v$_4$, while those in Chromosome 9 were placed with respect to the genes C, sh, and wx. Cytological positions have not yet been rechecked in those cases where genetical and cytological placement appear not to be in accord. With the Chromosome 9 translocations especially, accurate designation of the position of a translocation may be rendered difficult by the shortness of the chromosome and by the frequent occurrence of non-homologous association of the chromosomes. The cytological positions

listed were determined by Dr. Longley and are based on calculations of three or more camera lucida drawings of what appeared to be the most characteristic configurations among those that could be analyzed.

In Table 1, data on several Chromosome 2 translocations are summarized. Translocations designated by small letters represent those given permanent symbols in previous publications or those assigned by Dr. Anderson in this issue of the News Letter. Others are designated by their temporary identifying numbers. For convenience in comparing cytological and genetic information, the translocations are listed in the order of their position from left to right in the chromosome on the basis of their cytological placement. In some instances recombination values are also indicated for neighboring chromosome regions to indicate the degree of influence exerted by a translocation on linkage relations of adjoining genes. Recombination values in parentheses are based on a different total number of plants, the number being indicated in the second column to the right. Some of the translocations which appear from these data to be considerably to the right of sk may possibly be in the long arm of the chromosome proximal to v4.

In Table 2, the information on several Chromosome 9 translocations is summarized in a similar manner. In addition, the probable location of the translocation with respect to the short or long arm of the chromosome is indicated in several instances. In some cases this location will be evident from the linkage relations. In others, when the translocation is to the right of wx, it was still possible in certain instances to determine whether it is in the short region between wx and the centromere or whether it is in the long arm.

Adjacent-1 disjunction of the chromosomes from a heterozygous translocation at microsporogenesis gives rise to unbalanced gametic types which are duplicated for part of a chromosome arm and deficient for another. Pollen grains containing such duplicate-deficient complements often form readily-visible amounts of starch if the deficiency is not too detrimental. Pollen grains deficient for most of either the short or the long arm of Chromosome 9 form little starch, however. In some heterozygous translocations which involve Chromosome 9 and are closely linked to wx, partly-filled pollen grains are produced which carry an entire normal Chromosome 9 together with a duplication of most of either the short or the long arm. If such a translocation is heterozygous for wx, with the wx allele carried on the normal Chromosome 9, something of the position of the translocation may be inferred. If the break is between wx and the centromere most of the short arm will be duplicated in the partly-filled pollen. Such pollen will contain both a Wx and a wx allele and will stain blue with dilute iodine solution. If the break is just to the right of the centromere, nearly all of the partly-filled pollen will carry the wx allele only, and be duplicated for most of 9L. Such pollen will

Table 1.

Translocations Involving Chromosome 2

Translocation	Cytological Position in Chromosome 2	Linkage Relations	Number of Plants in Linkage Test: Values not in Parentheses	Number of Plants in Linkage Test: Values in Parentheses
2-3 e(a)*	S.64 (S.9)	T 0.4 lg 3.5 gl	283	
2-5 g	S.79	lg 6.9 gl 2.1 T 4.2 B	146	
2-3 5304-3	S.67	lg 7.3 gl 2.3 T (4.6) B	217	109
2-3 c	S.40	gl 12.1 B 2.0 T 4.0 sk	199	
2-8 5483-4	S.36	B 11.9 sk 27.4 T (9.4) v_4	201	117
2-3 6862-6	S.34	B 2.9 sk 8.7 T	69	
2-9 a	S.31	B 1.2 sk 1.2 T	81	
2-5 4741-4	S.30	B 4.2 sk 3.7 T	215	
1-2 5255-8	S.25	B 13.1 sk 9.3 T (3.7) v_4	183	27
2-8 c	S.17	B 6.9 sk 13.9 T (2.0) v_4	202	50
2-7 6372-2	S.13	B 7.5 sk 8.0 T 14.0 v_4	200	
2-5 e	S.12	B 13.1 sk 15.1 T (0) v_4	199	45
1-2 4937-8	S.11	B 8.9 sk 14.7 T (6.4) v_4	190	124

*This translocation stock, which was thought to be 2-3e, is probably 2-3a, whose cytological position as reported by Burnham is indicated in parentheses.

Table 2.

Translocations Involving Chromosome 9

Translocation	Cytological Position in Chromosome 9	Linkage Relations	Number of Plants in Linkage Tests: Values not in Parentheses	Number of Plants in Linkage Tests: Values in Parentheses	Probable Chromosome Arm
4-9 6222-1	S.~~82~~.68	C 3.3 T.0.3 sh 6.3 wx	368		S
3-9 5775-1	S.~~59~~.24	C 6.6 sh 11.0 wx 1.4 T	290		S
8-9 5300-3	S.~~41~~.43	C 3.4 sh 10.1 wx (0) T	209	283	S
7-8-9 7074-6	S.~~36~~.80	T 0.6 C (0.6) sh(14.2) wx	179	499	S
1-9 4398-4	S.~~32~~.19	C 6.6 sh 15.3 wx(2.1) T	287	377	S
2-9 6656-4	S.~~32~~.31	C 1.1 sh 11.0 wx(1.4) T	91	209	
5-9 a	S.~~21~~.17	C 1.4 sh 9.1 wx 0.5 T	429		S
3-9 c	~~S.20~~ ∠.12	C 12.4 wx 1.2 T	161		L
6-9 4505-4	~~S.16~~ etc.	C 27.1 wx 2.9 T	210		L
8-9 6673-6	S.~~15~~.31	C 15.6 wx(2.9) T	160	347	L
5-9 5614-3	~~S.15~~ ∠.06	C 27.9 wx 2.1 T	240		L
1-9 4995-5	S.~~14~~.20	C 6.0 sh 16.1 wx(4.6) T	317	456	
4-9 5657-2	S.~~14~~.25	C 12.4 wx(1.8) T	242	443	
7-9 4363-1	~~S.11~~ etc.	C 11.6 T 2.3 wx	129		S
5-9 4817-7	S.~~08~~.07	C 23.2 wx 3.4 T	267		L

stain red with iodine solution. Such pollen tests were applied in assigning the translocations to one arm or the other as indicated in Table 2. In the case of several of the translocations, the fact that the break points are not just to the left of wx was confirmed by showing that C and wx remain linked in the homozygous translocation.

As a result of crossing over between the wx locus and the point of translocation, partly-filled pollen of opposite staining reaction may result, the frequency of which may, in fact, be used as a measure of the wx - T distance.

In several of the translocations studied, duplicate-deficient eggs function and, when fertilized, give rise to plants having certain chromosome regions in triplicate. When test-crossed, genes carried in these regions give what appear to be trisomic ratios. Such plants have been useful in establishing or confirming the break points in several of the above translocations.

Earl B. Patterson

2. Location of mutant genes.

	Character	Chromosome	Technique used
Old genes	gl_7	3	translocation(wx 3-9c)
	gl_{10}	9	gene (wx) & translocations
	bt_2	4	hemizygous B-4a
Mutants from radiation studies	ragged seedlings	6	gene (Y_1)
	glossy-crinkly	3	translocation(wx 3-9c)
	olive green necrotic	1	hyperploid B-1a
	orobanche	6	gene (Y_1)
	anther ear	10	gene (R)
	blue fluorescent	5	translocation testcross
	yellow green seedling	6	gene (Y_1)
Miscellaneous	male sterile silky	6	gene (Y_1)

E. G. Anderson & H. J. Teas

3. A chromosomal technique used in biochemical studies on the developing endosperm of maize.

Biochemical studies on the developing endosperm of maize required an ontogenetic series of starchy and sugary seeds from the same ear. This separation does not become apparent until near maturity while a separation of yellow and white endosperm can be made by the early milk stage about two weeks after pollination. The separation of starchy and sugary seeds was accomplished by the use of translocation T 4-6a which linked the genes Y_1 and su with only 4.5 percent crossing-over.

In translocation T 4-6a, the cytological positions of the two breaks are 4L.33 and 6L.44. The break in chromosome 4 is between su and Tu. No crossovers were found with Y_1 in chromosome 6.

In the heterozygous translocation there is suppression of crossing-over as shown by a comparison with the normal linkage maps.

Chromosome 4

Standard Ts_5 - 15 - su - 29 - Tu

Translocation Ts_5 - 14.9 - su - 4.5-T- 5.2 - Tu

Chromosome 6

Standard Y_1 - 28 - Pl - 10 - sm

Translocation T - 4.2 - Pl - 5.2 - sm

Linkage tests with the homozygous translocation gave the following maps:

Chromosome 4^{6a} Ts_5 - 12.5 - su - 19.7 - Pl - 11.4 - sm

Chromosome 6^{4a} nucleolus - - - - Tu

E. G. Anderson

4. A short day mutant.

During routine testing of Bikini-exposed progeny, a recessive mutant showing prolonged growth and late fall flowering was observed. Investigation was begun in 1951 to determine if the late flowering resulted from an absolute requirement for short days. Seeds of a segregating culture were planted February 6 in Earhart Plant Research Laboratory under a 20 hour daily light period (long day) (Temperature 30°C day, 22°C night). Approximately three quarters of the plants had matured by May 1st. The remaining one quarter (25 plants) which showed no indication of flowering at this time were transferred to

an 8-hour daily light period (short day) (23°C day, 17°C night) to induce flowering. After 20 days they were transferred to natural day (23° day, 17° night). They began to tassel on June 15 and all had tasseled by August 30th. All of the 15 plants carried to maturity showed the same unusual development.

Comparison of normal and short day mutant plants at maturity

	Number of Leaves		Height in cm.	
	range	average	range	average
Normals	12-17	14	140-190	160
Mutants	28-50	35	210-450	298

Instead of only the usual 3-4 lower nodes showing prop roots, the mutants had an average of 21 nodes with prop roots, in some cases extending to within 3 nodes of the tassel. Ear primordia never formed in the leaf axils, but rather in a peculiar manner in the tassels. All tassels appeared normal when first emerged, but by the time the whole tassel was visible numerous irregularities were present. The top 3 or 4 branches produced functional anthers, whereas the lower 10-12 branches appeared to be a mass of vegetative plants. Many of these plant-like structures developed into very small but functional two rowed ears. The investigation is being continued making use of the approximately 100 selfed mutant seed that were obtained.

James L. Liverman

5. B vitamin levels in sugary and starchy endosperms.

The well known correlation of niacin level and "sugary" genes has proven difficult to explain. Assays for seven B vitamins on comparable Su and su endosperms have revealed that the niacin difference is not unique. Biotin, inositol, choline, pyridoxine, riboflavin, and pantothenic acid as well as niacin are higher (P less than 0.02) in su. A more general explanation is therefore required for the Su-su differences than directly relating niacin and carbohydrate metabolism.

H. J. Teas

6. List of translocations preceding the Bikini and Eniwetok series.

Permanent symbol	Old designation	Cytological determination		Permanent symbol	Old designation	Cytological determination	
1-2a				1-5c		1 cent	5 cent
1-2b		1S.44	2S.23	1-5d	a-37	1L.33	5S.47
1-2c		1S.75	2L.09	1-5e	a-90	1L.03	5L.09
1-2d	17	1S.89	2L.42	1-5f	D-5	1L.06	5L.06
1-2e	B-75	1S.26	2L.49	1-5g	I-24	1L.56	5S.93
1-3a		1L.13	3L.15	1-5h	X-1-37	1L.12	5S.51
1-3c		1S.26	3L.12	1-5i	X-23-2	1S.72	5S.71
1-3d		1L.63	3S.75	1-6a		1L.21	6L.59
1-3e	a-33	1L.62	3L.49	1-6b			
1-3f	B-2	1L.27	3L.07	1-6c		1S.17	6L.39
1-3g	B-104	1L.17	3L.13	1-6d	ConnR28	1S.2	6S.1
1-3h	C-15	1S.12	3L.11	1-6e	a-80	1S.30	6 cent
1-3i	C-43	1S.47	3S.21	1-6f	B-92	1L.30	6L.35
1-3j	F-10	1L.12	3L.20	1-6g	F-30	1L.15	6L.88
1-3k	g-3	1L.12	3L.07	1-6h	X-41-13	1L.06	6L.15
1-4a		1L.49	4S.66	1-7a		1L.29	7L.03
1-4b	ConnR29	1S.4	4L.8	1-7b		1L.54	7S.16
1-4c	a-57	1L.31	4S.16	1-7c		1L.34	7L.14
1-4d	B-2	1L.27?	4L.30	1-7d		1L.79	7S.38
1-4e	B-89	1L.22	4S.50	1-7e	42	1L.43	7L.08
1-4f	C-46	1L.01	4S.01	1-7f	a-69	1S.70	7L.72
1-4g	D-5	1L.11	4L.14	1-7g	B-49	1S.79	7S.37
1-4h	X-22-61	1S.96	4L.65	1-7h	B-94	1L.42	7L.15
1-5a		1L.52	5S.35	1-7i	I-17	1S.26	7L.24
1-5b		1S.29	5L.18	1-7j	X-55-16	1L.23	7L.59

Permanent symbol	Old designation	Cytological determination		Permanent symbol	Old designation	Cytological determination	
1-8a	ConnR20	1L.5	8S.5	2-4e	ConnR42	2L.4	4S.3
1-8b	B-42	1L.60	8L.82	2-4f	a-29	2L.78	4L.13
1-8c	B-89	1S.42	8L.70	2-4g	C-31	2L.13	4S.26
1-9a		1S.17	9L.17	2-4h	C-49	2L.94	4L.23
1-9b		1L.42	9L.54	2-4i	I-10	2L.22	4S.37
1-9c		1S.61	9L.32	2-4j	K-10	2S.19	4L.30
1-9d	I-9	1L.36	9L.35	2-4k	X-1-1	2L.12	4L.18
1-10a		1L.38	10L.21	2-4l	X-2-64	2L.56	4S.51
1-10b	ConnR41	1L.1	10S.1	2-4m	X-47-41	2S.08	4S.16
1-10c	a-50	1L.36	10L.67	2-5a		2L.16	5L.18
1-10d	a-84	1L.55	10L.70	2-5b		2L.02	5S.02
1-10e	B-98	1L.17	10L.30	2-5c	ConnR50	2S.1	5L.5
1-10f	C-36	1S.09	10L.27	2-5d	a-74	2L.89	5L.86
1-10g	C-47	1S.72	10L.10	2-5e	B-69	2S.12	5S.23
2-3a				2-5f	K-3	2L.90	5L.08
2-3b		2S.05	3S.10	2-5g	X-14-122	2S.79	5S.28
2-3c		2S.51	3S.66	2-6a		2L.51	6S.09
2-3d		2L.73	3L.63	2-6b		2S.69	6L.49
2-3e		2S.64	3L.34	2-6c		2L.32	6L.20
2-3f	a-61	2L.58	3S.70	2-6d		2L.52	6L.57
2-3g	F-35	2L.21	3S.11	2-6e		2L.28	6L.22
2-3h	K-7	2L.05	3L.08	2-6f	84-2	2L.77	6L.85
2-4a		2L.29	4L.16	2-7b		2L.41	7L.12
2-4b		2L.88	4L.54	2-7c		2L.48	7S.50
2-4c		2L.77	4S.09	2-7d	B-108	2L.16	7L.16
2-4d		2S.20	4L.25	2-7e	C-44	2L.77	7L.57

