Founding of the *Maize Genetics Cooperation News Letter* at Cornell University

Volume I

Rollins Adams Emerson (1873–1947)

A 90th Anniversary Tribute

Edited by
Lee B. Kass
Edward H. Coe, Jr.
Michael N. Cook
Margaret E. Smith
Judy L. Singer

*This Book – https://hdl.handle.net/1813/66550
Books and Articles Collection – https://ecommons.cornell.edu/handle/1813/63
The Internet-First University Press Directory – https://ecommons.cornell.edu/handle/1813/64826*
This content appears online at Cornell University’s eCommons for open access distribution and then in the more traditional physical form (bound book) for a modest user fee. This approach obviates the need for other libraries (or indeed individuals for personal usage) to acquire, catalog and store this content. However, redistribution and all other rights remain with the copyright holders. The IFUP was co-founded by J. Robert Cooke and Kenneth M. King.

Online access to this digital book is at:
https://hdl.handle.net/1813/66550

Books and Articles
https://ecommons.cornell.edu/handle/1813/63

The Internet-First University Press Directory (All content through August 2019)
https://ecommons.cornell.edu/handle/1813/64826.2

Perfect bound copies of this book may be ordered as separate Volumes (Volume I and Volume II) via e-mail: digital@cornell.edu

Cover photo:
Rollins Adams Emerson (1873–1947), Head of Cornell University Department of Plant Breeding from 1914–1942 (Courtesy of Plant Breeding files, Cornell University)

Published by The Internet-First University Press
Ithaca, NY, USA
© 2019 Lee B. Kass, Edward H. Coe, Jr., Michael N. Cook, Margaret E. Smith, Judy L. Singer and Plant Breeding & Genetics Section, Cornell University
All rights reserved, except as noted above.
Founding of the
Maize Genetics Cooperation News Letter
at Cornell University

A 90th Anniversary Tribute

Volume I
Thomas Hunt Morgan and Rollins Adams Emerson
Willard Straight Hall, Cornell University, Ithaca, New York.
Headquarters of the 1932 Sixth International Congress of Genetics, 24-31 August 1932.

Morgan was President of the Congress and Emerson the General Chairman of the Local Committee.
(Courtesy of Edward S. Buckler)
Founding of the
Maize Genetics Cooperation News Letter
at Cornell University
A 90th Anniversary Tribute

Volume I

Edited by
Lee B. Kass\textsuperscript{a,b}
Edward H. Coe, Jr.\textsuperscript{c}
Michael N. Cook\textsuperscript{d}
Margaret E. Smith\textsuperscript{a}
Judy L. Singer\textsuperscript{a}

\textsuperscript{a}Plant Breeding & Genetics Section, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853
\textsuperscript{b}Division of Plant and Soil Science, West Virginia University, Morgantown, WV 26506
\textsuperscript{c}United States Department of Agriculture-Agricultural Research Service, Plant Genetics Research Unit and University of Missouri, Columbia, Missouri 65211
\textsuperscript{d}Collection Development & Digital Collections, Albert R. Mann Library, Cornell University, Ithaca, NY 14853

The Internet-First University Press
https://ecommons.cornell.edu/handle/1813/62
To the Legacy of R.A. Emerson

&

To Maize Cooperators Worldwide
Volume I

CONTENTS

Frontispiece  T.H. Morgan and R.A. Emerson at 1932 International Congress of Genetics .......... ii
Copyright ................................................................. iv
Dedication ................................................................. v
Foreword by Edward S. Buckler .......................................... ix
Preface and Acknowledgments by Lee B. Kass and Edward H. Coe Jr. ............................... xi
Group Photograph of Congress Attendees, 1932 International Congress of Genetics ........... xiii
Introduction by Editors .................................................. 1

Introduction to Maize Genetics Cooperation News Letter, Volume 1 (1929) ....................... 7
Reprint: Maize Genetics Cooperation News Letter Volume 1 (1929) ............................... 8

Introduction to Maize Genetics Cooperation News Letters Volumes 2-14 (1932-1940) ........ 41
Reprint: Maize Genetics Cooperation News Letter Volume 2 (1932) ............................... 42
Reprint: Maize Genetics Cooperation News Letter Volume 3 (1933) ............................... 46
Reprint: Maize Genetics Cooperation News Letter Volume 4 (1933) ............................... 64
Reprint: Maize Genetics Cooperation News Letter Volume 5 (1934) ............................... 74
Reprint: Maize Genetics Cooperation News Letter Volume 6 (1934) ............................... 87
Reprint: Maize Genetics Cooperation News Letter Volume 7 (1934) ............................... 92
Reprint: Maize Genetics Cooperation News Letter Volume 8 (1934) ............................... 104
Reprint: Maize Genetics Cooperation News Letter Volume 10 (1936) ............................. 150
Reprint: Maize Genetics Cooperation News Letter Volume 12 (1938) ............................. 201
Reprint: Maize Genetics Cooperation News Letter Volume 13 (1939) ............................. 245
Reprint: Maize Genetics Cooperation News Letter Volume 14 (1940) ............................. 269

Volume II

Reprint: Maize Genetics Cooperation News Letter Volume 15 (1941) ............................. 332
Reprint: Maize Genetics Cooperation News Letter Volume 16 (1942) ............................. 390
Reprint: Maize Genetics Cooperation News Letter Volume 17 (1943) ............................. 452
Reprint: Maize Genetics Cooperation News Letter Volume 18 (1944) ............................. 507
Reprint: Maize Genetics Cooperation News Letter Volume 19 (1945) ............................. 541
Reprint: Maize Genetics Cooperation News Letter Volume 20 (1946) ............................. 592
Reprint: Maize Genetics Cooperation News Letter Volume 21 (1947) ............................. 628

Annotated Bibliography .................................................. B.1

To scroll to a menu item, click on it.
To return, use the "previous view" command.

vii
APPENDICES

Appendix I.
http://www.genetics.org/content/169/4/1787.full.pdf+html ........................................... A.1
Reprint: Kass et al. 2005 .................................................................................. A.2

Appendix II.
Reprint: Coe & Kass 2005 ........................................................................... A.14

Appendix III.
Contributor’s Biographical Sketches ............................................................ A.19

To scroll to a menu item, click on it.
To return, use the “previous view” command.
When Dr. Kass asked me to write a foreword for this volume, I was surprised; surely there were others in the maize community better suited? However, I can trace my scientific lineage as a maize geneticist directly to the community built by the *Maize Genetics Cooperation News Letter* (*MNL*). I did my PhD at the University of Missouri in evolution and archaeology. However, while I was there, Drs. Ed Coe (editor of *MNL* from 1974-2000, after Emerson, and others) and Jim Birchler (*MNL* co-editor with Mary Polacco, now Schaeffer) introduced me to maize genetics. In 1993, I drove in a van to my first Maize Meeting with their graduate students. Every year since, I have attended the Maize Genetics meeting, where over 600 people of all ages come to discuss and work on the intricacies of maize. But, before jet setting around the US or planet was possible, and before the myriad of Internet communication's tools were available, the *Maize News Letter* was a visionary way to build an effective and collaborative community.

How did this community come about? As I look out the window of my office today, I see the building where, in 1932, the greatest geneticists from around the world gathered at Cornell University for The Sixth International Congress of Genetics. Despite the world being in the throes of the Great Depression, scientists traveled to Ithaca, New York to discuss the incredible breakthroughs occurring in genetics — the first Golden Age of genetics. At the time, the rediscovery of genetics was about 30 years old and if we look at the meeting attendees and talks, we can see the origins of many of the major branches of genetics represented for the first time. And, at that meeting, Dr. Rollins Emerson (1st *MNL* Editor) called together a side group of maize geneticists to develop a process to share knowledge and discovery across the community. This side meeting invigorated the previously established *Maize Genetics Cooperation News Letter*, which would, for the next decades, be the key catalyst for the community.

What other newsletter is a cooperation newsletter? This sense of cooperation was instrumental to the creation of our community, initially with sharing of information and genetics stocks. But over time, these founding geneticists and breeders collaborated with nearly every other field of science – physiology to archaeology to engineering. Cooperation evolved and added collaboration. Today, the breadth of science that is possible when working on maize through collaboration is what I love most about our science. Our community answers questions as precise as how a change in a single base of DNA affects the structure of the tassel to questions as overarching as how maize can play a sustainable role in feeding the world in the face of climate change. The newsletter let people know years before an official publication came out what various groups were working on. While there is always some competition for discovery, the community around the newsletter was dominated by cooperation and collaboration.

In this volume, Drs. Kass, Coe, and co-editors show how the *Maize News Letter* is central to the origins of maize genetics and community, and in no small part the origins of the entire modern genetics community. While I never had the honor of meeting Rollins Emerson, Barbara McClintock, George Beadle, or Marcus Rhoades, I have worked on questions that all of these people asked and even reanalyzed some of their data that was first reported in the *MNL*. In this volume, Lee Kass brings to life these founders of our scientific community, where we came from, and how our community was built. While this work highlights some scientific questions that remain open, the greatest lesson the *MNL* can teach us and future generations is how to build a community of learning and discovery, where the scientist, the science, and society all win.
PREFACE

Rollins A. Emerson, second Head of Cornell’s Department of Plant Breeding, established the Maize Genetics Cooperation and the *Maize Genetics Cooperation News Letter (MNL)* at Cornell University (Kass et al. 2005, reprinted in this volume). It was published at Cornell from 1929 through 1955, and continued publication at The University of Illinois, Indiana University and The University of Missouri (Coe & Kass 2005, *MNL* 79; reprinted in this volume).

This 90th Anniversary book was inspired when in April of 2018 Kass searched the MaizeGDB online database (https://www.maizegdb.org/mnl) to locate a complete reference, including page numbers and author affiliations, for an article published in *MNL* 17, 1943. Coe, former *MNL* editor (1975-2000), helped locate the reference and confirmed that it was not possible to gain knowledge of affiliations for historical purposes without examining hard copies of the *MNL*. Many of those early News Letters had been retyped for the digital venue, and contributors’ reports were not always shown in groups by affiliation (e.g., University, College, or other Institution), as can be found in the originals.

While searching for this reference, it occurred to Kass that Plant Breeding & Genetics at Cornell had Emerson’s bound volumes of the earliest *MNL*s that were not in the Cornell Library. Before sending these *MNL* bound volumes (Vols. 2-14, 1932-1940; Vols. 15-21, 1941-1947, compiled by Emerson for the College of Agriculture Library) to the Cornell Archives, we desired to scan them “verbatim” and make them available in digital format. We also have a copy of what is now considered *MNL* Volume 1, 1929, Emerson, pp. 1-30. This was located among the papers of E.G. Anderson, at The University of Missouri, by Coe (*MNL* 53, Foreword, 1979). It was reprinted in a hard copy of *MNL* 53:117-130, March 1, 1979, “IV. 50 Years Ago,” as part of the Historical Notes of the *MNL*, but was not initially available in digital format (see *MNL* archived volumes https://www.maizegdb.org/mnl; https://mnl.maizegdb.org/mnl/53/). A pdf version of *MNL* Volume 53 has since been added as a link: (https://mnl.maizegdb.org/mnl/53/00MNL%2053or.pdf). Volume 22 to date has been added as verbatim pdf versions by Coe and are posted at the online database, (https://www.maizegdb.org/mnl).

The early *MNL* articles were presented online, but were incomplete (available at Maize Newsletter Archives, https://www.maizegdb.org/mnl). Also, the early volumes (1-3) were mis-numbered on this website [the correct volume numbers were published by Coe and Kass (2005)]. The 1932 issue was listed as Volume 1, but the first Volume issued in 1929 was not included at this archive link (this volume was reprinted in *MNL* 53, as mentioned above). Considered to be the first *MNL* by Emerson, Volume 1, 1929 is correctly cited as *MNL* 1 at MaizeGDB, Reference Record, Emerson, R.A., 1929, *MNL* 1:1-30, “You who attended the “cornfab” in my hotel room ...” (https://maizegdb.org/data_center/reference?id=9020573). This web-link also reports that *MNL* 1 was reprinted in *MNL* 53. Biographical references for R.A. Emerson are included at: (https://maizegdb.org/person?id=12877).

Because the early *MNL*s were not available in digital format, we reached out to Robert Cooke, publisher of the Internet-First University Press, to ask if he might have an interest in publishing, as an e-book, Volumes 1-21 (1929-1947) of the *Maize Genetics Cooperation News Letter*, including the correspondence that accompanies these volumes. He was enthusiastic to publish the volumes if we could make arrangements to have them scanned. We were fortunate that Michael Cook of Albert R. Mann Library Digital Collections had the funding and resources for this endeavor, and he offered, in addition, to produce a Cornell eCommons webpage where the scans could also be viewed (see Introduction). Cook also suggested reprinting Coe & Kass (2005) in this volume for ease of comparison with original *MNL* volume numbers (see Appendix II).

We are, therefore, pleased to present here the early *MNL*s compiled by R.A. Emerson, with relevant photographs (see Introduction) and perspectives on its founding at Cornell University, 90 years ago this April.

Lee B. Kass
Edward H. Coe, Jr.
9 February 2019
ACKNOWLEDGMENTS

We acknowledge with thanks: the staff of Albert R. Mann Library for providing resources for scanning *Maize News Letters*; Jeffrey Piestrak, Digital Collections Specialist, for making the excellent scans; and Michael Cook, Head of Collections, for supervision. We also acknowledge Ed Buckler, Cornell University, for providing 1932 ICG photos; and Evan Earle, Director Cornell Archives and Peter Fraissinet, L.H. Bailey Hortorium, for identifying the building where the 1929 group photo was taken. Dr. Alexandra S. Kadner, WV medical writer and scientific consultant, provided assistance by alerting us to more recent cooperative-type Newsletters. We thank The Genetics Society of America for granting permission to reprint Kass et al. 2005, *Genetics* 169 (April 1): 1787-1797. We deeply appreciate Mark Sorrells, Professor of Plant Breeding & Genetics, for reviewing the manuscript. Hard copies of this volume were made available courtesy of School of Integrative Plant Science, Plant Breeding & Genetics Section. LBK thanks Plant Breeding & Genetics, Cornell University, and Plant & Soil Sciences, West Virginia University for logistical support. Special recognition is given to our publisher, J. Robert Cooke, for encouraging our efforts to make this project a reality.
Group photo of Sixth International Congress of Genetics, 24-31 August 1932, Ithaca, New York, taken outside northwest corner of the New York State Armory and Drill Hall (now Barton Hall), Cornell University Campus. (Courtesy of Edward S. Buckler) [For IDs see Jones (1932, Volume 1) or Crow (1992)]
[Left Half] Group photo of Sixth International Congress of Genetics, 24-31 August 1932, Ithaca, New York, taken outside northwest corner of the New York State Armory and Drill Hall (now Barton Hall), Cornell University Campus. (Courtesy of Edward S. Buckler) [For IDs see Jones (1932, Volume 1) or Crow (1992)]
Group photo of Sixth International Congress of Genetics, 24-31 August 1932, Ithaca, New York, taken outside northwest corner of the New York State Armory and Drill Hall (now Barton Hall), Cornell University Campus. (Courtesy of Edward S. Buckler) [For IDs see Jones (1932, Volume 1) or Crow (1992)]
INTRODUCTION

The *Maize Genetics Cooperation News Letter* (**MNL**) was founded by Rollins Adams Emerson (1873-1947) at Cornell University and has been published annually since 1929. It is a compendium of notes and information about on-going research intended to be shared throughout the maize research community. The *News Letters* were published by the Department of Plant Breeding at Cornell University until 1955. A partial name contraction to *Newslette* was made with Volume 64 in 1990. The publication became fully and only digital with Volume 88.

Emerson was head of Cornell's Department of Plant Breeding from 1914 to 1942 (Murphy & Kass 2007, 2011). He had been called from the University of Nebraska to succeed H.J. Webber, who established the Department at Cornell in 1907. Emerson and his students established a school of Maize Genetics and Cytogenetics, and in 1929 he founded the *Maize Genetics Cooperation News Letter*.

In this book we offer a full page verbatim scan of the first **MNL**, sent to maize cooperators by R.A. Emerson on 12 April 1929. The scan was made by Coe from the archived files of E.G. Anderson, who had spent his retirement years at the University of Missouri. Anderson had received his Ph.D. (1920) at Cornell with Emerson (Murphy & Kass 2007, 2011, pp. 24, 31, 33-34, 119).

As Emerson planned his retirement, he arranged to have all copies of the **MNL** bound for the College of Agriculture Library. Two bound volumes resulted (see back cover). When the new library (Albert R. Mann Library) was established, Emerson's bound volumes remained in the Department of Plant Breeding and eventually were passed along to Margaret Smith (see Kass et al. 2005). The back cover of this volume shows the two bound volumes of the early **MNLs** that were compiled for the library. Verbatim scans of these first bound volumes are also included here, and the originals will be deposited in the Cornell Archives for their History of Science Collections.

The first set of bound **MNLs**, which we located in the Department of Plant Breeding at Cornell (**MNL**, Vols. 2–14, 1932–1940), was numbered by hand in pencil, beginning with October 1932, labeled “Vol. 2” (**MNL** 2; Coe & Kass 2005). The “Historical Notes on Maize Cooperation” listed on p. 56 of **MNL** 14 (1940) states that the mimeographed letter of April 12, 1929 is “considered News Letter 1.” The Cornell Plant Breeding Department's bound volumes appear to have been numbered retroactively under the guidance of Emerson, who was the secretary for **MNL**, Vol. 14, 1940. The binding on the first set of bound *News Letters* clearly shows that 1932 was considered to be **MNL** Vol. 2 (see image on back cover).

The **MNL** included unpublished data, unselfishly contributed by geneticists from many institutions (Murphy & Kass 2011, p. 23). This first and unique cooperative effort was so successful that it became widely copied. For example, the first volume of the *Drosophila Information Service* (**DIS**), issued in March 1934, mentioned the Emerson Cooperation and that *Drosophila* workers had planned to establish a similar service to that of the maize workers (Bridges & Demerec 1934, p. 2). Similar publications soon followed: *Mouse Genetics News* (Snell 1941, Law 1948), reestablished as *Mouse News Letter* (Dunn 1949); *Neurospora Newsletter* (1962-1985), later named *Fungal Genetics Newsletter* (1986-2007), and currently named *Fungal Genetics Reports* (2008-current); *Arabidopsis Information Service* (Röbbelen 1964-1973, Kranz 1974-1990), later The *Arabidopsis Information Resource* (**TAIR**); *Zebrafish Science Monitor* (1991-2000), which became ZFIN NEWS and then The *Zebrafish Information Network* (2004-current); *Worm Breeders Gazette* (**WBG**) (Edgar 1975-current); and a variety of other plant Newsletters that have come and gone, such as *Gramene* and The *Rice Genetics Newsletter* (1984-2007). See others as listed on the *Gramene* website (http://archive.gramene.org/newsletters/newsletters.html).

The first **MNL** (Vol. 1, 1929) was sent “To Students of Maize Genetics” in April of 1929, shortly after Emerson’s “cornfab,” held in his hotel room at the AAAS Christmas meetings, December of 1928, in New York City (Kass et al. 2005). This mimeographed letter included a long folder of linkage information—linkage data, lists of genes, and “rainbow maps”—and the names of researchers assigned to nine of the ten linkage groups known at that time (see **MNL** 1, 1929, p. 2). Most of the researchers assigned to study the maize linkage groups were working at Cornell; the more familiar names were [George W.] Beadle, [Barbara] McClintock, [Allan C.] Fraser and of course R.A.
Emerson. Others working on linkage groups were affiliated with Bucknell University, Lewisburg, Pennsylvania; Iowa State University, Ames, Iowa; The University of Minnesota, St. Paul, Minnesota; Ohio Agricultural Experiment Station, Wooster, Ohio, in cooperation with the Office of Cereal and Crops Diseases, Bureau of Plant Industry, U. S. Dept. of Agriculture, Beltsville, Maryland; University of Wisconsin, Madison, Wisconsin; and Kansas State University, Manhattan, Kansas. Barbara McClintock shared the study of linkage group B-LG with Lewis J. Stadler of The University of Missouri, Columbia, Missouri.

Beadle would later share the 1958 Nobel Prize in Physiology or Medicine for “… discovery that genes act by regulating definite chemical events” (https://www.nobelprize.org/prizes/medicine/1958/beadle/facts/). McClintock, 1983 Nobel Laureate in Physiology or Medicine, was awarded an unshared prize for her “discovery of mobile genetic elements” (https://www.nobelprize.org/prizes/medicine/1983/mcclintock/facts/; Kass 2013ff.).

Ever honest and forthcoming, Emerson claimed “no credit” for assembling this first summary of data. Professor Fraser had “abstracted the available published papers” before leaving for a year in Europe, Emerson explained. Emerson also noted that his graduate student, “Mr. Beadle, has completed that work and assembled my own unpublished records and has arranged all the tables and charts” (Emerson, MNL 1, p. 1).

Supplementary communications were sent out by Beadle in November and December of 1929 and February of 1930. Emerson sent a 17-page mimeographed folder of revised maps on April 17, 1930, and in July 1930 he sent a second folder of linkage data that included 23 pages. The latter two communications were found in the papers of E.G. Anderson and at the Rockefeller Archives Center, respectively. They were identified by Emerson in his Historical Notes published in MNL 14:56, but were not included in the Plant Breeding Departments’ bound volumes. These communications (not included here) were reprinted in MNL 54 (1980) and MNL 72 (1998), and are listed in Coe & Kass (2005).

The Maize Genetics Cooperation was formalized during the 1932 Sixth International Congress of Genetics held at Ithaca, NY (MNL 2, 1932), and was mentioned in Emerson’s Historical Notes published in 1940 (MNL 14:56). Shortly before that conference, Emerson notified maize geneticists of his plan to establish a Cooperation of Maize Geneticists (ref. MNL 14:56; Coe & Kass 2005). Soon after the Congress, Emerson and his former student Marcus Rhoades issued what has been considered to be the first “Maize Genetics Cooperation News Letter” (October, 1932), in which unpublished data were freely shared among the members. Rhoades assumed editorship of the MNL after Emerson and George Beadle. Rhoades numbered the October 5th 1932 MNL as number 1, but as we have shown this had been identified by Emerson as MNL 2, 1932 (see scanned MNL Vol. 2 in this volume, and bound volume image on back cover; see also Kass et al. 2005, reprinted Appendix I; Coe & Kass 2005, reprinted Appendix II).

A group photograph taken at the 1932 Congress of Genetics is published in this Anniversary volume (before the Introduction). The photograph is slightly different from the one published in the Proceedings (Jones 1932, Vol. 1), given that Emerson’s dog is included in the lower right corner. The scan was made from a photograph that was saved from the trash by Edward (Ed) Buckler, when he was affiliated with North Carolina State University (NCSU). We also have a similar photo in the Plant Breeding and Genetics files at Cornell. By examining the list of attendees at the Ithaca Congress (Jones 1932, Vol. 1, p. 25), we concluded that the framed photo that Buckler had saved from a storage closet at NCSU had been obtained by C.H. Bostian, who had joined the faculty at North Carolina State College, Raleigh, North Carolina (now NCSU) in 1930, and retired in 1973 (Bostian Wikipedia). He is identified by number 368, in the upper left side of the 1932 Ithaca Congress group photograph (see Crow 1992 or Jones 1932, Vol. 1). In addition, the President of the Ithaca Congress, T.H. Morgan, and R.A. Emerson, the General Chairman of the Local Committee, are seen in a photo (frontispiece) taken in Willard Straight Hall, the Headquarters of the Congress (Morgan 1932). This scanned image was also made from a photograph saved by Buckler. An image of the Executive Committee for the Congress, also from this NCSU collection, can be viewed on the eCommons webpage (Maize Genetics Cooperation News Letter, eCommons https://ecommons.cornell.edu/handle/1813/58745).
At the 1932 International Genetics Congress, Emerson gave an opening address titled “The Present Status of Maize Genetics” (Kass & Bonneuil 2004). In his introduction he declared:

“I cannot refrain from noting here a very real advantage experienced by students of maize genetics ... I am aware of no other group of investigators who have so freely shared with each other not only their materials but even their unpublished data. The present status of maize genetics, whatever of noteworthy significance it presents, is largely to be credited to this somewhat unique, unselfishly cooperative spirit of the considerable group of students of maize genetics. In this connection I want gratefully to acknowledge the help of many persons who have contributed directly or indirectly to this summary statement of the status of maize genetics” (Kass 2001, Kass et al. 2005).

By October 1932, MNL 2 (= Rhoades MNL 1) was issued from Cornell, and provides a record that ten linkage groups had been assigned to ten maize workers. A report of the meeting held at the International Congress of Genetics was included in this MNL, as recorded by Secretary Rhoades (see also Kass et al. 2005). Emerson's numbered MNL 3, January 23, 1933, 16 pages (= Rhoades MNL 2), is identified as the “Third Corn News Letter” (MNL 14:56), and provided a long list of known genes of maize, among other items. By November 13, 1933, Rhoades issued a two-page call for information anticipating the forthcoming MNL 4, published the following month. This November call is not included in the Emerson bound volume, but was included in the files at Missouri (Coe & Kass 2005). By December 1933, Emerson's and Rhoades’ MNLs were both numbered in agreement as MNL 4, 7 pages. Thereafter, the MNL volume numbers correspond (Coe & Kass 2005).

Rhoades left Cornell in 1935 and Emerson assumed editorship once again. In 1937, Derald Langham, Emerson's graduate student (Ph.D. 1939), became editor through MNL Volume 13 (March 1939). Emerson re-assumed editorship through 1944 (MNL 18), with the exception of MNL 15 (April 1, 1941), edited by Professor Fraser. Fraser had planned to assume editorship but, sadly, died in September of 1941. Robert L. Cushing was hired in 1943 to replace Fraser. Cushing edited MNLs 19 and 20 (1945-1946) and was succeeded by Harold H. Smith as editor and Professor of Genetics through MNL 26 (1952). It may have been Smith, in consultation with Emerson, who had the second set of MNLs (Volumes 15-21) bound for the library.

We have also included scans of the Cornell Plant Breeding Department's second bound volume of Maize News Letters (MNL 15-21, 1941-1947; see image on back cover). We believe that Emerson may have compiled this bound volume prior to his death on 8 December 1947. Note that MNL Volume 21, which we include in this book, was not scanned from this second bound volume. Due to technical difficulties with the library’s book scanner, MNL Volume 21 was scanned from an unbound identical Albert R. Mann Library copy instead. As mentioned in the Preface, Cook provided funds to scan these early maize volumes, and provided guidance on copyright, and other items of value to include for historical perspective.

Professor Margaret Smith (Cornell Ph.D. 1982) has held Cornell’s bound MNL collection for many years (Kass et al. 2005). She joined the Plant Breeding faculty in 1987. R.P. Murphy (Murph), former Chair of Plant Breeding (1953-1964), introduced Kass to Smith, when Kass sought information about McClintock's affiliation with the Maize Genetics Cooperation News Letter at the encouragement of former editor Coe (see Kass 2013ff.). Although Murphy had long ago left maize research, he had done his Ph.D. at Minnesota with one of the most prominent maize geneticists of his generation, Herbert K. Hayes, and continued his interest in the subject through the faculty in Plant Breeding (Murphy & Kass 2007, 2011). Having access to the early maize volumes led to cooperative efforts to expand the chronological list of materials related to maize cooperation (Coe & Kass 2005) and to provide historical perspectives on the cooperative spirit fostered at Cornell by Emerson (Coe 2001, Kass et al. 2005). Smith also tutored Kass in the reproductive biology of maize to further her understanding of the extensive field work required, and she introduced Kass to the cytogeneticists teaching in the Plant Breeding Department, who used slides prepared by McClintock for work reported in MNL (see Kass 2013ff.).

Judy Singer has been an invaluable resource to this project, and has been a long time member of Cornell’s Department of Plant Breeding and Genetics. Singer facilitated all contacts for obtaining the photographs that appear in this book, and she designed and took the photo that appears on the back cover. Singer’s cooperative spirit is reminiscent of the manner fostered by Plant Breeding Department Head Rollins A. Emerson. For many years, she has
worked towards the preservation of historical documents in this historically notable department, initiated by Dean Liberty Hyde Bailey in 1907 (Murphy & Kass 2007). Murphy, Kass, and Singer worked closely to save and identify documents for the history of Cornell's Plant Breeding Department (Murphy & Kass 2007), which was subsumed into the School of Integrative Plant Science when it was established in 2014, and to deposit these documents for posterity in the Cornell Archives.

In this tradition, and in celebration of the 90th Anniversary of the *Maize Genetics Cooperation News Letters*, the editors of this volume are pleased to present a digital record of the early *Maize News Letters*, founded at Cornell University by R.A. Emerson in April of 1929.

**References Cited**


Bridges, C.B., and M. Demerec. 1934. *Drosophila Information Service* [DIS] 1(March): 1–88. [DIS 1, p. 2 mentions a letter sent to *Drosophila* geneticists on Nov. 10, 1933, reporting that *Drosophila* workers plan to establish a similar service to that of the maize workers (Excerpts of DIS No. 1 have been digitized beginning with p. 54). *MNL* 4, p. 2, Dec. 18, 1933, reports that the *Drosophila* workers have decided to start a cooperative group modeled after the one for maize.]


Coe & Kass 2005 (see Annotated Bibliography and Appendix II)

Carter, T.C. et al. 1952. Nomenclature for Inbred Strains of Mice; Prepared by the committee on standardized nomenclature for inbred strains of Mice. *Cancer Res* 12:602-613. [Reference 1 states that the first *Mouse News Letter* was edited by L.C. Dunn at Columbia University. Subsequent issues were prepared by T.C. Carter, Hampstead, London. In this report there is no mention of Snell's (1941) or Law's (1948) previously published *Mouse Genetics News*.]

Crow 1992 (see Annotated Bibliography)


*Fungal Genetics Reports* (FGR). 2008--current. Published as an online resource by the *Fungal Genetics Stock Center*. Volumes 1 - 32 (1962 - 1985) were published as *Neurospora Newsletter*. From 1986 - 2007, *FGR* was continued as *Fungal Genetics Newsletter*, then *Fungal Genetics Reports* (2008-current), [https://newprairiepress.org/fgr/](https://newprairiepress.org/fgr/)


Jones 1932, Vol. 1 (see Annotated Bibliography)


Kass et al. 2005 (see Annotated Bibliography and Appendix I)


Maize Genetics Cooperation News Letter (see Annotated Bibliography)

Morgan 1932 (see Annotated Bibliography)


ZFIN NEWS, The Zebrafish Information Network, Volume 1, No. 1. Summer 2004 https://zfin.org/zf_info/news/Newsletter_Summer04.pdf; “ZFIN NEWS” is the ZFIN Newsletter, published bi-annually at the University of Oregon
Introduction to *Maize Genetics Cooperation News Letter*,
Volume 1 (1929)

The following pages offer a full page verbatim scan of the first *MNL*, sent to maize cooperators by R.A. Emerson on 12 April 1929 (Kass et al. 2005, Appendix I). The “Historical Notes on Maize Cooperation” listed on p. 56 of *MNL* 14 (1940) states that the mimeographed letter of April 12, 1929 is “considered *News Letter 1*” (see INTRODUCTION). The scan was made by Ed Coe from the archived files of E.G. Anderson (See Coe & Kass 2005, Appendix II).
April 12, 1929

TO STUDENTS OF MAIZE GENETICS:

You who attended the "corn lab" in my hotel room at the time of the winter science meetings in New York will recall that I promised to prepare a summary of the published data involving linkage groups in maize, to add my own unpublished data, and to send these records to each of you for criticism and the addition of such unpublished records as you may care to furnish me. I am now enclosing the records promised, but can claim no credit for having assembled them. Professor Fraser had, before leaving for a year in Europe, abstracted the available published papers. Mr. Beadle has completed that work, has assembled my own unpublished records, and has arranged all the tables and charts.

I hope that each of you, whether or not you attended the New York meeting, will send me such relevant data as you have not yet published, showing either linkage or independent inheritance. In so far as you have data ready for publication, I prefer to receive a copy of your manuscript, but shall be glad to have also records which you are not ready to publish, if you care to send them. I agree not to publish any such data without your consent and in any case to give proper credit. Any records sent, however, should be with the understanding that I am at liberty to use them in an early revision of the mimeographed sheets for distribution to other workers, pending the publication of the general linkage paper which I have been threatening to bring out for some years now.

I indicated at New York that the records were too incomplete to warrant publication now, a fact made strikingly obvious by the "rainbows" on the maps. The distribution of the data in mimeographed form should serve temporarily the needs of those actively studying maize genetics; and others can wait. The co-ordination of effort agreed to in New York should go far toward straightening out many of the question marks in the next year or two.
In this connection, I add here, as a reminder, a list of those to whom linkage groups were parcelled out at New York.

C-Wx group - Eyster, Bucknell; Beadle, Cornell.
R-G group - Lindstrom, Jenkins, Wentz, Ames.
Su-Tu group - Emerson, Cornell.
E-Le group - Stadler, Missouri; McClintock, Cornell.
Y-Pl group - Hill, Cornell.
P-Br group - Emerson, Cornell.
Rae-G1 group - Brewbaker, Minnesota; Brunson, Manhattan; Fraser, Cornell.
Pr-V2 group - Eyster, Bucknell; Jorgenson, Ohio; Li, Cornell.
D1-Pg2 group - Not assigned.
A-Ts4 group - Brink, Wisconsin; Li, Cornell.

To those not at the New York meeting, it should be explained that this assignment of groups was, so far as possible, made in accordance with the expressed interests of those assuming the responsibilities entailed. It was far from our purpose to preempt groups for ourselves and thereby warn off other workers. Our purpose rather was to make sure that each known group would be given immediate and adequate attention to the end that the not very exciting job of chromosome mapping may go forward with some dispatch, thereby making possible an attack on certain important genetic problems now awaiting just such tools as accurate linkage maps afford. It should go without saying therefore that the help of those of you who were not at the New York conference will be welcomed.

I suggest that those who have made themselves responsible for any group, request needed material directly from the workers most likely to have it, as indicated by the names in the last column of the table for that group. We at Cornell shall be glad to furnish on request tester stocks in so far as our somewhat limited supply will permit. It would doubtless be helpful if those who have particularly desirable testers for any group would proffer them to the ones who are primarily responsible for that group.

Sincerely,

R. A. Emerson
GENERAL NOTES

Linkage data.-

In the last column of the tables giving the linkage data for the several linkage groups, papers from which the records have been summarized are indicated by author and year. Not all published data are included. For instance, F₀ data are omitted when abundant back-cross data are available. Records credited to an author without indication of the year are unpublished. In general, unpublished data received in personal correspondence are not included, except when no published records are available. Such data are doubtless incomplete. It is thought, therefore, that workers will prefer to add their complete data as of the spring of 1959.

X and Y in the column headings of the several tables indicate the dominant genes of the first column and x and y their respective recessive allelomorphs.

In the second column under the heading "Link, phase", C = coupling and R = repulsion, Bc = back-crossed and S = selfed.

Data presented in the table of three-point tests are included not additional to, data in the several group tables. The first column of this table shows the genotype of one parent only, the other parent having obviously the respective allelomorphs of the genes of parent no. 1. The genotypes involved in columns 2 - 5 will be clear from the following illustration:

<table>
<thead>
<tr>
<th>Parental combinations</th>
<th>Region 1</th>
<th>Region 2</th>
<th>Regions 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>No. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T sh Wx C sh Wx-C Sh Wx C sh Wx-c sh Wx C sh Wx-C sh Wx-c sh Wx</td>
<td>1 and 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sh Wx I sh Wx-i sh Wx I sh Wx-i sh Wx I sh Wx-i sh Wx I sh Wx-i Sh Wx</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lamps.-

No attempt has been made to indicate map distance other than by observed cross-over percentages; 3 mm. = 1 per cent crossing over.

Starred genes (*) are those located with reasonable certainty; others probably belong in the general region indicated.

A gene tested with only one of the located genes is placed opposite that gene at a distance determined by the cross-over percentages, its locus being approximately at one end or other of the "rainbow".

Independence of linkage groups.-

This chart shows what tests have been made between genes of any one linkage group and those of other, presumably independent, groups. Thus, there are records involving approximately 9900 individuals from selfed parents indicating independence between C or I and A and approximately 2000 individuals in back-cross progenies indicating independence of sh and A. It is obvious that the data are not adequate to establish the independence of all the groups, and it is hoped that other workers will have unpublished data to fill in some of the "holes". As an example of the necessity of obtaining more nearly adequate data, a manuscript by Hayes and Brubaker (received after the stencils for the linkage tables had been cut) indicates that gl-11 belongs to the B-jg group, while Pendall's unpublished records suggest that Tl is in the C-wx group. The independence of these two groups is, therefore, questionable.
## C-SH-WX GROUP

### List of Genes

<table>
<thead>
<tr>
<th>Gene</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>arg</td>
<td>Argentic - finely striped leaf</td>
<td>Eyster 1929</td>
</tr>
<tr>
<td>au1</td>
<td>Aurea chlorophyll-yellow plant</td>
<td>Eyster 1929</td>
</tr>
<tr>
<td>au2</td>
<td>Aurea chlorophyll-yellow seedling</td>
<td>Eyster 1929</td>
</tr>
<tr>
<td>lp</td>
<td>Brown pericarp with c</td>
<td>Hoyers 1927</td>
</tr>
<tr>
<td>c</td>
<td>Colored aleurone with A and R</td>
<td>East and Hoyes 1929</td>
</tr>
<tr>
<td>d3</td>
<td>Dwarf plant</td>
<td>Suttle (Unpub.)</td>
</tr>
<tr>
<td>gl1</td>
<td>Defective endosperm</td>
<td>Brink 1927</td>
</tr>
<tr>
<td>gl2</td>
<td>Glasy seedling</td>
<td>Hoyes and East 1915</td>
</tr>
<tr>
<td>glm1</td>
<td>Germless</td>
<td>Eyster 1929</td>
</tr>
<tr>
<td>l</td>
<td>Inhibitor for aleurone color</td>
<td>East and Hoyes 1929</td>
</tr>
<tr>
<td>pk</td>
<td>Polka dot leaf</td>
<td>Demerec 1924</td>
</tr>
<tr>
<td>vl1</td>
<td>Virescent seedling</td>
<td>Phipps (Unpub.)</td>
</tr>
<tr>
<td>vl4</td>
<td>Virescent seedling</td>
<td>Phipps (Unpub.)</td>
</tr>
<tr>
<td>vl5</td>
<td>Virescent seedling</td>
<td>Demerec 1926</td>
</tr>
<tr>
<td>w11</td>
<td>White seedling</td>
<td>Collins 1909</td>
</tr>
<tr>
<td>wx</td>
<td>Waxy endosperm</td>
<td>Jenkins 1927</td>
</tr>
<tr>
<td>yg</td>
<td>Yellow-green plant</td>
<td>Jenkins 1927</td>
</tr>
</tbody>
</table>

### Notes

- **pk**: The 1929 data of Eyster on pk are not consistent with his earlier data. He makes the statement in his 1929 paper that pk and arg show relatively close linkage—hence pk probably lies on the wx side of C.
- **d3**: In the material on which the d3 and w11 counts were made, the C and R factors were segregating. Demerec states that a calculation of the recombination percentage with C would suggest that both d3 and w11 were on the wx side of sh but that a calculation on such material could not be depended on.
- **au1**: The location of au1 to the right of sh is somewhat doubtful. Recombination values with C and sh are based on separate progenies. Neither au1 or au2 have been tested with yg for allelomorphism.
- **vl4**: vl4 is known to be located in the C-sh-wx linkage group but the data (Phipps unpub.) are of such a nature that a recombination value cannot be calculated.
### Linkage Data

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link phase</th>
<th>Number of individuals</th>
<th>Recombinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>XI Xy XY xy XI xy</td>
<td>Total No. x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G A X</td>
<td>R Be</td>
<td>115 340 208 92</td>
<td>845</td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>858 310 214 791</td>
<td>2260</td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>371 115 165 397</td>
<td>1008</td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>2942 717 798 2710</td>
<td>6708</td>
</tr>
<tr>
<td></td>
<td>X Y</td>
<td>4052 149 1524054</td>
<td>8388</td>
</tr>
<tr>
<td></td>
<td>xy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G Sh</td>
<td>C Be</td>
<td>10077 366 2379 9866</td>
<td>20706</td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>638 2139 21066 672</td>
<td>45735</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Sh</td>
<td>R Be</td>
<td>1535 5991 5885 14688</td>
<td>14845</td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>9452 384 402 9377</td>
<td>15615</td>
</tr>
<tr>
<td></td>
<td>L Y</td>
<td>1487 584 547 1520</td>
<td>4138</td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>790 2217 2283 792</td>
<td>6082</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C V1</td>
<td>R Be</td>
<td>300 876 711 224</td>
<td>1981</td>
</tr>
<tr>
<td></td>
<td>V X V1</td>
<td>70 34 40 3</td>
<td>197</td>
</tr>
<tr>
<td></td>
<td>3 Pk</td>
<td>C S² 128 6 54 56</td>
<td>244</td>
</tr>
<tr>
<td></td>
<td>Pk</td>
<td>C S² 138 5 128 92</td>
<td>373</td>
</tr>
<tr>
<td></td>
<td>Sh Pk</td>
<td>R S² 140 6 60 283</td>
<td>10 2 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S³ 362 173 173 1173</td>
<td>739</td>
</tr>
<tr>
<td></td>
<td>Sh D²</td>
<td>328 36 284 283</td>
<td>1113</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Sh</td>
<td>R Be</td>
<td>487 193 161 897</td>
<td>32 12.4</td>
</tr>
<tr>
<td></td>
<td>W 11</td>
<td>C S 426 26 26 67</td>
<td>478</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Yg</td>
<td>S S 3</td>
<td>10 57 52 7</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Yg</td>
<td>R Be 193 546 439 99</td>
<td>1287</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S 2583 1212 1057 89</td>
<td>4941</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B 15</td>
<td>W X</td>
<td>397 129 297 412</td>
<td>1395</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Be</td>
<td>R C</td>
<td>2449 1146 1237</td>
<td>4622</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Pk</td>
<td>C S² 128 6 54 56</td>
<td>244</td>
</tr>
<tr>
<td></td>
<td>Pk</td>
<td>C S² 138 5 128 92</td>
<td>373</td>
</tr>
<tr>
<td></td>
<td>Sh Pk</td>
<td>R S² 140 6 60 283</td>
<td>10 2 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S³ 362 173 173 1173</td>
<td>739</td>
</tr>
<tr>
<td></td>
<td>Sh D²</td>
<td>328 36 284 283</td>
<td>1113</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Sh</td>
<td>R Be</td>
<td>487 193 161 897</td>
<td>32 12.4</td>
</tr>
<tr>
<td></td>
<td>W 11</td>
<td>C S 426 26 26 67</td>
<td>478</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Yg</td>
<td>S S 3</td>
<td>10 57 52 7</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Yg</td>
<td>R Be 193 546 439 99</td>
<td>1287</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S 2583 1212 1057 89</td>
<td>4941</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Be</td>
<td>R C</td>
<td>2449 1146 1237</td>
<td>4622</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Pk</td>
<td>C S² 128 6 54 56</td>
<td>244</td>
</tr>
<tr>
<td></td>
<td>Pk</td>
<td>C S² 138 5 128 92</td>
<td>373</td>
</tr>
<tr>
<td></td>
<td>Sh Pk</td>
<td>R S² 140 6 60 283</td>
<td>10 2 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S³ 362 173 173 1173</td>
<td>739</td>
</tr>
<tr>
<td></td>
<td>Sh D²</td>
<td>328 36 284 283</td>
<td>1113</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Sh</td>
<td>R Be</td>
<td>487 193 161 897</td>
<td>32 12.4</td>
</tr>
<tr>
<td></td>
<td>W 11</td>
<td>C S 426 26 26 67</td>
<td>478</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Yg</td>
<td>S S 3</td>
<td>10 57 52 7</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Yg</td>
<td>R Be 193 546 439 99</td>
<td>1287</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S 2583 1212 1057 89</td>
<td>4941</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. C and R segregating - 9:7 ratio
2. A, C and R segregating - 27:37 ratio
3. Ratio corrected for germination by author
4. See Three-point test data
5. Recombination value recalculated - author's calculation given as 39.7
### R-G GROUP

#### List of Genes

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>df</td>
<td>Flint defective</td>
<td>Lindstrom 1925</td>
</tr>
<tr>
<td>g</td>
<td>Golden plant</td>
<td>Lindstrom 1918</td>
</tr>
<tr>
<td>gm2</td>
<td>Germless</td>
<td>Demerec 1926</td>
</tr>
<tr>
<td>li1</td>
<td>Lithospermum leaves</td>
<td>Compton 1926</td>
</tr>
<tr>
<td>l1</td>
<td>Lutous seedlings</td>
<td>Lindstrom 1917</td>
</tr>
<tr>
<td>l2</td>
<td>Lutous seedlings</td>
<td>Lindstrom 1925</td>
</tr>
<tr>
<td>ml</td>
<td>Narrow-leaf</td>
<td>Emerson (Unpub.)</td>
</tr>
<tr>
<td>pg1</td>
<td>Pale-green seedling</td>
<td>Brunsen 1924</td>
</tr>
<tr>
<td>R</td>
<td>Aleurone color</td>
<td>East and Hayes 1927</td>
</tr>
<tr>
<td>S</td>
<td>Spotted aleurone with Rrr</td>
<td>Kompton 1919</td>
</tr>
<tr>
<td>v12</td>
<td>Virescent seedling</td>
<td>Phipps (Unpub.)</td>
</tr>
<tr>
<td>v20</td>
<td>Virescent seedling</td>
<td>Phipps (Unpub.)</td>
</tr>
<tr>
<td>w2</td>
<td>White seedling</td>
<td>Carver 1924</td>
</tr>
</tbody>
</table>
### Linkage Data

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link</th>
<th>Number of individuals</th>
<th>Recombinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>X Y</td>
<td>X Y x X Y x y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>G</td>
<td>C Bc</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C Bc</td>
<td>227</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R Bc</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R Bc</td>
<td>18</td>
</tr>
<tr>
<td>R</td>
<td>L1</td>
<td>C S</td>
<td>333</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R Bc</td>
<td>21</td>
</tr>
<tr>
<td>R</td>
<td>P-g1</td>
<td>C S</td>
<td>1907</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S</td>
<td>1199</td>
</tr>
<tr>
<td>G</td>
<td>P-g1</td>
<td>C S</td>
<td>628</td>
</tr>
<tr>
<td>L1</td>
<td>P-g1</td>
<td>R S</td>
<td>194</td>
</tr>
<tr>
<td>R</td>
<td>W2</td>
<td>C S</td>
<td>1329</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C S</td>
<td>648</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S</td>
<td>43</td>
</tr>
<tr>
<td>R</td>
<td>L2</td>
<td>R S</td>
<td>815</td>
</tr>
<tr>
<td>R</td>
<td>L2</td>
<td>R S</td>
<td>585</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S</td>
<td>560</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S</td>
<td>350</td>
</tr>
<tr>
<td>R</td>
<td>Gm2</td>
<td>R S</td>
<td>986</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S</td>
<td>837</td>
</tr>
<tr>
<td>R</td>
<td>Gm2</td>
<td>R S</td>
<td>2239</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R S</td>
<td>6876</td>
</tr>
<tr>
<td>W2</td>
<td>L1</td>
<td>R S</td>
<td>2810</td>
</tr>
<tr>
<td>Gm2</td>
<td>P-g1</td>
<td>R S</td>
<td>635</td>
</tr>
<tr>
<td>R</td>
<td>V18</td>
<td>C s</td>
<td>51</td>
</tr>
<tr>
<td>R</td>
<td>V20</td>
<td>C Bc</td>
<td>77</td>
</tr>
<tr>
<td>G</td>
<td>L1</td>
<td>R Bc</td>
<td>148</td>
</tr>
<tr>
<td>R</td>
<td>L1</td>
<td>C Bc</td>
<td>268</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C Bc</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C Bc</td>
<td>460</td>
</tr>
<tr>
<td>G</td>
<td>M1</td>
<td>R Bc</td>
<td>69</td>
</tr>
<tr>
<td>R</td>
<td>M1</td>
<td>C Bc</td>
<td>219</td>
</tr>
</tbody>
</table>

Notes:

1. 1918 data indicate complete linkage
2. C and R segregating - 9:7 allelurone ratio
3. W1 and W2 segregating
4. W2 and W3 segregating
5. W1, W2, and W3 segregating
6. C and R segregating
7. First two classes only

Some notes added after the table:

1. Lindstrom states that C and W3 are very closely linked but presents no data.
2. Kempton (1919) postulated this spotting factor, located so as to give about 12.5% recombinations with R. Emerson (Unpub.) has additional evidence in support of this assumption.
R g Group
### SU-TU GROUP

#### List of Genes

<table>
<thead>
<tr>
<th>Gene</th>
<th>Description</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>de</td>
<td>Defective endosperm</td>
<td>Mangelsdorf/1926</td>
</tr>
<tr>
<td>dc</td>
<td>Defective endosperm</td>
<td>Mangelsdorf 1926</td>
</tr>
<tr>
<td>dc16</td>
<td>Defective endosperm</td>
<td>Wenz 1925, Jones</td>
</tr>
<tr>
<td>Ga</td>
<td>Gamete - pollen tube growth</td>
<td>Mangelsdorf/1925</td>
</tr>
<tr>
<td>ge1</td>
<td>Premature germination</td>
<td>Mangelsdorf 1926</td>
</tr>
<tr>
<td>su</td>
<td>Sugary endosperm</td>
<td>East and Hayes 1911</td>
</tr>
<tr>
<td>T5</td>
<td>Tassel-seed</td>
<td>Emerson (Unpub.)</td>
</tr>
<tr>
<td>Tu</td>
<td>Tunicate ear</td>
<td>Collins 1917</td>
</tr>
<tr>
<td>Wl</td>
<td>White-base leaf</td>
<td>Stroman 1925</td>
</tr>
</tbody>
</table>

#### Linkage Data

<table>
<thead>
<tr>
<th>Gene</th>
<th>Linkage</th>
<th>Number of Individuals</th>
<th>Recombinations %</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Y</td>
<td>X Y X y X Y X Y Total No.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Su Tu</td>
<td>CS</td>
<td>113 4 7 25 149</td>
<td>6.3</td>
<td>Jones &amp; Gallistegui '19</td>
</tr>
<tr>
<td></td>
<td>C'bc</td>
<td>430 172 179 408 1180 344 29.1</td>
<td>Eyster '21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>612 290 208 562 1672 498 29.8</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>1031 2420 2093 407 6429 1638 28.6</td>
<td>Eyster '22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R Bo</td>
<td>63 215 164 87 499 120 24.0</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2360 7260 28.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Su Wl</td>
<td>RS</td>
<td>44 19 11 1 75</td>
<td>25.0</td>
<td>Stroman '24</td>
</tr>
<tr>
<td></td>
<td>RS RS</td>
<td>4452 2018 1961 93 8864</td>
<td>22.0</td>
<td>Carver '27</td>
</tr>
<tr>
<td>de16 Su</td>
<td>CS</td>
<td>20622 453 7201 228276</td>
<td>4.2</td>
<td>Wenz '25</td>
</tr>
<tr>
<td>Su V8</td>
<td>CS</td>
<td>940 214 179 143 1481</td>
<td>32.4</td>
<td>Emerson '26</td>
</tr>
<tr>
<td>V8 Tu</td>
<td>CS</td>
<td>450 1 1 Lothio 451</td>
<td>7.4</td>
<td>Phipps</td>
</tr>
<tr>
<td>De1 Su</td>
<td>RS</td>
<td>601 238 247 64 1150 39</td>
<td>Mangelsdorf &amp; Jones '25</td>
<td></td>
</tr>
<tr>
<td>de6 Su</td>
<td>RS</td>
<td>204 92</td>
<td>26</td>
<td>Mangelsdorf '21</td>
</tr>
<tr>
<td>Ge1 Su</td>
<td>RS</td>
<td>1218 474</td>
<td>40</td>
<td>Mangelsdorf '26</td>
</tr>
<tr>
<td>Su T5</td>
<td>C Be</td>
<td>578 41 42 457 1118 83 7.4</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td>T5 Tu</td>
<td>R Be</td>
<td>49 166 115 48 378 97 25.7</td>
<td>Emerson</td>
<td></td>
</tr>
</tbody>
</table>

#### Notes

- **de16** is used instead of **de**su for sugary defective of Wentz.
- **V8** is very near Tu but whether to the left or right is unknown.
- **Ga** is to the left of su because it disturbs the Tu-tu ratio very little if at all in pedigrees in which it disturbs the Su-su ratio materially (Emerson, Unpub.).
- **de01** is presumably to the left of Ga, because Ga is between de and su (Mangelsdorf and Jones 1925).
### List of Genes

<table>
<thead>
<tr>
<th>Gene</th>
<th>Description</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Intensifier of plant color</td>
<td>Emerson 1918</td>
</tr>
<tr>
<td>lg</td>
<td>Liguleless</td>
<td>Emerson 1912</td>
</tr>
<tr>
<td>sk</td>
<td>Silkless</td>
<td>Jones 1925</td>
</tr>
<tr>
<td>ts</td>
<td>Tassel-seed</td>
<td>Emerson 1920</td>
</tr>
<tr>
<td>v4</td>
<td>Virescent seedling</td>
<td>Demerec 1924</td>
</tr>
</tbody>
</table>

### Linkage Data

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link.</th>
<th>Number of individuals</th>
<th>Recombinations</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X Y</td>
<td>X Y XY X Y xy xy x y</td>
<td>Total No. %</td>
<td></td>
</tr>
<tr>
<td>B Lg</td>
<td>C Be</td>
<td>240 134 102 243 719 236 32.8</td>
<td>Emerson '18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>642 291 282 620 1835 573 31.2</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Be</td>
<td>2487 1469 1557 2609 8122 3026 37.2</td>
<td>Emerson &amp; Hutchison '21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>498 103 103 504 3124 1002 32.1</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13800 4637 35.0</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td>Lg Ts</td>
<td>C Be</td>
<td>117 52 72 74 315 124 39.4</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>51 65 64 42 222 93 41.9</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>537 217 40.4</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td>B V4</td>
<td>C Be</td>
<td>113 24 21 110 268 45 16.8</td>
<td>Demerec '24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>412 501 521 366 1800 778 43.2</td>
<td>Demerec '24</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>148 60 67 133 408 12 31.1</td>
<td>Anderson</td>
<td></td>
</tr>
<tr>
<td>B Sk</td>
<td>C Be</td>
<td>1332 97 106 1226 2761 203 7.4</td>
<td>Anderson</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R Be</td>
<td>2 82 66 6 156 8 5.1</td>
<td>Anderson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2217 211 7.2</td>
<td>Anderson</td>
<td></td>
</tr>
<tr>
<td>Lg Sk</td>
<td>R Be</td>
<td>187 288 315 167 957 354 37.0</td>
<td>Anderson</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1365 481 35.2</td>
<td>Anderson</td>
<td></td>
</tr>
</tbody>
</table>
### List of Genes

<table>
<thead>
<tr>
<th>Gene</th>
<th>Description</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bh</td>
<td>Blotched alcurone with A c R</td>
<td>Emerson (Unpub.)</td>
</tr>
<tr>
<td>F1</td>
<td>Fine streaked leaves</td>
<td>Anderson 1922</td>
</tr>
<tr>
<td>P1</td>
<td>Purple plant color</td>
<td>Emerson 1918</td>
</tr>
<tr>
<td>sm</td>
<td>Salmon silks</td>
<td>Anderson 1921</td>
</tr>
<tr>
<td>V6</td>
<td>Virescent seedling</td>
<td>Carver 1927</td>
</tr>
<tr>
<td>V7</td>
<td>Virescent seedling</td>
<td>Carver 1927</td>
</tr>
<tr>
<td>w1</td>
<td>White seedling</td>
<td>Stroman 1924</td>
</tr>
<tr>
<td>w5</td>
<td>White seedling with w5</td>
<td>Demerec 1924</td>
</tr>
<tr>
<td>w7</td>
<td>White seedling with w7</td>
<td>Demerec 1924</td>
</tr>
</tbody>
</table>

### Linkage Data

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link. Number of individuals</th>
<th>Recombinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X Y</td>
<td>Authority</td>
</tr>
<tr>
<td></td>
<td>X Y</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>F1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Bc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>79</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>172</td>
<td></td>
</tr>
<tr>
<td></td>
<td>367</td>
<td></td>
</tr>
<tr>
<td></td>
<td>135</td>
<td></td>
</tr>
<tr>
<td></td>
<td>106</td>
<td></td>
</tr>
<tr>
<td></td>
<td>591</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>F1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Bc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>107</td>
<td></td>
</tr>
<tr>
<td></td>
<td>148</td>
<td></td>
</tr>
<tr>
<td></td>
<td>234</td>
<td></td>
</tr>
<tr>
<td></td>
<td>506</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1606</td>
<td></td>
</tr>
<tr>
<td></td>
<td>465</td>
<td></td>
</tr>
<tr>
<td></td>
<td>601</td>
<td></td>
</tr>
<tr>
<td></td>
<td>37.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>506</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1606</td>
<td></td>
</tr>
<tr>
<td></td>
<td>37.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>506</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1606</td>
<td></td>
</tr>
<tr>
<td></td>
<td>37.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>506</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1606</td>
<td></td>
</tr>
<tr>
<td></td>
<td>37.5</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>W6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S</td>
<td></td>
</tr>
<tr>
<td></td>
<td>349</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>454</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>W6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1020</td>
<td></td>
</tr>
<tr>
<td></td>
<td>237</td>
<td></td>
</tr>
<tr>
<td></td>
<td>259</td>
<td></td>
</tr>
<tr>
<td></td>
<td>191</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1707</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>V6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R S</td>
<td></td>
</tr>
<tr>
<td></td>
<td>467</td>
<td></td>
</tr>
<tr>
<td></td>
<td>238</td>
<td></td>
</tr>
<tr>
<td></td>
<td>209</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>915</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>V7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C S</td>
<td></td>
</tr>
<tr>
<td></td>
<td>592</td>
<td></td>
</tr>
<tr>
<td></td>
<td>149</td>
<td></td>
</tr>
<tr>
<td></td>
<td>78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>79</td>
<td></td>
</tr>
<tr>
<td></td>
<td>998</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>V7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R S</td>
<td></td>
</tr>
<tr>
<td></td>
<td>491</td>
<td></td>
</tr>
<tr>
<td></td>
<td>277</td>
<td></td>
</tr>
<tr>
<td></td>
<td>146</td>
<td></td>
</tr>
<tr>
<td></td>
<td>79</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Bh</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C Bc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>164</td>
<td></td>
</tr>
<tr>
<td></td>
<td>51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>133</td>
<td></td>
</tr>
<tr>
<td></td>
<td>180</td>
<td></td>
</tr>
<tr>
<td></td>
<td>210</td>
<td></td>
</tr>
<tr>
<td></td>
<td>323</td>
<td></td>
</tr>
<tr>
<td></td>
<td>142</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32.3</td>
<td></td>
</tr>
</tbody>
</table>

1. w5 and w7 duplicate genes
2. Segregating for another V - not linked
3. Probably part of this class actually Bh
4. From Bh class

### Notes

m1) Anderson presents data which he interprets as showing linkage between m1 and m2 and also between m1 and Y.

m2) His data are sufficiently extensive only to suggest that these factors may belong to this linkage group.
Y Pl Group
### List of Genes

<table>
<thead>
<tr>
<th>Genes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bn</td>
<td>Brown flowering</td>
</tr>
<tr>
<td>gl1</td>
<td>Glossy seedling</td>
</tr>
<tr>
<td>in</td>
<td>Intensifier of aureone</td>
</tr>
<tr>
<td>Ps1</td>
<td>Pale-green seedling</td>
</tr>
<tr>
<td>ra</td>
<td>Ramose</td>
</tr>
<tr>
<td>sl</td>
<td>Slashed seedling</td>
</tr>
<tr>
<td>ar2</td>
<td>Striate - striped leaf</td>
</tr>
<tr>
<td>Vf5</td>
<td>Virescent</td>
</tr>
</tbody>
</table>

### Linkage Data

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link.</th>
<th>Number of individuals</th>
<th>Recombinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X Y</td>
<td>phase X Y X Y X Y X Y Total</td>
<td>No.</td>
</tr>
<tr>
<td>Bn gl1</td>
<td>C Bc</td>
<td>177 63 54 192 486 117</td>
<td>24.1</td>
</tr>
<tr>
<td>Gl1 V5</td>
<td>C Bc</td>
<td>106 9 6 120 241 15</td>
<td>6.2</td>
</tr>
<tr>
<td>Bn V5</td>
<td>C Bc</td>
<td>83 31 29 96 241 60</td>
<td>24.9</td>
</tr>
<tr>
<td>Bn Ra</td>
<td>C Bc</td>
<td>159 104 160 161 534 204</td>
<td>38.2</td>
</tr>
<tr>
<td>Bn Ps1</td>
<td>C S</td>
<td>203 8 5 65 281 45</td>
<td>4.5</td>
</tr>
<tr>
<td>Gl1 Sr2</td>
<td>R Bc</td>
<td>97 289 342 63 791 160</td>
<td>20.2</td>
</tr>
</tbody>
</table>

### Notes

- Hayes and Browbaker state that sl belongs to this linkage group.
- Hayes and Browbaker present data showing a linkage between two factors for yellow endosperm (X, and Yp) and a glossy seedling factor. Since the relation of the glossy character to gl1 is not evident, the placing of these two genes in this linkage group would appear uncertain.
r_{a-g_{1}} Group
### FR-V₂ GROUP

**List of Genes**

<table>
<thead>
<tr>
<th>Gene</th>
<th>Description</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>bm</td>
<td>Brown midrib</td>
<td>Eyster 1926</td>
</tr>
<tr>
<td>bv</td>
<td>Brevis - semi-dwarf plant</td>
<td>Suttlc (Unpub.)</td>
</tr>
<tr>
<td>f₂</td>
<td>Fine striped leaves</td>
<td>Eyster 1926</td>
</tr>
<tr>
<td>Pr</td>
<td>Purple alcurone</td>
<td>East and Hayes 1911</td>
</tr>
<tr>
<td>sc₁</td>
<td>Scarred endosperm</td>
<td>Eyster 1926</td>
</tr>
<tr>
<td>tn</td>
<td>Tiny plant</td>
<td>Eyster 1926</td>
</tr>
<tr>
<td>v₂</td>
<td>Virescent seedling</td>
<td>Demaree 1924</td>
</tr>
<tr>
<td>v₃</td>
<td>Virescent seedling</td>
<td>Demaree 1924</td>
</tr>
<tr>
<td>v₁₂</td>
<td>Virescent seedling</td>
<td>Phipps (Unpub.)</td>
</tr>
<tr>
<td>yg</td>
<td>Yellow green</td>
<td>Eyster 1926</td>
</tr>
<tr>
<td>ys</td>
<td>Yellow-stripe</td>
<td>Bemere c 1924</td>
</tr>
</tbody>
</table>

**Linkage Data**

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link.</th>
<th>Number of individuals</th>
<th>Recombinations</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X Y</td>
<td>X Y X Y X Y X Y Total</td>
<td>No. %</td>
<td></td>
</tr>
<tr>
<td>Pr V₂</td>
<td>R BC</td>
<td>377 532 499 366 1774 743 41.9</td>
<td>Phipps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C BC</td>
<td>67 46 41 31 205 87 42.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pr V₁₂</td>
<td>R BC</td>
<td>123 257 320 102 225 26.8</td>
<td>Phipps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C BC</td>
<td>41 15 4 75 155 19 12.4</td>
<td>Phipps</td>
<td></td>
</tr>
<tr>
<td>Pr Y₃</td>
<td>R</td>
<td>213 323 209 19 770 8.3</td>
<td>Beadle (29)</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

- bm Eyster states that bm shows about 20 per cent recombinations with Pr but presents no data.
- f₂ Eyster states that these genes belong to the Pr linkage group but presents no data.
- sc₁ Eyster states that these genes belong to the Pr linkage group but presents no data.
- tn Eyster states that these genes belong to the Pr linkage group but presents no data.
- bv Li (Unpub.) has evidence that bv and Pr are relatively closely linked.
Pr vs Group

[Diagram showing a graph with labeled axes and points.]
D_{1} - F_{2} GROUP

List of genes

- **d_{1}**: Dwarf plant
  - Emerson 1912
- **t_{2}**: Pale-green seedling
  - Demerec 1924
- **cr**: Crinkly leaves
  - Emerson 1921

Linkage Data

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link. phase</th>
<th>No. of individuals</th>
<th>Recombinations</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X Y</td>
<td>X Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d_{1} P_{2}</td>
<td>R S</td>
<td>1564</td>
<td>584</td>
<td>580</td>
</tr>
<tr>
<td>d_{1} P_{2}</td>
<td>R Bc</td>
<td>15</td>
<td>53</td>
<td>48</td>
</tr>
<tr>
<td>d_{1} P_{2}</td>
<td>C Bc</td>
<td>518</td>
<td>102</td>
<td>707</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1340</td>
<td>239</td>
<td>37.8</td>
</tr>
</tbody>
</table>
d, pg. Group
**A-Ts, GROUP**

**List of Genes**

<table>
<thead>
<tr>
<th>Genes</th>
<th>Link.</th>
<th>Number of individuals</th>
<th>Recombinations</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>XY</td>
<td>XY</td>
<td>XY</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>90</td>
<td>63</td>
<td>70</td>
</tr>
<tr>
<td>Ts</td>
<td></td>
<td>262</td>
<td>351</td>
<td>372</td>
</tr>
</tbody>
</table>

**Notes**

Li (Unpub.) has evidence that na is linked with A, showing about 40 per cent of recombinations. Jones (Unpub.) also has evidence of this linkage.
### Summary of Three-Point Linkage Tests in Maize

<table>
<thead>
<tr>
<th>Parent No. 1</th>
<th>Parent combinations</th>
<th>Recombinations</th>
<th>Coincidence</th>
<th>Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental combination 1</td>
<td>Region 1</td>
<td>Region 2</td>
<td>Region 1 &amp; 2</td>
<td>Total</td>
</tr>
<tr>
<td>C sh Wx 2538 2708 5246</td>
<td>116 113</td>
<td>601 626</td>
<td>4 2</td>
<td>6708</td>
</tr>
<tr>
<td>I Sh Wx 2215 2280 4495</td>
<td>121 139</td>
<td>669 653</td>
<td>2 3</td>
<td>6082</td>
</tr>
<tr>
<td>yg C Sh 64 51 105</td>
<td>7 9</td>
<td>3 1</td>
<td>1 0</td>
<td>126</td>
</tr>
<tr>
<td>C sh ar 4673 4138 8916</td>
<td>259 192</td>
<td>1243 1986</td>
<td>14 28</td>
<td>12543</td>
</tr>
<tr>
<td>Ta B Su tu 163 113 276</td>
<td>9 12</td>
<td>37 39</td>
<td>2 3</td>
<td>378</td>
</tr>
<tr>
<td>Ta b Lg 111 71</td>
<td>21 17</td>
<td>46 33</td>
<td>6 3</td>
<td>315</td>
</tr>
<tr>
<td>Ta 1 B Lg 57 57 296</td>
<td>6 21 1</td>
<td>31 21 7 8 222</td>
<td>537</td>
<td>0.77</td>
</tr>
<tr>
<td>St B Lg 148 131 227</td>
<td>13 8 56 52</td>
<td>2 2</td>
<td>410</td>
<td>0.36</td>
</tr>
<tr>
<td>Y Pl Sm 191 180 436 377 305 285</td>
<td>109 104 165 206 107 124</td>
<td>21 31 45 50 28 30</td>
<td>5 5 1 1</td>
<td>4023</td>
</tr>
<tr>
<td>Y Pl sm 333 411 2498</td>
<td>183 152 1150</td>
<td>66 59 330</td>
<td>16 12 45 12.6% 8.2% 1.12%</td>
<td></td>
</tr>
<tr>
<td>Ta 2 tr F 1 12 8 20</td>
<td>3 9</td>
<td>0 3</td>
<td>0 0 0 3 1 34.3% 8.5% 0.0% 0.0% 241</td>
<td></td>
</tr>
<tr>
<td>En Cl V 5 83 98 181</td>
<td>22 23 45 18.7% 6.2% 0.0%</td>
<td>6 0 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary of Data on the Independence of the

<table>
<thead>
<tr>
<th>Ye Cl sh wx v₁ au₁</th>
<th>R g₁ n₁ l₁ v₁₈ v₂₀</th>
<th>Tₛ₂₅ su Tu Tₛ₁ v₄ sk B lg</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>99 20 5 48</td>
<td>2 50 1 12 1₃ 30 6</td>
</tr>
<tr>
<td>B</td>
<td>1 5</td>
<td>2 5 5 4 60 4 0</td>
</tr>
<tr>
<td>Pr</td>
<td>8 5</td>
<td>5 3 3 1 1</td>
</tr>
<tr>
<td>v₂</td>
<td>13</td>
<td>34 6 14 3 4</td>
</tr>
<tr>
<td>v₃</td>
<td>8</td>
<td>6 6 4 4 4</td>
</tr>
<tr>
<td>v₁₈</td>
<td>4 7 4 11</td>
<td>8 5 27 3 3</td>
</tr>
<tr>
<td>v₁₉</td>
<td>4 10 3 12</td>
<td>9 5 2 15 9 9</td>
</tr>
<tr>
<td>Bn</td>
<td>26 14 14 9</td>
<td>6 29 2 5</td>
</tr>
<tr>
<td>G₁</td>
<td>7 6 4 4</td>
<td>16 3 3 16 7 4</td>
</tr>
<tr>
<td>v₁₆</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Pr</td>
<td>5 2 12 6 6 2</td>
<td>7 6 1 30 1 5 3 3</td>
</tr>
<tr>
<td>v₁₈</td>
<td>5 2 12 6 6 2</td>
<td>7 6 1 30 1 5 3 3</td>
</tr>
<tr>
<td>L₁</td>
<td>9</td>
<td>3 7 15 2 6</td>
</tr>
<tr>
<td>Y Sm</td>
<td>9 6 8 12 6 6</td>
<td>15 4 2 10 1 10</td>
</tr>
<tr>
<td>Pl</td>
<td>8 6 5 6 6</td>
<td>12 5 7 6 6</td>
</tr>
<tr>
<td>Tₛ₁ v₄ sk B</td>
<td>12 3 7 3 7</td>
<td>12 3 7 3 7</td>
</tr>
<tr>
<td>B</td>
<td>33 11 15</td>
<td>46 1 7 7 7</td>
</tr>
<tr>
<td>lg</td>
<td>11 10 15</td>
<td>5 13 10 21 23</td>
</tr>
<tr>
<td>Tₛ₅ su Tu</td>
<td>50 5 2 4 5 3 5</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>17 23 6</td>
<td></td>
</tr>
<tr>
<td>G₁</td>
<td>1 2 1 3 3</td>
<td></td>
</tr>
<tr>
<td>l₁ l₁ v₁₈ v₂₀</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page
The Linkage Groups in Maize

<table>
<thead>
<tr>
<th>Y</th>
<th>P</th>
<th>pl sm w1</th>
<th>ts2 br</th>
<th>r1</th>
<th>En gl1</th>
<th>v5 ra</th>
<th>d1 pg2 cr</th>
<th>Pr v2 v3 v12 tv</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td>15</td>
<td>7</td>
<td>7</td>
<td>20 14 2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5  3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>11</td>
<td>13</td>
<td>2 1</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2 5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>6</td>
<td>1 1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>3 7</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>8 7</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>23</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures in table represent approximately the number of hundreds of individuals counted, the counts suggesting independent inheritance. Counts on backcross progenies are distinguished by an underscore from counts from self pollinations.