Permanent symbol	Old designation	Cytological determination		Permanent symbol	Old designation	Cytological determination	
2-7f	F-29	2L.34	7L.64	3-6a		3L.07	6L.19
2-7g	I-3	2L.59	7L.24	3-6b		3S.82	6S.75
2-8a		2L.13	8L.26	3-6c	Conn R34	3S.4	6L.8
2-8b	a-1	2L.22	8L.19	3-6d	a-53	3L.44	6L.73
2-8c	a-36	2S.17	8S.13	3-7a		3S.23	7L.17
2-8d	C-24	2L.01	8L.01	3-7b		3S.90	7L.03
2-8e	C-40	2L.13	8L.26	3-7c		3L.36	7L.29
2-8f	C-57	2L.43	8S.50	2-7d	C-75	3L.66	7L.75
2-8g	g-2	2L.71	8S.42	3-7e	F-25	3L.07	7S.84
2-8h	X-42-32	2L.20	8L.22	3-8a		3L.40	8L.80
2-9a		2S.48	9L.85	3-8b		3L.15	8L.25
2-9b		2S.12	9L.12	3-8c	Burnham	3S.25	8L.85
2-9c	C-61	2S.58	9S.40	3-8d	a-21	3L.51	8S.45
2-9d	H-7	2L.92	9L.32	3-8e	a-22	3L.72	8L.21
2-10a		2L.17	10L.53	3-8f	a-104	3L.07	8L.03
2-10b	F-2	2S.45	10L.77	3-8g	B-37	3L.08	8L.43
3-5a		3L.72	5L.42	3-8h	X-23-26	3L.49	8S.32
3-5b		3L.54	5L.49	3-9a		3L.19	9L.40
3-5c		3L.72	5L.45	3-9b		3L.48	9L.53
3-5d				3-9c		3L.15	9S.20
3-5e	a-101	3S.24	5S.12	3-9d	a-41	3L.09	9L.21
3-5f	B-2	3L.07	5L.08	3-9e	a-94	3L.02	9L.29
3-5g	X-4-108	3 cent.	5S.99	3-9f	B-103	3L.46	9L.69
3-5h	X-7-38	3L.65	5L.23	3-9g	F-24	3L.46	9L.18

Permanent symbol	Old designation	Cytological determination		Permanent symbol	Old designation	Cytological determination	
3-9h	X-23-158	3L.05	9L.44	4-9a		4L.18	9L.50
3-10a		3L.28	10L.12	4-9b		4L.84	9L.34
3-10b		3L.61	10S.25	4-9c	bp	4L.81	9L.27
3-10c		3L.27	10L.31	4-9d	a-26	4L.14	9L.15
3-10d	B-29	3L.92	10L.23	4-9e	a-52	4S.60	9L.24
3-10e	F-25	3S.25	10S.40	409f	D-25	4L.63	9L.16
4-5a		4L.19	5S.29	4-9g	F-22	4S.35	9L.42
4-5b		4L.66	5S.66	4-10b		4L.18	10L.57
4-5c		4S.45	5L.38	4-10c	B-45	4S.70	10L.11
4-5d		4S.21	5L.19	4-10d	g-1		
4-5e	ConnR18	4S.6	5S.3	4-10e	K-17	4L.04	10L.01
4-5f	ConnR30	4L.5	5L.8	4-10f	X-12-57	4L.92	10L.14
4-5g	ConnR32	4S.5	5L.6	5-6a		5L.32	6L.47
4-5h	B-2	4L.30	5L.08	5-6b		5L.71	6L.29
4-5i	B-74	4L.10	5S.13	5-6c		5L.81	6S.11
4-5j	X-6-77	4L.25	5L.43	5-6d	A-75	5S.54	6S.91
4-5k	X-19-5	4S.21	5L.18	5-6e	A-77	5L.29	6L.64
4-6a		4L.33	6L.44	5-6f	X-23-41	5S.29	6S.70
4-6b		4S.71	6L.25	5-6	84	5S.84	7L.83
4-6c		4S.13	6S.86	5-7a		5L.77	7L.71
4-6d	ConnR43			5-7b		5L.17	7S.33
4-6e	X-57-31	4S.60	6L.51	5-7c		5L.38	7L.71
4-7a		4S.27	7L.07	5-7d		5S.23	7S.49
4-8a		4S.54	8L.23	5-7e	B-21	5S.59	7S.39
4-8b	X-17-108	4S.50	8L.23	5-7f	X-22-44	5S.84	7L.83

Permanent symbol	Old designation	Cytological determination	Permanent symbol	Old designation	Cytological Determination
5-8a		5L.55 8S.82	6-10a		6L.68 10L.19
5-8b	84	5S.28 8L.24	6-10b		6L.17 10L.14
5-8c	B-10	5S.32 8L.40	6-10c	A-23	6L.51 10S.40
5-8d	B-18	5S.49 8L.07	6-10d	C-27	6L.15 10L.06
5-8e	B-91	5L.21 8L.28	6-10e	D-13	6L.21 10S.62
5-8f	C-52	5L.07 8S.36	6-10f	I-22	6S.95**10S.20
5-8g	X-27-87	5L.37 8S.61	6-10g	X-17-15	6L.84 10L.17
5-8h		5L.76 8S.48	6-10h	X-46-13	6L.48 10L.86
5-9a		5L.80 9S.21	7-9a	A-76	7L.27 9L.20
5-9b	X-7-39	5L.70 9L.40	7-9b	F-11	7S.92 9S.24
5-9c	X-10-6	5S.21 9L.26	7-9c	X-56-86	7L.16 9L.18
5-9d	X-11-73	5L.22 9L.15	7-10a	D.36	7L.24 10L.04
5-9e	X-14-111		8-9a		8L.2 9L.4
5-10a	A-49	5L.14 10S.68	8-9b		8S.88 9L.88
5-10b	B-70	5L.05 10S.24	8-9c	C-12	8L.30 9L.36
6-7a	X-1-31	6L.74 7L.61	8-9d	X-22-92	8L.19 9S.22
6-8a		6L.50 8L.83	8-9e	X-26-8	8S.11 9L.24
6-8b	B-83	6L.73 8S.72	8-10a		8S.68 10S.83
6-8c	C-59	6L.37 8L.42	8-10b		8S.27 10L.14
6-8d	D-1	6L.51 8L.78	8-10c		8L.43 10S.51
6-9a		6S.79 *9L.40	8-10d	F-1	8L.37 10L.18
6-9b		6L.13 9S.42	8-10e	F-33	8L.48 10L.42
6-9c	A-66	6L.20 9L.17	8-10f	X-57-16	8S.76 10L.67
6-9d	C-23	6S.54 9L.76	9-10a		9L.14 10L.93
6-9e	X-25-78	6L.17 9L.22	9-10b		9S.11 10S.28

*organizer
**satellite

E. G. Anderson & A. E. Longley

7. Preferential Segregation in Translocations.

Preferential segregation of the abnormal form of chromosome 10 (abl0) to the basal cell of the linear tetrad during megasporogenesis is a phenomenon that is not completely understood.

Studies, the past season, indicate that when abl0 is substituted for normal 10 as the homologue in heterogygous A-type translocations involving chromosome 10, preferential segregation is restricted to cells with a cross-over between the translocated piece of 10 and the abl0 homologue. Preferential segregation was tested by marking the translocated piece with the dominant R gene and introducing the recessive r gene with the abl0. Progenies of reciprocal out-crosses to R-testers were scored to determine the types of gametes transmitted. A similar series with only normal 10 was grown for comparison.

The summarized data from six translocations are given in the following table, in which the percent of transmitted normal gametes (gametes that do not transmit the translocation) is given.

	Parent carrying Nor. 10 homologue.		Parent carrying abl0 homologue.	
	Egg %	Pollen %	Egg %	Pollen %
No crossing-over in distal section of 10.	53.2	52.0	55.2	53.0
Crossing-over in distal section of 10.	48.9	46.0	14.0	43.7

These data show the pronounced preferential segregation at megasporogenesis of divisions in which the distal section of 10 has crossed over with abl0. They fail to show any appreciable preferential segregation when crossing-over was restricted to the interstitial section. All translocations used had sufficiently long interstitial segments to allow an appreciable amount of crossing-over.

The conclusions from these observations are that crossing-over in the section adjacent to the abnormal piece of 10 is associated with preferential segregation and that crossing-over in the interstitial segment is followed by normal segregation. This difference may be associated with terminalization of cross-overs, since it seems possible that proximal cross-overs may terminalize through the primary rather than the secondary centric region.

Translocation B-10a was also used to observe the effect of abl0 when paired with a B^{10} chromosome. The following table gives the data from four parent types that were pollinated by a standard and the transmitted gametes scored in the F_1 progeny.

Parent	Gametes transmitted (containing) 10 or ab10 %	10^B %
10 10^B B^{10}	50.0	26.3
ab10 10^B B^{10}	48.6	26.2
ab10 10^B B^{ab10}	50.0	29.6
10 10^B B^{ab10}	50.0	31.2

The data fail to show any striking differences that indicate preferential segregation associated with the presence of ab10.

Crossing-over of 10^B with ab10 is restricted to the proximal 1/3 of the long arm. Consequently, as in the A-type translocations preferential segregation is absent when crossing-over is restricted to the section adjacent to the primary centromere.

The conclusions from both the A-type and the B-type translocations have not taken into consideration the possible presence of secondary centric regions in other arms of the translocation complex. In TB-10a such a centric region in the B part of the 10^B chromosome might nullify the effect of the secondary centric region of ab10, and eliminate the possibility of preferential segregation. It is possible that cytological checks will serve to show the presence or absence of a secondary centric region on chromosome 10^B when ab10 is present. Checks have not yet proven conclusive.

Albert E. Longley

8. Additional linkage information on several of the viviparous mutants.

Data on test-crosses, selfed to show segregation of vivipary.

F1 genotype	Parental combinations		Recombinations Region 1		Recombinations Region 2		Recombinations Regions 1 & 2		Total	% recombination Region 1	% recombination Region 2
+ vp_2 / pr +	79	58	27	38					202	32.2	
+ + vp_2 / wxT5-9c +	107	131	4	1	0	2	0	0	245	2.0	0.8
T1-3a + / + vp5	45	40	20	24					129	34.1	

(Continued on next page)

F_1 genotype	Parental combinations		Recombinations Region 1		Region 2		Regions 1 & 2		Total	% recombination Region 1	Region 2
+ vp7 / pr +	40	34	16	14					104	28.8	
+ + / pr vp_7	18	19	6	5					48	22.9	
T1-7c bm_2 / + vp_8 +	57	54	39	27	7	8	2	1	195	35.4	9.2

Donald S. Robertson

CHARLES F. KETTERING FOUNDATION
YELLOW SPRINGS, OHIO

1. Carbonic anhydrase activity in corn.

The rate of CO_2 evolution, as measured manometrically, was used as the index of carbon anhydrase activity. Etiolated normal and etiolated albino corn plants showed no significant activity. Light-grown albino corn plants showed substantial activity, usually equaling that shown by the green genotypes. Yellow seedlings ranged in activity from almost twice as high as green seedling to considerably less.

A certain pedigreed strain of Zea mays tested showed activity for yellow, green, and white seedlings, respectively, in the ratio of 1.7 to 1 to 0.4. Two other pedigreed strains showed activity for green and white seedlings, respectively, in the ratios of 5 to 6 and 3 to 5. The variation in carbonic anhydrase activity between similarly segregating strains is evidently under the control of independently assorting genes. Lack of chlorophyll in normal corn plants is not necessarily correlated with low carbonic anhydrase activity.

Thomas E. Brown & H. C. Eyster

2. White kernel with red embryo on red-white 1:1 ear.

Selfing the plant, derived from the above anomalous kernel, produced an ear with 3 red: 1 white kernels. The embryo hence was heterozygous red. The kernel with white endosperm and red embryo could have been produced by: (1) a mutation in the egg nucleus from r to R; (2) by mutation in the male nucleus, which united with polar nuclei, from R to r; or (3) the double fertilization of egg nucleus and polar nuclei could have been accomplished by male nuclei from

two different pollen tubes instead of from one pollen tube as is usual.

H. C. Eyster

3. Moths in yellow and white corn kernels.

An F_1 ear with F_2 seeds segregating 3 yellow: 1 white became mildly infested with moths. There were 45 infested seeds 40 being yellow and only 5 white.

	yellow	white
Actual	40	5
Expected (e)	34	11
Difference (d)	6	6
(d^2)	36	36

d^2/e 36/34 = 1.06 36/11 = 3.27

$X^2 = 4.33$

P (for 1 degree of freedom) = 0.04 (approx.)

For the moths to have chosen yellow or white kernels on the basis of chance, the probability should have been higher than 0.05. There is an indication of a possibility that there has been some selectivity. Rather than to assume that females select yellow kernels in preference to white on which to lay eggs, it seems more logical to assume that the survivial of moths was better in yellow than in white kernels because of carotene in the yellow.

H. C. Eyster

4. Study of vigor in F_2.

An F_2 derived from a cross between inbred line 38-11 (yellow starchy) and white sugary gave the following data on seed weights and seedling height (after 3 weeks growth in greenhouse). Height measurements are from soil line to tip of longest leaf.

Ear no. 1 segregating 9:3:3:1 ratio

Genotype	Average Wt. of Seeds	SE_M	Average Seedling height	SE_M
YY Su--	272.8 mgm	0.080 mgm	36.0 cm	0.50 cm
Yy Su--	276.4	0.074	36.7	0.41
Y--susu	231.8	0.075	34.3	0.6
yy Su--	272.8	0.136	37.2	0.64
yy susu	221.1	0.264	29.5	1.3

Ear no. 2 also segregating 9:3:3:1 ratio

Genotype	Average Wt. of Seeds	Average Seedling height	SEM
Y-- Su--	286.3 mgm	41.9 cm	0.40 cm
Y-- susu	239.0	38.5	0.47
yySu--	252.4	37.8	0.63
yy susu	252.4	34.4	0.82

H. C. Eyster

CONNECTICUT AGRICULTURAL EXPERIMENT STATION
NEW HAVEN 4, CONNECTICUT

1. Cytoplasmic pollen sterility in corn.

A new source of cytoplasmic pollen sterility has been found in a plant introduction from Turkey. The cytoplasmic condition from this source is being transferred to some of the same inbreds having sterile pollen from the three sources described previously for comparison.

Normal lines used to propagate cytoplasmic sterile lines in a completely sterile condition for many generations when applied to completely sterile plants of another source of sterility have produced progenies segregating for normal pollen production, partial pollen production and complete sterility. This indicates that the different sources of cytoplasmic sterility are genetically different. There are also some visible differences in the way the aborted pollen grains of different sources of sterility stain with iodine.

2. Lazy and normal corn plants growing in different positions.

Lazy plants tied upright to stakes grow normally. After the tissues have hardened the stakes can be removed and the plants remain upright. At any point, up to the base of the tassel, if the plants are not tied while the plants are growing the stalks turn and grown downward. The length of internodes is approximately the same whether the lazy plants are growing horizontally, vertically upright or vertically downward. Normal plants when tied down have their internodes very much shortened as long as the stalks are held in a horizontal position. At any point, up to the base of the tassel, when the stalks are left untied, the stalks turn upright at a short right angle and elongate normally until after pollen shedding is completed. This is a striking demonstration of the differences between lazy and normal corn in the growth hormone relation to gravity.