Continued from previous page
LITERATURE ON LINKAGE IN MAIZE

In general, only papers containing data on the linkage or independence of factors in known linkage groups are listed.


- Pericarp studies in maize. II. The allelomorphism of a series of factors for pericarp color. Genetics 9: 442-453. 1924.


(A short note without data in which it is stated that brindled, a chlorophyll defect, shows linkage with aw with about 26% of recombinations).


Demerec, M. - Inheritance of white seedlings in maize. Genetics 8: 561-593. 1923.

- Genetic relations of five factor pairs for virulent seedlings in maize. N. Y. (Cornell) Agric. Exp. Sta. Mem. 51: 3-58. 1924.


- Aberrant endosperm development as a means of distinguishing linkage groups in maize. Amer. Nat. 58: 272-277. 1924.


and Emerson, Sterling H. - Genetic interrelations of two androdioecious types of maize, dwarf and anther ear. Genetics 7: 202-236. 1922.

and Hutchison, C. B. - The relative frequency of crossing over in microspore and in megaspore development in maize. Genetics 6: 417-432. 1921.


- Inheritance of zigzag culms in maize. Genetics 7: 559-567. 1922.

- The intensity of linkage between the factors for sugary endosperm and for tunicate ears and the relative frequency of their crossing over in microspore and megaspore development. Genetics 7: 597-601. 1922.


and 


- The linkage of certain aleurone and endosperm factors in maize, and their relation to other linkage groups. Cornell Univ. Agric. Exp. Sta. Mem. 60: 1425-1473. 1922.


- Linkage between brachys and adherence in maize. Amer. Nat. 56: 461-464. 1922.


- Concerning the inheritance of green and yellow pigments in maize seedlings. Genetics 6: 91-110. 1921.
- Genetic research with maize. Genetics 5: 327-356. 1923.

- Complementary genes for chlorophyll development in maize and their linkage relations. Genetics 9: 305-326. 1924.


Stroman, G. M. - Genetic relations of chlorophyll and anthocyanin seedling characters in maize. Genetics 9: 91-123. 1924.


Introduction to *Maize Genetics Cooperation News Letters*, Volumes 2-14 (1932-1940)

The following pages offer verbatim scans of the first set of bound *MNL* Volumes 2-14 (1932-1940) numbered by hand in pencil, beginning with October 1932, labeled “Vol. 2” (*MNL* 2; Coe & Kass 2005, Appendix II; see also Kass et al. 2005, Appendix I). The binding on the first set of bound News Letters clearly shows that 1932 was considered to be *MNL* Vol. 2 (see image on back cover).

*MNL* Volumes 2-14 are arranged below sequentially, numbered as per Emerson's system (*MNL* 14:56, 1940), and inter-leafed with calls and other items as found in the Plant Breeding bound volumes (Scanning of *MNL* bound volumes was arranged by Michael Cook).

Not included here is the “second folder” of Linkage data mentioned by Emerson in his Historical Summary (*MNL* 14:56, 1940). That document was among the papers of E.G. Anderson and also in the archives of the Rockefeller Foundation (Kass et al. 2005, Appendix I; Coe & Kass 2005, Appendix II).

Note that both Emerson and Beadle sent many communications to maize cooperators prior to issuing *MNL* Vol. 2, 1932 (Coe & Kass 2005, Appendix II). Marcus Rhoades assumed editorship of the *MNL* as of October 5th 1932. Succeeding editors through 1940 were R.A. Emerson, Derald Langham, Emerson then Allan C. Fraser.
To Corn Geneticists:

Enclosed with this is a report of the meeting of corn geneticists held at Ithaca at the time of the Genetics Congress and a report of a committee provided for at that meeting.

In accordance with the action taken by the whole group and by the committee, it is requested that, as soon as convenient, you send to the undersigned a small quantity of seed of any stocks which you think may be useful to other workers now or which should be maintained for future use. As these lots of seed are received, a record of them will be made and later sent to all of you so that you may know what is available. As an illustration of combinations of genes such as should be available for distribution, a list of types now in our possession at Cornell is given below. You should not fail to send material even tho it duplicates stocks in this list.

1. LG-gl_{2}-b-v_{4}
2. Br-ra-v_{5}
3. Br-gl_{1}-v_{5}
4. y-pl-al
5. a_{1} P sh wx 1g f_{1}
6. A B Pl lg sh wx y
7. 1g g a_{1}-na-ts_{4}
8. p-(Ts_{2} Ts_{2})-(ff)-(Br br)-an
9. A_{1}-na-cr gl_{1}-v_{5} ts_{2}-f_{1} Y-pl
10. a_{1} j B-1g Y-pl C r^{f} pr
11. P-br-f-an
12. P-br-f-brn_{2}

A limited supply of trisomic seed is available for the b-lg, a-na, pr-v_{2}, Y-pl, ra-gl_{1}, j, c-wx and r-g linkage groups. We shall be glad to supply samples of this seed to the different individuals charged with the responsibility of the various groups. If the demand is not too great we shall try to supply all requests for trisomic seed.

If your work requires some unusual set-up or if you want better material of certain types than you now have, please indicate your needs at once. These requests will then be circulated from this office. As an illustration of what is in mind here, Emerson wants an early maturing stock involving green-striped. He also desires the combination adherent-aleurone ear.

M. M. Rhoades, Sec'y
Report of a meeting held during the Genetics Congress on August 26th by those interested in corn genetics

- M. M. Rhoades -

The meeting was called to order by Dr. R. A. Emerson. Approximately 45 individuals were present.

The following resolutions were discussed and favorably acted upon:

1. That the dropping of the second letter in bi-literal symbols to form a subscript be condemned as confusing and unsatisfactory.

2. That some place be designated as a 'clearing house' to assist in the assigning of appropriate names and symbols for characters and genes. Cornell was chosen as the institution where the records will be kept and help given in the assigning of symbols. An example of how this 'clearing house' may be expected to function is as follows: Two individuals, A and B, are working on glossy seedlings. A reports he has 5 and B reports he has 4 new glossy seedlings. A will then be assigned from gl₄ to gl₅ and B will be assigned from gl₁₀ to gl₁₂. This should avoid the confusion that arises when two investigators use the same symbols for different genes.

3. That a repository be formed for the storing and disseminating of new genes and of desirable multiple factor combinations, and that a list of such genes and combinations be furnished those interested from time to time.

4. That the geneticists refrain from designating the linkage groups by numbers until the cytologists agree to the size sequence of the different members of the haploid set.

5. That a committee be appointed by Dr. Emerson to consider the problems connected with the maintenance of a central seed repository. The report of the committee follows:

In accordance with the action noted above a committee was appointed consisting of Brink, Jones, Mangelsdorf, Stadler, and Emerson (chairman). The committee met and took action as follows:

1. The genetics group at Cornell, with M. M. Rhoades in charge, is to act as custodian of these stocks.

2. The custodian is to receive from the several workers seed of any stocks involving new characters considered by the finder as worth saving and certainly any such characters the linkage of which is known, also particularly useful combinations of genes in the several groups, etc.
3. The custodian will furnish those interested a list of the stocks received.

4. He will distribute on request small lots of particular stocks to workers having need of them.

5. The custodian will see that viable seed of these stocks is provided at least every three or four years by those charged with growing them.

6. The finder of a new character is expected to maintain the stock or to notify the custodian that he can not do so. Those assuming responsibility for particular groups will maintain stocks involving all the genes of those groups and will endeavor to build up desirable combinations of genes of the particular groups.

7. The following assignment of groups was made by the committee:

<table>
<thead>
<tr>
<th>Group</th>
<th>Stocks</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>P-br</td>
<td>Emerson</td>
</tr>
<tr>
<td>2.</td>
<td>B-lg</td>
<td>Beadle</td>
</tr>
<tr>
<td>3.</td>
<td>a1-ag</td>
<td>Brink</td>
</tr>
<tr>
<td>4.</td>
<td>su-Tu</td>
<td>Jones</td>
</tr>
<tr>
<td>5.</td>
<td>pr-v2</td>
<td>Burnham</td>
</tr>
<tr>
<td>6.</td>
<td>Y-pl2</td>
<td>Stadler</td>
</tr>
<tr>
<td>7.</td>
<td>gl1-ra</td>
<td>Jenkins</td>
</tr>
<tr>
<td>8.</td>
<td>j</td>
<td>Sprague</td>
</tr>
<tr>
<td>9.</td>
<td>c-vx</td>
<td>Eyster</td>
</tr>
<tr>
<td>10.</td>
<td>R-g1</td>
<td>Lindstrom</td>
</tr>
</tbody>
</table>

Any of the above who cannot assume or continue responsibility for the group assigned him is to notify the custodian at once. It is to be understood that anyone may begin or continue work with any group whether or not it has been assigned to him. The purpose is not so much to prevent duplication as to insure that no group is neglected. It is expected, however, that when two or more are interested in the same group, they will work in close cooperation!

R. A. Emerson (chairman)
January 23, 1933

The data presented here are not to be used in publications without the consent of the authors.

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
December 12, 1932

To Maize Geneticists:

If you have any good tester combinations you wish to send in so that they may be made available for the whole group or if there is any combination of genes you would like to have, will you please notify us here at Cornell so that we may list your contributions and wants in the corn-letter which will come out in the near future. January 1st has been set as the dead line for receipt of material to be included in the letter. Will you please cooperate with us so that we can make this cooperative affair a real service to all concerned.

We plan to include in the letter a summary of the technic employed by the Russian physiologist, Lysenko, in his "Springefication" of corn.

If any of you have this year's linkage data which could be added to the linkage summary, we shall be glad to receive them at once. The summary is in preparation for publication.

Sincerely yours,

M. M. Rhoades
To maize geneticists:—

We are including in this report an inventory of all maize characters whose description has either been published or called to our attention. We are also including a summary of the technique employed by Lyssenko in his 'Jarovization' of corn. Demerec was kind enough to make the translation from the Russian.

The response of the maize geneticists to the two letters from this office asking for their cooperation in establishing a clearing house and central repository has been good. Either seed or the statement that certain stocks were available and would be sent later has been received from the following institutions: Wisconsin, Texas A. and M., Missouri, Carnegie Institution, U. S. Department of Agriculture, Connecticut Agricultural Experiment Station, California Institute of Technology, Minnesota, Ames, Bucknell and Cornell. A list of these stocks is included in this report.

The following wants have been received:

1. Related stocks homozygous for Ga and ga. Sprague.

2. A multiple recessive stock for each chromosome involving as great a map distance as possible with genes so situated as to reduce undetected double crossovers to a minimum. Sprague.

3. Variegated pericarp material from different sources. Whenever possible variegated/red cob white combination is preferable. Demerec.

4. Allelomorphs or suspected allelomorphs of h such as marbled, stippled, navajo, mottled, etc., and allelomorphs of H affecting plant characters. Stadler.

5. Multiple recessive combinations of genes in the pr-v2 group. Rhoades.

6. Any recessive gene in the gl1 v5 group that is carrying dominant yellow endosperm. Hayes.

7. The combinations a1-Y-Pl; i1-ra-gl1; a1-na1 lg1-gl2-b; pr-bm1 su-gl3; Y-Pl pr-bm1; P-f1-an; p-f1-an. Burnham.
8. Multiple seedling combinations for the same and different linkage groups; particularly new genes such as \(1g_0\), glossies, argostripe. Randolph.

9. The combination \(a_{1pr}\) in with any glossy. Randolph.

10. Seedling genes in the Y-P1 group other than \(al\) and \(py\). Randolph.

Recommendations concerning symbols for new characters:

Since approximately 290 different characters in maize have been described and assigned symbols it is becoming more and more difficult to find appropriate symbols, suggestive of the character, for new genes. Therefore, we recommend the following:

When a new character arises which is similar in its appearance to a previously described character it should be given the same symbol as that used for the old character except that the subscript, of course, shall be different. This has been done in the past, e.g., the different virescents, glossy seedlings, etc., but it has not been followed in all cases. As a concrete example of what we have in mind, we have different striped leaves described as fine streaked, fine striped, green striped, yellow striped, japonica, iojap, striate, etc. The number of genetically different striped characters will probably be great. Therefore, instead of trying to find a new symbol for a new stripe designate it as \(j_2\) if it resembles japonica, or \(ys_2\) if it resembles yellow stripe, etc. The same holds for the male steriles, dwarfs, etc. Unless we are willing to do this we shall be forced to use tri-literal symbols, or bi-literal symbols which in no way suggest the appearance of the character.

We strongly urge that you correspond with this office before assigning symbols to new characters. We shall keep the list of assigned symbols up to date so that we can be of assistance in assigning the proper symbols. The success of this project depends entirely upon your cooperation. There have been several instances in the past where the same symbol has been used for different genes. This is confusing not only to maize geneticists but to others.

Listed below are the best available multiple combinations of genes in each of the 10 chromosomes:

Some of these stocks have just been isolated and the supply of seed is limited. By next summer enough seed should be available for everybody having a legitimate use for the stocks. However an attempt will be made this spring to supply any of the listed stocks as long as the supply holds out.
<table>
<thead>
<tr>
<th>Chromosome</th>
<th>Combination</th>
<th>Map distance covered by these factors</th>
<th>Total length of known genetic map</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>p-br-f-bm₂</td>
<td>125 ±</td>
<td>125 ±</td>
</tr>
<tr>
<td>II</td>
<td>lg₁-gl₂-b-v₄</td>
<td>30 ±</td>
<td>80 ±</td>
</tr>
<tr>
<td>III</td>
<td>a₁-na-cr₁</td>
<td>79 ±</td>
<td>79 ±</td>
</tr>
<tr>
<td>IV</td>
<td>su-Tu-gl₅</td>
<td>40 ±</td>
<td>70 ±</td>
</tr>
<tr>
<td>V</td>
<td>ys-pr-bm₁</td>
<td>30 ±</td>
<td>87 ±</td>
</tr>
<tr>
<td></td>
<td>pr-bm₁-v₂</td>
<td>57 ±</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>al-y-Pl-py</td>
<td>69 ±</td>
<td>69 ±</td>
</tr>
<tr>
<td>VII</td>
<td>Bn-gl₁-v₅</td>
<td>26 ±</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bn-ra-v₅</td>
<td>26 ±</td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>j-ms₂</td>
<td>20 ±</td>
<td>27 ±</td>
</tr>
<tr>
<td>IX</td>
<td>yg₂-c-sh-wx</td>
<td>52 ±</td>
<td>96 ±</td>
</tr>
<tr>
<td>X</td>
<td>r-g-nl</td>
<td>33 ±</td>
<td>33 ±</td>
</tr>
</tbody>
</table>

**Jarovization technique:**

At the Sixth International Congress of Genetics, Professor Vavilov reported Lyssenko's discovery by which the growing period of plants can be appreciably shortened (jarovization). If the claims of the workers investigating this problem are justified, this discovery is of great importance to plant geneticists and to plant breeders.

Following is the description of the method worked out for maize and described in the Bulletin of Jarovization, 283: 105-108, 1932.

(1) Add water to increase the water content of the seed to 30 per cent of weight.

(2) Keep the seed in darkness for 10 to 15 days at a temperature of 20 to 30 centigrade and allow it to germinate. By regulating moisture the germination process should be controlled so that the germ does not develop excessively.
The following stocks have been received:

**Brink** - (1) $lg_1-ts_1-v_4 \times lg_1-Ts_1-v_4$; (2) $u_1-lg_2$;
(3) $p-br-f-bm_2$; (4) $gl_2-fl-v_4$;
(5) $gl_2-ts_1-v_4 \times gl_2-Ts_1-v_4$.

**Sprague** - (1) $r-g-nl$; (2) $\underline{Ar}^E B\; P1\; su$; (3) $al-y-P1$;
(4) $Ba-gl_1-v_5$; (5) $Pc_1\; Pc_2\; Pc_3\; pc_4$ - $Pc = \text{purple}$
(6) $bt_2\; bt_2$; (7) $\underline{ACR}\; so_1\; so_2$ - so = colorrhiza;
(8) $sy\; sy$ - $sy = \text{yellow scutellum}$;
(9) $Sx$ - scutellum color; (10) $gl_1$; (11) $gl_2$;
(12) $gl_3$; (13) $gl_4$; (14) $gl_5$; (15) $gl_7\; v_17$;
(16) $gl_8$; (17) $gl_9$.

**Beadle** - (1) $sr$; (2) $gs$ (early); (3) $su-Tu-gl_3$.

**Demerec** - (1) $xu_2$; (2) $w_1$; (3) $pg_1$; (4) $pg_4$; (5) $pg_3$;
(6) $pb_1$; (7) $pb_2$ and $pb_3$ (duplicate factors);
(8) $pb_4$; (9) $zebra_1$; (10) $zebra_2$; (11) $zebra_3$.

**Stadler** - (1) $Y\; a\; R^E\; C\; pr\; in\; b\; pl$; (2) $a\; r\; C\; pr\; wx\; y$;
(3) $\underline{P^{yy}}\; A\; R^E\; c\; sh\; wx\; pr\; su$;
(4) $A\; C\; r^E\; sh\; wx\; y\; pr\; Su\; su$ - $r^E$ derived by
(5) $a\; C\; R^E\; pr\; in\; y\; wx\; Su\; su$.

**Jenkins** - (1) $A\; A\; C\; C\; R\; R\; pr\; pr\; a_2\; a_2$ (Bt bt);
(2) $gl_1\; ij\; YY$; (3) $gl_1\; v_5$;
(4) $gl_1\; ij\; YY$ seg. fr$_1$ and fr$_2$.

**Eyster** - (1) $g_3$; (2) $g_4$; (3) $pk$; (4) $l_6$; (5) $l_7$; (6) $l_5$;
(7) $f_3$; (8) $su_2$; (9) $yt$; (10) $da$; (11) $ar$; (12) $sa_1$;
(13) $au_1$; (14) $au_2$; (15) $cy$; (16) $ms_2$; (17) $ms_3$;
(18) $vp_1$; (19) $ms_{18}$; (20) $cr_2$; (21) $ms_{20}$; (22) $bt_4$;
(23) $pg_5$. 
Mangelsdorf writes that he can furnish the following late stocks:

(1) B b na na; (2) na g; (3) g; (4) Y y P1 pl;
(5) lg gl ra; (6) Pr Pr RR cc wx wx; (7) B b lg lg Sk sk;
(8) pr pr RR CC su su; (9) Tu tu su su;
(10) Tu tu Ts5 ts5 su su.

Kemptton advises that he can furnish:

(1) ra g li lg; (2) ra g lg br; (3) pr li lg f;
(4) cr li gl - gl = gigas; (5) lg ad f; (6) wx lg gl.

Lindstrom can furnish:

(1) r g li b pl; (2) R g li b pl; (3) r g nl b pl;
(4) R g nl b pl.

Singleton and Jones have the following multiple tester:

A c R lg g P Su y.

Anderson has seed of:

P-br-f-bu. g; various combinations of sm and sk.

We have not listed any stocks from Cornell. In the corn letter of October 5, 1932, we listed the multiple testers available here.

Appended herewith is the list of maize characters with their gene symbols. We have attempted to make this list as accurate and up to date as possible but mistakes and discrepancies are bound to occur. We will appreciate it if you will call any of these errors to our attention.

We are making an attempt to collect seed of all of the maize characters in the central repository at Cornell. In the list of genes we have noted the stocks of which we have seed. If any one has seed of a character listed as not on hand at Cornell, he should send us a small supply of such seed.
<table>
<thead>
<tr>
<th>Gene</th>
<th>Character affected</th>
<th>Chromosome</th>
<th>Seed at Cornell</th>
<th>Described by</th>
</tr>
</thead>
<tbody>
<tr>
<td>a&lt;sub&gt;1&lt;/sub&gt;, etc.</td>
<td>plant, aleurone and pericarp color</td>
<td>III</td>
<td>&quot;</td>
<td>Emerson '18, Emerson &amp; Anderson '32</td>
</tr>
<tr>
<td>a&lt;sub&gt;2&lt;/sub&gt;</td>
<td>plant and aleurone color</td>
<td>V</td>
<td>&quot;</td>
<td>Jenkins '32</td>
</tr>
<tr>
<td>ad&lt;sub&gt;1&lt;/sub&gt;</td>
<td>adherent tassel</td>
<td>I</td>
<td>&quot;</td>
<td>Kempton '20</td>
</tr>
<tr>
<td>ad&lt;sub&gt;2&lt;/sub&gt;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Eyster</td>
</tr>
<tr>
<td>ad&lt;sub&gt;3&lt;/sub&gt;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Eyster</td>
</tr>
<tr>
<td>al</td>
<td>albescent</td>
<td>VI</td>
<td>&quot;</td>
<td>Phipps</td>
</tr>
<tr>
<td>an&lt;sub&gt;1&lt;/sub&gt;</td>
<td>anther ear</td>
<td>I</td>
<td>&quot;</td>
<td>Emerson '22</td>
</tr>
<tr>
<td>ar</td>
<td>argentea</td>
<td>IX</td>
<td>&quot;</td>
<td>Eyster</td>
</tr>
<tr>
<td>?</td>
<td>argostripe</td>
<td>VII</td>
<td>&quot;</td>
<td>Eyster</td>
</tr>
<tr>
<td>as</td>
<td>asynapsis</td>
<td>I</td>
<td>&quot;</td>
<td>Beadle and McClintock '28</td>
</tr>
<tr>
<td>au&lt;sub&gt;1&lt;/sub&gt;</td>
<td>aurea</td>
<td>IX</td>
<td>&quot;</td>
<td>Eyster '29</td>
</tr>
<tr>
<td>au&lt;sub&gt;2&lt;/sub&gt;</td>
<td>aurea</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Eyster '29</td>
</tr>
<tr>
<td>B</td>
<td>plant color booster</td>
<td>II</td>
<td>&quot;</td>
<td>Emerson '22</td>
</tr>
<tr>
<td>ba&lt;sub&gt;1&lt;/sub&gt;</td>
<td>barren stalk</td>
<td>III</td>
<td>&quot;</td>
<td>Hofmeyr</td>
</tr>
<tr>
<td>ba&lt;sub&gt;2&lt;/sub&gt;</td>
<td>&quot;</td>
<td>II</td>
<td>&quot;</td>
<td>Hofmeyr</td>
</tr>
<tr>
<td>bd</td>
<td>branched sterile</td>
<td></td>
<td>&quot;</td>
<td>Collins and Kempton</td>
</tr>
<tr>
<td>be</td>
<td>branched ear</td>
<td></td>
<td>&quot;</td>
<td>Bryan</td>
</tr>
<tr>
<td>Bh</td>
<td>blotched aleurone</td>
<td>VI</td>
<td>&quot;</td>
<td>Emerson</td>
</tr>
<tr>
<td>?</td>
<td>branched silkless</td>
<td></td>
<td>&quot;</td>
<td>Kempton</td>
</tr>
<tr>
<td>bk</td>
<td>brittle stalk</td>
<td></td>
<td>&quot;</td>
<td>Wiggans</td>
</tr>
<tr>
<td>bl&lt;sub&gt;1&lt;/sub&gt;</td>
<td>blotched leaf</td>
<td></td>
<td>&quot;</td>
<td>Emerson '22</td>
</tr>
<tr>
<td>bl&lt;sub&gt;2&lt;/sub&gt;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Wiggans</td>
</tr>
<tr>
<td>bl&lt;sub&gt;1&lt;/sub&gt;</td>
<td>brown midrib</td>
<td>V</td>
<td>&quot;</td>
<td>Eyster '26</td>
</tr>
<tr>
<td>bn&lt;sub&gt;2&lt;/sub&gt;</td>
<td>&quot;</td>
<td>I</td>
<td>&quot;</td>
<td>Burnham</td>
</tr>
<tr>
<td>bn&lt;sub&gt;3&lt;/sub&gt;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>Burnham</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Chromosome</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------</td>
<td>------------</td>
<td>----------------------------</td>
<td></td>
</tr>
<tr>
<td>Bn&lt;sub&gt;1&lt;/sub&gt;</td>
<td>brown aleurone</td>
<td>VII</td>
<td>Kvakan '24</td>
<td></td>
</tr>
<tr>
<td>bp</td>
<td>brown pericarp</td>
<td>IX</td>
<td>Meyers '27</td>
<td></td>
</tr>
<tr>
<td>br</td>
<td>brachytic</td>
<td>I</td>
<td>Kempton '20</td>
<td></td>
</tr>
<tr>
<td>bs</td>
<td>barren sterile</td>
<td></td>
<td>Woodworth '26</td>
<td></td>
</tr>
<tr>
<td>bt&lt;sub&gt;1&lt;/sub&gt;</td>
<td>brittle endosperm</td>
<td>V</td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>bt&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Sprague</td>
<td></td>
</tr>
<tr>
<td>bt&lt;sub&gt;3&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>bt&lt;sub&gt;4&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>bv</td>
<td>brevis</td>
<td>V</td>
<td>Li</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>aleurone</td>
<td>IX</td>
<td>East &amp; Hayes '11</td>
<td></td>
</tr>
<tr>
<td>cb</td>
<td>chloroblotch</td>
<td>V</td>
<td>Emerson and Anderson '51</td>
<td></td>
</tr>
<tr>
<td>Ch</td>
<td>chocolate pericarp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cr&lt;sub&gt;1&lt;/sub&gt;</td>
<td>crinkly</td>
<td>III</td>
<td>Emerson '21</td>
<td></td>
</tr>
<tr>
<td>cr&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td>IX</td>
<td>Eyster '32</td>
<td></td>
</tr>
<tr>
<td>d&lt;sub&gt;1&lt;/sub&gt;</td>
<td>dwarf</td>
<td>III</td>
<td>Emerson '12</td>
<td></td>
</tr>
<tr>
<td>d&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Suttle</td>
<td></td>
</tr>
<tr>
<td>d&lt;sub&gt;3&lt;/sub&gt;</td>
<td></td>
<td>IX</td>
<td>Demerec '23</td>
<td></td>
</tr>
<tr>
<td>d&lt;sub&gt;4&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d&lt;sub&gt;5&lt;/sub&gt;</td>
<td></td>
<td>II</td>
<td>Perry</td>
<td></td>
</tr>
<tr>
<td>d&lt;sub&gt;6&lt;/sub&gt;</td>
<td></td>
<td>V</td>
<td>Eyster '32</td>
<td></td>
</tr>
<tr>
<td>da</td>
<td>dilute aleurone</td>
<td>IX</td>
<td>Eyster '32</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;1&lt;/sub&gt;</td>
<td>defective endosperm</td>
<td>IV</td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;2&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;3&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;4&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;5&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;6&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de&lt;sub&gt;7&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>Gene</td>
<td>Description</td>
<td>Cross</td>
<td>Ref.</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>-------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>de8</td>
<td>defective endosperm</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de9</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de10</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de11</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de12</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de13</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de14</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>de15</td>
<td>&quot;</td>
<td>IX</td>
<td>Brink '27</td>
<td></td>
</tr>
<tr>
<td>de16</td>
<td>&quot;</td>
<td>IV</td>
<td>Wentz '25</td>
<td></td>
</tr>
<tr>
<td>depl</td>
<td>&quot;</td>
<td></td>
<td>Mangelsdorf '26</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>flint defective</td>
<td>X</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td>dt</td>
<td>dotted leaf</td>
<td></td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>f1</td>
<td>fine striped</td>
<td>I</td>
<td>Lindstron '18</td>
<td></td>
</tr>
<tr>
<td>f2</td>
<td>&quot;</td>
<td>V</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>f3</td>
<td>&quot;</td>
<td>X</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>fl</td>
<td>floury endosperm</td>
<td>II</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>fr1</td>
<td>frayed</td>
<td>VII</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>fr2</td>
<td>frayed</td>
<td>VII</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>fs</td>
<td>fasciated</td>
<td>VI</td>
<td>Anderson '22</td>
<td></td>
</tr>
<tr>
<td>g1</td>
<td>golden</td>
<td>X</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>g2</td>
<td>golden</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>g3</td>
<td>golden</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>g4</td>
<td>golden</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>Ga</td>
<td>pollen tube growth factor</td>
<td>IV</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>gc</td>
<td>glucostactous</td>
<td></td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>ge1</td>
<td>premature germination</td>
<td></td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>ge2</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>Allele</td>
<td>Description</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>----------------------</td>
<td>--------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge3</td>
<td>premature germination</td>
<td>Mangelsdorf '26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge4</td>
<td>&quot;</td>
<td>Mangelsdorf '26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge5</td>
<td>&quot;</td>
<td>Mangelsdorf '26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gi</td>
<td>gigas</td>
<td>Kempton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl1</td>
<td>glossy</td>
<td>VII &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl2</td>
<td>glossy</td>
<td>II &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl3</td>
<td>glossy</td>
<td>IV &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl4</td>
<td>glossy</td>
<td>IX &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl5</td>
<td>glossy</td>
<td>- &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl6</td>
<td>glossy</td>
<td>- &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl7</td>
<td>glossy</td>
<td>- &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl8</td>
<td>glossy</td>
<td>- &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gl9</td>
<td>glossy</td>
<td>- &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gm1</td>
<td>germless</td>
<td>Demerec '23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gm2</td>
<td>germless</td>
<td>X &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gm3</td>
<td>germless</td>
<td>Demerec '26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gm4</td>
<td>germless</td>
<td>VI &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*gm6</td>
<td>germless</td>
<td>IX &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gs</td>
<td>green striped</td>
<td>I &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>soft starch</td>
<td>Emerson '12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hs</td>
<td>hairy sheath</td>
<td>Muma '29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>inhibitor of aleurone color</td>
<td>East &amp; Hayes '11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ij</td>
<td>iojap</td>
<td>VII &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in</td>
<td>intensifier of aleurone color</td>
<td>Fraser '24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* reported as gm1.
<table>
<thead>
<tr>
<th></th>
<th>Character</th>
<th>Value</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>j</td>
<td>japonica</td>
<td>VIII</td>
<td>Emerson '12</td>
</tr>
<tr>
<td>Kn</td>
<td>knotted leaf</td>
<td></td>
<td>Bryan</td>
</tr>
<tr>
<td>l1</td>
<td>luteus X</td>
<td></td>
<td>Lindstrom '17</td>
</tr>
<tr>
<td>l2</td>
<td>luteus X</td>
<td></td>
<td>Lindstrom '25</td>
</tr>
<tr>
<td>l3</td>
<td>luteus -</td>
<td></td>
<td>Jenkins &amp; Bell</td>
</tr>
<tr>
<td>l4</td>
<td>luteus X</td>
<td></td>
<td>Jenkins &amp; Bell</td>
</tr>
<tr>
<td>l5</td>
<td>luteus V</td>
<td></td>
<td>Eyster '32</td>
</tr>
<tr>
<td>l6</td>
<td>luteus IX</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>l7</td>
<td>luteus IX</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>la</td>
<td>lazy X</td>
<td></td>
<td>Jenkins</td>
</tr>
<tr>
<td>lg1</td>
<td>liguleless II</td>
<td></td>
<td>Emerson '12</td>
</tr>
<tr>
<td>lg2</td>
<td>liguleless III</td>
<td></td>
<td>Brink</td>
</tr>
<tr>
<td>li</td>
<td>lineate X</td>
<td></td>
<td>Collins and Kempton '20</td>
</tr>
<tr>
<td>lp</td>
<td>pollen lethal V</td>
<td></td>
<td>Rhoades</td>
</tr>
<tr>
<td>m1</td>
<td>yellow white seedling</td>
<td></td>
<td>Stroman '24</td>
</tr>
<tr>
<td>m2</td>
<td>&quot;</td>
<td></td>
<td>Stroman '24</td>
</tr>
<tr>
<td>mc</td>
<td>micropyle color</td>
<td></td>
<td>Singleton and Jones</td>
</tr>
<tr>
<td>md</td>
<td>mid cob color</td>
<td></td>
<td>Demerec '27</td>
</tr>
<tr>
<td>mg</td>
<td>miniature germ</td>
<td></td>
<td>Wentz '24</td>
</tr>
<tr>
<td>mi</td>
<td>midget plant</td>
<td></td>
<td>Perry</td>
</tr>
<tr>
<td>mr</td>
<td>midrib</td>
<td></td>
<td>Kvakan</td>
</tr>
<tr>
<td>ms1</td>
<td>male sterile VI</td>
<td></td>
<td>Singleton and Jones</td>
</tr>
<tr>
<td>ms2</td>
<td>&quot;</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>ms3</td>
<td>&quot;</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>ms4</td>
<td>&quot;</td>
<td></td>
<td>Beadle</td>
</tr>
<tr>
<td>ms5</td>
<td>&quot;</td>
<td></td>
<td>Beadle</td>
</tr>
<tr>
<td>ms</td>
<td>Description</td>
<td>Author</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>ms6</td>
<td>male sterile</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms7</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms8</td>
<td>&quot; &quot;</td>
<td>VIII Beadle</td>
<td></td>
</tr>
<tr>
<td>ms9</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms10</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms11</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms12</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms13</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms14</td>
<td>&quot; &quot;</td>
<td>Beadele</td>
<td></td>
</tr>
<tr>
<td>ms15</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms16</td>
<td>&quot; &quot;</td>
<td>Beadle</td>
<td></td>
</tr>
<tr>
<td>ms17</td>
<td>&quot; &quot;</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td>ms18</td>
<td>&quot; &quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>ms19</td>
<td>&quot; &quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>ms20</td>
<td>&quot; &quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>Mt</td>
<td>mottled aleurone</td>
<td>Kempton '19</td>
<td></td>
</tr>
<tr>
<td>na1</td>
<td>nana</td>
<td>Hutchinson '22</td>
<td></td>
</tr>
<tr>
<td>na2</td>
<td>nana</td>
<td>Perry</td>
<td></td>
</tr>
<tr>
<td>nl</td>
<td>narrow leaf</td>
<td>Emerson</td>
<td></td>
</tr>
<tr>
<td>o1</td>
<td>opaque endosperm</td>
<td>Singleton and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Jones</td>
<td></td>
</tr>
<tr>
<td>o2</td>
<td>&quot; &quot;</td>
<td>Singleton and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot; &quot;</td>
<td>Jones</td>
<td></td>
</tr>
<tr>
<td>oy</td>
<td>oil yellow</td>
<td>Eyster '32</td>
<td></td>
</tr>
<tr>
<td>P, etc.</td>
<td>pericarp color (many</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pb1</td>
<td>piebald</td>
<td>Demerec '26</td>
<td></td>
</tr>
<tr>
<td>pb2</td>
<td>piebald</td>
<td>Demerec</td>
<td></td>
</tr>
<tr>
<td>pb3</td>
<td>piebald</td>
<td>Demerec</td>
<td></td>
</tr>
<tr>
<td>pb4</td>
<td>piebald</td>
<td>Demerec</td>
<td></td>
</tr>
<tr>
<td>pb5</td>
<td>piebald</td>
<td>Demerec</td>
<td></td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>pc₁</td>
<td>coleorhiza color</td>
<td>Sprague</td>
<td></td>
</tr>
<tr>
<td>pc₂</td>
<td>&quot;</td>
<td>Sprague</td>
<td></td>
</tr>
<tr>
<td>pc₃</td>
<td>&quot;</td>
<td>Sprague</td>
<td></td>
</tr>
<tr>
<td>pc₄</td>
<td>&quot;</td>
<td>Sprague</td>
<td></td>
</tr>
<tr>
<td>pg₁</td>
<td>pale green</td>
<td>Brunson '24</td>
<td></td>
</tr>
<tr>
<td>pg₂</td>
<td>&quot;</td>
<td>Demerec '25</td>
<td></td>
</tr>
<tr>
<td>pg₃</td>
<td>&quot;</td>
<td>Demerec '25</td>
<td></td>
</tr>
<tr>
<td>pg₄</td>
<td>&quot;</td>
<td>Demerec '25</td>
<td></td>
</tr>
<tr>
<td>pg₅</td>
<td>&quot;</td>
<td>Eyster '32</td>
<td></td>
</tr>
<tr>
<td>pg₆</td>
<td>&quot;</td>
<td>Eyster '32</td>
<td></td>
</tr>
<tr>
<td>pg₇</td>
<td>&quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>pg₈</td>
<td>&quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>pg₉</td>
<td>&quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>pg₁₀</td>
<td>&quot;</td>
<td>Eyster</td>
<td></td>
</tr>
<tr>
<td>pi₁</td>
<td>development of secondary florets</td>
<td>Hudson and Gillis '29</td>
<td></td>
</tr>
<tr>
<td>pi₂</td>
<td>&quot;</td>
<td>Hudson and Gillis '29</td>
<td></td>
</tr>
<tr>
<td>pk</td>
<td>polka dot leaves</td>
<td>Eyster '24</td>
<td></td>
</tr>
<tr>
<td>po</td>
<td>polynototic</td>
<td>Beadle '31</td>
<td></td>
</tr>
<tr>
<td>pr</td>
<td>red aleurone</td>
<td>East &amp; Hayes '12</td>
<td></td>
</tr>
<tr>
<td>pu₁</td>
<td>purple plumule</td>
<td>Jenkins '26</td>
<td></td>
</tr>
<tr>
<td>pu₂</td>
<td>&quot;</td>
<td>Sprague</td>
<td></td>
</tr>
<tr>
<td>py</td>
<td>pigmy</td>
<td>Suttle</td>
<td></td>
</tr>
<tr>
<td>R, etc.</td>
<td>allelomorphic series, aleurone, plant and pericarp color</td>
<td>many</td>
<td></td>
</tr>
<tr>
<td>ra</td>
<td>ramosa</td>
<td>Gernert '12</td>
<td></td>
</tr>
<tr>
<td>Rg₁</td>
<td>ragged</td>
<td>Brink &amp; Senn</td>
<td></td>
</tr>
<tr>
<td>Rg₂</td>
<td>ragged</td>
<td>Singleton and Jones</td>
<td></td>
</tr>
<tr>
<td>Trait</td>
<td>Symbol</td>
<td>Chromosome</td>
<td>Reference</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------</td>
<td>------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Rolled leaves</td>
<td>ro</td>
<td></td>
<td>Carver '27</td>
</tr>
<tr>
<td>Rough sheath</td>
<td>rs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rootless</td>
<td>rt</td>
<td></td>
<td>Jenkins '26</td>
</tr>
<tr>
<td>Scutellum color</td>
<td>S₁</td>
<td>IV</td>
<td>Sprague</td>
</tr>
<tr>
<td></td>
<td>S₂</td>
<td></td>
<td>Sprague</td>
</tr>
<tr>
<td></td>
<td>S₃</td>
<td></td>
<td>Sprague</td>
</tr>
<tr>
<td></td>
<td>S₄</td>
<td></td>
<td>Sprague</td>
</tr>
<tr>
<td></td>
<td>S₅</td>
<td></td>
<td>Sprague</td>
</tr>
<tr>
<td>Striped auricle</td>
<td>sa₁</td>
<td>IX</td>
<td>Eyster</td>
</tr>
<tr>
<td></td>
<td>sa₂</td>
<td>V</td>
<td>Eyster</td>
</tr>
<tr>
<td>Slit blade</td>
<td>sb</td>
<td></td>
<td>Beadle</td>
</tr>
<tr>
<td>Scarred endosperm</td>
<td>sc</td>
<td>V</td>
<td>Eyster '26</td>
</tr>
<tr>
<td>Shrunked endosperm</td>
<td>sh</td>
<td>IX</td>
<td>Hutchinson '21</td>
</tr>
<tr>
<td>Silky</td>
<td>si</td>
<td>VI</td>
<td>Fraser</td>
</tr>
<tr>
<td>Silkless</td>
<td>sk</td>
<td>II</td>
<td>Jones '25</td>
</tr>
<tr>
<td>Slashed</td>
<td>sl</td>
<td>VII</td>
<td>Brewbaker</td>
</tr>
<tr>
<td>Salmon silks</td>
<td>sm</td>
<td>VI</td>
<td>Anderson '21</td>
</tr>
<tr>
<td>Small kernel</td>
<td>s₀₁</td>
<td>IX</td>
<td>Eyster '32</td>
</tr>
<tr>
<td>Orange scutellum</td>
<td>s₀₂</td>
<td></td>
<td>Sprague</td>
</tr>
<tr>
<td>Small pollen</td>
<td>sp</td>
<td>IV</td>
<td>Mangelsdorf and Singleton</td>
</tr>
<tr>
<td>Striate</td>
<td>sr</td>
<td>I</td>
<td>Brunson</td>
</tr>
<tr>
<td>Sticky chromosomes</td>
<td>st</td>
<td>IV</td>
<td>Beadle '32</td>
</tr>
<tr>
<td>Sugary endosperm</td>
<td>su</td>
<td>IV</td>
<td>Correns '01</td>
</tr>
<tr>
<td></td>
<td>su₂</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>Yellow scutellum</td>
<td>sy</td>
<td></td>
<td>Sprague</td>
</tr>
<tr>
<td>Threaded</td>
<td>th</td>
<td></td>
<td>Singleton and Jones</td>
</tr>
<tr>
<td>Tinged</td>
<td>tn</td>
<td>V</td>
<td>Eyster '26</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
<td>Volume</td>
<td>Author</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------</td>
<td>--------</td>
<td>--------------</td>
</tr>
<tr>
<td>Tp</td>
<td>teopod</td>
<td>VII</td>
<td>Lindstrom</td>
</tr>
<tr>
<td>ts₁</td>
<td>tassel seed</td>
<td>II</td>
<td>Emerson '20</td>
</tr>
<tr>
<td>ts₂</td>
<td>&quot;</td>
<td>I</td>
<td>Emerson '20</td>
</tr>
<tr>
<td>Ts₃</td>
<td>&quot;</td>
<td>III</td>
<td>Phipps '28</td>
</tr>
<tr>
<td>ts₄</td>
<td>&quot;</td>
<td>IV</td>
<td>Emerson</td>
</tr>
<tr>
<td>Ts₅</td>
<td>&quot;</td>
<td>IV</td>
<td>Collins '17</td>
</tr>
<tr>
<td>Ts₆</td>
<td>&quot;</td>
<td></td>
<td>Kvakan '25</td>
</tr>
<tr>
<td>Tu</td>
<td>tunicate</td>
<td>IV</td>
<td>Kvakan '25</td>
</tr>
<tr>
<td>tw₁</td>
<td>twisted seedlings</td>
<td></td>
<td>Kvakan '25</td>
</tr>
<tr>
<td>tw₂</td>
<td>&quot;</td>
<td></td>
<td>Kvakan '25</td>
</tr>
<tr>
<td>tw₃</td>
<td>&quot;</td>
<td></td>
<td>Kvakan '25</td>
</tr>
<tr>
<td>v₁</td>
<td>virescent</td>
<td>IX</td>
<td>Demerec '24</td>
</tr>
<tr>
<td>v₂</td>
<td>virescent</td>
<td>V</td>
<td>Demerec '24</td>
</tr>
<tr>
<td>v₃</td>
<td>virescent</td>
<td>V</td>
<td>Demerec '24</td>
</tr>
<tr>
<td>v₄</td>
<td>virescent</td>
<td>II</td>
<td>Demerec '24</td>
</tr>
<tr>
<td>v₅</td>
<td>virescent</td>
<td>VII</td>
<td>Demerec '24</td>
</tr>
<tr>
<td>v₆</td>
<td>virescent</td>
<td>VI</td>
<td>Carver '27</td>
</tr>
<tr>
<td>v₇</td>
<td>virescent</td>
<td>VI</td>
<td>Carver '27</td>
</tr>
<tr>
<td>v₈</td>
<td>virescent</td>
<td>IV</td>
<td>Demerec '26</td>
</tr>
<tr>
<td>v₉</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₀</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₁</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₂</td>
<td>virescent</td>
<td>V</td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₃</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₄</td>
<td>virescent (same as vₑ₂)</td>
<td>IX</td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₅</td>
<td>virescent</td>
<td>IX</td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₆</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td>v₁₇</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
<td>Origin</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------</td>
<td>---</td>
<td>----------</td>
</tr>
<tr>
<td>V18</td>
<td>virescent</td>
<td>X</td>
<td>&quot;</td>
</tr>
<tr>
<td>V19</td>
<td>virescent</td>
<td></td>
<td>Phipps '29</td>
</tr>
<tr>
<td>V20</td>
<td>virescent</td>
<td>X</td>
<td>&quot;</td>
</tr>
<tr>
<td>va1</td>
<td>variable sterile</td>
<td>VII</td>
<td>&quot;</td>
</tr>
<tr>
<td>va2</td>
<td></td>
<td></td>
<td>Beadle '32</td>
</tr>
<tr>
<td>vp1</td>
<td>vivipary</td>
<td>X</td>
<td>&quot;</td>
</tr>
<tr>
<td>vp2</td>
<td>vivipary</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>vp3</td>
<td>vivipary</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>vp4</td>
<td>vivipary</td>
<td></td>
<td>Eyster</td>
</tr>
<tr>
<td>w1</td>
<td>white seedling</td>
<td>VI</td>
<td>&quot;</td>
</tr>
<tr>
<td>w2</td>
<td>white seedling</td>
<td>X</td>
<td>&quot;</td>
</tr>
<tr>
<td>w3</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w4</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w5</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w6</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w7</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w8</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w9</td>
<td></td>
<td></td>
<td>Demerec '23</td>
</tr>
<tr>
<td>w10</td>
<td></td>
<td></td>
<td>Demerec '26</td>
</tr>
<tr>
<td>w11</td>
<td>warty anthers</td>
<td>IX</td>
<td>&quot;</td>
</tr>
<tr>
<td>wa</td>
<td>warty anthers</td>
<td></td>
<td>Beadle '32</td>
</tr>
<tr>
<td>wc</td>
<td>white cap endosperm</td>
<td></td>
<td>Kulkarni '24</td>
</tr>
<tr>
<td>Wh</td>
<td>dominant white endosperm</td>
<td>VII</td>
<td>&quot;</td>
</tr>
<tr>
<td>w1</td>
<td>white leaf base</td>
<td>IV</td>
<td>&quot;</td>
</tr>
<tr>
<td>ws1</td>
<td>white sheath</td>
<td></td>
<td>Clark '32</td>
</tr>
<tr>
<td>ws2</td>
<td></td>
<td></td>
<td>Clark '32</td>
</tr>
<tr>
<td>wx</td>
<td>waxy endosperm</td>
<td>IX</td>
<td>&quot;</td>
</tr>
<tr>
<td>x1</td>
<td>xantha</td>
<td>X</td>
<td>&quot;</td>
</tr>
<tr>
<td>x2</td>
<td>xantha</td>
<td></td>
<td>Trajkovich '24</td>
</tr>
</tbody>
</table>