D. F. Jones

CORNELL UNIVERSITY
ITHACA, NEW YORK
Department of Plant Breeding

1. Control mechanisms of cytoplasmic male sterility.

Variations in the degree of pollen sterility for the cytoplasmic sterile type in maize are quite common. Jones has reported that cytoplasmicly controlled male sterile lines originally isolated in Texas by Rogers and Mangelsdorf are far more stable in maintaining nearly complete sterility in crosses than are sterile lines from three other sources. These other sources include the USDA selection of Jenkins, a South American isolate of Brieger, and a line selected from Plant Introduction material at the Connecticut Station.

The question arises as to whether or not these various cytosterile lines represent an identical basic plasmagene control. It is presumably possible that varying concentrations of the same cytoplasmic inclusion result in variations of good pollen produced. However, a second possibility exists. These lines may represent related but distinctly different forms of the plasmagene for cytosterility. Jones has noted (Conn. A.E.S. Bul. 550) that "the Brazilian type of Dr. Brieger produces much pollen under Connecticut conditions. No completely sterile progenies have so far been obtained. Indeed, when crossed with C142, a long inbred and very uniform line of California Rice Pop, it produced from 20 to 50% normal pollen on all plants. This same pollinator, C142, on KysT4 (Texas Sterile) inbred produced no more than 1% pollen on two plants". Although limited in plant numbers involved, the results suggest a potency difference of the plasmagene.

More extensive tests were carried out in 1951. The inbreds Wis.W9, Minn.A71, and Ky21 were utilized as sources of pollen restoration. The first two inbreds are considered to be weak restorers while the latter inbred is a strong restorer. Pollen samples from several plants from individual rows of the three restorer type inbreds were mixed. These three pollen mixtures were used at random on three sterile inbreds--two USDA steriles, Ind.$P8^{S5}$ and $Wf9^{S5}$ and the third a Texas sterile, $I205^{t4}$. Table 1 illustrates the kind of pollen production obtained from progeny of each of the nine original single crosses.

These data indicate that a disproportion in plasmagene concentration could well account for the variations between the F_1 pollen productions of (Ind.$P8^{S5}$ x Wis.W9) and (Ind.$Wf9^{S5}$ x Wis.W9) as well as the other comparative crosses involving Ind.$P8^{S5}$ and Ind.$Wf9^{S5}$. However, the picture while not entirely critical in the case of restorer crosses with the $I205^{t4}$ sterilizer, points to a distinct change in plasmagene action (and perhaps potential). It is seen that Wis.W9, MinnA71, and Ky21 restore normal pollen pro-

duction to Ind.P8^{S5} and Ind.Wf9^{S5} in rather proportional amounts. However, two of these restorers, Wis.W9 and Minn.A71, show no restoration potency in combination with I205^{t4} while Ky21 returns I205^{t4} to practically normal pollen production. In fact, the amount of good pollen produced by the cross (I205^{t4} x Ky21) is greater than that shown by the cross (Ind.Wf9^{S5} x Ky21). Logically, some element beyond simple concentration effect is indicated. This fact may well be of great practical importance in evaluating commercial crossing fields of cytoplasmicly male sterile inbreds and single crosses. Certainly, knowledge of the source of the plasmagene and its response in varying hybrid combinations will aid immensely in determining which inbreds or selections with inbreds will facilitate the practical application of this form of pollen sterility as a by pass to the detasseling process.

One other limited experiment was conducted last summer: Since pollen production of some restored single crosses such as (Ind.P8^{S5} x Ky21), (I205^{t4} x Ky21), and (C106^{t4} x Ky21) is restored to normal, > 95% or 95% good pollen, it is highly probably that some of these functional pollen grains no longer carry the dominant allele of the restoration gene. It has been shown by Jones that restored plants when selfed will segregate in a 3:1 ratio in F_2 progenies; hence, the sterilizing element, or at least a precursor of the element, is still present in restored plants. Crosses of restored plants onto a normal fertile inbred were made in this way:

C106♀ x (C106^{t4} x Ky21)♂

Progeny of several such crosses were examined for evidences of cytoplasmic sterility. If the dominant restorer conditioned all pollen to function independently of the presence of the sterilizing plasmagene and independently of the dominant allele for restoration, certain pollen grains should carry the sterilizing effect over into the progenies observed. Table 2 presents the results from these observations and clearly indicates that the sterilizing plasmagene is not transmitted with any great frequency--if at all--through the restored pollen grains. Fluctuations shown in Table 2 are no greater than that which might be expected in any comparable sample from normally fertile material. The cause for a few plants with reduced amounts of normal pollen would likely be environmental upsets, however, these plants have been selfed and their progenies will be examined further.

H. L. Everett

Table 1.

CYTOPLASMIC STERILITY

Test for Uni - or Multi Particle Control

Source of Sterility ♀		Source of Restoration ♂ Wis. W9	Minn. A71	Ky21
Ind. P8^{S5} USDA	% Good Pollen	49.1% *	34.4%	94.5%
	Range	5 - 75	1 - 90	90 - >95
	No. Plants	29	25	32
Ind. Wf9^{S5} USDA	% Good Pollen	6.6%	11.8%	82.6%
	Range	< 1 - 20	< 1 - 90	10 - 95
	No. Plants	27	28	27
Iowa I205^{t4} Texas	% Good Pollen	0%	0%	91.3%
	Range	0 - 0	0 - 0	50 - >95
	No. Plants	21	26	31

* Drawings indicate type of Pollen Produced - Iodine test.

Table 2.

Test Crosses: C106♀ X (C106^{t4} X Ky21)♂

Summation

*Amount Good Pollen >	or 95%	90%	80%	60%
Cross I	40	1	1	0
Cross II	14	1	0	1
Cross III	26	2	0	0
Cross IV	26	3	0	0
Totals	106	7	1	1

* Iodine Test.

Grand Total = 115

2. Chemical mutagens.

As part of a study on chemical mutagens, pollen samples of a multiple dominant stock were treated last summer with certain gaseous compounds and used to pollinate a multiple recessive stock. Three of the chemicals were effective in causing altered endosperm characters in the F_1 kernels. These compounds are ketene ($CH_2 = C = O$), ethylene oxide ($\begin{matrix} CH_2 - CH_2 \\ \llcorner\!\!\_\!\!\lrcorner\, O \end{matrix}$), and dimethylamine $(CH_3)_2NH$. The ketene treatments were carried out by running the gas from a generator into a beaker (under hood) and, after allowing 15 seconds for saturation, pollen samples were exposed to the ketene vapor for periods of from 15 to 240 seconds. No seeds were produced from pollinations with samples that had been subjected to the longer treatments (30 to 240 seconds). One ear containing 124 kernels was produced by using the pollen treated for 15 seconds. None of the F_1 kernels was normal. Most (±99%) were apparently mosaics for the a locus in that they showed purple and colorless sectors of various sizes. At least one, and probably more, kernels were mosaics for the su locus. Whether or not heritable changes were induced in male nuclei contributing to the hybrid embryos remains to be tested.

Treatments with ethylene oxide and dimethylamine were carried out by using the apparatus described by Gibson, Brink and Stahman (J. Hered. 41:232-238. 1950). Effective dosages were 7 to 10 ml. of ethylene oxide for 10 minutes and 3 ml. of dimethylamine for 10 minutes. Each of the chemicals produced both entire and sectorial F_1 endosperm deficiencies.

Evidence suggesting that the activity at least of ethylene oxide may be mutagenic has been obtained from experiments in which the authors have utilized the back mutation technique in Neurospora.

H. H. Smith & A. M. Srb

JOHN INNES HORTICULTURAL INSTITUTION
HERTFORD, HERTS., ENGLAND

1. Cold room studies.

Advantage was taken of the newly installed controlled temperature room to study the effect of dosage of the Su gene on cold hardiness. Keeping embryo genotype constant by use of reciprocal crosses between different inbred sweet corns and an inbred dent, it was evident that at 50°F for 10 days seeds of endosperm constitution Su/Su/su were more tolerant than su/su/Su seeds. This might be in part due to an interaction between embryos and endosperms of different genetical constitution. There was also strong evidence that heterotic effects are important, as hybrid seeds were more cold tolerant than their inbred parents.

As cold tolerance is partly due to resistance to soil pathogens at low temperatures, a test was made to see if an antibiotic, penicillin, could be used to promote germination. Genetically uniform inbred lines of sweet and dent corn, treated with 5000 units of penicillin for 12 hours, were subjected to 50°F for 12 days but showed lower germination than untreated seed.

2. Soil blocks.

A joint experiment has been started with Mr. Newell using soil blocks to see if these help to avoid frit-fly attacks. The trial will have to be repeated next year as growing conditions in England for 1951 were exceptional. There was no evidence that soil blocks increased plant vigor or increased yields.

Gordon Haskell

MISION BIOLOGICA DE GALICIA
PONTEVEDRA, SPAIN

1. Investigations on the storage of sugar in corn stalks.

In Maize Genetics Coöperation News Letter numbers 23, 24 and 25, W. Ralph Singleton, Robert Van Reen and Tsunetoshi Sibuya reported corn stalk sugar storage. From D. F. Jones we received the inbreds C103, P8, M14, W22, N6, T1, C106, and hybrids W22 x (T1 x C103), (T1 x 103) x C106, T1 x C103, M14 x C103, and W22 x C103.

Refractometer readings on more than 30,000 plants were made. All the plants observed were selfed for breeding purposes.

86 indigenous varieties
685 lines (from S_0 to S_{10})
130 inbreds, parents of standard American double crosses

Planting dates were not the same for all the material, (Table 2). The summer of 1951 was cloudy and cold (see meteorological data Table 1) and, because of this, the later material planted was handicapped for sugar production.

Lines C103 and M14 were planted at two different dates (Table 2).

Refractometer readings range from 1% to 21% at maturity.

Related families show similar variations in sugar content. Uniformity in lines is proportional to the number of generations of selfing.

There seem to be some differences between yellow and white corn; yellow corn having higher readings than white corn. Inbreeding does not affect the mean reading (Table 3).

Some lines with very high readings were found, for example, inbred 47-L1-Sg had an average of 14.06 and a maximum of 21 (table 2). This inbred had perfectly matured and well-filled ears.

Table 1.

Meteorological Data

	Temperature C° Ave. Max.	Ave. Min.	Mean	Precipitation No. Rainy Days	Mms.
May	18.3	8.7	13.5	14	104.1
June	23.0	12.8	17.9	5	58.9
July	26.8	14.4	23.0	4	23.8
August	24.5	12.6	18.6	2	102.5
Sept.	24.2	13.0	18.6	9	62.1
Oct.	19.7	9.3	14.5	13	123.8
Nov.	15.5	8.9	12.2	21	349.9

Mariano Blanco & Jose L. Blanco

Table 2.

Refractometer readings in percentage of dissolved solids

Type of Corn	classes 2	3.5	5	6.5	8	9.5	11	12.5	14	15.5	17	18.5	20	21.5	Dates Planting	Observation	Ear maturity
C102				1		2	1								12/5	17/10	17/10
C103, first planting			5	3	2	2	2								12/5	30/10	30/10
C103, second "		3		5	4	8	2	1	2	2	1				16/6	10/11	8/11
C106	2	19	16	19	12	1	3	5							16/6	9/11	
T1				1	2										16/6	9/11	8/11
Nb	2	17	7	2	2										16/6	30/10	8/11
W22	2	5	8	19	6	4	1	1							16/6	30/10	8/11
P8				4	7	7	7	7	3						16/6	9/11	8/11
M14, first planting		7	10	2	8	4	1								16/6	30/10	8/11
M14, second planting	1	6	24	32	36	62	38	40	9						16/6	24/10	8/11
W22 x (T1 x C103)	2	10	2	8	3	4	9	10	10	4	1				16/6	10/11	12/11
M14 x C103	2	6	7	10	7	1	9	5	2						16/6	10/11	12/11
(T1 x C103) x C106	4	1	11	8	6	3		3	2	2	1				16/6	10/11	12/11
T1 x C103	1		2	13	7	10	7	14	2	2	1				16/6	10/11	12/11
W22 x C103	10	12	3	9	5	5	1	5	2						16/6	21/11-	22/11
Yellow Flint*	4	18	26	56	34	54	14	8	3						1/5	16/9-10/9	8/9-29/9
Yellow Dent*		4	18	68	53	71	20	18	4						1/5	11/9-14/9	17/9-18/1
White Flint*	1	8	5	32	9	13	2	1	1						1/5	15/9-18/9	17/9-3/10
White Dent*	1	8	26	27	13	11	1	2							1/5	19/9-20/9	20/9-18/1
47-L1-1-2-1-1-1-1-2-1 (yellow flint,8 rows)		3		1	1	2	3	3	4	9	6	5		1	1/5	3/10	5/10
Indigenous varieties*		5	15	23	15	15	9	4							16/5	17/10	17/9-17/1
American standard inbreds*		14	29	43	20	9	11	4									

*Figures correspond to number of means of inbreds.
In all other cases the figures correspond to number of individual plants.

Table 3. Means of varieties (S^0 and S_1) compared with the means of their inbreds.

	Variety number	kernel type	Average Percent Sugar 2	3.5	5	6.5	8	9.5	11	12.5	14	15.5	17	18.5	20	21.5	Mean of means
Inbreds	36	Flint yellow	2	1	3		5	2									6.28
Variety	36	" "			1	1	1										6.50
Inbreds	42	" "		1	3	1	7										6.75
Variety	42	" "			1		1	1									7.50
Inbreds	47	" "										1					15.50
Variety	47	" "				1	1		1								8.50
Inbreds	39	" "			1	1	1										6.50
Variety	39	" "			1	3	3	3	3								8.46
Inbreds	40	" "			1		1	2	1								8.60
Variety	40	" "			1	1	1	5									8.37
Inbreds	33	Dent "			1	1	5	6	1	1							8.80
Variety	33	" "		2		3	2	3			1						7.72
Inbreds	69	" "			1	2		2	2								8.42
Variety	69	" "			1	1		1									7.00
Inbreds	70	" "			1		1	1									7.50
Variety	70	" "			1	1	2										6.87
Inbreds	75	" "				2	5										7.57
Variety	75	" "				4	4	2									7.70
Inbreds	76	" "				2		2		1	1						10.08
Variety	76	" "			4	3	6	4									7.38
Inbreds	79	" "					4	2	2	1							9.50
Variety	79	" "			1	5	5	1	2								7.70
Inbreds	85	" "			1	1	1	2	2								8.64
Variety	85	" "					4	5	2	2							9.73
Inbreds	86	" "				3	2		1								7.75
Variety	86	" "			4	5	7	3	1								7.40
Inbreds	222	Flint white		2		1											4.50
Variety	222	" "		1	1	3		1									6.25
Inbreds	38	" "	1	1	2	4	3										5.95
Variety	38	" "		2	2	2	1	1									5.87
Inbreds	65	Dent "		1	2	5	1	2									6.63
Variety	65	" "			3	3	3			1							7.10
Inbreds	95	" "		1	3												4.62
Variety	95	" "			3		1										5.75
Inbreds	35	" "			1	3											6.12
Variety	35	" "			5	1	4				1						7.04

2. Pollen grain size of P_1, P_2, F_1, F_2, F_3, F_4, and F_5.

Pollen size of 5 to 6 plants was measured in each genetical class and 25 pollen grains of each plant were measured. The average pollen size and the average standard deviation of each genetical class are shown in Table 4.

Table 4.

	Mean	Av. S. D.	No. Plants
Kr(187-2) 1947	67.36	2.88	5
WF9	75.38	3.60	6
(WF9 x Kr) F_1	70.68	3.74	5
(do) F_2	70.13	3.90	6
(do) F_3	71.04	3.56	5
(do) F_4	69.36	3.15	5
(do) F_5	72.12	3.74	6

F_1 pollen size is intermediate between that of the parents. It appears that pollen size may be increased by inbreeding and selection.

We wish to thank Dr. D. F. Jones very much for this material.

Jose L. Blanco

MISSOURI BOTANICAL GARDEN AND PIONEER HI-BRED CORN COMPANY
ST. LOUIS, MISSOURI JOHNSTON, IOWA

The physical mechanism of denting in maize.

The physical mechanism of denting in maize must be understood before the genetics of denting can be explored intelligently. Denting generally has been attributed to a differential shrinkage of the horny and floury endosperm regions during final drying down of the kernel. It has been said that the floury endosperm shrinks more than the horny endosperm, causing the kernel to collapse in the crown region. This is not literally true; denting is caused by the collapse of a region within the floury endosperm. This conclusion is based on studies of several varieties of corn, including corn belt inbreds, eight-row Northern flints, Southern dents (extremely dented varieties), and eight-row flour varieties.

A region of comparatively starch-free cells, which often contains an acellular, fluid-filled cavity, was found in the central portion of immature endosperms of all varieties of corn

studied. This region, hereinafter referred to as the region of "loose-starch cells," is located within the floury endosperm zone, but its cells are distinct from the starch-packed cells of the floury endosperm. It extends from the base of the endosperm to a point near the crown of the kernel. The loose-starch cells and the acellular cavity collapse when the endosperm becomes dehydrated at maturity, and the region is represented in the mature kernel by collapsed and fragmented cells containing diminutive starch grains.

The amount of denting of an individual kernel depends primarily upon the degree of extension of the loose-starch region into the crown of the kernel. If there are several layers of starch-packed cells (cells of either horny or floury endosperm are equally effective) between the top-most extension of the loose-starch region and the pericarp, the kernel will not dent, for during endosperm dehydration the layers of starch-packed cells form a supporting arch and prevent collapse of the crown. However, if the loose-starch zone extends entirely to the pericarp in the crown region, the pericarp alone is not strong enough to support itself when the loose-starch region collapses; it is pulled down (or sometimes merely collapses) into the cavity left by the shrinkage of the loose-starch cells and acellular cavity, thus causing the kernel to dent. The volume occupied by the loose-starch zone, especially in the more basal portions, generally is filled in after its collapse with ingrowing floury endosperm tissue, whether or not the kernel has dented.

The "denting potential," that is, the proximity of the loose-starch region to the crown of the kernel, is the primary factor for determining denting in corn. The more of the crown region occupied by loose-starch cells, the deeper the dent. Differences in kernel length-width proportions, vigor and size will affect the degree of denting, but only within the limits prescribed by the denting potential. It is probable that the proportion of horny to floury endosperm is not a causative, but rather a consequent or a corollary phenomenon of denting.

Donald N. Duvick

OAK RIDGE NATIONAL LABORATORY
OAK RIDGE, TENNESSEE

Biology Division

1. Gamete factor on chromosome 9.

A gamete factor was found which shows close linkage with the waxy gene. In backcrosses of heterozygous Ga wx/ga Wx as the male to homozygous waxy plants, only 10% starchy kernels are obtained. Further testing of these B_1 starchy kernels revealed that 30% of them

are due to functioning of ga Wx pollen and 70% are crossovers. These data indicate that there is 3% functioning of ga pollen in competition with Ga and 7% crossing over between the Ga and Wx loci.

2. The effect of oxygen tension on the radiosensitivity of chromosomes.

Experiments conducted on the irradiation of pollen in different atmospheres revealed that there is a 3.2-fold decrease in chromosome aberrations when the exposures are made in 100% nitrogen as compared with exposure in air. The A_1-Sh_2 region was used in this study. A_1 Sh_2 pollen was irradiated and used to pollinate a_1 a_1 sh_2 sh_2 tester plants. Aberrations were detected in the endosperm as entire losses of the dominant characters and as mosaics. Irradiation in nitrogen decreased the frequency of entire losses by a factor of 2.7 while the mosaics were decreased by a factor of 9.9. This difference is statistically significant and strongly suggests that the effect of oxygen tension during irradiation is on the recovery process of broken ends rather than on the initial breakage mechanism as had previously been postulated.

Drew Schwartz

PENNSYLVANIA STATE COLLEGE
STATE COLLEGE, PENNSYLVANIA

Department of Botany

1. Disease resistance in maize.

The program is devoted largely to the practice of artificially producing disease epiphytotics under corn nursery conditions, so that disease resistant plants may be finally selected. Resistance to seedling blights and some forms of smut may be recognized at silking time but most resistant plants are positively identified September 10-20, for leaf blights, and at harvest time for stalk rots, ear rots, and other types of smut.

Disease treatment begins with planting and ends with stalk rot inoculations in August. Lines are seldom carried beyond F_4 in the disease nursery at which time they are turned over for yield testing. Lines surviving the yield test are reused in making new crosses for disease resistance. In this way the build up of resistant material is cumulative.

Gene frequency for resistance to Northern leaf blight caused by Helmenthosporium turcicum is rather low. Inheritance is quantitative. We now limit selection to plants rating 1.0 and 2.0. Plants of the higher rating segregate and must be reselected. As a matter of practical observation, a great many lines will continue to segre-

gate through F_4 for most diseases but susceptibles appear less frequently as inbreeding progresses. Plants highly resistant for a great number of diseases are rare.

Chief limitations of the disease program are our relatively short season which limits the expression of stalk rot and makes difficult an adequate build up of Southern leafblight caused by Helmenthosporium maydis.

We believe the detection and subsequent doubling of haploids to have distinct advantages in studying inheritance of disease resistance. A project is planned whereby work of this type may be carried out.

C. C. Wernham

2. Vestigial-tunicate hybrids in the production of glumeless sweet corn.

The advantages and the difficulties involved in utilizing Sprague's Vg gene in the production of glumeless sweet corn have been adequately described by Galinat (Jour. Heredity 42:115-116, and Nos. 24 and 25 of the News Letter). While engaged in maintaining the Cobp stocks in 1949, the writer, unaware of the similar work at Connecticut, began a series of crosses to incorporate the Vg gene in sweet corn. This work has been continued here. Apparently different methods and procedures have been used in the two programs. Both have been successful in producing glumeless ears on plants which shed pollen.

The starchy Vg stock (Cobp 49-40) was outcrossed to a number of sweet corn strains and also to genetic types which have very large tassel glumes. The latter included Ts6, Ts5, and Tu, all of which were homozygous for su. Two sources of tunicate were used--the original strain considered to be conditioned by a semidominant lethal, and Mangelsdorf's derived homozygous stock.

From limited F_2 and backcross populations planted in 1951, thirty-two segregates were observed which had glumeless ears but produced large quantities of pollen. All these segregates were in cultures derived from the vestigial-tunicate crosses. Tassel glumes on these modified plants ranged from mere vestiges in some to practically normal ones in portions of others. The amount of pollen shed also varied but was not necessarily higher in the larger glumed types. It is also of interest to note that these plants shed pollen under quite adverse conditions of temperature and drought.

Selfed and crossed seed of these plants will be used in studies this season to determine more about the nature and number of the modifier gene(s) concerned. Early production of glumeless sweet corn also seems feasible.

James E. Wright, Jr.

UNIVERSITY OF ILLINOIS
URBANA, ILLINOIS
Department of Agronomy

1. Monoploidy versus selfing in inbred production.

Isolation of monoploid maize plants by genetic screening methods was developed by Dr. L. F. Randolph and recently put into large scale operation by Dr. S. S. Chase. Many corn breeders are now interested in producing inbred lines by doubling monoploid plants.

The advisability of using this system in a breeding program depends upon two points; first, whether lines may be developed more cheaply than by selfing; and second, whether the lines are superior to selfed lines.

In 1950, four single cross hybrids were tested for frequency of haploidy. Results of this test are given in the table below.

Hybrid	Tester (a1A2CR^{r}BP1Pr1g)	Mean number of identified monoploids per thousand seedlings
B10 x Oh41	R 43687-1	3.0
B10 x Hy2	"	0.6
R61 x 187-2	"	1.2
WF9 x 38-11	"	1.6

Lines are being produced from the single cross B10 x Oh41 both (1) by doubling monoploid plants and then self-pollinating, and (2) by ordinary selfing. The relative value of lines produced by each method is to be assessed in field trials of single crosses between lines derived by each method and a common parent.

D. E. Alexander

2. A promising method of analyzing marked chromosome segments carrying genes for quantitative characters.

Backcross-heterozygote testing involves using two parents with contrasting genetic factors, which make it possible to separate the homozygote from the heterozygote on the basis of endosperm characteristics. Past studies of quantitative gene action have generally involved the entire chromosome complement. A more accurate test might be obtained by studying only segments containing genes linked with the marker gene.

With yellow endosperm as the marker, an F_1 between a white and a yellow inbred was backcrossed to both parents. Seed homozygous

and heterozygous for endosperm color may be separated in both backcrosses, giving the four classes in Table 1. The marked chromosome segments will be variable in size due to crossovers. However, with adequate sampling the marked segments should be equal in all classes.

Table 1. Types of Marked Segments and Possible Theoretical Action of Genes on These Segments

Class	Pedigree	Genotype of marked segment	Action of genes on the marked segments: R30(y) segment dominant	M14(Y) segment dominant	Heterosis for Y/y	Y interacting with R30 complement	y interacting with R30 complement
1	(M14XR30)R30	Y/y	1	1	1	1	1/3
2	(M14XR30)R30	y/y	1	0	0	0	1/3
3	(M14XR30)M14	Y/y	1	1	1	1/3	1
4	(M14XR30)M14	Y/Y	0	1	0	1/3	0

Classes 1 and 3 (Table 1) will be equal in regard to the marked segments, each having M14(Y) and R30(y) segments. Class 2 will be homozygous for the R30(y) segments and class 4 will be homozygous for the M14(Y) segments. The genotype of the remaining unmarked chromosomes on the average will be 3/4 R30 and 1/4 M14 when backcrossed to R30 and 1/4 R30 and 3/4 M14 when backcrossed to M14. In Table 1 this proportion of recurrent parent is assumed to have no differential effects independent of the marked segments. In actual tests this would not be true in many instances.

The actions of genes on the marked segments in Table 1 are theoretical. There also may be complicated interactions of the various types of gene actions, which would make it impossible to determine the gene actions concerned. However, there will be some instances in which the gene action is discernible.

Table 2. Performance of Single Cross Hybrid & Backcross-Heterozygotes*

Class	Pedigree	Genotype	Height: Ear	Height: Plant	Ear length	Kernel row no.	Ear weight
			in.	in.	in.	no.	lb.
1	(M14XR30)R30	Y/y	29.6	68.9	8.56	7.56	17.5
2	(M14XR30)R30	y/y	30.4	69.8	7.99	7.50	15.7
3	(M14XR30)M14	Y/y	30.2	70.6	8.20	8.34	14.8
4	(M14XR30)M14	Y/Y	26.4	66.6	8.30	8.09	13.9
	M14XR30		32.7	74.6	9.23	7.67	18.9
	L.S.D. 5%		1.8	1.4	.29	.37	1.6

*Four replications of 30 plants each.

Table 2 gives some actual data on such material. Classes 1, 2, and 3, possessing the R30(y) segment, exhibited greater plant and ear height than class 4 which has no R30(y) segment. This indicates the R30(y) segment carries genes dominant for greater plant

and ear height, while the M14(Y) segment carries recessive genes.

Classes 3 and 4 are of nearly equal ear length, despite the presence of R30(y) segment in class 3 and its absence in class 4. Therefore, the R30(y) segment does not appear to carry genes modifying ear length, or does not differ from the M14(Y) segment in such genes. The M14(Y) segment may carry dominant genes for ear length, but class 1 is longer eared than expected. These ear length data may fit the scheme in Table 1 in which genes on the M14(Y) segment are interacting with the unmarked R30 complement. This would account for the greater ear length in class 1 as it contains the M14 (Y) segment and has a maximum amount of R30 complement.

The larger proportion of M14 complement present in classes 3 and 4 resulted in higher kernel row number than classes 1 and 2 which are made up largely of R30 complement. Since classes 1 and 2 are nearly equal in row number, the presence of the M14(Y) segment in class 1 had little effect on row number. If the superiority of class 3 over 4 is significant, it might indicate that the R30(y) segment was interacting with the M14 complement.

Presence of a larger proportion of R30 in classes 1 and 2 (backcrossed to R30) resulted in greater yield than classes 3 and 4 (backcrossed to M14). Class 1 significantly outyielded class 2, due, of course, to the presence of the M14(Y) segment in class 1. The presence of the R30(y) segment in class 3 did not differentially affect yield in contrast to class 4 in which the R30(y) segment is absent.

All the possibilities of the backcross-heterozygote testing outlined above have not been discussed in this brief note. However, on the basis of the limited data, the method does appear to offer some promise in determining the action of genes affecting quantitative characters.

L. F. Bauman

Department of Botany

Mutable r allele.

Studies among the progeny of a single seed (of Peruvian origin) which had numerous small colored areas on a colorless ground indicate that the effect is due to an allele of r(designated r-mutable and probably similar to r-stipple). The allele is associated with green plant color and its aleurone effect is not to be confused with the mottling ordinarily obtained in Rrr endosperms.

Increasing doses of the r-m allele produce corresponding increases in the frequency of colored regions in the aleurone. It is not uncommon to find several wholly colored seeds on ears of homozygous

r-m individuals crossed with rr, and some of these have been shown to be germinal reversions. Under the same conditions changes to stable r (colorless aleurone) are much less frequent. Plants having the constitution R/r-m give rise to exceptional cases having a strikingly reduced frequency of reversion areas. These occur in ca. 4% of the offspring of such heterozygotes crossed with rr plants and apparently are not dependent on a specific R gene since all of several heterozygotes involving r-m and different R forms produced the exceptional offspring. From studies employing R/r-m heterozygotes marked with g and heterozygous for T9-10a(according to Dr. E. G. Anderson who kindly supplied this stock, the break-point is about 4 units beyond R) it is apparent that the occurrence of the exceptional individuals is associated with crossing over between g and T. It is considered tentatively that the high rate of reversion of the so-called r-m allele is a function of a linked modifier located about 4 crossover units from r-m and either absent or present in different form on the R-carrying chromosome.

John R. Laughnan

UNIVERSITY OF MINNESOTA
UNIVERSITY FARM, ST. PAUL 1, MINN.
Division of Agronomy and Plant Genetics

1. Brittle endosperm.

Tests are reported with characters which appeared in the corn breeding project and were turned over to us for testing. Tests with three brittle endosperms show that two of them are allelic and indistinguishable phenotypically from bt_2. The third one is allelic and similar to bt_1.