62
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Volume</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>yellow endosperm</td>
<td>VI</td>
<td>&quot;</td>
</tr>
<tr>
<td>yd</td>
<td>yellow dwarf</td>
<td>VI</td>
<td>&quot;</td>
</tr>
<tr>
<td>yg₁</td>
<td>yellow green</td>
<td>V</td>
<td>&quot;</td>
</tr>
<tr>
<td>yg₂</td>
<td>&quot;</td>
<td>IX</td>
<td>&quot;</td>
</tr>
<tr>
<td>yg₃</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>ys₁</td>
<td>yellow stripe</td>
<td>V</td>
<td>&quot;</td>
</tr>
<tr>
<td>ys₂</td>
<td>&quot;</td>
<td>II</td>
<td>&quot;</td>
</tr>
<tr>
<td>yt</td>
<td>yellow top</td>
<td>III</td>
<td>&quot;</td>
</tr>
<tr>
<td>z</td>
<td>zigzag stalk</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>zg</td>
<td>&quot;</td>
<td>I</td>
<td>&quot;</td>
</tr>
<tr>
<td>zb₁</td>
<td>zebra striped</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>zb₂</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>zb₃</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>zb₄</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>zl</td>
<td>zygotic lethal</td>
<td>I</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

It should be unnecessary to do so, but we urge everyone to go carefully over the list of "wants" and if he has the desired stock to send it to the chap who requested it. Failure to cooperate will defeat the purpose of this service.

If enough requests for material come in we shall send out another corn letter before spring planting.

M.M. Rhoades
MAIZE GENETICS COOPERATION
NEWS LETTER

December 18, 1933

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
November 13, 1953

To Maize Geneticists:

As was the case last year, this laboratory will again attempt to act as a clearing house for information and a distributing point for genetic stocks.

This letter is a call for information to be used in succeeding corn letters. We thought it would be appropriate if the first letter in the fall of each year presented new and pertinent information of value to all maize investigators, such as new linkages, revised or corrected linkage maps, new combinations of genes, new allelomorphs, reoccurrences of known mutations, etc. So we are, therefore, requesting all maize geneticists to send us any information they deem of value to others. It is understood that any information or data which appear in this series of corn letters can not be cited in publications without the direct consent of the contributor. As an example of the kind of information we would like to have for the first letter, we will give the following unpublished facts:

1. Emerson has a new glossy seedling which is linked with fine-striped (f). Seed available.
2. Hayes reports that argostripe (ag) is allelomorphic with lojap (ij) and that lazy (la) shows linkage with the su-Tu group.
3. Lindstrom has a new recessive sun red plant color. Seed available.

The above are sample items of a type that will interest everyone. We want more of them for the first corn letter. We would like to have this letter in your hands before the Christmas meetings at Boston so the dead line for contributions will be December 15th. Everyone is urged to contribute so that these letters will be of real value.

This winter we hope to make an inventory of all the genetic stocks in maize. The stocks will be listed under two categories: (1) Combinations of factors belonging to the same linkage group and (2) combinations of genes belonging to different linkage groups. It should be of great help to all investigators to know whether a desired combination of genes is already in existence or whether you must spend several years in
building it up. For that reason we are asking that you go over your genetic material and list the different combinations under the two categories. Care should be taken that the proper subscript is used for the different glossies, etc. If possible state whether of early or late season. We should like to have these lists as soon as possible. We hope to have the complete list ready for mailing by February 1st, so January 15th is set as the dead line for receipt of this information.

You will be interested in knowing that the Drosophila workers have recently decided to start a cooperative group modeled after the one for maize. The following paragraph is taken from the letter calling on the different laboratories to organize:

"For several years now workers on genetics of maize have been receiving mimeographed circulars prepared in Professor Emerson's laboratory, containing information contributed by various investigators. This service proved to be so useful that steps are being taken to extend it and make it a permanent institution."

We are glad that the success of the maize group has stimulated the Drosophila investigators to undertake a similar cooperative enterprise and we hope they find the same generous spirit of cooperation which you maize workers have shown.

Remember we would like to have the requested information as soon as possible.

Sincerely yours,

M. M. Rhoades

M. M. Rhoades
To maize geneticists:

The response to our request for news items has been good. The various contributions which have been received comprise the bulk of this letter. All of the information given in this letter is unpublished and your cooperation has made it possible to place this mass of information in the hands of maize investigators considerably in advance of its publication. We believe you will find this letter interesting and profitable. If its success justifies it we plan to have a similar news letter in the fall of each year so that the workers in the different laboratories can keep in closer touch.

While this corn letter is essentially a list of new information, we shall be glad to include in subsequent letters for this year any facts which you think will be of interest to others.

I wish to emphasize again that the listing of information in these news letters does not constitute publication. The consent of the contributor should be obtained if you wish to cite his data in your papers.

News items from Ithaca:

1. Dwarf_{g} (d_{g}) gives approximately 35 per cent recombination with \( e_{1} \). (Singh).

2. Dwarf_{g} (d_{g}) is in linkage group X. Order is \( d_{g}-e_{1}-e_{1} \). (Singh).

3. Glossy 10 (\( e_{10} \)) gives 15 per cent recombination with fine striped 1 (\( f_{1} \)). (Emerson).

4. Pigmy_{g} (p_{g}) belongs in linkage group I. (Emerson).

5. Japonica_{g} (\( J_{g} \)) is about 5 units from Tu. Order unknown at present. (Emerson).

6. Two new allomorphs. \( R^{fr} \) gives with red plant, red anthers, green silks; \( r^{fr} \) gives with a green plant, green anthers, red silks. (Emerson).
7. $F_2$ families segregating for $a$ give data which indicate the order is $a$. (Fraser).

8. Aurea (Au) lies between $v$ and $u$ in linkage group IX. Order is $a-s-h-w-x-au-v$. (Creighton).

9. Yellow-green ($y - g$) is about 1 cross over unit from the terminal knob on the short arm of chromosome 9. (Creighton).

10. Argentea ($ar$) and $y$ whose loci fall close together on the genetic map are not allelomorphs. (Creighton).

11. Brown midrib ($bm$) is situated in the short arm of chromosome 5 and there is good evidence which suggests it lies extremely close to the insertion region. (McClintock).

12. A new narrow-leaved character is linked with $e$. (McClintock). (as I remember, McClintock told me last summer it gave 30 per cent recombination with $e$ - Ed.)

13. Data from crossing over in trisomes indicate that $pa$ and $p$ lie on opposite sides of the insertion region of chromosome 7. (Rhoades).

14. A dominant modifier interacts with recessive $e$ to give a speckled or spotted aleurone. Interaction with recessive $c$ and $r$ unknown as yet. No difficulty in classification. (Rhoades).

15. In addition to the $#5$ and $#7$ trisomes, $#2$, $#10$ and $#10$ trisomes can be distinguished from their disomic sibs by morphological differences. (Rhoades).

16. There is an extremely high correlation between small seeds and trisomy for chromosomes 5 and 6. (Rhoades).

Note: Seed is available for all the new characters listed under the Cornell heading.
News items from Pasadena:

1. Chromosome 1 is involved in 17, chromosome 2 in 20, chromosome 3 in 22, chromosome 4 in 15, chromosome 5 in 16, chromosome 6 in 14, chromosome 7 in 11, chromosome 8 in 11, chromosome 9 in 15, and chromosome 10 in 16 different reciprocal translocations. Most of these translocations have been obtained in a homozygous condition. (Anderson).

Note: Anderson has kindly offered to furnish any of his translocations to anyone who can use them as a tool in his research. The complete list of these interchanges (reciprocal translocations) will be listed in the next corn letter. Anyone desiring an interchange should write to Anderson and explain his needs to him.

2. Chocolate pericarp (Ch), that long elusive gene, seems to belong in chromosome 5. (Anderson).

3. Something wrong with albescent (al). Does not seem to belong in linkage group VI. (Anderson).

News items from New Haven:

1. The character ramosa (ra) has appeared three times in different inbreds. All were alleloonorphic with ra-1. (Singleton and Jones).

2. Mutation of Su to su occurred in one seed out of a total of 127,000. (Singleton and Jones).

3. A brittle endosperm was found in a flint corn from Germany. Tests showed it to be alleloomorphic with bt1. In this same flint corn two lazy (la) plants appeared in the second year. Tests are being made with la-1. (Singleton and Jones).

4. A dominant ragged (rg) similar to rg-1 occurred in a Leaming Evergreen hybrid back crossed twice to Leaming. Is being tested with rg-1. Tentatively called rg-2. (Singleton and Jones).

5. A new brown midrib appeared in an inbred line of Country Gentleman. Is being tested with the other brown midribs. (Singleton and Jones).
6. A viviparous seed-white seedling combination appeared in an F2 population. The development of the character varies. Sometimes the seeds germinate on the ear. If they do not, the seeds have a pale yellow endosperm in contrast to the normal orange yellow seeds of this strain. Pale yellow seeds always produce white seedlings. Orange seeds produce only normal green seedlings. (Singleton and Jones).

7. Dull brown blotches (d1) appeared in the endosperm of one of our y su Country Gentleman inbreds. This behaves as a recessive character. Dull blotched seeds when planted produce sterile dwarf plants, about 2 feet high, with no tassel or ear. Non-blotched seeds produce normal plants. (Singleton & Jones).

8. The linkage relations of the following characters, which segregate sharply, are being studied:

a. opaque1 (o1) - endosperm soft starch, entirely opaque.

b. opaque2 (o2) - similar in appearance to o1. Both give 25 per cent opaque in F2.

c. threaded (th) - seedling and plant character. Very fine pin stripes similar to "threaded" cloth.

d. semi-dwarf1 - plants about 2-1/2 feet high.

e. semi-dwarf2 - plants about 2-1/2 feet high.

f. Rugged2 (R2) - may be R1.

g. lady2 - may be l1.

h. yellow dwarf (y2) about 25 per cent recombination between x and yd.

i. microphyll color (mc) intense red dot at microphyll when plants have large P. Tests are being made to determine whether an allelomorph or modifier of P.

j. Additional tests are being made to determine the linkage relations of sp and l2 with characters in the fourth linkage group other than su. (Singleton and Jones).
9. A much-branched ear and tassel character was found in a field of corn at Fort Atkinson, Wisconsin. Same as \( r_{-1} \). (Burnham).

10. New genes being studied:
   - brown-midrib \( (bm_2) \)
   - yellow green \( (yG_2) \)
   - green stripe \( (gs?) \)
   - a mottling allelomorph of \( r_1 \) and an inhibitor of this mottling. (Burnham).

11. Revision of linkage group V. The most probable order is \( v_2-v_5-r_1-p_b-v_{-1} \) with \( b_{t1} \) very close to \( b_{u1} \). \( v_{-1} \) lies toward the end of the longer arm. (Burnham).

12. There is some evidence to indicate that \( r_2 \) is either between \( r_{-1} \) and \( v_5 \) or that the order is \( r_{-1}-v_5-r_2 \). (Burnham).

13. Albescent \( (al) \) may not be in chromosome 6. (Burnham).

**News from Madison:**

1. A new workable character, pale midrib \( (pm) \), appears to show 10 to 20 per cent crossing over with \( R_{-1} \). Seed available. (Brink).

2. A new allelomorph of the unplaced gene, golden \( g \), is reported. Golden \( g \) \( (g_2) \) appears to be independent of \( r \). (Brink).

3. A new ramose \( (R_{g2}) \), less extreme than \( R_{-1} \), but readily classifiable, is reported. Seed available. (Brink).

**News from the U.S.D.A.:**

1. Lazy \( (l_{-1}) \) shows linkage in \( F_2 \) with \( su \) and \( \Delta_{13} \), and in back cross counts with \( T_u \). Appears very close to \( su \) since there was only one crossover among several hundred \( F_2 \) plants. (Jenkins).

2. \( A_2 \) is linked with \( b_{t1} \) with about 7 per cent of crossing over. Limited data of a three point backcross indicate the order is \( pr-b_{t1}-A_2 \). (Jenkins).
3. A new tobacco plant chlorophyll deficiency, tenta-
tively called gs, is in the second linkage
group much closer to B than to Ia. (Sprague).

4. One of the duplicate factors for orange scut-
ellum (s1) is in linkage group IX. The
order is apparently s1-c-sh-wx. (Sprague).

5. Glossy 4 (g4) is in linkage group IX. Gives
about 40 per cent recombination with v1 and
independence with c and sh. (Sprague).

6. An almost complete linkage was found between
light colored seeds and albino seedlings.
(Brunson).

News from Minnesota:

As was stated in the corn letter of November 18th, the
following facts were reported:

1. Argostripe (ag) is allelomorphic with irjap (iij).
   (Hayes).

2. Lazy (li) shows linkage with the su-Tu group.
   (Hayes).

News items from Bucknell:

(During the past year Eyster sent in to this office the
following pieces of unpublished information:

1. A dominant white me diluter (Da2) is 6 units
   from c. Order is Da2-c-sh-wx.

2. Opaque endosperm3 (e3) belongs to linkage
group IX.

3. Scarred endosperm2 (se2) belongs to linkage
group IX.

4. Yellow flecked seedling leaves (yl) belongs to
   linkage group IX.

5. Su2 gives about 87 per cent recombination with
This office has already received several lists of genetic stocks. The dead line for receipt of lists of these stocks is January 15th. We strongly urge those of you who have not made an inventory of your genetic strains to do so in the near future so that the next corn letter may present an adequate list of existing stocks.

In the coming corn letter we hope to be able to present for your criticism a tentative system of nomenclature for maize genetics.

Sincerely yours,

M. M. Rhodes

Marcus M. Rhodes
MAIZE GENETICS COOPERATION
NEWS LETTER

January 25, 1934

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
To maize geneticists:

The inventory of genetic stocks which comprises the bulk of this letter is, of course, not complete but it will serve as a basis for future and more extensive lists. We wish to thank those maize geneticists who have cooperated in making this inventory possible. Its value should be apparent to everyone. In a plant such as maize where it takes several years to build up a required stock for a certain experiment, it is essential that the list of existing stocks be kept up to date and be available so that the investigator can make use of these stocks.

No attempt has been made to credit the stocks to different investigators. Those stocks which are marked with an asterisk are those which have not been received here at Cornell. It by no means follows that those stocks which are not marked by an asterisk were synthesized here at Ithaca. In the past we have received so many stocks from different cooperators that an attempt to trace the origin of the different stocks seemed a hopeless task. So we have purposely avoided listing the origin of any of the stocks. This does not give the credit due those investigators who have spent a great deal of time in building up good genetic strains. In the future we shall try to remedy this condition.

In order that this laboratory may serve efficiently as a distributing center for genetic strains, we urge those of you who have the stocks marked by an asterisk to send a small amount of seed to us so that it can be increased for distribution.

At the Boston meetings a system of nomenclature was agreed upon by representatives of the Drosophila and maize groups. This proposed system, as it applies to maize, is submitted in this report for your consideration and your criticisms and suggestions are requested. It was agreed that the needs and requirements of maize and Drosophila genetics were so diverse that it would be unwise to attempt to formulate an identical system of nomenclature. Yet in the matter of symbolizing genes, designating translocations, deficiencies, etc., it was felt that a uniform system could be employed with advantage, and the symbols which are used in the proposed system were agreed upon by the representatives of the two groups.

It should be clearly understood that the proposed system is only tentative. It can and will be modified in any way that will make for a better and more useful system.
The proposed nomenclatorial system for maize is as follows:

1. The linkage groups will be designated by Arabic numerals. Group 1 will include those genes which lie in the longest of the monoploid set of 10 chromosomes, etc. The longest chromosome will be called chromosome 1 and the shortest chromosome 10. Arabic numerals will be used for both linkage groups and chromosomes since the Roman numerals are too cumbersome.

2. Whenever biliteral symbols are used the second letter shall not be dropped as a subscript. Italicize gene symbols.

3. Literal superscripts shall be used to represent different members of an allelomorph series, e.g., $R^F$, $R^E$, $r^F$, $r^E$.

4. Numeral subscripts shall be used to represent different genes which give phenotypically similar effects, e.g., $V_1$, $V_2$, $V_3$, etc.

5. The normal allelomorph of a mutant gene shall be designated by the use of the $+$ sign as a superscript, e.g., the normal allelomorph of sugary (su) will be $su^+$, and not Su or +. The plus sign alone may be used for normal allelomorphs in such genotypic formulae as $su^+ Tu^+$, but these allelomorphs should be designated as indicated above when the formula is written as $su^+ Tu^+ / su Tu$.

   This suggestion was made by the Drosophila group and we believe it meritorious. It enables one to tell whether the mutant gene is dominant or recessive to the normal or average condition. And, too, the normal gene is nothing more than an allelomorph of the mutant one.

6. The letter $T$ (italicized) shall denote reciprocal translocations or segmental interchanges. $T(1-2)_1$ would represent the first case of a reciprocal translocation between chromosomes 1 and 2, $T(1-2)_2$ the second, etc. Numeral subscripts instead of literal ones are recommended to denote the different translocations. There are several objections for using $a$, $b$, $c$, etc. to denote the different translocations. When more than 26 different translocations involving the same two chromosomes are found we should be forced to use biliteral subscripts, such as $aa$, $ab$, $ac$, etc. The letters of the alphabet have in the past been used for symbolizing genes. For example, we have designated the different virescents as $V_1$, $V_2$, $V_3$, etc., and not as $V_a$, $V_b$, $V_c$, etc.

7. The symbol $Df$ (italicized) shall be used for Deficiency. For example, the first deficiency involving chromosome 10 will be represented as $Df_{101}$; the second as $Df_{102}$, etc.

8. The symbol $In$ (italicized) shall stand for Inversion. An inversion involving chromosome 4 will be represented as $In_{41}$; the second one as $In_{42}$, etc.
9. It was decided that there was, as yet, no need to formulate a system of nomenclature for duplications.

This office will do all that it can to enable you to secure any of the stocks listed in this letter but it should be remembered that in several cases the amount of seed is small and we may not be able to fill your request.

Sincerely yours,

[Signature]

M. M. Rhoades

ENCLOSURES
Linkage group 1

1. \( p \) br \( f_1 \) \( bm_2 \)
2. \( p \) br \( f_1 \) \( bm_2 \)
3. \( \frac{p}{f} \) br \( f_1 \) \( bm_2 \)
4. \( p \) an \( bm_2 \)
5. \( p \) ad\(_1\) \( bm_2 \)
6. \( P \) \( g_1 \) \( 10 \) \( f_1 \)
7. \( p \) br \( f_1 \) \( ad\(_1\) \)
8. \( p \) br \( ad\(_1\) \)
9. \( f_1 \) an may seg. \( bm_2 \)
10. \( p \) \( f_1 \) \( bm_2 \)
11. \( ts_2 \) \( f_1 \) may seg. \( bm_2 \)
12. \( ts_2 \) an may seg. \( f_1 \) \( bm_2 \)
13. \( P + + \) an \( bm_2 \) \( F_2 \)
14. \( \frac{p \) br \( f_1 \) \( ad\(_1\) \)}{p \) br \( f_1 \) \( + \) \( bm_2 \)} \( F_2 \)
15. \( P \) br \( f_1 \) an \( + \)
16. \( \frac{p \) \( ts_2 \) \( br \) \( f_1 \) \( an \)}{p \) br \( f_1 \) \( + \) \( gs_1 \}) \( F_2 \)
17. \( P \) \( gl \) \( 10 \) \( f_1 \) \( an \)
18. \( \frac{p \) \( br \) \( f_1 \) \( + \)}{p \) \( br \) \( f_1 \) \( ad\(_1\) \) \( + \)} \( F_2 \)
19. \( p \) \( ts_2 \) \( br \) \( f_1 \) \( + \)
20. \( P \) \( sr \)

Linkage group 2

1. \( lg_1 \) \( gl_2 \) \( b \) \( v_4 \)
2. \( lg_1 \) \( gl_2 \) \( b \) \( v_4 \) seg. \( ts_1 \)
3. \( fl \) \( v_4 \)
4. \( lg_1 \) \( B \) \( v_4 \)
5. \( lg_1 \) \( b \) \( v_4 \)
6. \( lg_1 \) \( B \) \( ba_2 \) seg.
7. \( lg_1 \) \( b \) \( ba_2 \) seg.
8. \( gl_2 \) \( x \) \( sk \) \( F_2 \)
9. \( gl_2 \) \( v_4 \) seg. \( ts_1 \)
10. \( gl_2 \) \( f_1 \) \( v_4 \)
11. \( gl_2 \) \( f_1 \)
12. \( lg_1 \) \( v_4 \) seg. \( ts_1 \)
13. \( lg_1 \) \( b \) \( sk \) \( v_4 \)
14. \( B \) \( sk \)
15. \( lg_1 \) \( B \) seg. \( ts_1 \)
Linkage group 3

1. $a_1$-na-$$ts_4$
2. $a_1$-$$ts_4$
3. $\frac{a_1}{+}$ na $+\crcr$
4. $\frac{a_1+d_1}{+\ Rg} cr$
5. $a_1$-na-cr
6. $a_1$-na-$$ts_4$
7. $\frac{cr}{+\ +pg_2} F_2$
8. $\frac{a_1\ ts_4}{+\ +cr} F_2$
9. $a_1$-na-$$ts_4$-cr

10. $a_2$ $d_1$-cr
11. $l g_2$-$d_1$
12. $a_1$-$l g_2$
13. $a_1$-cr $*$
14. $a_1$-Rg $*$
15. $a_1$-ba$1$
16. cr$1$-ms$3$
17. $pg_2$-$d_1$ seg.
18. $a\ ts_4$ $+$ $+$ ba$1$ $F_2$
19. $a_1$ $d_2$

Linkage group 4

1. su Tu gl$3$
2. su gl$3$
3. su Tu
4. su Ts$5$
5. $\frac{su\ Ts_5}{+\ +\ wi} F_2$
6. $\frac{su\ Tu}{+\ +\ wi} F_2$
7. $\frac{su\ gl_3}{+\ +\ wi} F_2$
8. $\frac{su\ Tu}{+\ +\ j_2} F_2$

9. $\frac{su\ Ts_5}{+\ +\ j_2} F_2$
10. su j$2$
11. su j$2$
12. su st $*$
13. su Tu Ts$5$ $*$
14. $F_2$ seg. su and vp$3$
15. su la $*$
16. Tu la $*$
17. $\frac{su}{+\ l o} 18. \frac{su\ lo}{+\ +}$
18. $su$ $+$ $+$
19. $su$ + $sp$
20. $su$ + $sp$
Linkage group 5

1. pr $v_2$
2. pr $v_3$
3. $v_2$ pr $bm_1$
4. pr $bm_1$
5. $ys_1$ pr bt
6. $a_2$-bt$_1$-pr
7. $v_2$ $ys_1$ pr *
8. pr $bv$ $bm_1$ *
9. $v_2$ pr $bv$ *

10. $bt_1$ $bm_1$ *
11. $ys_1$ pr $bm_1$ *
12. $ys_1$ pr $bm_1$ seg. $v_2$ *
13. pr $v_{12}$ $bm_1$ *
14. pr $v_3$ $bm_1$ *
15. $ys$ pr $v_3$ *
16. $v_2$-$bv$
17. pr $v_{12}$

---

Linkage group 6

1. y Pl py
2. Y Pl py
3. y Pl py
4. y Pl py
5. po y Pl *
6. po Y Pl *
7. po y pl *
8. sm Py py $\otimes$ *

9. Y Bh Pl
10. y pl sm
11. y-si-pl seg.
12. $v_7$-y-pl
13. $v_7$-Y-pl
14. $v_6$-Y-pl
15. $v_6$-Yy-pl

$\otimes$ Stocks carrying al are not listed since there is considerable doubt that al belongs in this linkage group.
Linkage Group 7

1. bn gl₁ v₅
2. Bn gl₁ v₅
3. gl₁ ij seg. fr₁ and fr₂
4. ra-gl₁-v₅
5. ra v₅
6. Bn gl₁ ra *
7. \( \frac{ra + gl₁ + ij}{gl₁ + ij} \) F₂ *
8. Wh gl₁
9. ra sl
10. Bn gl₁ sl may seg. ra
11. bn gl₁ sl
12. gl₁ v₅ va₁ *
13. in gl₁ v₅ seg.
14. in ij
15. in gl₁
16. gl₁ ij
17. gl₁ sl ra

Linkage group 8

1. \( \frac{j + ms₈}{+ ms₈} \) F₂

oooooo

oooooo

81
Linkage Group 9

1. yg₂ c sh wx
2. c sh wx v₁
3. c sh v₁₅ wx
4. ARC wx homozygous terminal knob on 9 *
5. c sh bp wx *
6. ar pk sh *
7. c sh wx
8. da₁ au₁ au₂ sh
9. c sh wx w₁₁ seg.
10. sh ms₂

11. g₄ sh ar
12. au₁ au₂
13. c sh wx d₃ seg.
14. yg₂ sh d₃ seg.
15. sh l₆
16. sh-wx-w₁₁ F₂
17. \( \frac{c \ sh \ wx \ au₁}{C \ sh \ Wx \ au₁} \) F₂
18. da au₁ sh
19. l sh

Linkage Group 10

1. r g₁
2. r g₁ n₁₁
3. R g₁ n₁₁
4. R g₁
5. g₁ li
6. l₂ r g₁ seg.