A yellow stripe character is the same as the first ys.

Ed. Clark

2. Sugary endosperm.

An endosperm type resembling su_2 when weakly expressed is not the same as su_2, but when crossed with $su^{am}du$ gave this type.

C. R. Burnham

3. Deficiencies.

Tests for deficiencies were continued in F_1's between translocations involving the same two chromosomes. As reported in the 1951 News Letter, T1-7a/b x f produced some f plants in F_1,

interpreted as carrying a deficiency resulting from a new combination of the four translocated chromosomes. New tests of bd, ra gl v_5 on T1-7a/b F_1 plants gave all normals. Tests of zb_4, and sr on T1-9a/c F_1 plants were negative but a br f stock crossed on T1-9a/c produced irregular and unexpected results for these characters. (Tests of ra_2, lg_2, gl ra, and bd on T3-7a/b gave all normals. Tests of v_2, y_s, and la on T4-5d/c gave all normals.

D. M. Gopinath
(Potato Research Institute
Kufri, Simla Hills, Simla,
India.)

4. Cytological loops.

An examination of the F_1 of T5-7a x T5-7c shows a loop on 5 and on 7. From the backcross of T(5-7a/c)x a, two plants had no loops, one had one and three had two loops. Crosses for deficiency tests were made.

Slavko Borojevic
(Poljoprivredno-sumarski
fakultet, Zagreb, Jugoslavia)

5. Mustard gas treatment.

A further cytological test places doubt on last year's report of a ring of four chromosomes in one of the plants with partial sterility derived from nitrogen mustard gas treatment of pollen. (See 1951 News Letter)

6. Corn borer resistance.

Readings from corn borer hand infestation will be obtained this summer on the backcrosses involving translocation markers and borer reaction. Readings from hand infestation of the last two summers showed that the translocation stocks differed in their reaction to borer, some were resistant, others less resistant and others susceptible. A few preliminary readings on a few backcrosses to resistant and to susceptible parents were made last summer (seed for which was produced in Mexico and in the greenhouse at Calif. Tech.). The backcrosses to the resistant inbred lines did not appear to segregate while those backcrossed to the susceptible line did, suggesting some dominance of the resistance in these lines.

M. A. Ibrahim

7. Linkage tests.

Another endosperm type which appeared in the Northrup King breeding plots usually has more soft starch on the cap with shrunken vitreous areas elsewhere. The original ear had typical brittle - 1 kernels also. The latter gave all bt when crossed with bt_1. A Ga factor is also in the material, but tests suggest the new type may be closely linked with bt_1 or an allele which may mutate to bt.

A small F_2 population (135 plants) shows no evidence of linkage between na_2 and golden-1. These data, together with the value of about 40% between Og and na_2 reported by Lindstrom, indicate the order is probably na_2 - Og - g.

The polymitotic stock from the Coöp shows the expected linkage of po with Y (26.3% on a small population).

Several more new characters in addition to those listed last year are being tested for linkage: fired (only a few survive), dwarf with compact tassel.

Although cytologically pa (pollen abortion) in chromosome 1 shows no indication that it is a deficiency it may be too short to be detected easily. In a small test of het. pa x het. as there is no evidence that pa is deficient for the as locus. Both are at about the same region.

Attempts have been made to determine if Y is in the short or the long arm of chromosome 6. The ideal translocation for this is T5-6c in which the break in 6 is in the short arm adjacent to the centromere; the method planned being to test plants homozygous for the translocation but heterozygous for Y and Pl. Thus far no crossover has been identified which places Y in the translocated chromosomes. Three supposed crossovers were grown last summer but proved not to be.

C. R. Burnham

8. Inheritance of characters in corn with special reference to the European corn borer.

A357, a susceptible inbred, was crossed with Floury 235, a resistant inbred. The parents, F1, F_2, and both backcrosses were grown in replicated randomized blocks under manual infestation. Characters studied by a class rating system were leaf feeding, overall damage (to leaves, internodes, mid-ribs, and tassels), tillering, and maturity. An additional character, rind hardness, was determined in the field by a puncture-test machine. The genes for resistance, hard rind, and tillering showed partial phenotypic dominance in the F1 while genes for maturity showed an intermediate reaction. Data for

both leaf feeding and overall damage analyzed by Power's and Mather's methods indicated two major gene pairs differentiated the parents. Estimates of heritability for leaf feeding and overall damage were .25 and .23. Rind hardness appeared to be controlled by at least three and probably four factor pairs and was not associated with corn borer overall damage although it was associated with low below-ear stalk breakage. Rind hardness would probably be expected to be more highly associated with damage by second brood borer than by first brood borer. Differences in tillering appeared to fit a two factor hypothesis better than one or three factor pairs. Rated maturity values were correlated with overall damage at the low level of +.23 and adjustments of resistance values were not made although the early plants showed a tendency to be more susceptible. The data suggested that a minimum of four factor pairs and probably more were differentiating the parents for maturity.

On the basis of these and similar studies it is concluded that the backcross method of breeding may be advantageous for adding corn borer resistance to otherwise desirable lines.

Attie A. Fleming
(now Univ. of Georgia)

9. Correlated inheritance of corn borer resistance from inbred lines to single and double cross progeny.

Where manual application of borer egg masses is used to secure a uniform initial infestation it is rather generally accepted that visual ratings of plant damage reflect the amount of borer survival quite well. It is of considerable interest to see how well the visual ratings of established inbreds are correlated with ratings given their hybrid offspring in the same or different seasons.

At the Waseca sub-station in 1950, 16 lines varying in resistance were grown in duplicate 15 plant rows, infested uniformly, and each row rated for resistance. Ratings on a 1 to 5 scale, with 1 the resistant class, were made for leaf feeding damage and also, at a later date, for total damage points occurring in the internodes, leaf sheaths, midribs, and tassel. One hundred and four single cross combinations made from these 16 lines were planted and infested in the same manner and visual ratings made.

In Table 1 the associations between visual ratings of the inbreds and ratings of all their single cross progenies are shown to be rather satisfactory considering the small number of replications used in the plots of inbreds.

Table 1. Correlations among visual ratings for leaf feeding (L.F.) and damage points (D.P.) of 16 inbreds and the average of single cross progeny.

		Inbred D.P.	Average of S.C. Progeny L.F.	Average of S.C. Progeny D.P.
Inbred	L.F.	+ .64	+.62*	+.68
"	D.P.		+.71	+.75
Single Cross	L.F.			+.89
" "	D.P.			

*1% pt. for 14 D.F. = +.62

Where the leaf feeding rating of each single cross, 104 in all, was compared with the mean rating of the two inbred parents a highly significant correlation of +.59 was obtained. The relationship for damage point rating of the singles with their parental average was +.90.

Another group of 20 inbreds was grown in duplicate plots at Waseca in 1950 and each row rated for leaf feeding and damage points in a similar manner. In 1951, 27 double crosses from these 20 inbreds were grown in single hill plots of 3 plants per hill, spaced 42 x 42 in., replicated 20 times in a randomized block design, infested by hand, and <u>each plant</u> rated from 1 to 5 for both leaf feeding and damage points.

Ratings obtained on each double cross in 1951 were compared with the average ratings for the 4 component parent inbreds as determined in 1950. The calculated correlations are as follows; both values exceed the 1% point for significance:

Leaf feeding of inbreds vs. L.F. of double crosses = +.65
Damage points of inbreds vs. D.P. of double crosses = +.63

These parent-offspring correlations indicate that corn borer resistance is transmitted to hybrids at about the same level of effectiveness as many other agronomic characters of the corn plant.

E. L. Pinnell, E. H. Rinke, and F. G. Holdaway

10. <u>Production of haploids</u>.

About 15,000 seedlings have been examined from a cross of (A344 x A334) x ABPlcr without finding a single haploid plant. Two reasons are possible for this failure: (1) This single cross may have a low frequency of haploids or (2) any haploids occurring in the

population may have failed to germinate because the seed had been two years in storage before attempts were made to extract the haploids.

The ABPlcr tester stock does not appear to develop root color as rapidly as another stock a1 A_2 BPl CR and it is undesirable in that no aleurone color is produced.

To date five haploids have been found in 6000 kernels of single crosses x tester a1 A2 CRBPl.

Studies are under way to determine the most desirable temperature for identification of possible haploids in the germinator.

A. H. Corzo & E. L. Pinnell

UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI
Department of Field Crops

1. Mutation at the Dt locus.

Facilitated by the a^m-1 allele at the a locus, which is very effective in expressing the action of the Dt gene, mutation experiments have been conducted to determine the frequency, direction, and extent of Dt mutation. Crosses of a^s a^s Dt Dt and a^m a^m Dt Dt by a^m dt have been made for this purpose with the following results:

Table 1. Dt mutation rate from crosses by a^m a^m, dt-sh-wx

Culture	Genotype	Total No.	dt	Low Dt 1-75 dots	Med. Dt. 75-150 dots	Dt+
536	a^s a^s Dt Dt	3,930	3 + 1*	3	4	0
537	"	6,420	3	5	1	0
Total		10,350	6	8	5	0

*This case is dt sh, Wx, therefore probably a deficiency of the Dt Sh segment, and does not enter into the frequency.

The data from the 536, 537 cultures are still subject to remote possibility of a change at the a^m locus which might simulate Dt → dt mutation. However, mutations of a^m in the absence of Dt have not been previously found and whole seed changes of a^m to a^s after fertilization must indeed be rare.

Additional evidence (Table 2) was obtained from crosses (a^m a^m Dt Dt and a a Dt Dt x a^m a^m dt sh wx) which exclude this possibility by providing two mutable or dottable a's in each seed to test its

Dt constitution. The additional a^m, since it comes with Dt, can mutate however to a^s giving an a^s a^s a^m Dt Dt Dt seed which will simulate an intermediate Dt mutant. Therefore, Table 2 gives evidence only on mutation to the dt level.

Table 2. Dt Mutation from crosses by a^m a^m, dt-sh-wx

Culture	Genotype	Total No.	dt
532	a^m a^m Dt Dt	4,830	0
533	"	1,740	0
534	"	1,290	0
535	"	4,005	0
		11,865	0
506	a a Dt Dt	2,305	1
Total		14,270	1

The total frequency of Dt → dt mutation (7/24520) compares favorably with that of other genes. Also the above data indicate wide variation in frequency in different stocks.

A low dotting mutant previously found and designated Dt-2 has been tested and found to be rather peculiar. It occurred on an ear from a cross of A^d/a^m Dt dt x a^s a^s Dt Dt. It had 5 dots while sib seeds had 500 or more. When outcrossed on a^m a^m dt dt it gave seeds ranging in dots from 1 to 6, and also occasional seeds with sectors of heavy Dt tissue as though Dt-2 itself were mutating quite frequently back to the parent Dt allele. When 3 doses of Dt-2 are present, with a^m, the seeds have a patch-like, mosaic appearance with areas of low, intermediate, and very high dotting.

2. Canvass of exotics for Dt genes.

A series of 42 exotics from Central and South America which had been prepared in F_1's with an a dt tester by P. C. Mangelsdorf were crossed on a^m dt in the hopes of finding other Dt or Dt-like genes. The F_1's included the following number of accessions: Argentina (1), Bolivia (6), Brazil (5), Colombia (9), Ecuador (5), Guatemala (1), Honduras (1), Mexico (2), Peru (8), and Venezuela (4). All of these gave negative results except for one from Brazil which showed clear dotting on one half of the colorless seeds. The linkage of this Dt effect has not yet been tested.

M. G. Nuffer

UNIVERSITY OF NEBRASKA
LINCOLN, NEBRASKA

Department of Agronomy

Heterosis and yield of grain in corn.

In recent years interest in overdominance (Aa>AA or aa) for yield in corn has been shown primarily as the result of Hull's analysis of single cross trials in corn. On the basis of his findings he has proposed a method of recurrent selection for specific combining ability in corn (Jour. Amer. Soc. Agron. 37:134-245. 1945).

The type of gene action for yield in corn is of considerable importance in that the breeding approach required to obtain maximum yields is dependent upon it. If "Aa> AA or aa' is the predominant type of gene action, crosses between lines differing in their genotypic constitution so as to give a maximum number of heterozygous loci when crossed should result in greatest possible yields. This suggests that maxium heterozygosis and hence yield will result when progressively better lines are crossed with progressively poorer lines, assuming of course that the good and poor lines are such because of the difference in numbers of favorable dominant genes in their genetic structure. Three relatively high-combining S_1 lines selected for progressively higher combining ability through testcross performance in S_2 to S_5 inclusive and likewise three low-combining S_1 lines selected for progressively lower combining ability through testcross performance in S_2 to S_5 inclusive were crossed in all possible single cross combinations within each generation of inbreeding. The lines had been tested against a single cross tester, Wf9 x M14, after each inbred generation and selections were made on that basis.

The yields in bushels per acre obtained from a test of this material planted at Lincoln, Nebraska in 1951 is shown in the accompanying table.

Class	Generation of Inbreeding					
	S_1	S_2	S_3	S_4	S_5	Means
Low x Low	60.3	52.2	60.1	56.4	54.8	56.8
Low x High	60.6	67.3	63.7	70.8	70.5	66.6
High x High	69.0	75.1	68.5	73.0	77.5	72.6

Selection for progressively lower - or higher - yielding ability was effective in that a trend downward in yield for the low x low combinations and upward for the high x high combinations with continued inbreeding is evidenced in the data. The low x high combinations are centered between the two groups at each generation

of inbreeding but tend to follow rather closely the trend of the high x high combinations. The evidence obtained seems to contradict the hypothesis of over-dominance as the predominant type of gene action for yield in this material.

J. H. Lonnquist

UNIVERSITY OF SÃO PAULO
PIRACICABA, S.P., BRAZIL
Department of Genetics

1. Regions of indigenous races in Brazil.

New samples received confirm our former view that there are at least six well defined areas in which different sets of indigenous races are cultivated by the Indians: Pilcomayo-Paraguay-Paraná Basin, divided into two areas: (a) of the Guarani and (b) of the Caingang; (c) the Western and Southern margin of the Amazon Basin, covering territory belonging to Peru, Bolivia and Central Brazil, characterized by races with long ears and strongly interlocked rows; (d) the eastern part of the Amazon Basin, up to the borders of the Guianas, showing some relation to the former region, since interlocked rows are still found; (e) the Atlantic coast with a very hard yellow flint race; (f) in the NW-region bordering Colombia, races are cultivated which seem to belong in a general way to the southern Colombian-Ecuadorian area. No samples were received so far of the central part of the Amazon Valley, around Manáus, and it seems possible that no indigenous maize exists in this region.

2. Indigenous corn from Colombia.

The studies of material collected in 1949 and of samples received from my colleagues Drs. Chavariaga, Villamil, Alberto Goncalez and Ernesto Villegas and also from Dr. Reichel-Domitoff, have now progressed sufficiently to allow some conclusions. Of these samples, the last mentioned lot from northern Colombia and the region of the Sierra de Sta. Martha has been especially interesting. The material grown in Arroyo Grande for Barranquilla market, in the valley of the Sevilla river near Sta. Martha, by the Chimilo and by the Motilones Indians show a perfect gradation from introduced races to pure indigenous material. From this material it seems quite evident that two racial groups: yellow-orange flint (often called "Cuba") and yellow or white dent are introductions, much favored by the white population, they are not really indigenous in the area, but a post-Colombian introduction. Among the numerous indigenous races some soft corn races with beaked kernels are especially interesting; they may or may not be dented. There is also an interesting dent corn race, often called "Cariaco", with very

long yellow kernels on short, cylindrical, many-rowed ears.

On the Pacific coast the Choco Indians cultivate a peculiar kind of small seeded pop corn, with tillering plants, small, many-rowed and somewhat conical ears. This race seems to be highly resistant to inbreeding, but shows pronounced vigor when outcrossed to other races of corn, a fact also observed with other races of maize from "backwood" areas such as the races from Assam.

In Central Colombia one finds a complex mixture of dent and flint corn in cultivation, which I think should be considered as mentioned above, as post-Colombian introductions. There are, however, at least two older races, though both of them have a distribution which reaches north into Mexico: both have generally large conical ears with pronounced butts. One called "Capio" is a soft corn generally white and evidently identical with the Mexican Cacuhacintle and the corresponding Guatemalean race. The other old Colombian race has hard yellow flint kernels and may be called "Mountain Yellow". The latter seems not to penetrate further south while the Capio reaches the Ecuadorian area.

Pop corn is grown though evidently not very extensively. The main type of white color corresponds very closely to the Central American "Reventador". Pop corn with conical ears, straight salient rows and beaked kernels was obtained only from the area of Boyacá.

3. Relation of Mexican and Andean (Peru-Bolivia) races.

In their recent description of Mexican races Wellhausen et al gave the information that Mexican indigenous sweet corn seems in all detail identical with Andean sweet corn. After having been shown material of more Mexican races, I am sure that the same may be said with regard to other races. Thus there is a black seeded soft corn race which finds its exact counterpart in an Andean race. Even some of the Mexican races of dent corn, with conical ears and somewhat pointed kernels find their counterpart in types of the Bolivian "Secchys". However, all these races are completely absent both in Central and Northern Colombia as far as our present knowledge goes. This raises a number of important questions: a) It is impossible to assume that several races, so nearly identical in their appearance, may have been produced independently by the aboriginal plant breeders. Thus we must assume that there has been some migration or transportation of corn races. b) Since these races are absent in the intermediate area, this transportation must have been made by the sea route and not by land. c) The nature of the three races cited is such that it seems highly improbable that the white colonizers were responsible for their distribution, since in this case one should expect to find in the Bolivian-Peruvian area typical dented field corn of the Mexican

type or the yellow Caribbean flint corn. d) Since however it is known that at least the Incas possessed sea-going balsas, it may be assumed that they were responsible for the distribution of some of their old established races and that thus the migration was from south to north. It is also understandable that they carried with them races of "Toasting" maize.

4. The distribution and origin of pop corn.

Since in a recent paper, Erwin (1949) reached some conclusions about the question, it seems to me interesting to state that these conclusionshave to be revised today. Pop corn is now known to occur in the form of old indigenous races in a number of places in South America: the pointed and round seeded "Pipoca" of the Guarani and Caingang (in the Paraguay-Paraná area), the pointed seeded pop corn "Pisankalla" of the Andes of Boliva-Peru, the round-seeded "Pira" of Colombia, the Choco-corn on the Pacific coast of Colombia, etc. These races seem to have several basic characters in common, but occupy completely separated areas. It seems practically impossible to assume that the early Indian breeders may have obtained by independent selection, all these races starting from the soft races predominantly or exclusively present among South-American indigenous races. Thus it seems more probable to assume that all these pop corn races are of common origin and relics of a very old basic race which survived as a special purpose corn and only in some regions. In the absence of South-American archeological relics, nothing definite can be said about the center of origin of this racial group, and its routes of migration and distribution in prehistorical time. The distribution, as found today, is not in contradiction however with the hypothesis of the origin in the lowlands and mountain regions, east of the Andes, of northern Bolivia and Brazil. On the basis of Mangelsdorf and Smith's conclusions about the Bat cave material - disregarding the possibility of more extensive infiltration by teosinte genes in the material - pop corn appeared in this area some 4,000 years ago at least.

5. Distribution and origin of dent corn.

The situation with regard to dent corn races is quite different from that of pop corn. First it must be noted that denting is not caused by the presence of some corneous starch. South-American (Caingang) dent corn is a typical indented flour corn. On the whole throughout all the South-American area, genes for denting occur in a scattered fashion, and may be accumulated by selection directed towards pronounced denting. Thus we may assume that dent corn races appeared when, for some reason, the indigenous breeder started selecting in their favor, as occurred evidently in at least two widely separate areas: the Paraná basin and in Mexico, besides some minor unconnected areas between these

extremes. Wherever, on the contrary, the selection was in favor of flint corn, as in the cases of the North-Eastern Little Flint or the Caribbean and South-American Yellow-Orange Flints, it was carried out in the extreme, eliminating all genes for denting.

6. Origin and distribution of flint corn.

Flint corn predominates in the coastal areas of the northern and southern Atlantic and in the Caribbean area where soft corn would probably be difficult to keep from moulding. Otherwise flint races appear sporadically though the situation in the Amazon Valley is not yet clear.

The origin of flint corn may be explained either by selection following hybridization of pop and floury corn, or by selection after mutation from Floury to flinty in the latter type only. There are so far at least the following flint races: North-Eastern Little Flint, Caribbean and South-American Orange-Yellow, Mountain Yellow from Colombia and Central America, and two more races from the slopes of the high Andes of Boliva-Peru. They have in common only the corneous endosperm, but differ otherwise very profoundly.

7. Genetical research and breeding work.

Since we are now in the middle of the pollinating season, it will not be possible to present a fuller report until later.

F. G. Brieger

UNIVERSITY OF WISCONSIN
MADISON 6, WISCONSIN

Department of Agronomy

1. Cg (corn-grass) gene in chromosome 3 linkage group.

Three point backcross linkage data on a population of 335 plants gave 5.2% crossing over between d1 and Cg and 26.8% crossing over between Cg and lg_2. From the known relations between the d1 and lg_2 loci and from the fact that the crossover classes of + + + and d1 Cg lg_2 are the least frequent, it may be inferred that the order of the genes is d1 Cg, lg_2. The total of 32% recombination between d1 and lg_2 agrees closely with the 33% obtained by Brink (1933) between these latter 2 genes.

2. Modification of corn-grass.

The Tp (teopod) gene does not act as a + (plus) modifier for

the Cg (corn-grass) gene as suggested by Singleton. The same + modifiers may reduce the phenotypic expression of either the Cg or Tp genes. These + modifiers are numerous and recessive. They have some expression on their own in the absence of the Cg gene in that they completely inhibit tillering. Genes causing 2 or 3 tillers on typical corn, will cause 25-30 tillers in the presence of the Cg gene. This tillering characteristic of corn-grass results in many of its secondary morphological proliferations.

A sufficiently high + modifier level has been accumulated in some experimental lines to reverse the phenotypic expression of the Cg gene from that of a dominant to that of a recessive. Even at a low - (minus) modifier level, the dominance of the Cg is not complete in that the Cg/Cg plants are more extreme than the Cg/ + plants in an F_2 segregation.

Some corn-grass hybrids made with + modified Cg lines such as Cg^m A158 and a tillering pop corn inbred C142 give a very proliferous hybrid of possible forage value.

Observations on the interaction of the Cg gene with several mutant genes affecting corn-morphology have been made.

3. Pollen shedding vestigial glume tassels.

In addition to the plus modifiers which bring back some of the glume to the tassels and so prevent pollen blasting, other factors such as anther color, possibly lodicule development, and profuseness of pollen production affect Vg pollen shedding.

Walton C. Galinat

Department of Genetics

1. Rediscovery of red cob variegated pericarp (VR)[1/]

R. A. Emerson in 1929 reported the discovery of a red cob variegated pericarp type among strains of maize collected in the Andes Mountains. The common Calico type of variegated pericarp is associated with variegated cob. Since no mention of Emerson's strain has been made in the literature since, it is presumed to have been lost. Red cob variegated, of apparently the same phenotype, has now been found again in two collections, both made in Boliva. We are indebted to H. C. Cutler for the stocks from which the red cob variegated type was reisolated. Red cob variegated heterozygous with white cobbed white (RV/WW), backcrossed to WW/WW,

1/ The P alleles (P^{VV}, P^{WR}, P^{WW}, and P^{RR}) are represented in these contributions by their superscripts only.

gives the two parental types in equal numbers. The frequency of self red ears among the colored progeny from this mating appears to be low compared to that found in similar matings involving the ordinary type of variegated.

R. A. Brink & R. E. Anderson

2. The amount of aborted pollen in VV/WR and WR/WR plants in segregating families.

A preliminary experiment has been made to determine whether the presence of the mutable allele, variegated pericarp, is associated with an effect on fertility of the plant as measured by the frequency of aborted pollen grains. The test population was a series of sister families involving a VV/WR hybrid twice backcrossed to a highly inbred WR parent. VV was a variegated allele from a single source. The recurrent WR parent was a commercial line known as Wisconsin Inbred 8, which now constitutes seven-eighths of the germplasm.

Tassel segments of 50 plants from each of 12 sister families were collected during the summer of 1951. Six families had a parent ear with a light variegation grade, and six had parent ears with medium variegation grades. Pollen from the anthers of three spikelets, usually sampling three tassel branches, was stained with an iodine solution. Percentage of aborted pollen was based upon the microscopic examination of approximately 400-450 pollen grains per plant. The results are presented in Table 1.

The differences in average percent of aborted pollen between the segregating VV and WR progenies in any family are small, and random in direction. Heterogeneity within a progeny group was common, and often was very considerable. An occasional tassel chimera was observed, with great differences found in pollen sterility in anthers from spikelets in separate tassel branches. These chimeras occurred in both VV and WR plants.

When the material is grouped in accordance with the variegation class of the parent ears (light and medium), non-significant differences in percent of aborted pollen are noted in the paired VV and WR classes. Variation between families within a group is large in all four cases. Thus the differences in manner of phenotypic expression of the light and medium classes of variegation apparently are not associated with any developmental dissimilarities which would be detected as differential pollen sterility percentages.

The net amount of sterility observed, 14%, is considered high for a line whose parentage is seven-eighths Inbred 8. Though no pollen sterility counts were made on Inbred 8, it is improbable

Table 1.

Percent of aborted pollen among the progeny of VV/WR sister families of light and medium classes of variegation.

Family	Parental variegation class and grade	VV Progeny		WR Progeny	
		Number of plants	Average percent of sterility	Number of plants	Average percent of sterility
62-1	Light (1)	24	8.1	25	9.6
62-3	" (1)	18	11.2	27	12.4
62-4	" (1)	27	12.1	22	15.8
62-8	" (1)	21	16.1	23	12.9
62.6	" (2)	25	20.0	22	21.8
62.7	" (2)	21	18.2	24	19.3
	Total	136	14.3	143	15.1
62-9	Medium (3)	14	18.0	29	19.6
62-10	" (3)	32	16.6	14	16.0
62-11	" (3)	20	6.7	26	9.7
62-14	" (3)	28	7.1	20	11.8
62-18	" (3)	25	11.4	22	9.2
62-19	" (3)	24	15.5	23	14.2
	Total	143	12.4	134	13.5

that inherent sterility of as much as 14% of the pollen would have permitted its selection and use as a commercial inbred. Furthermore, selfed ears of Inbred 8 are fully filled.

It may be a fact, therefore, that there is a larger amount of pollen abortion in the test families segregating for VV than in the closely related inbred line 8. This point should be checked by direct comparison. The present results show, however, that within the test families, the VV/WR plants produce no more aborted pollen than the WR/WR individuals. This observation demonstrates that the pollen abortion is not directly associated with the mutable gene VV, at the P locus.

R. E. Anderson

3. The relation between light variegated and medium variegated pericarp.

We presented data last year (News Letter 25, March 17, 1951) demonstrating that the difference between two distinct variegated pericarp phenotypes, light and medium, is attributable to a genetic element which assorts with both the VV (variegated) and WR (red cob white) gametes formed by VV/WR heterozygotes and, hence, is separate from the P locus at which the VV and WR genes reside. A tentative hypothesis was set up to account for the breeding evidence then available. A second locus was postulated which was termed Modulator, as descriptive of the regulatory effect exercised on the variegated phenotype by the Modulator alleles. Mp_1 (Modulator-1), in conjunction with VV at the P locus, was assumed to condition light variegated pericarp. Substitution of Mp_2 for Mp_1 resulted in the medium variegated phenotype. It was suggested that Mp_1 and Mp_2 mutate to each other with relatively high frequency. The irregular ratios of light and medium variegated plants in certain families led to the further suggestion that still other Modulator alleles might occur, some of which were stable and others unstable.

Two additional bodies of data bearing on these relations are now available. The first was obtained by continuing into the second backcross generation the mating plan, described in last year's News Letter, whereby the VV gametes from VV/WR heterozygotes were evaluated with reference to the differential between light variegated and medium variegated. The second set of facts concerns the genotypes of the kernels in twin spots (adjacent light variegated and self colored areas on otherwise medium variegated ears).

Thirty families were grown in 1951 in the second backcross generation from medium variegated parent ears in the four respective series involving inbred lines 8, 22, 23 (red cob colorless pericarp) and 4Co63 (white cob colorless pericarp). These families gave the same kinds of distributions of light variegated, medium variegated, and self colored plants as had been observed in the corresponding first generation backcross families (News Letter 25). That is to say, most of the offspring were medium variegated, a few were light variegated, and a slightly higher proportion were self colored. Family 62-12, for example, contained 91.7% medium variegated, 3.7% light variegated, and 5.6% self colored ears. The proportions in the other families were of the same general order, although the data are clearly not homogeneous, even with a given backcross series.

The second generation backcross families from light variegated seed ears likewise corresponded to the first generation families from ears of this class.

According to the Modulator hypothesis, as formulated in last year's report, light variegated ears should have appeared in only one-half of the second generation backcross families from medium variegated ears, the assumption being that the remaining families

would be homozygous for the stable Modulator allele derived from the inbred line used as the recurrent parent. Since all 30 second generation families grown from medium variegated seed ears contained both light and medium variegated individuals, the Modulator hypothesis, in its original form, is invalidated.

The fairly extensive first and second generation backcross data now available show that light variegated arises regularly from medium variegated with frequencies comparable to those with which the VV gene mutates to self color. The similarity in frequency with which the two genetically separable effects occur suggests that they are correlated phenomena, and may result from a single mutational event. The evidence from twin spots gives direct support to this view.

The proportion of self colored mutant areas, including five kernels or more, which were twinned with light variegated was determined on 1413 medium variegated second generation backcross VV/WR or VV/WW ears. One hundred five such self colored areas were found, of which 66% were twinned with light variegated.

An additional generation is needed to complete the progeny tests on the kernels in five pairs of twins which are being analyzed in detail. First generation data are now available, however, on the inheritance transmitted through the VV and RR (self color) gametes from these twins. The numbers of plants are small, but the results are in accord with the view that the light variegated component of a twin is genetically the same as light variegated occurring on the numerous entire ears of this class which have been tested in these stocks. The self colored kernels from twin spots, likewise, appear to carry the well known self colored (RR) allele at the P locus. The WR or WW segregates from the twin spot phenotypes remain to be assayed for their composition with reference to the differential between light and medium variegated.