7. pg₁ g₁ r seg.
8. pg₁ l₂ seg.
9. g₁ l₄ seg.
10. d₇ r g₁ seg.
11. r tester stock which does not carry the inhibitor of the mottling allelomorph.
12. g₁-r mottled
Multiple combinations involving two or more groups

A1 C-sh-wx r-g Pr
A1 C-sh-wx r-g pr
A1 C-sh-wx R-g Pr
A1 C-sh-wx R-g pr
A1 C-sh-wx R-g nl Pr
A1 B-lg Y-Pl su-Tu
A1 B-lg Y-Pl Su-Tu
A1 B-lg y-Pl Su-Tu
A1 B-lg y-Pl su-Tu
A1 B-lg y-Pl su-Tu+
A1 + + y+ su+e13 F1
BB-Lg lg Su-tu Yy-Pl pl wx *
Bb-lg Su su-tu Yy-Pl pl wx *
BB-Lg lg su-Tu tu Yy-pl Wx wx *
Bb-Lg lg su-Tu tu Yy-pl Wx wx *
b-Lg lg su-tu y-pl wx *
a1 pr in wx y C Rg Su su
a1 E Pl C R Pr Y
A1-cr C Rg pr su y-pl b-lg j
a1 B-lg Y-Pl Pr C R
A1 B-lg y-Pl Pr C R S
A1 B Y-Pl Pr C R Su
A1-cr C? r^-g pr in-Bn bn
Su su y-pl b-lg bm2
may seg. ts2 d1 j
A Cc Rg pr In in Su su y-pl
b-lg bm2 j v? may seg.
g1 d1 cr ts2
A1 Rg c-Sh sh-wx pr in su y P

a1 rF C B-lg Y-pl pr j
a1 R C lg y pr j in Su
a1 R c-wx Bb-lg Y-pl pr su
a1 R c-sh-wx B-lg Yy-Pl Pr su
a1 Rg C pr Y in b pl *
A1 c Rg-g pr In Su su Y-pl
b-lg bm2 j may seg.
cr ts2 d1
pr gl1-v5
pr lg in
lg gl1-v5
pr in-gl1
pr in-ij
pr-bm1 an *
pr f1-(Br br)-(Bm2 bm2) *
pr lg-gl2-b F2 *
pr ts4 *
pr a1-na-ts4 C R *
pr-bm1 su Tu tu *
pr-bm1 y *
pr gl1-ra *
pr-bm1 sh-wx *
pr-bm1 wx *
pr-bm1 sh-wx su *
pr-bm1-v3 wx F2 *
bm1-ylg wx *
A R c-sh-wx pr-bm1-v2 *
A R C-sh-wx-v1 pr *
1. C R b pl F_2

A B pl lg ts_1 F_2

A C R b pl pr v_2

A C R pr-bm_{1} wx mly seg. v_2

A C R lg-B-v_4 pr bv Yy-pl F_2

A C r j Y

a_{1}-na-cr Y-pl gl_{1}-v_{5}

a_{1}-na-cr Y-pl b-lg gl_{1}-v_{5}

a_{1}-na b-lg Y-pl

a_{1}-na-cr b-lg Y-pl

a_{1}-na na-Ts_{4} ts_{4} b-lg gl_{1}

a_{1}-na b-lg Y-pl gl_{1}-v_{5}

A C R Pr gl_{1}-ra *

A C R so_{1} so_{2}

A a Rr-g_{1} B Pl su

#2 trisome

#3

#5

#6

#7

#8

#9

#10

A C (Rr)? Pr (Bb)? pl Yy tetraploid

A C r_{2} b pl y Su tetraploid

A_{1} C R pr y Su

A_{1} C R Pr y Su

A_{1} C R pr y su *

A_{1} C R pr y
Three inbred strains of Leaming selfed for 29 years. *

Strain resistant to physiological forms 1 and 3 of Puccinia sorghi.

Strain susceptible to physiological forms 1 and 3 of P. sorghi.

Strain resistant to physiological form 1 but susceptible to physiological form 3 of P. sorghi.

List of reciprocal translocations at Cal. Tech.

<table>
<thead>
<tr>
<th>Pedigree No.</th>
<th>Chromosomes involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 11</td>
<td>1-7</td>
</tr>
<tr>
<td>A 12</td>
<td>1-3</td>
</tr>
<tr>
<td>A 13</td>
<td>4-9</td>
</tr>
<tr>
<td>A 14</td>
<td>4-5</td>
</tr>
<tr>
<td>A 15</td>
<td>3-10</td>
</tr>
<tr>
<td>A 16</td>
<td>3-10</td>
</tr>
<tr>
<td>A 17</td>
<td>2-7</td>
</tr>
<tr>
<td>A 18</td>
<td>3-10</td>
</tr>
<tr>
<td>A 19</td>
<td>2-3</td>
</tr>
<tr>
<td>A 20</td>
<td>5-10</td>
</tr>
<tr>
<td>A 21</td>
<td>5-8</td>
</tr>
<tr>
<td>A 22</td>
<td>6-10</td>
</tr>
<tr>
<td>A 23</td>
<td>6-10</td>
</tr>
<tr>
<td>A 24</td>
<td>1-5</td>
</tr>
<tr>
<td>A 25</td>
<td>2-7</td>
</tr>
<tr>
<td>A 26</td>
<td>3-10</td>
</tr>
<tr>
<td>A 27</td>
<td>3-7</td>
</tr>
<tr>
<td>A 28</td>
<td>3-5</td>
</tr>
<tr>
<td>A 29</td>
<td>1-2</td>
</tr>
<tr>
<td>A 30</td>
<td>3-6</td>
</tr>
<tr>
<td>A 31</td>
<td>3-9</td>
</tr>
<tr>
<td>A 32</td>
<td>1-5</td>
</tr>
<tr>
<td>A 33</td>
<td>2-6</td>
</tr>
<tr>
<td>A 34</td>
<td>1-9</td>
</tr>
<tr>
<td>A 35</td>
<td>4-6</td>
</tr>
<tr>
<td>A 36</td>
<td>4-6</td>
</tr>
<tr>
<td>A 37</td>
<td>3-8</td>
</tr>
<tr>
<td>A 38</td>
<td>1-5</td>
</tr>
<tr>
<td>A 40</td>
<td>2-6</td>
</tr>
<tr>
<td>A 41</td>
<td>2-4</td>
</tr>
<tr>
<td>A 42</td>
<td>1-9</td>
</tr>
<tr>
<td>A 43</td>
<td>1-9</td>
</tr>
<tr>
<td>Pedigree No.</td>
<td>Chromosomes involved</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>A 52</td>
<td>3- 5</td>
</tr>
<tr>
<td>n 53</td>
<td>1- 3</td>
</tr>
<tr>
<td>A 61</td>
<td>4-10</td>
</tr>
<tr>
<td>A 62</td>
<td>5-10</td>
</tr>
<tr>
<td>A 64</td>
<td>1-10</td>
</tr>
<tr>
<td>A 66</td>
<td>4- 5</td>
</tr>
<tr>
<td>A 69</td>
<td>2- 7</td>
</tr>
<tr>
<td>A 70</td>
<td>4- 6</td>
</tr>
<tr>
<td>A 73</td>
<td>1- 7</td>
</tr>
<tr>
<td>A 74</td>
<td>1- 3</td>
</tr>
<tr>
<td>A 75</td>
<td>2- 5</td>
</tr>
<tr>
<td>A 76</td>
<td>2- 9</td>
</tr>
<tr>
<td>A 77</td>
<td>1- 9</td>
</tr>
<tr>
<td>A 78</td>
<td>2- 8</td>
</tr>
<tr>
<td>A 79</td>
<td>4- 9</td>
</tr>
<tr>
<td>A 80</td>
<td>2- 6</td>
</tr>
<tr>
<td>A 83</td>
<td>3- 2</td>
</tr>
<tr>
<td>A 84</td>
<td>8-10</td>
</tr>
<tr>
<td>A 85</td>
<td>4-10</td>
</tr>
<tr>
<td>A 87</td>
<td>1- 3</td>
</tr>
<tr>
<td>A 88</td>
<td>2- 4</td>
</tr>
<tr>
<td>n 90</td>
<td>2- 3</td>
</tr>
<tr>
<td>A 94</td>
<td>3-10</td>
</tr>
<tr>
<td>Al01</td>
<td>2- 4</td>
</tr>
<tr>
<td>Al03</td>
<td>1- 7</td>
</tr>
<tr>
<td>Al11</td>
<td>6- 8</td>
</tr>
<tr>
<td>Al18</td>
<td>2- 3</td>
</tr>
<tr>
<td>Al19</td>
<td>6- 9</td>
</tr>
<tr>
<td>Al22</td>
<td>1- 4</td>
</tr>
<tr>
<td>Al29</td>
<td>2- 4</td>
</tr>
<tr>
<td>Al33</td>
<td>3-10</td>
</tr>
<tr>
<td>Al36</td>
<td>5- 7</td>
</tr>
<tr>
<td>Al37</td>
<td>4- 7</td>
</tr>
<tr>
<td>C &amp; n 125</td>
<td>3- 6</td>
</tr>
<tr>
<td>A &amp; C 6452</td>
<td>5- 6</td>
</tr>
<tr>
<td>A &amp; C 6460</td>
<td>2- 9</td>
</tr>
<tr>
<td>A &amp; C 6462</td>
<td>4- 5</td>
</tr>
<tr>
<td>A &amp; C 6465</td>
<td>3- 9</td>
</tr>
<tr>
<td>A &amp; C 6466</td>
<td>1-10</td>
</tr>
<tr>
<td>A &amp; C 6467</td>
<td>4- 8</td>
</tr>
<tr>
<td>A &amp; C 6468</td>
<td>3- 5</td>
</tr>
<tr>
<td>A &amp; C 6470</td>
<td>6- 9</td>
</tr>
<tr>
<td>A &amp; C 6471</td>
<td>2- 6</td>
</tr>
<tr>
<td>A &amp; C 6472</td>
<td>4- 5</td>
</tr>
<tr>
<td>A &amp; C 6473</td>
<td>2-10</td>
</tr>
<tr>
<td>A &amp; C 6474</td>
<td>3- 7</td>
</tr>
<tr>
<td>A &amp; C 6475</td>
<td>5- 7</td>
</tr>
<tr>
<td>A &amp; C 6477</td>
<td>2- 8</td>
</tr>
</tbody>
</table>
February 21, 1934

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
To Maize Geneticists:

The proposed nomenclatorial system for maize has provoked considerable discussion and we have received comments and suggestions from Jones, Brink, Sprague, Jenkins, Stadler, Mangelsdorf, Beadle and Anderson. As might be expected, the proposed system in its present form was not acceptable to everyone. In this letter we shall list the different items in the proposed system and then state the criticisms or comments made about each item.

Item 1 - (see proposed nomenclatorial system in corn letter of January 25th).

Comments: This seemed to be generally acceptable to everyone but Anderson suggests that it be worded as follows: "Arabic numerals are preferred to Roman for designating both linkage groups and chromosomes except where other usage helps clarify or simplify expression." It is, of course, possible that in some special study clarity can not be obtained by using Arabic numerals throughout and there should be, in those exceptional cases, no hesitation in using some other means of designating either linkage groups or chromosomes. But in the majority of cases the use of Arabic numerals will satisfactorily meet all requirements and it seems to us best that the statement, as made in the corn letter, should stand.

Item 2 - Whenever biliteral symbols are used the second letter shall not be dropped as a subscript. Italicize gene symbols.

Comments: Satisfactory to everyone.

Item 3 - Literal superscripts shall be used to represent different members of an allelomorphic series, e.g. \( R^1, R^2, r^1, r^2 \).

Comments: Satisfactory to everyone.

Item 4 - Numeral subscripts shall be used to represent different genes which give phenotypically similar effects, e.g. \( Y_1, Y_2, V_3, \) etc.

Comments: O.K. but Anderson suggests it might be well to dispense with all subscripts and raise the numeral to the same level as the rest of the symbol.

While this suggestion seems good we believe that the present system of dropping the numerals as subscripts has become widely used and is satisfactory so that any benefits which might accrue from raising the numeral to the same level as the rest of the symbol are
not of sufficient value to justify the change.

Therefore we suggest that Item 4 remain as stated.

Item 5 - (see proposed nomencclatorial system in corn letter of January 25th).

Comments: This suggestion has met with such widespread objection that we withdraw it and believe that the old system for designating normal allelomorphs should be continued, i.e. that either a + sign or capital letters be used (e.g. Ra, Su, Lg for the normal allelomorphs of re, au and lg). Sprague and Jenkins made the interesting suggestion that the + sign be used to designate the dominant allelomorph rather than the normal allelomorph since such a procedure would tell at a glance whether the cross was made in coupling or repulsion phase.

Item 6 - (see letter of January 25th).

Comments: This was acceptable to all save Anderson, who wishes to use T 1-2a, T 1-2b, etc., in place of T(1-2)1, T(1-2)2, etc. He meets the objection that the use of the letters of the alphabet will necessitate the use of biliterals by stating that it will be some time before we have more than 26 translocations involving the same two chromosomes. He further objects to the use of parentheses and sees no need for italicizing the letter T (as does Jones). But the question of whether or not Anderson's system is preferable is meaningless now since he has a paper in press in which he has listed all known translocations and has designated them by T 1-2a, etc.

Therefore it seems best that we modify the proposed system to agree with Anderson's terminology. Since some objection has been raised to italicizing the letter T we suggest that it shall not be italicized.

Stadler states that he sees no reason why the symbol T can not be used for any kind of translocation, i.e. simple, reciprocal or progressive. We see no a priori reason why his suggestion is not workable.

Item 7 - The symbol Dr (italicized) shall be used for Deficiency. For example, the first deficiency involving chromosome 10 will be represented as Dr 101; the second as Dr 102, etc.

Comments: Generally satisfactory although Anderson would prefer Dr 10a in place of Dr 101. However Stadler states that he will have a good many deficiencies involving a single chromosome so the alphabet would soon be outstripped and since Stadler is using Dr 101 and finds it satisfactory, we suggest that the proposed system for deficiencies stand as listed except that the symbol Dr shall not be italicized.
Item 8 - The symbol In (italicized) shall stand for Inversion. An inversion involving chromosome 4 will be represented as In 4\(_1\); the second one as In 4\(_2\), etc.

Comments: Same as for Item 7.

Item 9 - It was decided that there was, as yet, no need to formulate a system of nomenclature for duplications.

No comment necessary.

****

We want to strongly emphasize that in the attempt to formulate a nomenclatorial system for maize there is no intention of establishing a set, rigid system which can not be modified to fit the varied needs of a rapidly changing field of research. That there will arise occasions when a modification of the proposed system is necessary for clarity we do not doubt, but without question some general rules of nomenclature which will be followed when possible are essential. To provide such a general code has been one of the purposes of these corn letters. We wish to thank those of you who have been sufficiently interested to communicate your views to us.

After taking into consideration your comments and criticisms we wish to submit a revised nomenclatorial system for maize which has been modified so as to incorporate some of the changes which were recommended.

The modified nomenclatorial system for maize is as follows:

1. The linkage groups and chromosomes will be designated by Arabic numerals. Linkage group 1 will include those genes which lie in the longest chromosome, etc. The longest chromosome of the monoploid set of 10 will be called chromosome 1 and the shortest chromosome 10.

2. Whenever bilateral symbols are used the second letter shall not be dropped as a subscript. Italicize gene symbols.

3. Literal superscripts shall be used to represent different members of an allelomorphic series, e.g. \(R^p, R^s, R^r, R^g\).

4. Numerical subscripts shall be used to represent different genes which give phenotypically similar effects, e.g. \(V_1, V_2, V_3\), etc.

5. The normal allelomorph of a recessive mutant gene shall be designated as has been customary in the past, i.e. either by a + sign or by a capital letter; e.g. the normal allelomorph of su can be either Su or +, depending upon which is the most convenient to use. The normal allelomorphs of what are commonly considered dominant genes can be designated, as in the past, by either a + sign or by small letters, i.e. the normal allelomorph of Tu can be either + or tu.
6. The letter T (not italicized) shall denote translocations. T 1-2a would represent the first case of a reciprocal translocation between chromosomes 1 and 2, T 1-2b the second, etc.

7. The symbol Df (not italicized) shall be used for Deficiency. For example, the first deficiency involving chromosome 10 will be represented as Df 10₁; the second as Df 10₂, etc.

8. The symbol In (not italicized) shall stand for Inversion. An inversion involving chromosome 4 will be represented as In 4₁; the second as In 4₂, etc.

Again it should be stated that this nomenclatorial system can be further modified so if you have any objections to the system as outlined in this letter please advise us.

Sincerely yours,

M. M. Rhoades

MMR:B

M. M. Rhoades 73
September 13, 1934

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
To Maize Geneticists:

We have the pleasure to announce that the Rockefeller Foundation has made a grant to support the cooperative maize work for a period of five years. We are indebted to Brink for having suggested to the Rockefeller people that they aid in a financial way the cooperative maize genetics enterprise.

Last fall we issued for the first time a call for news items such as new linkages, linkage data, short accounts of specific problems, new genes, etc. The response and interest manifested was sufficient to warrant the issuing of a similar call this fall. We would like to have the different items by November 15th. This time limit should make it possible to obtain seedling counts this fall before sending in your news items. The listing of new genetic testers is desired so that we can keep the list of available maize stocks up to date.

In addition to serving as a distributing and cooperative bureau this laboratory shall attempt to collect and maintain stocks of all corn characters. With this purpose in mind, this past summer we grew 8000 plants in our gardens and over 3000 pollinations were made. Included in this collection were characters which had not been grown in recent years, and were in danger of being lost, as well as desirable stocks which had become depleted through calls for seed. The great majority of the pollinations were made by Mr. John Shafer, a graduate student here at Cornell. While our primary purpose shall be to preserve the genes which have previously been isolated, we hope to produce, in a limited manner at least, some desirable multiple combinations.

Since January, 1934 this laboratory has distributed on request over 350 stocks to different investigators.

Through the kindness of R. C. Wiggans we have secured a dozen inbreds which are fairly early in season and are very resistant to the strains of corn smut present at Ithaca. Since some of our genetic testers are extremely susceptible it seems advisable to cross them with resistant lines to obtain resistant testers. In order to determine which of the inbreds will prove best we shall send samples of seed of the different inbreds to several stations so that their smut resistance in different parts of the country can be tested. Those inbreds which are most resistant will then be used in crosses with the susceptible genetic testers.
It is becoming increasingly more important to have lists of cytological testers, i.e., strains in which the chromosome morphology is known. Those of you who are engaged in cytogenetic research please go over your material to see if you can furnish such information and, if so, send us the lists.

Pollen classification

Anderson sends the following concerning classification of pollen for semi-sterility, etc. "We cut out some blocks of light redwood, bored holes in them like this and attached handles. Usually we have 96 holes (8 rows of 12). We collect pollen only in the forenoon. No tags are used. We write the family number on the block and then check the plants collected in the record book, skipping a hole as we pass from one family to the next for safety. The pollen sheds plentifully especially after an hour or more. Tapping the tassel over a slide gives lots of pollen which we look at dry. When pollen is plentiful it is easier to classify dry than in a KI-I preparation. You get used to shriveled pollen after a while so it doesn't bother much. If it is too shriveled we put on a drop of weak iodine solution."

Anderson states that his assistant has made as many as 800 classifications in a single day.

Leitz makes a small pocket microscope (Tauschen Mikroskop) which sells for about $14.00. This pocket microscope can be used in classifying pollen in the field. It is a very fast and convenient method but can be used only when the anthers are shedding pollen. On a quiet morning, however, it is possible to work for several hours before the pollen has been completely shed.

Induced mutants

Stadler has kindly furnished this laboratory with the following mutants which he obtained in his X-ray work. We increased these stocks this past summer and they are available for distribution to anyone wishing to study their linkage relations.

<table>
<thead>
<tr>
<th>Segregating mutant</th>
<th>Viability</th>
<th>Linkage indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentia (ar&lt;sub&gt;a&lt;/sub&gt;)</td>
<td>good</td>
<td>close to su</td>
</tr>
<tr>
<td>dwarf (d&lt;sub&gt;b&lt;/sub&gt;)</td>
<td>good</td>
<td>none</td>
</tr>
<tr>
<td>dwarf (d&lt;sub&gt;c&lt;/sub&gt;)</td>
<td>good</td>
<td>slight - Y repulsion</td>
</tr>
</tbody>
</table>
The names and symbols given to these mutants are merely for convenient reference. When they have been more thoroughly tested names and symbols will be assigned to them.

Maize genetics in the U.S.S.R.

American maize geneticists will be glad to learn that an active group of workers in maize genetics is springing up in the U.S.S.R. This work is under the direction of M. I. Hadjinov. We have received the following letters from him which are transcribed here for your information.

"Your letter of November 13, 1933 I received only 13th January, 1934. I am enclosing herewith information about our works on the maize genetics. I hope it will be of some value though strongly delayed.

During the last 2-3 years we have carried out this work some results of which will be shortly published. The greater part of them I am sending you today.

I should be much obliged if you would kindly send me the mimeographed circulars of the Cornell University on maize genetics and also some genetics stocks.

I should like to ask you if you would find it possible to send me also numbers of circulars previously years of which I possess only that of 1930 "Linkage in Maize".

I wish to state that I am familiar with the Chromosome Map in the report of Prof. R. A. Emerson on the VIth Genetic Congress."
Dr. G. D. Karpetchenko asks me to send his best wishes to you.

Yours sincerely,
(Signed) M. I. Hadjinov.

The enclosure:

"Recurrences of known mutations

liguleless. From 7 stocks: Shanghai, Primorsky Region (F. East) 2 different stocks, Middle Volga region, Armenia, U.S.A. Learning (all tested) and one from the N. Caucasus (non-tested).

ramosa. From 4 stocks: Italy, 2 different stocks of Georgia, N. America (tested).

shrunken. From 2 stocks: Middle Asia, North America (varieties Minnesota 23) (tested).

golden. From West China (tested).

green striped. From 2 stocks: Georgia, Learning (non-tested).

Teopod. From early sugar varieties (names unknown) supplied by Prof. Larionow from Ukraine, where Teopod has never been grown before.

fine-striped. From 2 stocks: Mexico, N. America (tested).

anther ear. From 2 stocks N. America (non-tested).

dwarf. From 2 stocks (tested).

dwarf. From 1 stock (tested).

barren-sterile. (Prof. Hayes). From Spain (non-tested).

barren-stalk. (Prof. Emerson). From Italy (non-tested).

tassel seed. From 2 stocks. Primorsky Region, N. America (tested).

tassel seed. From 2 stocks. Georgia, Armenia (tested).

lazy culm. From Ivory King (N. America) (non-tested).

brown midrib. From 2 stocks: Georgia, Sterling (N. America) (non-tested).

4 cases of cytoplasmatic male sterility: Azerbaijan, Peru, N. Caucasus, America.

male sterility. 25 stocks segregated for male sterility are being studied.
New genes

1. **Rh^1 Rh^1.** Rough sheaths. A dominant gene producing warts in the leaf sheaths in the lower part of the leaf blade near the auricole. This character appearing in the plant in the stage of 7 to 8 leaves. The vitality of the plant is normal. Seed available.

2. **rh^2 rh^2.** Rough sheaths. A recessive gene producing the character similar to that of Rh^1 Rh^1. Beside warts this gene causes sometimes a narrowing of the leaf blade and the appearance of thread-like leaves. The vitality of the plant is somewhat low, but in some families normal. Seed available.

3. **gl^4 gl^11.** Glossy. 11 different allelomorphs gl^1- gl^11 have been recorded from 15 different stocks. Among the 11 genes of glossy by intercrossing and linkage there have been found gl^1 - gl^3 previously described. The linkage of the remaining genes will be shown below.

4. **cr^2 cr^2.** Crinkly. A gene similar to crinkly but non-allelomorphic with it. Seed available.

5. **vg^3 vg^3 vg^4 vg^4.** Yellow-green. Duplicate genes. The seedlings are yellow-green till the flowering stage. After the flowering the yellow pigment disappears. It segregated as a simple recessive gene in the original stock. In crossing with non-allied families gives 15:1. The vitality of plant is extremely low. Seed available.

6. **rs-rs.** Ramosa-silkless. This gene causes a branching of the ear similar in appearance to ramosa but with the complete absence of silks. At the same time it causes an, in the tassel, increasing of glums, flower spikelets and anthers in the pair spikelets. It gives a normal pollen. The vitality of the plant is normal. Seed available.

7. **at at.** Antherless. Causes a complete absence of anthers. The vitality of the plant is normal. Seed available.

8. **hf hf.** Hermaphrodite flowers. A pistilate flower is developed in the male flower beside anthers giving a silk 2-3 cm. long. Sometimes instead of a silk there is only a rudimentary pistil. The pollen is very rarely developed. The ears have a low fertility. The vitality of plant is normal.

9. **vb vb.** Variable brachyte. Causes a sharp shortening of the internodes up to 1 cm. This character is much variable. This shortening may affect either a considerable part of internodes in what case it produces a dwarf plant, or only a part of internodes. Very often the shortened internodes alternate with the normal. Non-allelomorphic with brachyte.
The allelomorphism of vb vb with brevis will be stated in summer 1934. Seed available.

In answer to my reply to the above letter the following was received:

"I have received your kind letter and mimeographed circulars. I am very grateful to you for information and multiple testers which you are sending me. The connection I am trying to establish with you and which, I trust, will be strengthened in future will greatly help us in our work on maize genetics, which I am carrying on now. I hope not to be soon the only worker on maize genetics in U.S.S.R. because I try incorporate into it a considerable number of persons carrying selectional work in corn inbreeding. These workers introduce up to 10-12 thousand new self pollinations every year. Without close association with you our work would be extremely difficult.

In regard to your observations on new mutation characters I am going to say the following:

1) I agree with you that Rs₁ and rs₂ are better symbols for Rough sheath₁ and rough sheath₂. I gave them symbols Rh₁ and rh₂ because by rs I have designated ramosa-silkless which, as I read shortly in the Journal of Heredity seems to be similar to 'branched silkless' bd.

2) I hope to come to an agreement with Dr. Sprague regarding the allelomorphism of Dr. Sprague and my glossies.

3) My crinkly is non-allelomorph cr₁. A limited generation of F₂ from crossing \( \frac{t + c₂}{sh \ wx} \) shows that it is not located in 9 chromosomes and thus seems non-allelomorph cr₂ of Dr. Eyster. I will designate it by cr₃.

4) Genes yellow green³,⁴ - duplicate genes which you think to be similar to au₁,₂ of Dr. Eyster will be tested in linkage with the genes wx and C. I have these F₂.

5) My ramosa-silkless is similar to branched-silkless of Dr. Kempton. My data, however, on linkage (bd) do not coincide with those of Dr. Kempton, who believes it (bd) to be located in 4 (su-Tu) chromosome.

The table below shows my

<table>
<thead>
<tr>
<th>Progeny Phase</th>
<th>Genes</th>
<th>Edx : Edx ; bdx : bdx</th>
<th>Total</th>
<th>Crossover</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>F₂</td>
<td>R : Susu</td>
<td>728 : 152 : 227 : 42</td>
<td>1156</td>
<td>47.6±1.55</td>
<td></td>
</tr>
<tr>
<td>F₂</td>
<td>C : Tutu</td>
<td>102 : 33 : 41 : 8</td>
<td>184</td>
<td>57.0±4.01</td>
<td></td>
</tr>
<tr>
<td>F₂</td>
<td>R : Bnbn</td>
<td>252 : 143 : 101 : 19</td>
<td>515</td>
<td>34.7±2.55</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>R : Bnbn</td>
<td>9 : 41 : 15 : 6</td>
<td>60</td>
<td>36.6</td>
<td></td>
</tr>
</tbody>
</table>
which induce me to think (bd) located in 7 (ra-gl) chromosome. This summer I shall have the linkage (bd) with larger progeny.

6) I have genes $t_{s1}$, $t_{s2}$, $t_{s4}$ and I am aware of the genes $T_{s3}$. All these genes produce grains on tassels and in $t_{s1}$, $t_{s2}$, $t_{s4}$ there is nearly always a complete replacement of male flowers by female. $T_{s3}$ produces also grain on the tassel. A small ovary with a sport silk or without it is developed in the hermaphrodite male flowers in which seeds are never formed. Anthers are nearly normal, but pollen degeneration occurs soon after tetrads during the formation of pollen walls. $h_{f}$ is associated with a strong sterility of female flowers, $h_{f}$ is not linked with $s_{u}$. I have sent you the drawings of $h_{f}$ male flowers.

At the same time I am sending you small quantity of seed $r_{s1}$, $r_{s2}$, $c_{r}$, $a_{t}$, $h_{f}$, $v_{b}$, $b_{d}$, $r_{a}$ and my $g_{l12}$, $g_{l13}$, $g_{l15}$, $g_{l16}$, $g_{l17}$, $g_{l18}$, $g_{l19}$, $g_{l10}$. In autumn I will forward a series of characters after testing their mode of heredity.

Some time ago I read your paper on plasmatic sterility in the Journal of Genetics. The results which I obtained and mentioned at the time in my letter to Dr. Karpetchenko, then in Pasadena, are completely identical with yours. The experiments with artificial infection of seedlings by fresh juice from flowering ears showed me, as in your case, negative results. I am, however, inclined to consider this phenomenon as a result occasioned by the virus diseases. Presently in connection with investigations of the Mendelian type of male sterility from 35 different sources I came upon 4 cases of plasmatic sterility. One type of plasmatic sterility inherited in $F_1$ through pollen I have in sorghum. I am studying it presently. In regard to the work of the Mendelian type of male sterility I have got myself in connection with Dr. Beadle, through whose kindness I received all his genes of male sterility.

With best wishes, I am

Sincerely yours,

(signed) M. I. Hadjinov."

Unfortunately the seed Hodjinov sent was received too late for planting here at Ithaca last summer. Next fall, however, we shall have seed available for distribution.
Corrections and additions to list of genetic factors
(See maize letter of January 23, 1933)

at (antherless) Hadjinov
ag (argostripe) is allelomorphic with if (ic,jap).
The symbol bd is for branched silkless. The character branched sterile is non-existent.
be (branched ear) proved from tests made this summer to be allelomorphic with bd.

bn₂ (brown aleurone) is in chromosome 3. Sprague.
cr₃ (crinkly leaves). Hadjinov.
d₇ (dwarf plant) is in chromosome 10. Singh.
De₂ (dominant aleurone diluter). In chromosome 9, 6 units from C. Order is Dₑ₂-c-wx. Eyster.
d₁ (dull brown endosperm blotch). Singleton and Jones.
dm (dead leaf margins). Kempton '23.
fl₂ (floury endosperm). Mumm.
g₁₀ (glossy seedling). In chromosome 1. Emerson.
g₂₂ (green striped). In chromosome 2. Sprague.
hf (hermaphroditic flowers). Hadjinov.
j₂ (japonica). In chromosome 4. Emerson.
le (lemon endosperm). In chromosome 5. Eyster.
l₀ (lethal ovule) may be allelomorphic with sp. In chromosome 4. Singleton '32.
me (mealy endosperm). Mangelsdorf '32.
pb₅ (piebald).Apparently non-existent.
pe (pubescens-hairy sheath). Tavcar '32.
ps (panicula specialis). Tavcar '31.
r₆₂ (ramosa). Brink.
re$_2$ (reduced endosperm) chromosome 5. Eyster '31.
R$_s_1$ (rough sheath - dominant). Hadjinov.
rs$_2$ (rough sheath - recessive). Hadjinov.
Rw$_1$, etc. (row number genes). Tavcar.
si$_2$ (silky) (si$_2$ and si$_3$ are duplicate genes). Fraser.
si$_3$ (silky). Fraser.
su$_{em}$ (an allelomorph of su). Mangelsdorf.
w$_{le}$ (white seedling). Chromosome 4. Lindstrom.
ws$_3$ (white sheath). Rhoades.

Please add these to the list in the maize letter of January 9, 1933. We would appreciate it if you would notify us of any mistakes, oversights, etc. Notify this office of any new symbols you may wish to use before publishing so that we can help avoid duplication of symbols.
List of maize geneticists

Anderson, E. G., Institute of Technology, Pasadena, Calif.
Beadle, G. W., Institute of Technology, Pasadena, Calif.
Brink, R. A., Genetics Dept., Univ. of Wisconsin, Madison, Wis.
Clokey, Ira M., 1635 Laurel St., S. Pasadena, Calif.
Cooper, D. C., University of Wisconsin, Madison, Wis.
Creighton, Miss H. B., Conn. College for Women, New London, Conn.
Dennert, M., Carnegie Inst., Cold Spring Harbor, Long Island, N.Y.
Emerson, R. A., Plant Breeding Dept., Cornell Univ., Ithaca, N.Y.
Eyfer, W. H., Botany Dept., Bucknell University, Lewisburg, Pa.
Fraser, A. C., Plant Breeding Dept., Cornell Univ., Ithaca, N.Y.
Hayes, H. K., Agronomy Dept., University Farm, St. Paul, Minn.
Hull, Fred, Agronomy Dept., Agric. Exp. Station, Gainesville, Fla.
Kvakan, Paul, Dobricevo Cuprija, Jugoslavia.
Li, H. W., Honan University, Kaifeng, Honan, China.
Lindstrom, E. W., Genetics Dept., Iowa State College, Ames, Iowa.
McClintock, Miss Barbara, Plant Breeding Dept., Cornell University, Ithaca, N.Y.
Mangelsdorf, P. C., Agronomy Dept., Agric. Exp. Station, College Station, Texas.
Meyers, M. T., Farm Crops Dept., Ohio State Univ., Columbus, Ohio.
Muma, W. J., Agronomy Dept., Univ. of Illinois, Urbana, Ill.
Perry, H. S., Botany Dept., Duke Univ., Durham, N. Car.
Randolph, L. F., Botany Dept., Cornell University, Ithaca, N.Y.
Reeves, R. G., Biology Dept., Agric. Exp. Sta., College Station, Tex.
Rhoades, M. M., Plant Breeding Dept., Cornell Univ., Ithaca, N.Y.
Rhoades, V. H., Botany Dept., Cornell University, Ithaca, N.Y.
Singh, S., Plant Breeding Dept., Cornell University, Ithaca, N.Y.
Stadler, L. J., Field Crops Dept., Univ. of Missouri, Columbia, Mo.
Tavcar, A., Dept. of Plant-Breeding, Univ. of Zagreb, Zagreb, Jugosl.
Thomas, H. C., Genetics Dept., University Farm, St. Paul, Minn.
Weatherwax, Paul, University of Indiana, Bloomington, Ind.
Wentz, J. B., Farm Crops Dept., Iowa State College, Ames, Iowa.
In addition to the preceding list the maize letters are sent to the following individuals who have requested that they be included on the mailing list. Some of them have been active in the past in corn genetics but have in recent years become inactive. Others on the list are anxious to receive the letters so that they may closely follow the progress of corn genetics.

Brunson, A. M., Agronomy Dept., Kansas State College, Manhattan, Kansas.
Dorsey, E., Plant Breeding Dept., Cornell Univ., Ithaca, N.Y.
Garber, R. J., Agronomy Dept., Univ. of W. Va., Morgantown, W. Va.
Hofmeyr, J. D. J., P.O. Marabastad, Pietersburg, South Africa.
Horovitz, S., Univ. of Buenos Aires, Buenos Aires, Argentina.
Krug, C. A., Inst. Agronomica do Estado Campinas, Sao Paulo, Brazil
Mains, E. B., Botany Dept., Univ. of Michigan, Ann Arbor, Mich.
Miles, L. G., Agric. Dept., Queensland Univ., Brisbane, Australia.
Neal, Norman P., Genetics Dept., Univ. of Wisconsin, Madison, Wisc.
Richey, F. D., Assoc. Chief, Bureau of Plant Industry, U.S.D.A.
Washington, D. C.
Sharp, L. W., Botany Dept., Cornell Univ., Ithaca, N.Y.
Wiggans, R. G., Plant Breeding Dept., Cornell Univ., Ithaca, N.Y.

Do not forget that the dead line for receipt of news items is November 15th. Please cooperate so that we can make these maize letters of real service and interest to you.

Sincerely yours,

M. M. Rhoades

M. M. Rhoades
To Maize Geneticists:

This letter is composed of data and information which you have generously contributed so that we can all keep in closer contact and be better informed about the work in the different laboratories. The response to our request for news items has been good and the information included in this letter will be of interest and value to everyone. Most, if not all, of the information listed in this letter has not been published so we wish to emphasize, in order that there will be no misunderstanding, that the appearance of information in these series of corn letters does not constitute publication. If you wish to refer to any data you should ask the direct consent of the contributor.

Since these corn letters are a cooperative affair it seems just that only those who show sufficient interest to cooperate should receive the letters. Not everyone will have something to contribute and no one will be dropped from the mailing list for that reason. This office should, however, receive an acknowledgement of the request for news items even though you have nothing to contribute. We feel that anyone who does not value these letters sufficiently to include his own data has no claim to the unpublished data of others who have generously cooperated.

News items from Ithaca

1. Zebra<sub>5</sub> (zb<sub>5</sub>) which shows in seedlings as a virescent and in mature plants as a zebra stripe (transverse bands of green and yellow tissue) shows no crossing over with <em>dz</em>. Order is zb<sub>5</sub>-<em>R</em>-<em>g</em>. Classification excellent and viability good. Singh.

2. Zigzag stalk (<em>zg</em>) is linked closely with <em>P</em>l and <em>sm</em>. Exact order unknown. Classification satisfactory. Singh.

3. A dominant gene (<em>Dt</em>) interacts with <em>a</em> to give dotted aleurone. <em>Dt</em> does not interact with <em>a</em>, <em>c</em> or <em>r</em>. Seeds of <em>a</em><sup>P</sup><em>a</em><sub>1</sub> <em>A</em><sub>2</sub> <em>C</em> <em>Rs</em> <em>Dt</em> constitution have a pale purple background on which appear the more intense dots. The ratio of the number of dots on seeds of <em>a</em><sub>1</sub> <em>a</em><sub>1</sub> <em>a</em><sup>P</sup> <em>Rs</em> <em>Dt</em> <em>Dt</em> genotype to the number of dots on seeds of <em>a</em><sub>1</sub> <em>a</em><sub>1</sub> <em>a</em><sup>P</sup> <em>Rs</em> <em>Dt</em> <em>Dt</em> <em>Dt</em> constitution is 2 : 3, while the ratio for seeds of <em>a</em><sup>P</sup><em>a</em><sub>1</sub> <em>P</em> <em>a</em><sup>P</sup><em>P</em> <em>A</em><sub>2</sub> <em>C</em> <em>R</em> <em>S</em> <em>Dt</em> <em>Dt</em> <em>Dt</em> genotype to seeds of <em>a</em><sub>1</sub> <em>a</em><sub>1</sub> <em>a</em><sup>P</sup> <em>Rs</em> <em>Dt</em> <em>Dt</em> <em>Dt</em> constitution is 1 : 3.8. These ratios suggest that the dosage of <em>a</em><sup>P</sup> affects the number or else that <em>a</em><sup>P</sup> has an inhibitory effect which is
proportional to the dosage of $a_1^p$. $Dt$ is not linked but is independent of $a_1$, $a_2$, $c$, $r$, $su$ and $lg$. Rhoades.

4. Plants which have 20 chromosomes plus the short arm of chromosome 5 are intermediate in appearance between disomes and trisomes for chromosome 5. The fragment has a terminal insertion region as the break occurred exactly at the spindle fiber region. In 50% of the cases a trivalent group is formed at metaphase I, and in 50% of the cases a bivalent and the fragment as a univalent are formed. When a trivalent is formed the disjunction in anaphase I is such that the fragment passes to the same pole as one of the normal 5 chromosomes. The two normal chromosomes rarely, if ever, pass to the same pole and fragment plants have never thrown the primary trisome. Through a study of genetic ratios in plants carrying the fragment it has been possible to assign certain genes in chromosome 5 to the long and short arms, respectively. The available data suggest that $v_2$ is pr and bt are in the long arm of chromosome 5, while $b_m$ is in the short arm. Whether a gene shows a 5:3 or a 1:1 ratio in a back cross using the fragment plants as female determines if a given gene is in the long or short arm. Rhoades.

5. An inbred strain gave in $F_2$ approximately 65% of luteus seedlings. This aberrant ratio was caused by the linkage of a gene for small pollen with the normal allelomorph of the luteus gene. Small pollen (sp) has 2% crossing over with luteus. A variable percentage of the eggs with the small pollen gene abort giving in different $F_2$ populations a range from 55 to 90% of luteus seedlings. Small pollen germinates as rapidly as normal pollen but never, or rarely, succeeds in fertilization. Cytological examinations at pachytene showed no visible deficiency. The gene for small pollen is being tested with sp$. Rhoades.

6. White sheath$^3$ (ws$^3$) is in chromosome 2 according to trisomic tests. ws$^3$ shows as seedling and can be classified until shortly after flowering. Rhoades.

7. $\frac{+}{bt_1} \times \frac{bt_1}{+} \frac{b_m}{+}$ gave $128 + b_m : 1 ++ : 2 bt_1 b_m : 119 bt_+$ which gives 1.2% crossing over. Rhoades.

8. $\frac{+}{v_2} \times \frac{+}{pr} \frac{+}{b_m} \times \frac{v_2}{pr} \frac{b_m}{pr}$.

region 1 = 45.4% crossing over
region 2 = 2.3% crossing over
Coincidence = .80.

Rhoades.
9. Branched ear (be) is allelomorphic with branched silkless (bd). Rhoades.

10. The studies on mutation and tetraploidy induced by heat treatments are being continued. The first seedling crop in the greenhouse this fall gave two new mutations, a glossy and a white seedling, from less than 100 F₂ ears tested. Randolph.

11. Treatments to obtain 4N commercial hybrid strains were repeated this past summer. A number of 4N plants from commercial inbreds treated a year ago looked very promising early in the season but failed to mature seed, due largely to unfavorable cultural conditions. Randolph.

12. The B-type chromosomes produce marked sterility when present in numbers higher than 16 or 18, and are structurally unstable. Randolph.

13. A survey of chromosome morphology in different strains of maize has revealed types of Indian corn from the southwest which are more nearly like teosinte than any previously known. Randolph.

14. Perennial teosinte in the greenhouse this fall was pollinated abundantly with corn pollen from ligulate brown plants to obtain haploids, and odds are being offered (3 : 1) that if any are obtained they will be annual. Randolph.

15. A summary of all data now available indicate recombination percentages as follows for the group of genes near the end of the known linkage map for chromosome 1:

<table>
<thead>
<tr>
<th>Gene</th>
<th>Number of individuals</th>
<th>Per cent of recombination</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-ts₂</td>
<td>3196</td>
<td>1.3</td>
</tr>
<tr>
<td>P-zl</td>
<td>2567</td>
<td>1.6</td>
</tr>
<tr>
<td>P-ms₁₇</td>
<td>2706</td>
<td>3.0</td>
</tr>
</tbody>
</table>

The order of these four genes is unknown. Emerson.

16. My collection includes the following aleurone, anther, and silk color combinations, in which "+" indicates colored and "-" colorless:

<table>
<thead>
<tr>
<th></th>
<th>aleurone</th>
<th>anther</th>
<th>silk</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&lt;sup&gt;F&lt;/sup&gt;G</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>R&lt;sup&gt;G&lt;/sup&gt;G</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>r&lt;sup&gt;F&lt;/sup&gt;r</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>r&lt;sup&gt;G&lt;/sup&gt;r</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>r&lt;sup&gt;G&lt;/sup&gt;g</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

I need the following:-
The nearest approach to this in my former collections was Navajo-pattern colored aleurone, colored anthers, and colored silks. Colored anthers appear always to be associated with some color in glumes, sheaths, brace roots, etc., and, except in the presence of B, colorless anthers with colorless glumes, sheaths, and brace roots. It is of interest to note that, if this series of supposed allelomorphs is an example of very close linkage, Webber was probably the first to report linkage in corn (Webber, H. J. - Rept. Amer. Breeders' Assoc. 2: 76-81, 1906). Emerson.

News items from Columbia, Mo.

1. V₃ is located on the longer arm of chromosome 5, not far from the insertion region. This is the cytological position of Df 5₁, which includes V₃. Linkage data indicate the Df is between B₃ and Bv, very close to Bv. The Df does not include B₃, Bt, or Bv. This internal deficiency markedly reduces crossing over, both in the B₃-Bv region and in the Bv-Pr region. This shows that in maize crossing over may be inhibited by deficiency outside the region homologous to the Df, which appears not to be the case in Drosophila. Stadler.

2. A new high-mosaic strain gives endosperm mosaics with a frequency higher than that ordinarily found in heavily X-rayed ears. The various endosperm loci show differing frequencies of loss corresponding at least roughly to their relative frequencies in common maize. The high frequency of chromosomal aberrations is limited to the early divisions in endosperm development, the proportion of small sectors being hardly more than normal. The factor responsible for this effect is transmitted through both male and female gametes. The chromosomes derived from both the male and the female parent are affected in endosperms which have received this factor from either parent. In an F₂ progeny segregating for an unknown yellow seedling factor and for the high-mosaic factor, seedlings sectorial for the yellow seedling character were common in the progenies with high mosaic frequency. Plants heterozygous or homozygous for the high-mosaic factor are normal in development and have normally fertile pollen and ears. Stadler.

3. Dr. Sprague and I have begun some work on ultra-violet treatment of pollen, with the collaboration of Dr. F. S. Brackett of the Smithsonian Institution. The experiments haven't gone very far as yet, but it is clear that ultra-violet treatment of pollen induces genetic changes which show up as both whole endosperm and mosaic endosperm deficiencies at rates rather
surprisingly high. A single progeny now growing in the greenhouse also shows about 10% of the plants with segregating pollen sterility. The results thus far therefore correspond to the changes to be expected from an X-ray treatment of pollen, with frequencies corresponding to a dosage of X-rays considerably lower than the maximum. However, the doses of ultra-violet radiation used were also well below the maximum. Results from filtered and monochromatic ultra-violet radiations are not yet available. Studler.

4. Linkage data :-

<table>
<thead>
<tr>
<th>Gene</th>
<th>Linkage phase</th>
<th>Number of individuals</th>
<th>Recombinations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>XY</td>
<td>xy</td>
</tr>
<tr>
<td>X y</td>
<td></td>
<td>37</td>
<td>53</td>
</tr>
<tr>
<td>Gs Lg</td>
<td>RBC</td>
<td>162</td>
<td>4</td>
</tr>
<tr>
<td>Gs B</td>
<td></td>
<td>128</td>
<td>35</td>
</tr>
<tr>
<td>Pcs R</td>
<td></td>
<td>204</td>
<td>19</td>
</tr>
<tr>
<td>Pcs G</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sprague.

News items from Morgantown

1. New linkage stocks :-

Chromosome 1
- p f₁ an bn₂
- p br f₁ bn₂ (pale yellow endosperm)
- f₁ bn₂ y
- P f₁ bn₂ (segregating ts₂).

Chromosome 5
- pr bt₁ bn₁ (not homozygous for ACR).

Chromosome 7
- ra sl₁ ij (or at least the F₁ in coupling).

Burnham.

2. New characters :-

Several characters are either segregating or are in homozygous condition in the inbred lines here at Morgantown. Among them are the following: glossy seedling, tassel seed, ramosa tassel with normal ears, purple seedling leaf color which is dilute sun red in mature plant. This last character is a dominant.

Burnham.
3. Linkage data including a few tests with unlinked genes - 3 point tests:

<table>
<thead>
<tr>
<th>Genes x y</th>
<th>Linkage:</th>
<th>Number of individuals:</th>
<th>New combinations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>x y y x</td>
<td>X Y X y; x Y x y</td>
<td>Total:</td>
<td>No.: %</td>
</tr>
<tr>
<td>r x i j</td>
<td>R S</td>
<td>437; 111; 201; 4; 754; -</td>
<td>19.0</td>
</tr>
<tr>
<td>v_2 y s_1</td>
<td>C B</td>
<td>113; 48; 51; 113; 225; -</td>
<td>30.5</td>
</tr>
<tr>
<td>b n y s_1</td>
<td>C B</td>
<td>153; 276; 308; 123; 860; 276; 32.1</td>
<td></td>
</tr>
<tr>
<td>b u_1 x b u_1 x + b t b t</td>
<td>---</td>
<td>260; 465; 17%</td>
<td>0; 897; 16%</td>
</tr>
<tr>
<td>b u_1 y v_2</td>
<td>C B</td>
<td>111; 101; 138; 115; 625; 299</td>
<td></td>
</tr>
<tr>
<td>b n_1 c h</td>
<td>C B</td>
<td>104; 98; 106; 39; 287; 104</td>
<td></td>
</tr>
<tr>
<td>y g_1 c h</td>
<td>C B</td>
<td>113; 102; 97; 84; 287; 200</td>
<td></td>
</tr>
<tr>
<td>b n_1 y g_1</td>
<td>C B</td>
<td>163; 136; 142; 143; 589; 378; 47.2</td>
<td></td>
</tr>
<tr>
<td>b n_3 c h</td>
<td>C B</td>
<td>57; 48; 48; 36; 187; 94</td>
<td></td>
</tr>
<tr>
<td>g_2 c h</td>
<td>C B</td>
<td>59; 57; 61; 47; 224; 118</td>
<td></td>
</tr>
<tr>
<td>x y</td>
<td>C B</td>
<td>32; 15; 5; 176; 69; 20; 29.0</td>
<td></td>
</tr>
<tr>
<td>y g_1 - t_4 - 5_4</td>
<td>C B</td>
<td>143; 14; 145; 142; 599; 378; 47.2</td>
<td></td>
</tr>
<tr>
<td>b n - t_5 - 7_4</td>
<td>R B</td>
<td>5; 148; 95; 14; 244; 19; 7.9</td>
<td></td>
</tr>
</tbody>
</table>

* Those include those in the 3 point tests.

Burnham.

4. Linkage data from a 3 point F_2 test:

<table>
<thead>
<tr>
<th>Genetic constitution:</th>
<th>Pr + v p_2</th>
<th>Pr - v p_2</th>
<th>pr + b t</th>
<th>pr - b t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ v p_2</td>
<td>+ v p_2</td>
<td>+ v p_2</td>
<td>+ v p_2</td>
</tr>
<tr>
<td>Pr + v p_2</td>
<td>Pr + v p_2</td>
<td>Pr + v p_2</td>
<td>Pr + v p_2</td>
<td></td>
</tr>
<tr>
<td>pr + b t</td>
<td>pr + b t</td>
<td>pr + b t</td>
<td>pr + b t</td>
<td>pr + b t</td>
</tr>
</tbody>
</table>

* Not certain that these are v p_2 grains. The recombination percentages are calculated as though these were v p_2.

pr - v p_2 = 25% 
bt - v p_2 = 10% 
pr - bt = 15%

Burnham.
5. Linkage data from 3 point back crosses:

<table>
<thead>
<tr>
<th>Genetic constitution</th>
<th>Regions</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 :</td>
<td>1 :</td>
</tr>
<tr>
<td></td>
<td>149</td>
<td>: 35</td>
</tr>
<tr>
<td>bm₁ + + + pr ys</td>
<td>81 : 87</td>
<td>13 : 21</td>
</tr>
<tr>
<td></td>
<td>167</td>
<td>: 34</td>
</tr>
<tr>
<td>bm₁ pr ys (also seg. v₂ 3:1)</td>
<td>118 : 79</td>
<td>: 21 : 11</td>
</tr>
<tr>
<td></td>
<td>197</td>
<td>: 42</td>
</tr>
<tr>
<td>+ + + Ch</td>
<td>61 : 45</td>
<td>39 : 5</td>
</tr>
<tr>
<td>bm₁ yg₁ ch</td>
<td>106</td>
<td>: 91</td>
</tr>
<tr>
<td>No linkage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ T5-7a bn</td>
<td>36 : 40</td>
<td>6 : 1 :</td>
</tr>
<tr>
<td>g₁₁ + Bn</td>
<td>76</td>
<td>: 7</td>
</tr>
<tr>
<td>T5-7a + + g₁₁ v₅</td>
<td>142</td>
<td>: 214</td>
</tr>
<tr>
<td>+ v₁₁ ra</td>
<td>107 : 74</td>
<td>4 : 39</td>
</tr>
<tr>
<td>ra g₁₁ +</td>
<td>131</td>
<td>7 : 81</td>
</tr>
<tr>
<td>T₁-7 + + g₁₁ ij</td>
<td>292</td>
<td>: 201</td>
</tr>
<tr>
<td></td>
<td>493</td>
<td>: 13</td>
</tr>
</tbody>
</table>

* v₂ classification was not entirely satisfactory.

6. Notes on the above data:

The linkage of T₄-5a with yg₁ is the first found for yg₁. If it is in chromosome 5 it must be out in region where v₂ is or even nearer the end. Of course it may be in chromosome 4. The break in each chromosome was near the subterminal knob. The data on chromosome 7 are mostly from interchanges. In T₅-7a both breaks were near the subterminal knobs, while in T₁-7 the break in 7 was on the long arm not far from the spindle fiber insertion. The data indicate that Bn is out toward the end of the long arm, with ra near the break in 1-7 and g₁₁ in between. Vg₂ apparently is on the bm₁ side of pr. Burnham.
1. Technique.

A map measure (K & E) has been found very useful in measuring the length of chromosomes. By tracing the camera lucida drawing with the map measure the length (in inches or centimeters) is registered on the dial of the measure. This is useful in determining arm lengths and relative lengths of the chromosomes. The map measure was suggested by an engineer, George W. Burke, on an FERA project here at the Experiment Station. Singleton.

2. Additions or Corrections to last year's notes.

a) The gene ramosa has appeared in another stock, a Leaming inbred. It has proved allelomorphic with ra1. This makes the fourth occurrence of this gene in our stocks.

b) Preliminary tests with la2 give an indication of linkage with su. No crossovers occurred in a row of 20 plants. It is probably allelomorphic to la2.

c) Micropyle color Mc is a modifying factor of the P factor, rather than allelomorphic. Backcrosses of Pmc to pnc showed a segregation into Pmc, Pnc and p plants, which could not occur if Mc were allelomorphic to P. Singleton.

3. New data.

a) The factor e2 has shown linkage with ramosa (C.O. 18 per cent on the basis of F2 data). Backcross data will be available next year.

b) Backcross data have shown that both la and sp are on the Ts5 side of su. They may be allelomorphic.

c) Backcross data of material sent by Dr. Emerson indicate that w1 is between Ts5 and su. The order probably is Ts5-w1-su-Tu. Singleton.

4. New genes or reoccurrence of known genes

a) ramosa - Sweepstakes inbred. It is being tested with ra1.

b) brown midrib - Sweepstakes inbred.

c) glossy1 Country Gentleman inbred.

d) glossy (not 1, 2, or 3) - Sweepstakes inbred.

e) crinkly - Sweepstakes inbred.

f) adherent tassel - Sweepstakes inbred.

g) yellow stripe - Sweepstakes inbred.

h) yellowish japonica - Sweepstakes inbred.

i) yellowish threaded - Sweepstakes inbred.

j) dwarf - Sweepstakes inbred.

k) fine stripe (may be allel. to f1) - Sweepstakes inbred.

Singleton.

5. Soft starch (h) of Munro is different from both opaque 1 and opaque 2. Singleton.
**News items from College Station, Texas**

1. Amylaceous sugary (su<sup>am</sup>) is allelomorphic with su. This new sugary gene is expressed only when another gene, du, which produces a null endosperm similar in appearance to waxy but staining blue instead of red, is also present in the recessive condition. Ratios in most crosses are 15 : 1. The gene su<sup>am</sup> shows the same linkage relations as su while the gene du is located in the R-g group. The new sugary is not as good a character as the original sugary but it has some bearing on the inheritance of pseudo-starchiness. A synthetic pseudo-starchy can be produced by crossing amylaceous sugary with true sugary. Seed are available. Mangelsdorf.

2. In Tripsacum hybrids with maize the number of Tripsacum chromosomes can be determined by an examination of the pollen. Plants with 80 Zea chromosomes plus one Tripsacum chromosome have 50 per cent normal and 50 per cent small pollen. Plants with two Tripsacum chromosomes have 25 per cent normal, 50 per cent small, and 25 per cent empty pollen. Apparently a single Tripsacum chromosome causes reduction in size while two or more cause complete abortion of the pollen. Extra chromosome plants can be readily identified in the field by pollen examination. We now have a large number of stocks all having 80 maize chromosomes and one extra Tripsacum chromosome. We are attempting to identify these extra Tripsacum chromosomes by crossing with corn stocks in which the chromosomes are marked by two or more recessives. We are badly in need of multiple recessive stocks for this work. Mangelsdorf.

3. A few stocks which we have developed for Texas conditions and which are available to other maize geneticists in the South are :-

   B 1g
   a a Bb pl pl Lg<sub>2</sub> Lg<sub>2</sub>
   Pp Br br F f Bn Bu Lg 1g G1 gl Rn ra - F<sub>2</sub>
   Pp Br br F f Bn Bu su wx - F<sub>2</sub>
   Lg 1g su wx
   Lg 1g Gi gl Rn ra su wx
   Y Pi B 1g su Tu wx
   aa Pp.

   Mangelsdorf.

4. We have a number of F<sub>1</sub> plants of diploid Zea x tetraploid Tripsacum which can be propagated by division. Anyone wishing some of this material is welcome to it. Mangelsdorf.
News items from Ames, Iowa

1. Linkage data:

<table>
<thead>
<tr>
<th>Pedigree: Genes</th>
<th>x</th>
<th>y</th>
<th>Total</th>
<th>Recombinations: Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Y: Linkage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase: XY Xy : xY xy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>h</td>
<td>R S: 120: 49: 20: 213: 40.3:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>h</td>
<td>C S: 86: 73: 60: 64: 303: 155 50.5:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>h</td>
<td>C B: 2366: 977: 980: 159: 4482: 37.0±0.9:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>h</td>
<td>C B: 31: 33: 59: 58: 181: 92 50.8:</td>
<td></td>
</tr>
</tbody>
</table>

1) A new recessive anthocyan gene.

2) Assigned w4 because the original w in the mimeographed sheets is not shown to be linked with anything, and since the gene is on the new 4th chromosome.

News items from Washington, D. C.

1. In back cross counts involving 227 plants rootless (rt) showed 18.5% crossing over with Rg. Jenkins.

2. Lazy (la) shows 11.4% crossing over with su and is on the opposite side of su from Tu and gl as based on a 4-point back cross test. Jenkins.

3. A 3-point back cross test with ra Tp and ij indicates the order to be ra-Tp- ij with the total ra-ij distance about 11 units. Jenkins.

4. Branched silkless (bd). Our results agree with those of Hadjino in that (bd) is not located in the fourth chromosome with Tu. Our latest progeny in repulsion phase with su gives Su Bd 261: Su bd 82: su Bd 42: su bd 14 with x less than 1. The deficiency of su plants is accounted for by the poor stand. Kempton.
### Linkage data from Madison

1. \[ \frac{a_1 \text{Lg}_2 \text{Rg}}{a_1 \text{Lg}_2 \text{Rg}} \times a_1 \text{Lg}_2 \text{Rg} \]
   - \( a_1 \text{Lg}_2 \text{Rg} \) 702
   - \( a_1 \text{Lg}_2 \text{Rg} \) 406
   - \( a_1 \text{Lg}_2 \text{Rg} \) 138
   - \( a_1 \text{Lg}_2 \text{Rg} \) 60

Total = 1315

2. \[ \frac{a_1 \text{Na ts}_4 \text{Rg}}{a_1 \text{Na ts}_4 \text{Rg}} \times a_1 \text{Na ts}_4 \text{Rg} \]

<table>
<thead>
<tr>
<th>Crossing-over</th>
<th>( a_1 - \text{na} )</th>
<th>( \text{na} - \text{ts}_4 )</th>
<th>( \text{ts}_4 - \text{Rg} )</th>
<th>( \text{na} - \text{Rg} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ( a_1 \text{Na ts}_4 \text{Rg} = 235 )</td>
<td>( a_1 \text{na Ts}_4 \text{Rg} = 216 )</td>
<td>451</td>
<td>( a_1 - \text{na} )</td>
<td>23.1%</td>
</tr>
<tr>
<td>1 ( a_1 \text{Na ts}_4 \text{Rg} = 42 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 81 )</td>
<td>123</td>
<td>( \text{na} - \text{ts}_4 )</td>
<td>35.7%</td>
</tr>
<tr>
<td>2 ( a_1 \text{Na ts}_4 \text{Rg} = 140 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 105 )</td>
<td>245</td>
<td>( \text{ts}_4 - \text{Rg} )</td>
<td>8.7%</td>
</tr>
<tr>
<td>3 ( a_1 \text{Na ts}_4 \text{Rg} = 27 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 27 )</td>
<td>51</td>
<td>( \text{na} - \text{Rg} )</td>
<td>40.9%</td>
</tr>
<tr>
<td>1 &amp; 2 ( a_1 \text{Na ts}_4 \text{Rg} = 32 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 56 )</td>
<td>68</td>
<td>( a_1 - \text{na} )</td>
<td>11.8%</td>
</tr>
<tr>
<td>1 &amp; 3 ( a_1 \text{Na ts}_4 \text{Rg} = 4 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 9 )</td>
<td>13</td>
<td>( \text{na} - \text{ts}_4 )</td>
<td>15.1%</td>
</tr>
<tr>
<td>2 &amp; 3 ( a_1 \text{Na ts}_4 \text{Rg} = 14 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 3 )</td>
<td>17</td>
<td>( \text{ts}_4 - \text{Rg} )</td>
<td>9.7%</td>
</tr>
<tr>
<td>1, 2 &amp; 3 ( a_1 \text{Na ts}_4 \text{Rg} = 2 )</td>
<td>( a_1 \text{Na ts}_4 \text{Rg} = 3 )</td>
<td>5</td>
<td>( \text{na} - \text{Rg} )</td>
<td>3.7%</td>
</tr>
</tbody>
</table>

Total = 995

Brink.
3. \((lg_2 \times na) \odot\)

No \(lg_2\) na plants appeared among about 5000 offspring. This result does not tally with expectation on the basis of the above results, viz. \((lg_2 - Rg = 15.7\%\) c.o., and \(na - Rg = 40.9\%\) c.o.) \((a_1-na = 25.1\%\), and \(a_1-lg_2 = 36.0\%\)).

Brink.

4. 
\[
\frac{Lg_2 \, d_1}{Lg_2 \, D_1} = 1g_2 \, d_1
\]

\[
D_1 \, Lg_2 \} 162
\]

\[
d_1 \, Lg_2 \} 162
\]

\[
D_1 \, Lg_2 \} 96
\]

\[
d_1 \, Lg_2 \}
\]

\[
Total \ 258
\]

Brink.

5. 
\[
\frac{d_1 \, Rg \times d_1 \, rg}{D_1 \, rg \times D_1 \, rg} \]

\[
d_1 \, Rg \} 591
\]

\[
D_1 \, Rg \}
\]

\[
d_1 \, Rg \} 94
\]

\[
Total \ 383
\]

Brink.

6. \(na \, Pa \, Rg \times na \, pu \, rg\)

\(Na \, pm \, rg\)

<table>
<thead>
<tr>
<th>Numbers</th>
<th>(na , Pa , Rg)</th>
<th>(Na , pa , rg)</th>
<th>(Na , Pa , Rg)</th>
<th>(na , pa , rg)</th>
<th>(Na , pm , Rg)</th>
<th>(na , pm , Rg)</th>
<th>(Na , Pa , rg)</th>
<th>(na , Pa , rg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>115</td>
<td>189</td>
<td>109</td>
<td>57</td>
<td>13</td>
<td>21</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>314</td>
<td>314</td>
<td>166</td>
<td>166</td>
<td>34</td>
<td>34</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

\(pm = pale \, midrib\)

\(Rg - na = 40.8\% \, c.o.\)

\(Rg - pm = 7.7\% \, "\)

\(pm - na = 33.1\% \, "\)

Brink.
7. \[
\frac{A_1 B_{a_1} Rg}{a_1 b_{a_1} Rg} \times a b_{a_1} Rg
\]
\[
A b_{a_1} Rg \quad 20
\]
\[
A b_{a_1} Rg \quad 18 \quad \text{Crossing-over}
\]
\[
A b_{a_1} Rg \quad 10
\]
\[
A b_{a_1} Rg \quad 1
\]
Total = 49

8. \[
\frac{Rg R_{a_2}}{rg r_{a_2}} \times r g r_{a_2}
\]
\[
Rg R_{a_2} = 38
\]
\[
rg r_{a_2} = 67
\]
\[
Rg r_{a_2} = 26
\]
\[
rg R_{a_2} = 29
\]
Total 160

9. \[
\frac{a B p_{1}}{r_{a_2}} \times s a n e
\]
\[
A R_{a_2} = 152
\]
\[
A r_{a_2} = 29
\]
\[
A R_{a_2} = 43
\]
\[
A r_{a_2} = 9
\]
\[
\frac{ad}{bc} = \frac{1368}{1247} = 1.1
\]
\[
c.o. = ca. 50\%
\]

News items from Pasadena

1. New stocks - chromosome 2
   - \(l_{1} g_{1} v_{4}\) segregating c sh wx
   - \(l_{1} g_{1} B v_{4}\)
   - b sk \(v_{4}\) segregating \(l_{1}\) and \(g_{1}\)
   - j sk \(v_{4}\)
   - b ts_{1} \(v_{4}\)
   - B ts_{1} \(v_{4}\)

Clokey.
2. Linkage data:

On a back cross of 1100 plants for \( r_{a1} \) \( gl_{1} \) \( i_{j} \) the order from the first 700 plants is \( r_{a1} \) \( gl_{1} \) \( i_{j} \) with a cross over value of 4-5 per cent between \( r_{a1} \) and \( gl_{1} \).

3. Data from cross \( \frac{sm^{+} \times pl \; sm \; py}{pl \; + \; py} \)

<table>
<thead>
<tr>
<th>Py plants</th>
<th>py plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: pl ; sm: 150</td>
<td>pl + : 121</td>
</tr>
<tr>
<td>1: Pl ; sm: 17</td>
<td>pl + : 37</td>
</tr>
<tr>
<td>2: Pl + : 6</td>
<td></td>
</tr>
<tr>
<td>1-2: pl + : 0</td>
<td></td>
</tr>
</tbody>
</table>

From Py plants only - \( Pl \; sm = \frac{17}{135} = 8.6\% \)

\( sm \; py = \frac{26}{195} = 13.5\% \)

From all plants - \( Pl \; py = \frac{80}{361} = 22.2\% \)

Order is therefore \( Pl \; sm \; py \).

News items from Sao Paulo, Brazil

a) Ear and seed characters

<table>
<thead>
<tr>
<th>Ear and seed characters</th>
<th>No. of strains available</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) premature germination (3:1)</td>
<td>1</td>
</tr>
<tr>
<td>2) several kinds of defective endosperms (shrunken, floury, etc.)</td>
<td>6</td>
</tr>
<tr>
<td>3) variegated pericarp</td>
<td>1</td>
</tr>
<tr>
<td>4) mottled aleurone</td>
<td>1</td>
</tr>
</tbody>
</table>
b) **Leaf characters**

1) concentric spots* ........................................ 1
2) oily spots (?)* ........................................ 8
3) crinkly (?) ........................................ 3
4) rolled leaves ........................................ 12
5) ragged (?) ........................................ 6
6) narrow leaves ........................................ 1
7) hairy sheath ........................................ 2

**Chlorophyll-deficient types**

1) white seedlings ........................................ 7
2) yellow seedlings ........................................ 2
3) several kinds of striped ................................... 14
4) zebra striped seedlings (?) .............................. 7

**Genes affecting the whole plant**

1) several types of dwarfs ................................... 13
2) ultra-dwarf ........................................ 1
3) ranose (?) ........................................ 1

**Abnormal sex-distribution**

1) tassel-ear, tassel-seed ................................... 4
2) hermaphr. flowers on the ear ............................ 1
3) male flowers on the ear* .............................. 1
   (upper half of ear is *)
4) female plants* ........................................ 1

The characters marked with * are supposed to be new ones. Some of the abnormalities appeared in more than one strain, but they may not be allelomorphs.
Results of first inbreeding three corn varieties:

<table>
<thead>
<tr>
<th>Type of Variations Found</th>
<th>Varieties Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;Amarello&quot; : &quot;Crystal&quot; : &quot;Imparo&quot;</td>
</tr>
<tr>
<td></td>
<td>No. : % : No. : % : No. : % : No. : %</td>
</tr>
<tr>
<td>White seedlings</td>
<td>12 : 1.74 : 60 : 5.70 : 2 : 2.8 : 74 : 4.08</td>
</tr>
<tr>
<td>Yellow seedlings</td>
<td>5 : 0.73 : 5 : 0.47 : 0 : 10 : 0.55</td>
</tr>
<tr>
<td>Transv. striped lvs.</td>
<td>5 : 0.73 : 12 : 1.14 : 0 : 17 : 0.93</td>
</tr>
<tr>
<td>Light green lvs.</td>
<td>19 : 2.76 : 6 : 0.57 : 1 : 1.4 : 26 : 1.43</td>
</tr>
<tr>
<td>Striped leaves</td>
<td>15 : 2.18 : 9 : 0.85 : 1 : 1.4 : 25 : 1.37</td>
</tr>
<tr>
<td>Concentric spots</td>
<td>1 : 0.14 : 11 : 1.04 : 0 : 12 : 0.66</td>
</tr>
<tr>
<td>Ragged (?)</td>
<td>1 : 0.14 : 11 : 1.04 : 0 : 12 : 0.66</td>
</tr>
<tr>
<td>Rolled leaves</td>
<td>6 : 0.87 : 15 : 1.42 : 1 : 1.4 : 22 : 1.21</td>
</tr>
<tr>
<td>Crinkly</td>
<td>6 : 0.87 : 0 : 1 : 1.4 : 7 : 0.33</td>
</tr>
<tr>
<td>Oily spots (?)</td>
<td>4 : 0.58 : 5 : 0.47 : 1 : 1.4 : 10 : 0.55</td>
</tr>
<tr>
<td>Narrow leaves (?)</td>
<td>0 : 0.19 : 2 : 0.19 : 0 : 2 : 0.11</td>
</tr>
<tr>
<td>Hairy sheath</td>
<td>0 : 0.19 : 2 : 0.19 : 0 : 2 : 0.11</td>
</tr>
<tr>
<td>Dwarfs</td>
<td>5 : 0.75 : 5 : 0.47 : 1 : 1.4 : 11 : 0.60</td>
</tr>
<tr>
<td>Abnormal sex dis-</td>
<td>25 : 3.63 : 8 : 0.76 : 2 : 2.8 : 35 : 1.92</td>
</tr>
<tr>
<td>Abnormal sex dis-</td>
<td>25 : 3.63 : 8 : 0.76 : 2 : 2.8 : 35 : 1.92</td>
</tr>
<tr>
<td>Ramosa (?)</td>
<td>0 : 0.09 : 1 : 0.09 : 0 : 1 : 0.05</td>
</tr>
<tr>
<td>Branched ear</td>
<td>4 : 0.58 : 4 : 0.38 : 0 : 4 : 0.38</td>
</tr>
</tbody>
</table>

In 1932 we selfed about 3,000 plants of these three varieties. Among the selfed ears we found a great many with defective endosperm seeds, one case of "premature germination" (3:1), one with semitunicate grains, besides a great number of diversely diseased ears which were eliminated. From these 3,000 ears we selected only 1812 for further planting; the variations found among these ear-rows are given in the above table.