The evidence, as far as it goes, suggests that variegated pericarp rests upon a genetic basis such that, when variegated mutates to the stable self colored condition, a differential may be established simultaneously elsewhere in the genome which, in the presence of the VV gene, distinguishes between the light variegated and medium variegated phenotypes. Further evidence, which cannot be summarized conveniently for this report, indicates that the differential in question may take different positions in the chromosome complement. The differential assorts as though it is linked with P in some plants and independent of this locus in other individuals.

The following revised hypothesis is consistent with the present evidence and provides a basis for further tests.

1. It is assumed that the unstable variegated (VV) allele is a modified form of the stable RR (self color) gene, the difference

between them being that VV embodies a unitary element termed Modulator (Mp) which inhibits pigment formation. Mutation of VV to RR consists in the loss of Mp from the P locus.

2. Following removal from the P locus, Mp may become attached at one or another site elsewhere in the chromosome complement. Modulator thus situated, plus VV, gives the light variegated phenotype. VV, without Mp elsewhere in the genome, conditions the medium variegated phenotype.

3. The relatively few light variegated and self colored offspring of medium variegated plants are interpreted as newly arisen mutations many of which involve concurrent changes at the P locus and at a point elsewhere in the genome. The distribution of light and medium variegateds and self colored ears in families from light variegated parents is conditioned by such mutations and also the segregation of Modulator as a unit separate from the P locus.

4. The varying proportions of light and medium variegated offspring of light variegated plants are interpretable in terms of linkage or independence of Modulator relative to the P locus.

It is clear from the experimental evidence that Modulator cannot be interpreted in conventional genetic terms either in respect to origin or mechanism of transmission. Nor can a firmly supported explanation now be given on any other basis. The largely speculative hypothesis outlined above brings into relief the main features of the data and thus serves to indicate the directions in which the analysis may be continued.

R. A. Brink & R. A. Nilan

III. MAIZE PUBLICATIONS - 1951

(Including some early 1952 publications.)

Abbe, E. C., Phinney, B. O. and D. F. Baer. The growth of the shoot apex in maize: internal features. Am. Jour. Bot. 38: 744-751. 1951.

Anonymous. Wisconsin releases two new hybrid corns. Seed World, p. 78, June 1, 1951.

Anonymous. New outstanding Texas corn hybrids. Seed World, p. 20, April 20, 1951.

Anonymous. Borer-tolerant hybrids are announced by Iowa crops workers. Crops and Soils 3 (5):26. 1951.

Anonymous. Attempt solution of Florida corn problems. Seed World. 68(5): 44. 1951.

Anonymous. U. S. scientists help Mexico improve corn strains. Crops and Soils 3(4): 25. 1951.

Anonymous. Report of the fifth meeting on maize. 27 and 28 July, 1950 at the Pergamino Experimental Station. Minist. Agric. Gonad Nacion, Argentina 1950, pp. 213. (Mimeographed)--P.B.A. 21 (4): 843-844. 1951.

Bauman, L. F., Jugenheimer, R. W., Woodworth, C. M., Alexander, D. E., and Koehler, B. Experimental corn hybrids, 1950 tests. Ill. Agr. Exp. Sta. Bul. 543, 1951.

Bennett, E. Sugars of the hemicelluloses of cornstalks. Plant Physiol. 26:182-185. 1951.

Blanco, J. L. and A. J. DeOliveira. Hibridacion en cadena. Produccion de emergencia de semilla hibrida de maiz. (Chain crossing. Emergency production of hybrid maize seed.) Genetica Iberica 2: 15-27. 1950 (P.B.A. 21 (2):336. 1951.)

Bottger, G. T. Sugars and protein in the corn plant as related to nutrition of the European corn borer. J. Econ. Entom. 44: 40-44. 1951.

Brimhall, B. and Sprague, G. F. Unsaturation of corn oil - Inheritance and maturity studies. Cereal Chem. 28(3):225-231. 1951.

Brodell, A. P. and Cooper, M. R. Trends in planting and fertilizing corn. Agr. Situation (Washington) 35 (7):7-8. 1951.

Brown, W. L. and Mangelsdorf, P. C. The effects on yield and morphology of the addition of teosinte germplasm to maize. Genetics 36(5): p. 544. 1951.

Burdick, A. B. Evidence concerning the structure of an ear of corn. Amer. Nat. 85(825): 353-356. 1951.

_____, Dominance, as function within organism environment in kernel-row number in maize. Genetics 36 (6):652. 1951.

Carter, G. F. Origin of maize. Geog. R. 41:338-340. 1951.

Cooper, D. C. Caryopsis development following matings between diploid and tetraploid strains of Zea Mays. Am. Jour. Bot. 38: 702-708. 1951.

Costa, A. S. and Penteado, M. P. Corn seedlings as test plants for the sugar-cane mosaic virus. Phyopath. 41:758-763. 1951. (abst.)

Cutler, H. C. The geographic origin of maize. Biologia 2. Chron. Bot. 12:4-6. 1951.

Cunningham, J. C. Maize bibliography for the years 1937 to 1945, inclusive. Iowa Corn Research Inst. 3(3). 1951.

Dungan, G. H. and Gausman, H. W. Clipping corn plants to delay their development. Agron. Jour. 43:90-93. 1951.

Dunn, G. and Kramer, H. H. Gene dosage effects on carbohydrate content in corn endosperm. Abstract, Amer. Soc. Agron. August, 1951.

Dvonch, W., Kramer, H. H. and Tsuchiya, H. M. Polysaccharides of high-amylose corn. Cereal Chem. 28(4):270-279. 1951.

Erwin, A. T. Sweet corn, mutant or historic species. Econ. Bot. 5:302-306. 1951.

Everett, H. L. New twist to the double cross. Gard. Jour. N.Y. Bot. Gard. 1:114-116. 1951.

_____. Mankind's debt to Mendelism: hybrid corn (Zea Mays). Pflanzenz. 29:394-405. 1951.

Fabergé, A. C. Ultra-violet induced chromosome aberrations in maize. Genetics 36(5): p. 549-550. 1951.

Fairchild, R. S. Comparative development of the embryos of inbred and hybrid maize. Iowa State College Jour. Sci. 25:203-205. 1951.

Finan, J. J. Maize in the Great Herbals. Chronica Botanica Co. N.Y. pp.99. 1950.

Fleming, A. A. Inheritance of characters in corn with special reference to European corn borer. Abstract. Amer. Soc. Agron. August, 1951.

Frey, K. J. The interrelationships of proteins and amino acids in corn. Cereal Chem. 28(2):123-131. 1951.

Galinat, W. C. Glumeless hybrid sweet corn. Jour. Hered. 42(3): 115. 1951.

_____ and Naylor, A. W. Relation of photoperiod to inflorescence proliferation in Zea Mays L. Amer. Jour. Bot. 38:38-47. 1951.

Gardner, C. O., Harvey, P. H., Comstock, R. E. and Robinson, H. F. Estimates of the average degree of dominance for genes determining quantitative characters in maize. Abstract. Amer. Soc. Agron. August, 1951.

Gilles, A. and Randolph, L. F. Reduction of quadrivalent frequency in autotetraploid maize during a period of 10 years. Am. Jour. Bot. 38:12-17. 1951.

Gundy, L. F. Prediction of corn hybrids from single cross data. Agron. Jour. 43:245-246. 1951.

Hamilton, T. S., Hamilton, B. C., Johnson, B. C. and Mitchell, H. H. The dependence of the physical and chemical composition of the corn kernel on soil fertility and cropping system. Cereal Chem. 28:163-176. 1951.

Harrison, C. M. The story of hybrid corn. Hoard's Dairyman 96: 392. 1951.

Haskell, G. and Dow, P. Studies with sweet corn V. Seed setting with distance from pollen source. Emp. J. Exp. Agric. 19:45-50. 1951.

_____. Studies with sweet corn IV. The frit fly problem. Bull. Ent. Res. 42:519-526. 1951.

Heimsch, C. and Stafford, H. J. Developmental relationships of the internodes of maize. Torrey Bot. Club Bul. 79(1):52-58. 1952.

Hooker, A. L. The corn embryo as a factor in resistance in Pythium during germination. Phytopath. 41:17. 1951. (Abst.)

Hofmeyer, J. D. J. Application of male sterility in the production of hybrid maize. Fmg. S. Afr. 25:281. 1950.

Jenkins, M. T. and Robert, A. L. Inheritance of resistance to the leaf blight of corn caused by Helminthosporium turcicum. Abst. Amer. Soc. Agron. August, 1951.

Jenkins, M. T., Watkins, W. P., Ferguson, C. E. and Eckhardt, R. C. Hybrid maize (corn) in European countries. Columbia Univ. Press. pp.59. 1950.

Jensen, C. O., Sacks, W., and Baldauski, F. A. The reduction of triphenyltetrazolium chloride by dehydrogenases of corn embryos. Science 113 (2925):65. 1951.

Jones, D. F. The induction of cytoplasmic pollen sterility and the restoration of fertility in maize. Genetics 36(5):557. 1951.

Josephson, L. M. Injury to seed corn from vapors of TCA. Agron. Jour. 43:513-514. 1951.

_____. Effect of maleic hydrazide in delaying flowering in corn. Agron. Jour. 43:404-405. 1951.

_____, and Reid, D. A. Variety tests of wheat, oats, barley and corn in the Pennyroyal area of Kentucky, 1946-50. Ky. Agr. Exp. Sta. Bul. 569: 31p. 1951.

Jugenheimer, R. W. Agriculture in Turkey. Crops and Soils 3:8. 1951.

_____, Bauman, L. F., Alexander, D. E., Woodworth, C. M. and Koehler, B. Experimental corn hybrids tested in 1951. Ill. Agr. Exp. Sta. Bul. 551. 1952.

Kavanagh, L. R. The story of hybrid maize. Agr. Gaz. N.S. Wales 62: 61-66. 1951.

Kennedy, N. F. Chemurgy and corn; the corn processor talks to the corn breeder. Chemurgic Digest 10:14-15. 1951.

Kiesselbach, T. A. A half-century of corn research. Amer. Sci. 39: 629-655. 1951.

Kinman, M. L. Composite sibbing versus selfing in the development of corn inbred lines. Iowa State College. Jour. Sci. 25:273-275. 1951.

Koehler, B. Husk coverage and ear declination in relation to corn ear rots. Phytopath. 41:22. 1951. (Abst.)

Kohnke, H. and Miles, S. R. Rates and patterns of seeding corn on high-fertility land. Agron. Jour. 43(10):488. 1951.

Krantz, B. A. and Chandler, W. V. Lodging, leaf composition and yield of corn as influenced by heavy applications of nitrogen and potash. Agron. Jour. 43(11):547-552. 1951.

Laughnan, J. R. Reaction sequence in anthocyanin synthesis in maize. Genetics 36(5):559-560. 1951.

Leng, E. R. Time-relationships in tassel development of inbred and hybrid corn. Agron. Jour. 43:445-450. 1951.

_____, Earle, F. R. and Curtis, J. J. Direct effect of pollen parent on protein content of the corn kernel. Cereal Chem. 28 (6):479-482. 1951.

Livingston, J. E. Effect of controlled low temperature on the emergence of seedlings from artifically dried seed corn. Phytopath. 41:24. 1951. (Abst.)

Lonnquist, J. H. Recurrent selection as a means of modifying combining ability of corn. Agron. Jour. 43:315-320. 1951.

Lutz, J. A., Jr. From poverty grass to 100-bushel corn. Crops and Soils. 3(8):21. 1951.

Mangelsdorf, P. C. Hybrid corn. Scientific American 185:39-47. 1951.

_____, and Oliver, D. L. Whence came maize to Asia? Harvard U. Bot. Mus. L. 14:263-291. 1951.

Maramorasch, K. Mechanical transmission of corn stunt virus to an insect vector. Phytopath. 41:833-838. 1951.

Martinez, J. J. and Wellhausen, E. J. Relation between yield and plant color in corn. Abstract. Amer. Soc. Agron. August, 1951.

McKeen, W. E. Seedling susceptibility of dent corn inbreds to root rot caused by pythium arrhenomanes. Sci. Agr. 31:475-479. 1951.

_____. A preliminary study of corn seedling blight in Southern Ontario. Canadian Jour. Bot. 29:125-137. 1951.

_____. A corn root-and-stalk-rot complex hitherto known as Gibberella zeae stalk rot. Phytopath. 41:26. 1951. (Abst.)

Menezes, O. B. De. A new method for predicting the performance of the multiple hybrid resulting from crossing 2 three-way hybrids (3 x 3). Rev. Agric. S. Paulo 26:43-47. 1951. (P.B.A. 21(4): 847. 1951.)

Miller, P. A. Variation of oil percentage in the corn kernel and a study of its inheritance through the use of chromosomal translocation. Iowa State Coll. Jour. Sci. 25:301-303. 1951.

_____. Use of chromosomal interchanges for investigating the inheritance of oil in the corn kernel. Agron. Jour. 43:229-234. 1951.

_____, and Brimhall. Factors influencing the oil and protein content of corn grain. Agron. Jour. 43: 305-311. 1951.

Morgan, D. T. and Rappleye, R. D. Polyembryony in maize and lily following X-irradiation of the pollen. Jour. Hered. 42:91-93. 1951.

Muhr, G. R. and Rost, C. O. The effect of population and fertility on yields of sweet corn and field corn. Agron. Jour. 43:315-319. 1951.

Murthy, G. S. Hybrid maize. Indian Farming 1(5):20-22. 1951.

Nicholson, A. A hand in the future of hybrid corn. Country. Gent. 121(5):22. 1951.

Organization for European Economic Cooperation. Hybrid maize (corn) in European countries; report by United States specialists, M. T. Jenkins, W. P. Watkins, C. E. Ferguson and R. C, Eckhardt. Paris, 1950.

Pendleton, J. W., Dungan, G. H., Koehler, B., Bigger, J. H., Lang, A. L., Jugenheimer, R. W. and McKibben, G. E. Illinois tests of corn hybrids in wide use in 1951. Ill. Agr. Exp. Sta. Bul. 552. 1952.

Randolph, L. F. New evidence on the origin of maize. Abstract. Amer. Soc. Agron. August, 1951.

Richey, F. D. Old corn: new bottle. (Review of "Corn and Corn Growing." - Wallace and Bressman, 5th edition). Jour. Hered. 42:197-198. 1951.

_____, and Dawson, R. F. Experiments on the inheritance of niacin in corn. Plant Physiol. 26:475-493. 1951.

Riedl, W. A. Rincker, C. M. and Quayle, W. L. Hybrid corn adaptation trials in Wyoming for 1947-1950. Wyo. Agr. Exp. Sta. Bul. 306:15p. 1951.

Rinke, E. H. and Pinnell, E. L. Genetics aids the hybrid makers. Minn. Agr. Exp. Farm & Home Sci. 9:14. 1951.

Rhoades, M. M. Duplicate genes in maize. Am. Nat. 88:105-110. 1951.

Robinson, H. F., Comstock, R. E. and Harvey, P. H. Estimates of the additive genetic and dominance variance in open-pollinated varieties of corn. Abstract. Amer. Soc. Agron. August, 1951.

_____, _____, and _____. Genotypic and phenotypic correlations in corn and their implications in selection. Agron. Jour. 43:282-287. 1951.