Krug.
Sando's work with plant color pigments

In a former paper Sando and Bartlett showed that the pigment in \(BB\) \(Pl\) \(Pl\) plants was a yellow flavonol glucoside, isouercitrin. Sando, Milner and Sherman have a paper in press on the nature of the pigment in \(BB\) \(Pl\) \(Pl\) plants. This purple pigment proves to be the anthocyanin of isouercitrin, chrysanthemin.

To quote Sando: "If it is assumed that the anthocyanin in purple-husked maize is formed directly from the flavonol glucoside the reduction representing the possible formation of chrysanthemin (as chloride) from isouercitrin may be expressed briefly as follows:

\[
\begin{align*}
\text{isouercitrin} & \quad - \quad \text{C}_{21}\text{H}_{20}\text{O}_{12} \\
\text{Chrysanthemin Cl} & \quad - \quad \text{C}_{21}\text{H}_{20}\text{O}_{11}\text{HCl}.
\end{align*}
\]

Inbreds resistant to smut

In the corn letter of September 13, 1934, we stated that we had several inbreds which were resistant to smut under field conditions here at Ithaca and that it seemed desirable to cross some of the more susceptible genetic stocks to these inbreds providing they proved resistant when grown at other stations. Hayes writes that they have made extensive tests for smut resistance at Minnesota and have inbreds which were resistant to smut brought in from various localities. This material should be ideal for our purposes and Hayes has kindly offered to supply a limited amount of seed for testing next summer. We should like very much to send small lots of seed to four or five different stations. If you are willing to grow this material and note its resistance to smut under your field conditions, please notify this office.
Miscellaneous

The following changes and corrections should be noted:

1. The symbol dt was originally given to the character dotted leaf. No description of this character was ever published, it was never linked, and the stock has been lost. Therefore, the symbol Dt has been assigned to dotted aleurone (see news items from Ithaca).

2. gl₁₁₀ was erroneously reported in the newsletter of last year as being linked with f₁. The striped character proved to be v₁₀ instead of f₁ and the glossy is gl₁ instead of a new gene. N₁₂ was reported as showing linkage with a₁. More extensive counts failed to substantiate this linkage.

3. The names of A. E. Longley and C. E. Sando have been added to the mailing list. Both are with the U. S. Department of Agriculture at Washington, D. C.

We hope to issue another corn letter in the spring. This letter will include such news items as are sent in and a more complete list of genetic stocks.

Sincerely yours,

M. M. Rhoades

M. M. Rhoades
March 6, 1935

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
January 21, 1935

To Maize Geneticists:

This letter is a call for lists of new genetic stocks, news items, etc., for another corn letter which will be issued around the first of March. Please go over your genetic testers and list any new combinations you have developed. Also send a small sample of each stock to this laboratory and we will increase it for general distribution. News items are, of course, always welcome additions. The dead line for receipt of this material is February 15. Your cooperation is not only desired, it is essential.

Sincerely yours,

(signed) M. M. Rhoades

To Maize Geneticists:

This maize letter contains a list of new genetic stocks, as well as a considerable number of news items. Several new stocks were listed in the last maize letter—they will not be repeated here. The response of the various investigators to the request for material has, as heretofore, been gratifying and has made possible this series of maize letters.

The new stocks have been grouped together as follows:

From Singleton

Chromosome 4 stocks:

1. \( \frac{+ su}{+} + + + su + + wi \)
2. \( \frac{+ su}{+} + + + wi + + tu \)
3. \( \frac{+ sp}{+} + + + + sp \)
4. \( + + + + + sp \)
5. \( + + + + + \)
6. \( + + + + \)
7. \( + + + + \)
8. \( + + + + \)
9. \( + + + + \)
10. \( + + + + \)

Stocks other than chromosome 4:

Chromosome 1. \( Pt \)
Chromosome 2. \( V_{4} \)
Chromosome 3. \( V_{2} \)
Chromosome 4. \( V_{l} \)
Chromosome 5. \( V_{l} \)

From Burnham

Chromosome 1. \( f_{1} \)
Chromosome 2. \( f_{1} \)
Chromosome 3. \( f_{1} \)
Chromosome 4. \( f_{1} \)
Chromosome 5. \( f_{1} \)
Chromosome 6. \( f_{1} \)
Chromosome 7. \( f_{1} \)
Chromosome 8. \( f_{1} \)
Chromosome 9. \( f_{1} \)
Chromosome 10. \( f_{1} \)
From Randolph

10-chromosome tester stocks:

1. \(a_1\)-na-cr C R^E pr \text{in} su y-pl b-lg_1 j bm_2.
2. \(a_1\)-Na na (Cr cr)? C R^E pr \text{in} su y-pl j b-lg_1 bm_2 \frac{ts_2}{Ts_2 ts_2}.
3. \(a_1\) c R^E-g_1 pr In-Bn su y-pl b-lg j bm_2.
4. \(a_1\)-cr c R^E-G_1g_1 pr In (in)? - Bn Su su y-pl b-lg_1 j bm_2.
5. \(a_1\)-D (a)? c R^E-g_1 pr In (in)? - Bn Su Su and Su su y-pl b-lg_1 j bm_2 - Ts_2 ts_2.
6. \(a_1\)-D (a)? c R^E-g_1 pr In-Bn su y-pl b-lg j bm_2 PVV.

From Jenkins

Chromosome 5:

1. \(a_1\) C R a_2 bt_1 bv-pr.
2. \(a_1\) a_2 C R bt_1 bv-pr.
3. \(a_1\) C R a_2 bt_1 bv-pr.
4. \(a_1\) a_2 C R bv-pr-v_2.
5. \(a_1\) a_2 C R bt_1 bv-pr.

Jenkins will have pollen this summer from:

a_2 bt_1 bv-pr-v_2 plants.

Chromosome 4:

1. la-su-Tu tu-gl_3.
2. la-su-tu-gl_3.

News items from Ithaca

1. Order is su-Tu-j_2 with j_2 about 5 units from Tu. Emerson.
2. Ws_3 which was reported in the November 24, 1934, maize letter to be in chromosome 2 on the basis of trisomic ratios is linked closely with l_5_1 on the basis of F_2 repulsion data. Rhoades.
3. Gl_8 is in chromosome 5 according to trisomic ratios. F_2 repulsion data indicate that pr and gl_8 are closely linked. Rhoades.
4. $ad_2 = ad_1$, so $ad_3$ is dropped to $ad_2$.

5. $bt_4 = bt_1$.

6. The gene for resistance to physiological form 3 of *Puccinia sorghi* is in the short arm of chromosome 10 according to cytological studies of x-ray induced deficiencies. Trisomic ratios confirm the placings of this gene in chromosome 10. Data from trisomic plants segregating for both $R$ and the rust resistant gene indicate that the two loci are linked.

V. H. Rhoades.

7. Eyster's duplicate genes for zigzag stalk are $zg_1$ and $zg_2$ and Singh's $zg$ factor in chromosome 6 becomes $zg_3$.

**News items from Morgantown, W. Va.**

1. According to genetic tests my gs, mentioned in the December 18, 1933, corn letter, appears to be the same as gs\_1. This is a much earlier stock, however.

Burnham.

2. Ed. note: Burnham reported several weeks ago that he had some indication that al and B were linked. Unfortunately I have misplaced his letter so I cannot give the data. But if al is in chromosome 8 and the yellow endosperm gene of Perry's $Y_x$ should also be in chromosome 8 since it is linked with al.

**News items from Pasadena, Calif.**

Data on interchanges

**Chromosome 1:**

Near P: l-8b, 1-9c.

Between P and br: 1-3a, 1-5b, 1-9a, 1-10b.

Near br: 1-3d, 1-7b, 1-7c, 1-9b, 1-10a.

Between br and $bm_2$: 1-7d. 1-4 and 1-5a about 10 to 20 units from br but order uncertain.

**Chromosome 3:**

Between a and nana: 3-5c, 1-3b and probably 3-9b.

Near n: 3-5b.

Nearer $ts_4$: 1-3a, 2-3c, 3-7b, 3-8, 3-9a, 3-10a.

**Chromosome 4:**

Near su: 1-4, 4-6a, 4-6b, 4-6c, 4-8, 4-9a, 4-10a, 4-10b, 4-5d.

Between su and Tu: 2-4b.

Near Tu: 2-4d.
Chromosome 5:

Between pr and bm^l 2-5b, 4-5d.
Close to bm^l 1-5b, 1-5c.

Chromosome 6:

In Y-Pl neighborhood with much suppression of crossing over 2-6d, 3-6a, 4-6a, 4-6b, 6-8, 6-9b.
Near pigmy 6-10 (probably sm-t-py).

Chromosome 7:

Near ra 1-7b, 2-7b, 2-7c, 3-7a, 3-7b.
Distant from ra 2-7a.

Chromosome 8:

Near jap 8-10c, 3-8a.
15 to 25 units from jap 5-8, 6-8, 3-10a.
Far from jap 3-8b, 4-8, 3-10b, 8-10d.

Chromosome 9:

All tested are in long arm beyond wx.
Less than 10 units from wx 3-9a, 6-9b, 4-9a.
10 to 15 units from wx 6-9a, 1-9a.
About 40 units from wx 1-9b.

Chromosome 10:

Left of R 9-10.
Near g 4-10b, 3-10c.
10 to 20 units beyond g 6-10, 8-10b, 1-10a, 8-10c, 3-10b.
20 to 30 units beyond g 3-10a, 8-10a.

Of the interchanges recorded in my list in Genetics (January, 1935 issue) all but 8 I believe have been obtained in homozygous condition.

Anderson.

Preliminary linkage data on a long inversion in chromosome 2, involving most of the chromosome, indicates that there is a map distance from v_4 to the end of the inversion about equal to the map distance from B to v_4. The "left" end of the inversion lies between lg and B about 25 units from lg and 7 from B. Cytological observations show both ends beyond the inversion to be of about equal length. That would suggest that nearly half of the linkage map for chromosome 2 should lie to the right of v_4. In agreement with this, about half of the known interchanges involving chromosome 2 lie beyond v_4. Anderson.
I now have enough data on the yellow-albescence situation to indicate quite clearly that my hypothesis last spring was correct. I have two factors for yellow endosperm - "Y_1" linked with Al (p = 0.01 - 0.02) and Y_x linked with Pl (p = 0.15 - 0.20). I have found no evidence of linkage between these two Y's or between Y_x and Pl or py. Selfed plants of the constitution Y_1 Y_1 Y_x Y_x give F_2 distributions of nine yellow to seven "not yellow" ranging from "lemon" to "white". I selfed some plants from the yellow seeds in such an F_2 and found three groups as follows:

<table>
<thead>
<tr>
<th>All yellow</th>
<th>3:1</th>
<th>2:7</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

which came pretty close to the 1:4:4 expected. I grew a few seedlings from some of the three-to-one ears for linkage tests. (F_2 was also segregating for Pl, Al, and py). Some showed linkage with Pl, some with Al. Only two were segregating for both Pl and Al and the distributions for these were as follows:

<table>
<thead>
<tr>
<th>Y_1</th>
<th>Y_x</th>
<th>Y_1</th>
<th>Y_1</th>
<th>Y_1</th>
<th>Y_1</th>
<th>Y_1</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>Al</td>
<td>Pl</td>
<td>Al</td>
<td>Al</td>
<td>Pl</td>
<td>Al</td>
<td>Y_1 Pl</td>
</tr>
<tr>
<td>58</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>219</td>
<td>0</td>
<td>7</td>
<td>0.42(or 0.58)</td>
</tr>
<tr>
<td>74</td>
<td>0</td>
<td>22</td>
<td>1</td>
<td>124</td>
<td>0</td>
<td>5</td>
<td>0.44(or 0.56)</td>
</tr>
</tbody>
</table>

Combined progenies
122 0 33 1 343 0 12

Of course, results like these don't rule Y_1 (or Al) out of #6 if #6 is very long "genetically" but at least it is at considerable distance from the known factors of that group with which it has been tested. Maybe the trisomics will clear that up. Besides the 9:7, the dihybrid ratios 3:5 and 1:3 have been obtained.

H. S. Perry.

Dwarf_1 (d_1) allelomorphs
The following series of allelomorphs exist for the d_1 locus:

- d_1 as described by Emerson.
- d_1^s semi-dwarf-endromonoecious 50% height of normals.
- d_1^m approaching monoecious condition 60-65% height of normal sibs.
- D_1 normal height.

The d_1^s and d_1^m allelomorphs are dominant to d_1 and recessive to normal. The three dwarf allelomorphs have different origins:
News items from New Haven, Conn.

1. The brown midrib found in a Country Gentleman inbred (Maize letter December 13, 1933, p. 3) is allelic to \( b_{1} \). This is the second occurrence of \( b_{1} \) at New Haven.

2. The brown midrib found in a Sweepstakes inbred (Maize letter November 24, 1934, p. 8) is \( b_{2} \) or an allelic or.

3. The fine stripe reported in a Sweepstakes inbred (Maize letter November 24, 1934, p. 8) has proved to be allelic to \( f_{1} \).

News items from Columbia, Mo.

Mutant seed characters of possible value from x-ray experiments:

<table>
<thead>
<tr>
<th>Mutant</th>
<th>Description</th>
<th>Linkage Indications</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarred a</td>
<td>Seed small and distinctly scarred. Separation clear. Only best seeds give usable plants.</td>
<td>Close to ( Y ).</td>
<td></td>
</tr>
<tr>
<td>Scarred b</td>
<td>1/8 to 1/2 volume, usually scarred. About 3/4 are germless.</td>
<td>Possibly with ( Y ).</td>
<td></td>
</tr>
<tr>
<td>Scarred c</td>
<td>1/8 to 3/4 volume. Have fair embryos, and larger seeds give fairly good plants.</td>
<td>Possibly with ( Pr ).</td>
<td></td>
</tr>
<tr>
<td>Etched</td>
<td>Seed full size, etched pattern distinct, separation clear, and viability good. Somewhat resembles scarred but can be separated from it.</td>
<td>Possibly with ( Pr ).</td>
<td>All et seeds give virescent seedlings, turning fine striped then green. (Viability good.)</td>
</tr>
<tr>
<td>Mutant</td>
<td>Description</td>
<td>Linkage</td>
<td>Indications</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Rudimentary1</td>
<td>2/3 height and width, 1/5 thickness, germless. Can be separated for aleurone color, wx, etc.</td>
<td>With Pr.</td>
<td>None.</td>
</tr>
<tr>
<td>Tiny</td>
<td>Very small seed but germinates and produces small seedlings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thin</td>
<td>Normal height and width but less than 1/3 thickness to empty. Some have germs and a few might grow.</td>
<td>With CWx</td>
<td></td>
</tr>
<tr>
<td>Miniature3</td>
<td>Reduces size of seed, especially thickness. Possibly overlaps normal.</td>
<td>Probably with Wx.</td>
<td></td>
</tr>
<tr>
<td>Miniature9</td>
<td>3/4 to full height and width, 1/2 thickness. May overlap normal.</td>
<td>With Pr.</td>
<td></td>
</tr>
<tr>
<td>Miniature18</td>
<td>1/2 to 2/3 height and width and 1/3 to 1/2 thickness of normal. Clear separation. Low ratio. Good viability.</td>
<td>With Pr.</td>
<td></td>
</tr>
<tr>
<td>Germless a</td>
<td>Full size endosperm, typical germless.</td>
<td>Possibly with Y.</td>
<td>Not induced.</td>
</tr>
</tbody>
</table>

A simplification of chromosome-mapping technic is possible by the use of haplo-viable deficiencies transmitted through female and not through male germ cells. These are fairly common among the variants induced by x-ray treatment. The most useful ones are those located in the middle region of the chromosome. This technic may be illustrated by an example using Df 51 (described in abstract in Records Genetics Society 3: 56-57). This deficiency includes the locus of V and is located on the longer arm of chromosome 5 near the spindle node. It is transmitted with little loss through female gametes but deficient pollen is defective and does not function. Stadler.
In using the deficiency for chromosome mapping it is used with a dominant marker on the same chromosome. We use Pr, since the mutants to be treated are induced in a Pr stock. (With mutants not known to be Pr the same method could be used with Ch as the dominant marker, since all new mutants will presumably be ch.

The new mutant x is crossed on the Df 5 Pr stock and a Df 5 plant of the F1 (recognized by its partially defective pollen) is crossed on the x stock. The progeny of this cross shows the location of the new mutant with reference to the loci of V3 and Pr, and since it is virtually a backcross test a relatively small progeny is sufficient. Since the Df pollen is eliminated, the dominants Pr and x appear only in gametes resulting from crossing over between their loci and that of the Df. Thus the regional location of the new locus will be indicated in three point order in the second generation from the original cross, without the necessity of producing the double recessive in a large F2 and a third generation for the backcross ratio.

If Df 5 is representative in its effect on crossing over, these crosses will not serve to determine the normal crossover frequency. Df 5 greatly reduces crossing over in the region including it (Pr-V3 reduced from 26-23% to 5-13%; V3-Br reduced from 4-6% to 1%). Cytological observations indicate that this effect may be general for internal deficiencies. This means that backcrosses of non-deficient individuals will have to be used for final mapping, but the non-deficient sibs of the same crosses may be used for this. The reduction of crossing over in the deficient plants will be an advantage in reducing the genetic length of the chromosome so as to permit the detection of linkage over longer actual distances.

It might be worthwhile to construct haplo-viable Df stocks deliberately for this purpose, particularly in the case of the longer chromosomes. Probably one well placed Df would do for each chromosome. Preferably the Df should include a locus somewhere in the middle region, and the dominant marker used should be far enough away for fairly frequent crossing over. The dominant should be one not likely to occur in the mutant stocks, as F, B, F2, Ch, Fl, etc. The recessive should be a seedling character so that a large number of plants may be examined for the induced deficiencies. Such deficiencies may be obtained by irradiating the pollen of the dominant stock, pollinating on the recessive, growing to maturity the F1 plants showing the recessive character, and pollinating all which by their plant development and pollen development seem likely to be haplo-viable deficiencies. The best pollen to use on these plants will be pollen carrying two (or more) recessive markers widely separated in the chromosome. Then, when the Df plants are pollinated by the new mutant, the Df progeny may be used as outlined above and a few non-deficient sibs may be selfed to provide F2 material with widely separated markers, for accurate mapping if the Df test indicates linkage. Thus, for chromosome 3, a suitable technic would be as follows: Treat F2 and pollinate on 1g2, save
only 1g2 seedlings, and pollinate suitable ones by a d1. The Rg (1g2)/ a d1 plants thus secured are suitable for pollination by the new mutants, and the Df stock is maintained by pollinating in each generation by a d1 and using only the Rg Df plants of the progeny.

If any corn breeder not having x-ray equipment available wishes to make up such a stock for his chromosome, we should be glad to make the necessary treatments and pollinations for him here next season, using the stocks designated by him for the purpose. Stadler.

News items from Washington, D. C.

From a perennial teosinte-corn hybrid has been isolated a cornlike strain with 20 chromosomes in which chromosome IX has a terminal knob on the short arm and a large internal knob on the long arm. Measurements show the terminal knob to be approximately 0.33 of the whole length of the chromosome from the spindle fibre attachment, the internal knob approximately 0.52 of the whole length of the chromosome from the spindle fibre attachment and approximately 0.15 from the end of the long arm.

The terminal and internal knobs are frequently stuck together so that at first it gave the impression that the loop was due to the pairing of a normal IX with a IX that had an inversion.

Seed of this strain is available. A. E. Longley.

News items from Bucknell University

1. A new fine-striped* chlorophyll pattern in Chromosome 10 as indicated by its linkage with the aleurone color gene.

<table>
<thead>
<tr>
<th>Backcrosses</th>
<th>R</th>
<th>r</th>
<th>R St</th>
<th>R st</th>
<th>r St</th>
<th>r St</th>
</tr>
</thead>
<tbody>
<tr>
<td>1206</td>
<td>1213</td>
<td>822</td>
<td>121</td>
<td>203</td>
<td>776</td>
<td></td>
</tr>
</tbody>
</table>

Crossing over ca 17%.

*Ed. note: This gene is f3.

2. Bn1 in chromosome 5.

<table>
<thead>
<tr>
<th>A) Field grown Group</th>
<th>Bn</th>
<th>bn</th>
<th>Approx. Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2495</td>
<td>763</td>
<td>3.27 : 1</td>
</tr>
<tr>
<td>2</td>
<td>633</td>
<td>101</td>
<td>6.27 : 1</td>
</tr>
<tr>
<td>3</td>
<td>1055</td>
<td>64</td>
<td>16.43 : 1</td>
</tr>
<tr>
<td>4</td>
<td>282</td>
<td>3</td>
<td>97.33 : 1</td>
</tr>
</tbody>
</table>
### B) Greenhouse grown

<table>
<thead>
<tr>
<th>Group</th>
<th>bn</th>
<th>bm</th>
<th>Approx. Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4456</td>
<td>1510</td>
<td>2.95 : 1</td>
</tr>
<tr>
<td>2</td>
<td>3551</td>
<td>1123</td>
<td>3.16 : 1</td>
</tr>
<tr>
<td>3</td>
<td>1616</td>
<td>111</td>
<td>14.56 : 1</td>
</tr>
<tr>
<td>4</td>
<td>745</td>
<td>10</td>
<td>74.50 : 1</td>
</tr>
</tbody>
</table>

### C) Relation between Pr and bm

<table>
<thead>
<tr>
<th>F2</th>
<th>Pr Bn</th>
<th>Pr bm</th>
<th>pr Bn</th>
<th>pr bm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field grown</td>
<td>1370</td>
<td>341</td>
<td>298</td>
<td>436</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>941</td>
<td>124</td>
<td>167</td>
<td>224</td>
</tr>
<tr>
<td>Backcrosses-field</td>
<td>503</td>
<td>2169</td>
<td>2048</td>
<td>2387</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>2551</td>
<td>765</td>
<td>767</td>
<td>2306</td>
</tr>
<tr>
<td>Backcrosses-coupling</td>
<td>441</td>
<td>198</td>
<td>199</td>
<td>408</td>
</tr>
</tbody>
</table>

### D) Relation between Bu and Tn

<table>
<thead>
<tr>
<th>F2</th>
<th>Bu Tn</th>
<th>Bu tn</th>
<th>bm Tn</th>
<th>bm tn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field grown</td>
<td>814</td>
<td>35</td>
<td>57</td>
<td>135</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>699</td>
<td>7</td>
<td>6</td>
<td>134</td>
</tr>
<tr>
<td>Backcrosses-coupling</td>
<td>3894</td>
<td>58</td>
<td>56</td>
<td>1266</td>
</tr>
<tr>
<td>Repulsion</td>
<td>95</td>
<td>48</td>
<td>52</td>
<td>0</td>
</tr>
</tbody>
</table>

### E) Relation between Pr and Tn

<table>
<thead>
<tr>
<th>Backcrosses</th>
<th>Pr Tn</th>
<th>Pr tn</th>
<th>pr Tn</th>
<th>pr tn</th>
</tr>
</thead>
<tbody>
<tr>
<td>452</td>
<td>197</td>
<td>190</td>
<td>393</td>
<td></td>
</tr>
</tbody>
</table>

### F) Cross involving Pr, Bn, and Tn

<table>
<thead>
<tr>
<th>Backcrosses</th>
<th>A B</th>
<th>A b</th>
<th>a B</th>
<th>a b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bu Tn</td>
<td>116</td>
<td>2</td>
<td>1</td>
<td>102</td>
</tr>
<tr>
<td>Pr Tn</td>
<td>32</td>
<td>88</td>
<td>85</td>
<td>16</td>
</tr>
<tr>
<td>Pr Bn</td>
<td>32</td>
<td>88</td>
<td>86</td>
<td>15</td>
</tr>
</tbody>
</table>

### G) Relation between Bu and Oy

<table>
<thead>
<tr>
<th>F2</th>
<th>Bu Oy</th>
<th>Bu oy</th>
<th>bm Oy</th>
<th>bm oy</th>
</tr>
</thead>
<tbody>
<tr>
<td>458</td>
<td>154</td>
<td>126</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

### H) Relation between Pr and Oy

<table>
<thead>
<tr>
<th>F2</th>
<th>Pr Oy</th>
<th>Pr oy</th>
<th>pr Oy</th>
<th>pr oy</th>
</tr>
</thead>
<tbody>
<tr>
<td>348</td>
<td>105</td>
<td>112</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

### I) Relation between Pr and Vp

<table>
<thead>
<tr>
<th>F2</th>
<th>Pr Vp</th>
<th>Pr vp</th>
<th>pr Vp</th>
<th>pr vp</th>
</tr>
</thead>
<tbody>
<tr>
<td>repulsion</td>
<td>1474</td>
<td>616</td>
<td>690</td>
<td>21</td>
</tr>
<tr>
<td>284</td>
<td>149</td>
<td>116</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>47</td>
<td>39</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>49</td>
<td>46</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

### J) Relation between Pr and reduced kernel (re).

Re and Vp are extremely closely linked.

In above data under H and Tn all vp kernels were also reduced. The following data involve re but not vp.

<table>
<thead>
<tr>
<th>F2</th>
<th>Pr Re</th>
<th>Pr re</th>
<th>pr Re</th>
<th>pr re</th>
</tr>
</thead>
<tbody>
<tr>
<td>241</td>
<td>129</td>
<td>180</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
K) Relation between Bm and an ovule lethal or rather embryo sac lethal.*

\[
\begin{array}{cccc}
\text{Bm} & \text{ol} & \text{Bm} & \text{ol} \\
127 & 6 & (6) & (39)
\end{array}
\]

*Ed. Note: Symbol should be lo₂.

L) Relation between Pr and stiff leaved plant (sf).

<table>
<thead>
<tr>
<th>Type</th>
<th>Pr</th>
<th>Sf</th>
<th>pr</th>
<th>Sf</th>
<th>pr</th>
<th>Sf</th>
<th>pr</th>
<th>Sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>F₂ repulsion</td>
<td>235</td>
<td>21</td>
<td>109</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>coupling</td>
<td>274</td>
<td>67</td>
<td>79</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M) Relation between Bm and Sf

<table>
<thead>
<tr>
<th>Type</th>
<th>Pr</th>
<th>Sf</th>
<th>pr</th>
<th>Sf</th>
<th>pr</th>
<th>Sf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45</td>
<td>21</td>
<td>24</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N) Relation between Pr and a yellow green (yg)

<table>
<thead>
<tr>
<th>Type</th>
<th>Pr</th>
<th>Yg</th>
<th>pr</th>
<th>Yg</th>
<th>pr</th>
<th>Yg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backcross</td>
<td>59</td>
<td>81</td>
<td>96</td>
<td>65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Sugary endosperm. The sugary endosperm which has been used in experimental work since the beginning of maize genetics is designated as su₁.

A) Interrelation between sugary₁ and sugary₂

\[
\begin{align*}
su_1 \times su_2 & - \text{All starchy} \\
su_2 \times \text{starchy} - \text{starchy in F₁ - F₂} & 4407 \quad 1318 \\
\text{Backcrosses} & 1884 \quad 1594 \\
\end{align*}
\]

\[
\begin{array}{cccc}
\text{Su₁} & \text{Su₂} & \text{Su₁} & \text{Su₂} \\
9493 & 2991 & 1 su₁ & 1 su₂ \end{array}
\]

\[
\begin{array}{cccc}
\text{F₂ from } su₁ \times su₂ & 4069 \\
\end{array}
\]

B) Relation between su₂ and Y.

\[
\begin{align*}
\text{F₂} & \quad Y \text{ su}_2 \quad Y \text{ su}_2 \quad y \text{ su}_2 \quad y \text{ su}_2 \\
1930 & \quad 394 \quad 393 \quad 340 \\
\text{Backcrosses} & \quad 1065 \quad 492 \quad 577 \quad 895
\end{align*}
\]

C) Sugary₃ in chromosome 9

a) Relation between sugary₃ and shrunken endosperm

<table>
<thead>
<tr>
<th>Type</th>
<th>Su₃</th>
<th>Sh</th>
<th>Su₃</th>
<th>sh</th>
<th>su₃</th>
<th>Sh</th>
<th>su₃</th>
<th>sh</th>
</tr>
</thead>
<tbody>
<tr>
<td>17050-4 (X)</td>
<td>267</td>
<td>18</td>
<td>13</td>
<td>113</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-7 (X)</td>
<td>261</td>
<td>71</td>
<td>54</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-5 (X)</td>
<td>114</td>
<td>15</td>
<td>15</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
b) Relation between su³ and pr²

<table>
<thead>
<tr>
<th></th>
<th>Pr Su</th>
<th>Pr su</th>
<th>prSu</th>
<th>pr su</th>
</tr>
</thead>
<tbody>
<tr>
<td>17011-4 (X)</td>
<td>184</td>
<td>15</td>
<td>17</td>
<td>55*</td>
</tr>
<tr>
<td>-1 (X)</td>
<td>170</td>
<td>9</td>
<td>7</td>
<td>45*</td>
</tr>
<tr>
<td>17012-1 (X)</td>
<td>157</td>
<td>71</td>
<td>78</td>
<td>4**</td>
</tr>
</tbody>
</table>

* coupling
** repulsion

4. A new gene for red or rather for purple aleurone. This gene is called Pr² and belongs in chromosome 9 as indicated by linkage relations between Pr² and wx and also with su³.

<table>
<thead>
<tr>
<th></th>
<th>Wx Pr</th>
<th>Wx pr</th>
<th>wx Pr</th>
<th>wx pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>17078-6 (X)</td>
<td>207</td>
<td>58</td>
<td>65</td>
<td>43</td>
</tr>
<tr>
<td>-1 (X)</td>
<td>170</td>
<td>73</td>
<td>63</td>
<td>30</td>
</tr>
</tbody>
</table>

5. New genes in chromosome 9.

A) Pr² and su³ have already been mentioned.

B) Defective kernel

<table>
<thead>
<tr>
<th></th>
<th>Da¹ De</th>
<th>Da¹ de</th>
<th>da¹ De</th>
<th>da¹ de</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>168</td>
<td>13</td>
<td>(13)</td>
<td>(54)</td>
</tr>
</tbody>
</table>

C) Pale green seedling and plant

<table>
<thead>
<tr>
<th></th>
<th>Sh Pg</th>
<th>Sh pg</th>
<th>sh Pg</th>
<th>sh pg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>127</td>
<td>42</td>
<td>33*</td>
<td>17**</td>
</tr>
<tr>
<td></td>
<td>194</td>
<td>72</td>
<td>46*</td>
<td>21*</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>14</td>
<td>9*</td>
<td>2*</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>43</td>
<td>40*</td>
<td>18*</td>
</tr>
</tbody>
</table>

*Deficiencies due to poor germination of sh kernels.

<table>
<thead>
<tr>
<th></th>
<th>Wx Pg</th>
<th>Wx pg</th>
<th>wx Pg</th>
<th>wx pg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>163</td>
<td>82</td>
<td>87</td>
<td>3**</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>40</td>
<td>41</td>
<td>22*</td>
</tr>
<tr>
<td></td>
<td>112</td>
<td>68</td>
<td>101</td>
<td>1**</td>
</tr>
</tbody>
</table>

* coupling
** repulsion

D) Duplicate genes for zigzag culm showing linkage with genes in chromosome 9.

<table>
<thead>
<tr>
<th></th>
<th>Ms² Zg</th>
<th>Ms² zg</th>
<th>ms² Zg</th>
<th>ms² zg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>210</td>
<td>10</td>
<td>97</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>224</td>
<td>9</td>
<td>66</td>
<td>15</td>
</tr>
</tbody>
</table>

E) New chlorophyll pattern

<table>
<thead>
<tr>
<th></th>
<th>Wx St*</th>
<th>Wx st</th>
<th>wx St</th>
<th>wx st</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>237</td>
<td>8</td>
<td>31</td>
<td>59</td>
</tr>
</tbody>
</table>

*Ed. Note: St has been used for sticky chromosomes. Some other symbol is necessary.
f) Lethal male gametophyte (Gm_2?)*

<table>
<thead>
<tr>
<th>Sh wx x Sh wx Gm</th>
<th>Wx Sh</th>
<th>Wx sh</th>
<th>wx Sh</th>
<th>wx sh</th>
</tr>
</thead>
<tbody>
<tr>
<td>sh wx sh Wx gm</td>
<td>250</td>
<td>135</td>
<td>1895</td>
<td>200</td>
</tr>
</tbody>
</table>

*Ed. Note: Gm is used for germless seed. Another symbol is necessary.

sh --- 17 92 --- Wx --- 17.52 --- gm.

g) A second male gametophytic lethal is almost completely linked with the Wx wx gene pair. Call this gm_3?

6. Reduced kernel linked with aleurone color, but not with the gene C, as indicated by tests with a number of genes in chromosome 9.

<table>
<thead>
<tr>
<th>Colored</th>
<th>Colorless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re</td>
<td>re</td>
</tr>
<tr>
<td>313</td>
<td>26</td>
</tr>
<tr>
<td>280</td>
<td>32</td>
</tr>
<tr>
<td>334</td>
<td>124</td>
</tr>
<tr>
<td>256</td>
<td>37</td>
</tr>
<tr>
<td>352</td>
<td>89</td>
</tr>
</tbody>
</table>

| 75       | 76        | 12        | 57       |

7. Pale green seedling linked with aleurone color but not with the C c gene pair.

8. Defective endosperm due to a gene in chromosome 10 as indicated by linkage with striped chlorophyll pattern described in 1 in this newsletter.

<table>
<thead>
<tr>
<th>De St*</th>
<th>De st</th>
<th>de St</th>
<th>de st</th>
</tr>
</thead>
<tbody>
<tr>
<td>235</td>
<td>15</td>
<td></td>
<td>32</td>
</tr>
</tbody>
</table>

* st = f_3.


<table>
<thead>
<tr>
<th>Sh Vp</th>
<th>Sh vp</th>
<th>sh Vp</th>
<th>sh vp</th>
</tr>
</thead>
<tbody>
<tr>
<td>273</td>
<td>31</td>
<td>63</td>
<td>36</td>
</tr>
<tr>
<td>175</td>
<td>47</td>
<td>40</td>
<td>123</td>
</tr>
<tr>
<td>75</td>
<td>76</td>
<td>12</td>
<td>57</td>
</tr>
</tbody>
</table>

10. Reduced kernel in chromosome 9.

<table>
<thead>
<tr>
<th>A B</th>
<th>A B</th>
<th>A b</th>
<th>a B</th>
<th>a b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sh Re</td>
<td>185</td>
<td>55</td>
<td>68</td>
<td>30</td>
</tr>
<tr>
<td>244</td>
<td>63</td>
<td>69</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>196</td>
<td>69</td>
<td>62</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>245</td>
<td>58</td>
<td>69</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>216</td>
<td>63</td>
<td>71</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>279</td>
<td>103</td>
<td>38</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>71</td>
<td>29</td>
<td>2--?</td>
<td></td>
</tr>
</tbody>
</table>
11. Linkage between speckled aleurone and lethal yellow seedling. Linkage group not known.