Rogers, J. S. The utilization of cytoplasmic male-sterile inbreds in the production of corn hybrids. Abstract. Amer. Soc. Agron. August, 1951.

_____, and Edwardson, J. R. The utilization of cytoplasmic male-sterile inbreds in the production of corn hybrids. Agron. Jour. 44 (1):8-12, 1952.

Roman, H. and Ullstrup, A. J. The use of A-B translocations to locate genes in maize. Agron. Jour. 43:450-454. 1951.

Rounds, W. T. Rate, method and date of planting corn. Mich. Ag. Exp. Q. Bul. 33:373-387. 1951.

Rush, G. E. and Neal, N. P. The effect of maturity and other factors on stands of corn at low temperature. Agron. Jour. 43: 112-117. 1951.

Sagar, Ruth. On the mutability of the waxy locus in maize. Genetics 36(5):510. 1951.

Salamov, A. B. New data on the problem of fertilization in maize. Agrobiology 4:110-118. 1950. (Russian) (P.B.A. 21 (3):585. 1951)

Schmidt, J. W. and Frolik, E. F. Effects of thermal-neutron irradiation of maize and barley kernels. Nebr. Ag. Exp. Res. Bul. 167:1-29. 1951.

_____, and _____. Comparative effects of thermal neutron irradiation of maize pollen and maize seed on subsequent seedling growth. Jour. Hered. 42: 172-177. 1951.

Schultz, J. Effect of ultra-violet radiation on a ring chromosome in Zea Mays. Natl. Acad. Sci. Proc. 37:590-600. 1951.

Schwartz, D. A case of male sterility in maize involving gene-cytoplasm interaction. Genetics 36(5):575. 1951.

Shaw, R. H. and Thom, H. C. S. On the phenology of field corn, the vegetative period. Agron. Jour. 43:9-15. 1951.

_____, and _____. On the phenology of field corn, silking to maturity. Agron. Jour. 43(11):541-546. 1951.

Sherbakoff, C. D. A correction of the identification of Helminthosporium causing black ear rot of corn. Phytopath. 41:378-380. 1951.

Singleton, W. R. Effects of continuous gamma radiation on corn. Abstract. Amer. Soc. Agron. August, 1951.

Singleton, W. R. Effect of continuous gamma radiation on mutation rate in maize. Genetics 36(5):575-576. 1951.

_____. Inheritance of corn grass a macromutation in maize, and its possible significance as an ancestral type. Amer. Nat. 85: 81-96. 1951.

Sokolov, B. P. Increasing the efficacy of breeding work with maize. Agriobiology 5:36-44. 1950. (Russian) (P.B.A. 21(3):582. 1951.)

Sprague, G. F. The breeding of corn for increased feeding value. Abstract. Amer. Soc. Agron. August, 1951.

_____, and Federer, W. T. A comparison of variance components in corn yield trials: II. Error, Year X variety, Location X variety, and Variety components. Agron. Jour. 43(11):535. 1951.

_____, and Miller P. A. New corn hybrids for Iowa. Iowa Farm Sci. 5:137-178. 1951.

Standley, P. C. Teosinte from Honduras. Rev. Bot. Appl. 30: 331-333. 1950. (P.B.A. 21(1):106. 1951.)

Stringfield, G. H. and Thatcher, L. E. Corn row spaces and crop sequences. Agron. Jour. 43:276-282. 1951.

Tatum, L. A. and Kehr, W. R. Observations on factors affecting seed-set with inbred strains of dent corn. Agron. Jour. 43: 270-276. 1951.

Taylor, G. S., Semenivk, G., and Melhus, I. E. Guatemalan corn as a source of resistance to Helminthosporium turcicum in maize. Phytopath 41:34. 1951. (Abst.)

Teas, H. J. and Anderson, E. G. Accumulation of anthranilic acid by a mutant of maize. Proc. Nat. Acad. Sci. 37:645-649. 1951.

_____, and Newton, A. C. Tryptophase, niacin and indoleacetic acid in several endosperm mutants and standard lines of maize. Plant Physiol. 26:494-501. 1951.

Thompson, D. J. and Hutchcroft, C. D. Accuracy of estimating the mean percentage of nondetasseled plants in double cross corn seed production fields. Agron. Jour. 43(12):609-616. 1951.

Thompson, M. A. Hybrid corn moves southeast - still room for expansion. Agr. Situation (Washington) 35(8):2. 1951.

Van Staden, J. F. "Missing link" in hybrid maize experiments; three promising lines developed and vital clues confidentially expected. Farmer's Wk. (Bloemfontein) 82:41. 1951.

Ullstrup, A. J. The effect of some leaf diseases on grainyield in corn. Phytopath. 41:36. 1951. (Abst.)

Walter, E. V. The development of sweet corn varieties resistant to earworm (Heliothis armigera). Amer. Assoc. Econ. Ent. No. Cent. States. Br. Proc. 6:13-14. 1951.

Wellhausen, E. J. El maiz hibrido y su utilización en Mexico. Mex. Sec. de Agr. y Ganad. Fol. Tec. 6:57. 1951.

_____, Roberts, L. M. and Wortman, L. S. Relationship between first and advanced generation selfed lines of corn in combining ability. Abstract. Amer. Soc. Agron. August, 1951.

_____, Roberts, L. M. and Ochoa, R. E. Experiences in visual selection for combining ability in corn. Abstract. Amer. Soc. Agron. August, 1951.

_____, and others. Razas de maiz en Mexico; su origen. Characteristicas y distribution. Mex. Sec. de Agr. y Ganad. Fol. Tech. 5:237. 1951.

Widdakas, William, and Widdifield, R. B. 1951 hybrid corn field trials. N. Dak. Agr. Exp. Sta. Agron. Mimeo. Circular 84. Released January, 1952.

Wortman, L. S. and Rinke, E. H. The inheritance of cold-test reaction in Zea mays. Abstract. Amer. Soc. Agron. August, 1951.

Zuber, M. S. Effect of the Y-y factor pair on yield and other agronomic characters in corn. Iowa St. Coll. Jour. Sci. 25: 392-394. 1951.

Val W. Woodward
Julian P. Craigmiles

IV. SEED STOCKS PROPAGATED AND RECEIVED

This past summer most of the material propagated involved the growing of cultures from old seeds which were in danger of losing viability, incorporating genes into new linkage testers and reselecting within previously-made hybrids. In addition, inbred lines were outcrossed to certain weak stocks to obtain more vigorous combinations.

In the following inventory is listed the stocks of genes and gene combinations which are now available at Cornell. Only stocks later than 1944 are included since eight years is about the maximum time viability can be maintained under our storage conditions.

It may be assumed that genetic stocks other than those listed here have been lost or have never been incorporated into our collection.

A_1 48-23,36; 49-10,11,14,15,16,17,21,81,93,106; 50-11,54,57, 114,115; 51-35,65,66,68,69,70

A_2 48-21; 49-17,50,93; 50-43

a 44-163; 45-68,147,151; 47-23,26; 48-72,90; 49-08,09,20,53; 50-70,71,72,82; 51-25,26,35,65,66,86

a_2 45-78,92; 47-44,173; 48-21,47,48,49,75; 49-12; 51-75

a_3 45-127,102; 47-102; 49-13; 50-123

a 49-107; 50-67

ad 47-100; 50-124

ag 47-76,77; 48-76,77; 49-27,96; 50-30,31,32; 51-99 (grasshopper resistant gene)

al 49:105; 50-66

an 47-6,13,101; 48-19,27; 50-47,48,87,88,109; 51-60,71,76,82

an_2 48-61,62,63

ar 45-95; 47-58; 50-125; 51-107

as 48-109,110,111,112,113,114; 49-17; 50-43

at 45-94; 47-103

au 47-64; 48-64

b 45-11; 47-171; 49-11,15,21,93; 50-11,54,114; 51-35

B 47-17; 48-23; 49-14,106,107; 50-67; 51-65,66,86

B^W 44-205; 47-159

ba 45-42; 45-96; 49-45; 50-73,126,127

ba_2 45-97; 49-45

fn	from S. Horowitz (phenol reaction)
fs	45-104; 47-68
g	44-90; 45-12,90; 47-62,63,173; 48-60,78,79; 49-20,21
g_2	44-76; 47-123; 51-74
g_3	48-67
g_4	44-41; 48-68; 50-41,77
gl	44-159; 45-80,82,84,98,122; 47-50,51,52,53,173; 48-26,53,54, 56,60,65; 49-20,87,98; 50-18,52,131; 51-12
gl_2	45-8,9,10; 47-14,18,19,20,21,71; 48-9,26,32,33,35,69; 49-11, 15,35; 50-37,104,105,130,114; 51-18,19,68,69
gl_3	45-71,72,73; 47-36,38,39; 48-45,67; 49-73; 50-74,111; 51-17, 21,22,23,31
gl_4	45-20,51,52,89,103,106; 47-56,59; 48-20; 49-05,06; 50-04,05, 24,25,68,134; 51-15,24,51
gl_5	44-5,36; 49-68
gl_6	45-107; 47-109
gl_7	45-139; 48-69; 49-95; 50-09
gl_8	44-88,89; 47-125
gl_9	47-126
gl_{10}	45-109; 47-110; 50-35
gl_x	44-66
gm	(mutable golden) 49-102; 51-104
ge	47-12,13; 48-27; 49-04,27; 50-21,22,30,31,32,109; 51-76
ge_2	45-11; 47-15,16,127; 48-34
h	45-110; 47-128
hf	45-111; 47-111; 48-16,17,70
hm	50-120,121
Hm	50-122
He	45-112; 47-112
I	47-82; 51-98
i	51-70
ij	45-82; 47-49,51,52,113; 48-54; 49-98; 50-18; 51-12
in	44-170; 45-151; 48-72; 49-08,21,53; 50-70,71,72,82; 51-25, 26,35
it	50-78
j	47-55,173; 49-20,21,55,99; 50-55,83,84; 51-13
j_2	44-191; 45-72; 48-73; 50-48,74,110,111; 51-17,21,22,23

Kn 45-113; 49-54

l 43-26; 44-6,7,42,43; 49-55

l_2 48-60,79

l_3 44-95; 47-129

l_4 45-140; 49-56; 50-45

l_6 44-156; 48-11; 50-59,60,85

l_7 43-128; 44-8,44,45,77; 48-58

la 47-131; 49-73; 50-74

lg 44-69,76,92; 45-9,10,11,61,106,145,149; 47-14,15,16,17,18,19, 20,21,22,173; 48-9,32,33,34,35; 49-11,15,20,35,69,73,106; 50-37,104,105,114; 51-18,19,30; 51-74

lg_2 44-177,178; 45-18,65,68,69; 44-163; 45-68; 47-23,27,32; 48-12, 13,43,90; 49-25,26; 50-107; 51-84

Lg_3 44-162; 45-63; 48-37,38

lg_x 48-52

li 45-12,91; 47-61; 48-59; 50-83,84

lo 47-133

lu 50-102

mg 44-9,10,11,12,46; 49-58; 50-86

mi 44-13,47,78; 47-134,135,136; 49-80

ms_2 45-73; 48-81,58,81

ms_3 44-107; 47-137,138

ms_5 47-139,140; 49-79

ms_6 44-99; 47-142

ms_7 44-157; 45-116; 47-143,144

ms_8 44-10; 47-145,146; 48-99; 50-55,56; 51-13

ms_9 48-82

ms_{10} 44-101; 48-83

ms_{11} 45-117; 49-32

ms_{12} 44-102; 47-147,148; 49-34

ms_{13} 45-118, 47-87

ms_{14} 45-119; 47-88

ms_{17} 47-9; 48-29; 49-74; 50-36; 51-40,41,42,43,45,92

ms_{18} 44-108,137; 48-84

ms_{20} 48-85; 51-20

ms_{34} 43-48,49,50; 47-149,150

WW	51-40,41,42,43,45
wa	47-99
We	50-135
Wc	45-142
Wh	47-118
wl	44-86; 47-34,167; 49-72
ws	45-89; 50-134; 51-31,51
ws_2	47-39; 48-45,55,56
ws_3	45-60; 47-18,19; 51-18; 51-19
wx	44-156,170,174,206; 45-88,95,141,146,148,150,154; 47-56,58,59; 48-20,36,57,68,72; 49-05,06,07,08,10,17,20,21; 51-15,24,25,26,107
y	45-68,133,149; 47-173; 48-50,52,72; 49-08,20,21; 50-10,11,54; 51-25,26,30,36,38,39,86
yx	50-78
yg	48-103
yg_2	44-174; 45-20; 48-20; 49-05,06,07; 50-04,05,24,25,68; 51-24
yg_3	45-143; 47-168
ys_1	47-43; 48-14,15,46; 49-36,37,38; 50-69; 51-32
Y	49-53,105,109; 50-66,70,71,135; 51-35
zb	44-38,73,112; 48-105
zb_2	44-74; 48-106
zb_3	44-39,98; 48-107
zb_4	45-57; 44-63,104; 47-7,10,11; 48-28,30,31; 49-28,39,57,70; 51-40,41,42,43,45,47
zb_5	49-92,109
zb_6	45-144; 47-120; 50-113
zg_3	43-192; 44-94; 49-66,67
zl	47-9; 48-29; 49-74,92
zn	49-101 (zebra neciosis)

Dominant inhibitor or partial inhibitor of yellow endosperm. (1947, Meyer and Richey)

Several types from Rurrenabaque, lowland Boliva, (H. C. Cutler, 1947).

Linkage Testers

Chromosome 1

bm_2 br p^{rr}	47-4; 48-25
br f an gs	47-6; 50-30,31; 51-79
ms_{17} zl	47-9
br f an gs bm_2	47-13; 48-27; 49-27
p^{rr} br f_1 gs_1 bm_2 an	49-27; 50-32,109; 51-76,78,80
gl_{10}	50-35
p^{rr} br bm_2	49-22
gs br f_1 an_1 ms_{17}	51-77

Chromosome 2

lg gl_2 v_4 ts	47-14,22; 48-35; 49,35; 50-104,105 51-81
lg gs_2 v_4	47-16; 48-34
ws_3 lg gl_2	47-19
lg gl_2 v_4 fl	47-21; 48-9; 49-69

Chromosome 3

Rg d	47-25; 48-37,38; 50-106; 51-83
na ts_4	47-28; 48-39
lg_2 d ts_4	47-32; 48-12,43; 50-107

Chromosome 4

su gl_3 j_2	48-73; 50-111; 51-89
su Tu gl_3	47-36; 51-96
Ts_5 su wl	47-34; 49-72
su gl_3 la	50-74
J_2 su	50-110; 51-88
zb_6 su	50-113

Chromosome 5

yg_1 bm_1	48-103
bm v_2 pr ys	47-43; 49-36,37,38
pr v_{12}	47-45
a_2 bt_1 bv pr bm_1	48-75; 51-97

Chromosome 6

w_1 py_1	50-12
(AbP) Pl sm py y	47-46; 48-50; 50-11
si_1 su_2 Y	50-10; 51-93

tester stocks would be assembled and maintained at Illinois.

"If those in the North Central Region will keep this in mind as seed is prepared for this year's work, the foundation may be laid for a better start."

It is planned to schedule a meeting of corn workers during the A.I.B.S. meetings at Ithaca in September and a notice will be printed in the regular program of events.

H. H. Smith