<table>
<thead>
<tr>
<th>Self colored aleurone</th>
<th>Speckled aleurone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Yellow</td>
<td>Yellow</td>
</tr>
<tr>
<td>89</td>
<td>42</td>
</tr>
<tr>
<td>96</td>
<td>7</td>
</tr>
</tbody>
</table>
| Extensive data on cards but not summarized.

12. New yellow lethal in chromosome 9

133 C L - 32 C l - 30 c L - 25 c l.

13. Yellow green linked with aleurone color, specific gene not known.

<table>
<thead>
<tr>
<th>Colored aleurone</th>
<th>Colorless aleurone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Yellow green</td>
<td>Yellow green</td>
</tr>
<tr>
<td>374</td>
<td>64</td>
</tr>
<tr>
<td>88</td>
<td>35</td>
</tr>
</tbody>
</table>

14. Yellow green linked with sugary endosperm. Yg plants viable and grow to maturity.

15. The gene Le modifies endosperm color from lemon yellow to orange. Y Le gives orange yellow, Y le gives lemon yellow endosperm color.

A gene for yellow lethal seedling (l) is almost completely linked with the gene for le. Extensive data on cards but not summarized at present.

Sample - 233 Le L - 16 Le l - 1 le L - 78 le l.

16. A gene for purple (a-type) seedling in chromosome 9 closely linked with yg2.

17. A gene for reduced kernel closely linked with a gene for semi-dwarf, stiff leaved, finely but distinctly lined (chlorophyll pattern) plant.


19. Duplicate genes for aurea chlorophyll. Extensive data on cards but not summarized.

20. Conspicuous seedling fine chlorophyll stripe closely linked with one of the genes for striped auricle (sa). Linkage group not known.
21. co and ad are alleles.

22. Male sterile in chromosome 5 almost completely linked with the gene for stiff leaves (sf). Although thousands of plants having stiff leaves have been examined only less than a half dozen such plants with fertile tassels have ever been observed.

Eyster.

Mr. Burr Robinson, graduate of the Connecticut Agricultural College and for several years assistant in genetics at the Connecticut Agricultural Experiment Station, has been appointed to the Fellowship in Genetics in the Bucknell Laboratory, established by the W. Atlee Burpee Seed Company.

A limited number of copies of a monograph, "GENETICS OF ZEA MAYS", reprinted from Bibliographia Genetica, Vol. XI, are available and will be sent postpaid for $1.50. Orders should be sent to Dr. William H. Eyster, Botanical Laboratory, Bucknell University, Lewisburg, Pa.

Eyster.
Paraffin Method for Root-Tip Chromosome Counts

L. F. Randolph

The reagents employed and the sequence of transfers from fixation to paraffin-ribbon mounts are as follows:

1. Fix roots 12 to 24 hours in "Craf" (Chromo-acetic-formalin):
   Solution A, Chromic 1 gr., Acetic 7 cc., Water 92 cc.
   Solution B, Formalin 30 cc., Water 70 cc.
   Mix equal parts A and B just before using.
   This fluid was developed primarily for making chromosome counts in the root-tips of maize, but it has proved to be very useful for similar studies in many other plants.

2. Transfer roots directly from Craf to 75\% alcohol, changing several times at half-hour intervals to remove most of the fixing fluid; then to 85\% alcohol.

3. From 85\% alcohol to normal butyl alcohol as follows:
   (1) H\textsubscript{2}O 15 cc., 95\% ethyl 50 cc., butyl 35 cc.
   (2) \textquotedblleft 5 cc., \textquotedblright 45 cc., \textquotedblright 55 cc.
   (3) Absolute ethyl 25 cc., butyl 75 cc.
   (4) Normal butyl, 3 or 4 changes.

   Leave roots at least an hour in each solution, 2-3 hours in pure butyl.

4. Infiltrate gradually with paraffin: Add melted paraffin (melting point 54-55° C.) in an amount equal to about one-third the volume of the butyl alcohol covering the roots. Add the paraffin slowly so it will solidify on top of the butyl alcohol. Place the receptacle (preferably a 30 or 50 cc. pyrex beaker) containing the roots and butyl-paraffin mixture in a paraffin oven at 56° C. Leave over night. As the paraffin melts it passes slowly to the bottom of the beaker and gradually infiltrates the roots. The next day pour off the butyl-paraffin mixture and add pure liquid paraffin. Repeat 3 or 4 times at hourly intervals.

5. Embed, cooling the paraffin rapidly in ice water.

6. Prepare cross-sections 10 to 15 microns in thickness. Spread ribbons on slides and dry for several hours at about 40° C.

L. F. Randolph

To facilitate the handling of root-tips in the paraffin method they may be mounted on cards in the following manner.

1. Prepare small pieces of heavy paper approximately 2 cm. x 2.5 cm. in size (the heaviest grade of Y and Z filing cards is suitable). Smear the base of a card with DuPont household cement, or LePage’s waterproofing cement. Add roots and cover with more cement, leaving at least .5 cm. of the tip of the root free (fig. 1). Invert at once in the fixing fluid, keeping the cards separated until the cement has partially hardened.

2. After fixation and transfer to 75% alcohol, snip off the tips of the roots from the original card in a petri dish containing a small amount of alcohol. Prepare a second smaller card, approximately 7 x 12 cm. in size. Label one side (Fig. 2a), and coat the other side with a thin layer of mucilage, using a clear, amber-colored grade of Carter’s or Stafford’s mucilage evaporated to the consistency of heavy syrup. Rapidly transfer the roots one by one from the petri dish to blotting paper for removal of excess alcohol, and then to the second card. Add more mucilage and a thin strip of paper to help hold the roots in place (Fig. 2b). Immerse the card with roots attached at once, right side up, in 85% alcohol. The mucilage may be conveniently applied with a No. 2 or No. 3 camel-hair brush. For transferring the roots quickly from the blotting paper to the card a bent dissecting needle applied to the moist surface of the root is very effective (Fig. 3). The final orientation of the roots on the card may be completed after transfer to 85% alcohol. The root-tips should project approximately 2 mm. beyond the edge of the card, and care must be taken that the tips are kept free of mucilage since it causes trouble in sectioning.

3. After the mucilage has hardened the card mounts are placed in a 30 cc. or 50 cc. pyrex beaker and dehydration and infiltration are completed in the usual manner. The mounts should be embedded with the labelled side down so that the mounts may be identified readily. Paraffin ribbons from two or more card mounts may be placed on the same slide (Fig. 4).
Crystal Violet Staining Procedure for Root-Tip Chromosomes.

I. F. Randolph

1. Place slides in xylol to remove the paraffin. Flush with fresh xylol, then with absolute alcohol. Pass the slides successively through 95%, 60%, and 30% alcohol to water, 3-5 minutes for each step.

2. 1% potassium permanganate, 2-3 minutes. Rinse in tap water.

3. 5% oxalic acid, until the sections are bleached - usually 1-3 minutes. Prolonged treatment with oxalic acid sometimes causes the sections to come off the slide. Wash in tap water 15 minutes. The bleaching process in permanganate and oxalic is not always necessary, but it usually adds contrast.

4. Mordant in 1% chromic, 20 minutes. Rinse in tap water and then in 2 or 3 changes of distilled water.

5. 1% aqueous solution of crystal violet, 4 hours. It is often desirable to vary the staining period. If the stain comes out too rapidly in the alcohols and clove oil, leave the slides in the stain longer. If destaining is prolonged, shorten the period. Rinse in tap water.

6. Treat with iodine-potassium iodide (iodine 1 gm., potassium iodide 1 gm., 80% alcohol 100 cc.) until the color of the sections changes from blue to brown, usually 1-2 minutes.

7. Rinse in 95% alcohol and pass through 3 changes of absolute alcohol to clove oil. Differentiate in the alcohols and clove oil, ordinarily 1-5 minutes. Watch the process in the final stages under the microscope. The metaphase chromosome groups under a 16 mm. objective should stand out sharply against a practically colorless background of cytoplasm.

8. Pass through several changes of xylol to remove all of the clove oil. Mount in thin xylol-balsam. After the cover glass is in place invert the slide on paper toweling and apply mild pressure to force the excess balsam from under the cover glass. Add a few drops of xylol to the edges of the slide, cover with another paper towel and a piece of heavy glass, or other suitable weight. As soon as the slides are dry they may be examined. This method of mounting removes all excess balsam and brings the cover in close contact with the material, so that high-power objectives may be used with greater safety.
Publication of new linkage data

It has become increasingly difficult to secure publication of papers presenting linkage data for new genes in maize. Some scientific journals refuse to accept this type of work for publication. Yet it is extremely important that a short description of new characters and a summary of the linkage data appear in some recognized journal so that this information will be made generally available.

In conversations with Richey, Jenkins and Brink at the recent Pittsburgh meetings the following solution was suggested: "That there be published annually a paper under the general heading 'New Linkages in Maize', or some similar title, which would present short descriptions of new characters with the linkage data given in summary form. This material would be contributed by the various workers. The name and address of the contributor would appear either before or after each linkage he reported so that he would get the credit which rightfully belongs to him."

The above suggestion will, of course, have to be developed in greater detail but we believe it should receive careful consideration from you because it offers a remedy to the rather serious problem of securing publication for new linkages.

The amount of space devoted to each character will have to be limited to not more than one printed page and preferably less. This allotment should prove sufficient, although some leeway would, of course, be permitted. This proposed publication is not, in any sense, to be considered as supplanting the maize letters because as we have so often reiterated, the appearance of information in the maize letters does not constitute publication.

If this proposed annual paper of new linkages will not be acceptable for publication in one of the Journals, we suggest that space be purchased at so much per page. For the next four years at least there will be funds available from the grant made by the Rockefeller Foundation to the Maize Genetics Cooperation which can be used to pay for the publishing of this paper. One attractive feature of purchasing space is that we could secure immediate publication. The contributions from the various investigators would be edited and compiled by the Secretary of the Maize Genetics Cooperation.

Give us your opinion of this idea and, more important, would you be willing to take part in such an enterprise?

Below is a copy of a letter which was received from Jones in response to an enquiry as to what he thought of the idea from his point of view as Editor of GENETICS:

"Dear Dr. Rhoades:

I am much interested in your suggestion as to a way of publishing linkages. I should like very much to try something of this kind and see no reason why it would not be acceptable in GENETICS. I agree with you that the information should be published but in the past, authors have usually expanded each individual
case of linkage into a 5 or 6 page paper or more, and facilities have not permitted the publication of this much material. If each item could be condensed into a page or less, I think the arrangement would be advantageous for all concerned. Some provision would have to be made for references so that each separate contribution should have a main heading together with the author's name and address.

The principal difficulty that I see will be to get someone to summarize this material and get it in shape for publication. If you are willing to do this or anyone else can be persuaded to do it, we shall be very glad to do our part.

(Signed) D. F. Jones.

Inasmuch as I am severing my connections with Cornell to take a position with the U. S. Department of Agriculture at Ames, Iowa, I necessarily am relinquishing my duties as Secretary of the Maize Genetics Cooperation. Until, however, Dr. Emerson appoints my successor I shall be willing to continue to act as Secretary so that there will be no lapse in the functions performed by this office. Until March 20th I can be reached here at Ithaca and after March 20th at Ames, Iowa, c/o Department of Farm Crops, Iowa State College.

I wish to state that I have really enjoyed my work with the Maize Genetics Cooperation and I hope that my successor will receive the same fine cooperation from the maize geneticists which has made possible this unique series of corn letters.

Sincerely yours,

M. M. Rhoades

MMR:B
The enclosed maps of the linkage groups were made from the data which Emerson has assembled for the forthcoming paper on linkages in maize by Emerson, Fraser and Beadle. Only those loci whose position is known with reasonable accuracy are listed. We are indebted to the Division of Cereal Crops and Diseases, U. S. Department of Agriculture, for furnishing the copies of these maps.

M.M.R.
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>LG1</td>
<td>A1</td>
<td>DE1</td>
<td>A2</td>
<td>V7</td>
<td>V5</td>
<td>MS8</td>
<td>KNOB</td>
<td>YG2</td>
</tr>
<tr>
<td></td>
<td>GL2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CHROMOSOME MAPS OF MAIZE
1935
To Maize Geneticists:

The summary of linkage in maize is finally off the press as Cornell Agricultural Experiment Station Memoir 180, and a copy has been mailed to each of you. The authors realize that this summary is already a year or two out of date, but hope that it will serve a useful purpose as a base of reference for future linkage studies. It will, of course, have to be revised from time to time, but probably a general revision should not be attempted for some years. Your secretary believes that, for the present at least, it will be better for those of you who are interested in a particular linkage group to publish a revision of that group when you have data sufficient to straighten out any of the confusing and even contradictory situations apparent in many of the groups as presented in the summary. When one has evidence sufficient for a thorough-going revision of any one of the ten groups, it should not be difficult to find a place for publication of a concise paper setting forth the revision.

Pending the time when any of us are ready to publish such revision, the data obtained should be made available to others. Moreover, most workers find a miscellaneous lot of linkages the data on which should be made known to the rest of us. In the past many such records have been sent to you in mimeographed form, but always with the caution that such distribution does not constitute publication and that no one other than the one who contributed the data has any right to use them without permission, in a published paper. This is not an ideal arrangement. The data should be published at once. But it is almost impossible to find a journal that will accept a paper presenting data say on a single linkage.

It has been proposed that those of you who have linkage data worth publishing but not of sufficient importance to warrant a separate paper send to the secretary of Maize Genetics Cooperation brief, concisely worded accounts embodying the data and that these short papers be published together under some general heading, but each to be signed by the responsible author. I have been informed that the outgoing editor in chief of Genetics has approved this suggestion, but it has not been presented to the incoming editor, Dr. Dunn. If the publication of such a collection of brief papers is paid for from sources other than the publishers of Genetics, very prompt publication can be assured. It would seem that the grant of funds made by the Rockefeller Foundation for the support of Maize Genetics Cooperation might be used legitimately for this purpose. Before presenting this proposal to the Rockefeller Foundation for
decision, I desire an expression of opinion, favorable or un-
favorable, from as many of you as possible. I shall also want
an indication of how many of you may desire to have papers in-
cluded in such a collection to be published late this winter or
early in the spring.

II

Reports have been received from a few of you who grew in-
bred strains last summer to determine relative resistance to
smut and other diseases, general adaptability, etc. I trust
that the others who received seed of these strains will report
soon so that all reports can be tabulated for the next news
letter. It is already apparent that no one or two of these
strains will be useful in all regions of this country. Since
the strains tested the past summer came from only two sources,
Dr. Hayes and Dr. Wiggans, it seems probable that others of you
may have or know of inbred lines better adapted to some regions
than any of the strains so far tested. If you will indicate
this to me, a further test can doubtless be arranged next sea-
son.

Altho the inbred strain test was started with the hope of
finding one or more strains widely resistant to smut, which is
a serious drawback to many of the genetic stocks grown by some
of us and particularly serious in case of plants injured in
collecting sporocyte material for cytological study, the cross-
ing of good inbred strains with genetic stocks may prove very
useful in other ways. If one desires to make an accurate com-
parison of segregates in any culture involving even so few as
two allelomorphic characters, it is necessary to use relatively
large numbers of individuals to make sure that the nine chromo-
some pairs other than the one directly involved in the compari-
on are, on the average, the same in both segregates. When, by
the nature of the comparison, one is limited to a few individ-
uals, as might well be the case in certain histological, phys-
iological, or chemical investigations, it becomes essential to
employ material with as uniform as possible a background of
genes other than those involved in the study. Such material
can probably best be obtained by repeated backcrosses of the
recessive segregates to the same inbred line. Backcrossing
separately to two inbred lines makes it possible later to study
the segregates in vigorous material by intercrossing two such
backcrossed progenies. In line with this purpose, crosses were
made last summer of six dwarf and semidwarf types with two of
the inbred strains which did well at Ithaca. This was done to
get material for Mrs. Abbe's (Minnesota) histological and devel-
opmental study of these types. In so far as possible, other
undesired genes linked with the pair to be studied were involved
in the crosses. When in progressive backcrosses these unwanted
genes are lost, one can be reasonably sure that a considerable
part of the chromosomes carrying the genes to be studied, as
well as the other nine pairs, are relatively uniform genetically
for both normal and dwarf segregates. Even one or two back-
crossings should afford material that is much more nearly uni-
form than are most segregating genetic stocks now in use.
III

Hand pollinations of the cooperative material last summer were for the most part highly successful. We shall be able to include a list of these stocks in the next news letter.

A list and seed of new stocks which any of you may have and which have not previously been sent to the secretary are herewith called for. The list should be ready for the next news letter and the seed should be sent as soon as convenient.

IV

This is also a call for items of interest to be included in the next news letter. Please include new genes, indications of linkage of new or well known genes, etc. Linkage data might well be included unless you intend to submit them later for independent publication or for collective publication as proposed in this letter.

V

- Summary -

1. Please report promptly on behavior of inbred strains if you grew them and have not yet reported (See II above)
2. Send list and seed of new stocks (III)
3. News items are now due (IV)
4. Indicate (a) whether you do or do not favor the proposed collective publication of short signed articles on linkage in maize, (b) whether you will probably be able to submit such articles by late winter or early spring, (c) deadline date favored for reception of such articles.
5. All these items (1-4 above) should reach me by December 20, 1935, so that the next news letter can be sent out early in January.

(Signed) R. A. Emerson
Secretary "pro tem"
MAIZE GENETICS COOPERATION

NEWS LETTER

10

March 4, 1936

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
To Maize Geneticists:--

This letter contains information from many sources, arranged under the following heads:--

I. Collective publication of linkages.
II. General news items. Includes notes on linkage without data, lists of seed stocks, etc.
III. Linkage data.
IV. Seed stocks received, and those propagated in the Cooperation garden at Ithaca.
V. Tests of inbred strains for disease resistance.
VI. Special notices.

Most of these reports are given almost verbatim but are not put in quotation marks because in numerous instances they have been somewhat abbreviated and sometimes the phraseology has been changed (without, I trust, a change in meaning). Statements enclosed in brackets, [ ], are gratuitous comments by your secretary.

I. Collective Publication of Papers on "Linkage in Maize"

Perhaps the most important matter presented in this news letter relates to the collective publication of separately headed and signed articles on linkage (see news letters of March 6 and November 30, 1935).

The response from cooperators has been wholly favorable and several have indicated their readiness to contribute to such a series of papers.

Dr. Hanson, representative for the natural sciences of the Rockefeller Foundation, has written as follows:

"Regarding your request to use a small part of the fund for the publication of brief papers in Genetics, since this seems to you to be merely using a somewhat different mechanism than you originally contemplated for putting this maize material before the geneticists interested, the Foundation will have no objection to a small portion of the funds being used for that purpose.

With kind regards, I am

Cordially yours,

(Signed) Frank Blair Hanson"
Dr. Dunn, editor in chief of Genetics, with reference to our proposal, says:

"I see no danger in this so long as we adhere to the basic rule for publication in GENETICS -- i.e., soundness, significance and permanent value of the material printed, and so long as we are just as free to accept or refuse such papers as any others. I think the publication of such material should differ as little as possible from other papers published; that is, it should not form a separate department of the journal which would constitute a special privilege and might bring resentment from other groups. I think we shall be able to make satisfactory arrangements and suggest that when ready, you send in some sample copy which we can use as the basis for settling form, etc. We go to press on February 15th (May Number) and thereafter on the first of each odd numbered month. If an arrangement is made, copy can be printed in two months (plus about five days) from receipt of mss.

Sincerely yours,

(Signed) L. C. Dunn"

See also suggestions by Jones (news letter March 6, 1935, pp. 19, 20).

Of course, we should not expect to receive preferential treatment from Genetics, and could not expect our papers to be accepted unless they meet the standards set for that periodical. I am anxious to try the plan this spring. It is obvious that we cannot get material ready for the May issue of Genetics. The July issue goes to press May 1 (I assume from Dunn's letter), and manuscripts should be in the editor's hands some time before that. I ask, therefore, that you send such material as you desire to include to reach me not later than March 31.

Manuscripts should be typed and ready for publication without change. When new genes are involved, a short, concise description of the characters differentiated by them might well be included. Well known genes should not require such treatment. Tables should be presented in summary form. Different cultures involving the same kind of data should not be listed separately unless that is essential in order to demonstrate significant differences between them. Of course $F_2$ and backcross data for coupling and repulsion must be entered separately in the tables. A single frequency distribution may often be displayed in the text to better advantage than in a table. Tables of data should be accompanied by such discussion only as is essential to make clear any points not obvious from an examination of the tabular data themselves, or as is necessary to indicate the relation of the reported observations to other linkage tests, etc. The tabular arrangement and headings used in the Linkage Summary are convenient and I, naturally, think them good.

No limit can be set now to the length of the individual contributions, but, unless a very considerable amount of data are presented, individual papers might well be kept to not over one or two pages of printed matter, and it is my hope that some may be not more than half that long.
II. General News Items

Maize Genetic Cooperation, Ithaca, N. Y. —

1. D. G. Langham, formerly of the State College, Ames, Iowa, and now a graduate student in genetics at Cornell, is to serve as assistant in the Maize Cooperation work.

2. Several glossies received from Hadjinov were crossed last summer with standard glossies and the seedling progenies have been grown and noted this winter. Pollinations were made by John Shafer and seedling tests by D. G. Langham. These tests indicate that:

\[
\text{Hadjinov's glossy 3} = \text{gl}_{14} \\
\text{"} = \text{gl}_{16} \\
\text{"} = \text{gl}_{13}.
\]

Hadjinov's glossy 5 gave normal seedlings in crosses with glossies 1, 2, 3, 4, 6, 7, 9; with gl3 it gave seedlings normal in appearance but which exhibited the behavior of glossies in holding sprayed water; it was not tested with glossies 5 and 6.

Hadjinov's glossy 7 gave normal seedlings in crosses with glossies 1, 3, 4, 6, but has not been tested with glossies 2, 5, 8, 9. Hadjinov's glossy 8 has not been adequately tested.

In the records of Cooperation cultures, I find these notes by Rhoades: "Hadjinov's 3 is possibly the same as gl3 since it is linked with su", and "Sprague reports that Hadjinov's 10 is allelomorphic to Stadler's glc".

Cornell University, Ithaca, N. Y. —

1. Corrections to the linkage summary (Cornell Memoir 180):—

Page 13. Delete the gl10 (see news letter November 24, 1934). We missed this in proof reading.

Page 25. The stock of Demerec's w4 having been lost, w4 was assigned to a white seedling found by Lindstrom to belong to group 4 (see Linkage Summary, p. 46).

Page 52. The last item in table 15 should read

\[
\begin{array}{cccccccc}
\text{Ch} & + & + & 61 & 45 & 54 & 59 & 43 & 44 & 52 & 39 \\
+ \text{bm} \text{r} & \text{gel} & 106 & 113 & 87 & 91 & 397 & \text{Burnham} & 23.5\% & 21.9\% & 22.9\%
\end{array}
\]

Page 57, table 18. Gl1 Ij, second line, read 11 not 1.1 per cent.

It will be helpful to all of us to have any other corrections called to my attention, so please send them on and observe my excellent imitation of pleasure.

2. To get for chemical studies material of the several plant color types with as uniform a genetic background as possible, I have tested the germination of seed samples stored in my cases for seven years. A brown plant, a1 B P1, was crossed with a dilute sun red, A1 b P1, inbred strain, and a brown from F2 of this cross was backcrossed to the same inbred strain. Ears of the several color types of F2 from this backcross were tested. Four ears of purple, A1 B P1, averaged 43\% germination, while 14 ears including some of each of the other color types, namely, sun red, dilute purple, dilute sun red, brown and green, averaged 95\% germination. The observed difference between purple and the
other color types is interesting, but probably without significance.

The seedlings of all color types, however, gave striking evidence of the effect of age. Normally the primary roots of germinating seeds show before the plumules do and grow more rapidly for some time. In most lots of this old seed the plumules showed before the primary roots did, and in one lot that germinated 100% no primary roots were visible at any time, but secondary roots started after the plumule was one-half inch or more long. Moreover, many seedlings died after being potted in good soil. Of seedlings from lots ripened last summer, those germinated two weeks later, and planted in the same soil, none have died and the lot as a whole is now (a month after planting) two or three times the size of those from old seed. This is so similar to Randolph's results in germinating seed and growing seedlings from kernels subjected to high temperatures while dormant as to make the problem seem worth further study.

R. A. Emerson

3. Quantitative studies on the frequency of chromosome doubling in corn seedlings treated at different temperatures for varying periods of time indicate that 20, 40, and 60 minute treatments at 36°, 38°, 40° and 42° C are effective in producing a markedly increased frequency of tetraploid sectors in the root-tips and stem-tips, more mutant sectors being produced in the roots than in the stems of the same treatment. Negative results were obtained from a study of the persistence in the mature plants of tetraploid sectors induced by heat treatment of the germinating seed. Over 300 plants were included in the experiment and no tetraploid ears or ears with tetraploid sectors, as determined by applying pollen from tetraploid plants to the treated plant and noting the set of seed, were obtained.

4. Heat treatments of diploid corn, barley and einkorn in early embryogeny and in the seedling stage induced an increased frequency of segregating mutant seedling types differing from the normal either in growth habit or morphology or in the amount of chlorophyll development.

5. Inbred stocks of tetraploid maize after four generations of selfing have good vigor, reasonably good uniformity, and in some cases an increase in fertility over the original parental tetraploid stock. Tetraploid strains of commercial yellow corn are being tested in cooperative bio-chemical and animal assay experiments to determine their vitamin A potency. Since the tetraploid yellow maize endosperm has six doses of Y rather than three as in the normal diploid yellow corn the vitamin A potency may be twice as great in the former as in the latter.

6. The tolerance of dormant seed to heat treatment varied with the moisture content of the seed. Corn and barley seed with 24 per cent moisture was killed with one 30-minute treatment at 100° C. With a reduction of moisture content to 9 per cent the seed was not injured by a 30-minute treatment at 100° C, but after 60 minutes germination was only 30 per cent, and after 2 hours only 10 per cent of the seed germinated. Seeds with 5 per cent moisture germinated perfectly after 2 hours treatment at 100° C, but were killed after 30 minutes at 115° C. Seeds with 2 per cent moisture, the reduction in moisture content being accomplished by drying approximately 3 weeks at 60° C, germinated well after 30
minutes at 115° C, but only 10 per cent germinated after 60 minutes, and 30 minutes at 130° C killed all of the seed. The corn seedlings from the sub-lethal dosages at the different moisture contents were weak and chlorotic, many failing to survive, but the development of normal green color was not similarly altered in the barley seedlings.

7. In further studies on the B-type chromosomes in maize the number in individual plants has been increased to 32-35, with no marked decrease in plant vigor but with an appreciable decrease in fertility among these extremely high numbered B-type plants. Both Florida and Durango teosinte occasionally have B-type chromosomes which are morphologically identical with those in maize, and exhibit the same synaptic behavior and breeding relationships. Plants of Florida teosinte with 5 B-type chromosomes and plants of Durango with as many as 10-12 have been obtained by inter-crossing plants with lower numbers. From an extensive survey of chromosome morphology in various stocks of maize and teosinte, primarily for the purpose of determining the origin of the B-type chromosomes, an extremely wide variation in prophase morphology in different stocks has been noted; maize stocks with as many as 13-14 sizable knobs and others with as few as 1 or 2 have been discovered, also Durango and Florida teosinte stocks with very few and other stocks with numerous knobs. However, a careful search for a chromosome arm in these diverse stocks similar to or identical with the B-chromosome has been fruitless thus far. This suggests that the B-chromosome may be a composite of several parts from different regions of the same or different A-chromosomes.

L. F. Randolph

8. Mosaic plants in part heterozygous and in part homozygous for a chromosome 5 deficiency. - Breakage in the spindle fiber insertion region of chromosome 5 resulted in two chromosomes, one a deficient rod-shaped chromosome and the other its reciprocal, a ring-shaped chromosome, each with an insertion region, the two equivalent genomically to one chromosome 5 (McClintock, Proc. Nat. Acad. Sci., 1932). Two such cases were described. In one case, known as the large deficiency large ring, the ring involved approximately one-sixth of the length of the chromosome, including the locus of Bmp. In the other case, called the small deficiency small ring, the ring involved about one-twentieth of the length of the chromosome and also included the locus of Bmp.

It has been found that the small deficiency can function through the eggs without the small ring being present also. Pollen having the large deficiency plus the large ring-shaped chromosome (the full genomic complement for chromosome 5) can function as well as normal pollen with an intact chromosome 5. When two such gametes fuse, an individual having the small deficient chromosome, the large deficient chromosome and the large ring-shaped chromosome is produced. As stated in the above publication, loss of the ring-shaped chromosome occurs in some mitotic divisions. In the plants resulting from the described cross, the nuclei and thus cells which arise after such a loss of the ring chromosome will be homozygous deficient for the amount of chromosome represented by the length of the small deficiency. Such plants should
be therefore, a mosaic of heterozygous and homozygous deficient tissue if cells whose nuclei have undergone the loss of the ring chromosome can continue to propagate themselves. It was known that the heterozygous deficient tissues do not vary noticeably from non-deficient tissues. If, in these plants, the homozygous deficient tissue is viable and if the homozygous deficiency alters the structure of the cell, streaks of altered tissue should be detectable. Streaks of altered tissue were very obvious in the leaves of such plants. A histological study of the nature of the alterations is being conducted by Mrs. Lucy Abbe. From the appearance of the homozygous deficient tissue it is probable that such tissue would be inviable if not surrounded by normal tissue.

The original "double-deficient" plants were obtained by crossing plants having a normal chromosome 5 with \( \text{Bmp} \), a deficient chromosome 5 with no locus for Bmp and the ring chromosome carrying Bmp. The "double-deficient" plants were all Brmp except one plant which was variegated for Bmp and bmp. The introduction of the bmp locus of the normal chromosome 5 into the deficient chromosome is believed to have occurred as the result of a non-homologous crossover between the normal and deficient chromosomes with a resulting shift in the position of the deficiency (as described by Stadler in the Amer. Nat., 1934).

9. Several inversions, two involving sections of chromosome 9 and one involving a section of the long arm of chromosome 4, have been detected and isolated by Miss Creighton and myself. One of the inversions on chromosome 9 should eliminate single crossovers within the short arm of this chromosome, although the tests have not been completed.

10. Disjunction studies on interchanges have shown that sister spindle fiber regions do not separate in I, that crossing-over between the spindle fiber and the break is followed by disjunction of homologous spindle fiber regions, that the passage of two homologous spindle fiber regions to the same pole in I is increased when the crossing-over is decreased, and that whether 4 or 6 types of spores will be formed and their proportions depend upon the relative distances between the spindle fiber regions and the breaks coupled with crossing-over in these regions.

Barbara McClintock

11. Data from crosses of Florida teosinte with maize, backcrossed to maize, showed little or no crossing over in the short arm of chromosome 9, but between wx and v1, there was from 6.4% (Creighton) to 40% (Allen) of crossing over.

Sylvia M. Allen and Harriet B. Creighton

12. An inbred strain of yellow dent corn, which, after having been selfed for nine generations, has been propagated by sib-crossing or mass pollination for three years, has given rise to two striking mutations, namely, yellow to white endosperm and normal stature to a slender dwarf type. All the white endosperm kernels germinate prematurely.

R. G. Wiggans

University of Minnesota, St. Paul, Minn.
florets on the tip of the ear. In other cases the upper half of the ear is divided somewhat like ramose-1. In crosses, however, either of these types can be separated from ra1 with considerable accuracy. Linkage studies of ramose tassel were made last year using F2 data from crosses with representative genes of the ten groups. It is linked with ra1 or1 and py in group 3 [py is in group 6]. It has occurred to me that this may be the same factor or an allelomorph of ra2 reported by Brink but not published. (Brink's linkage data (Linkage Summary, pp. 41, 42) give a1-ra2 51% and ra2-Rg 34% recombination.)

2. I note your statement [Linkage Summary, p. 12] that floury is difficult to classify in many stocks. I have had no difficulty except where some of the virecent seedlings were concerned. I classify commonly over a ground glass with light underneath.

H. K. Hayes.

U. S. Dept. of Agric., Cereal Crops & Diseases, Ames, Iowa

1. A branched ear was observed in F2 (1923) of the station strain of Reid's Yellow Dent. It appears similar in all respects to the one described by Kompton as branched silkless, bd, and was reported by Rhoades (Maize letter, November 24, 1934) to be allelomorphic to that gene. F2 data involving bd with two other genes show it to belong to group 7. (The data (see III, below) seem to place bd to the right of ij, near Bn1. Hadjinov's data (Linkage Summary, p. 57) give about 36% recombination between his bd and Bn1. His bd has not been tested with either Bryan's or Kompton's.)

2. A character similar to Brunson's cuzcoid was found in F2 of the variety Krug in 1934. It tasselled very late but produced no ear shoots. It had about 50% more nodes than normal corn. It apparently is controlled by a single recessive gene.

A. A. Bryan

3. The study of the factor interaction of a1 and Dt has been continued (see maize letter of November 24, 1934). On the basis of rather extensive counts the ratio of the average number of dots on seeds of a1 a1 a1Dt Dt dt to the average number of dots on seeds of a1 a1 a1 Dt DtDt dt constitution is 3:2. The ratio for seeds of a1 a1 a1 Dt Dt dt to a1 a1P a1P Dt dt Dt constitution is 3:1. Since in the comparisons the Dt gene is held constant while the dosage of a1 varies, it is apparent that the effect of increasing the dosage of recessive a1, as indicated by the average number of dots, is an arithmetic one. In reciprocal crosses between two closely related lines (a1 a1 dt dt x a1 a1 Dt Dt) the ratio of the average number of dots on seeds of Dt Dt dt to seeds of Dt dt dt constitution was 4:1. Some data have also been obtained on the number of spots of Dt Dt Dt constitution. These data indicate that the effect of increasing the dosage of Dt may be geometric.

4. Further study with the chromosome 5 fragment (see maize letter of November 24, 1934) has placed the following genes in the long arm of chromosome 5: v2, ys, pr, v12, v3, and bt. The loci of a2 and bm1 are in the short arm of chromosome 5. The fragment chromosome, which is composed of the short arm of chromosome 5 and has a terminal insertion region, occasionally passes
through the pollen. In the progeny of a selfed fragment plant there occurred an individual with the normal complement of 20 chromosomes plus two fragment chromosomes. In genetic constitution and appearance this 22 chromosome plant was identical with the secondary trisome found several years ago in which the single supernumerary chromosome was composed of two short arms of chromosome 5. Plants having a single fragment chromosome were studied at pachytene. As reported before, the fragment pairs with the two normal chromosomes 5 in approximately half the cells. It was occasionally observed in those cells where the fragment was unpaired that the terminal insertion region presented the appearance of being split. This observation may have some theoretical importance since some of the prevalent theories of meiosis assume that the reason the spindle fiber region undergoes a reductional division in the first meiotic anaphase is that the division of the insertion region is delayed to a late prophase stage while the split of the chromosome thread occurs in the early prophase stages.

5. An inbred strain gave in F2 approximately 65% luteus seedlings (again see maize letter of November 24, 1934). The genetic constitution of this line was sp+ with about 2 per cent crossing over between the sp and 1 loci. These two genes have been linked with factors in chromosome 10. They are very close to g1 and give about 20 per cent of recombinations with R. The luteus gene is designated as lg and the small pollen gene as sp2. Seed available.

6. A triploid individual occurred in a cross of gl1 x ws3. The constitution of the triploid was Gl1 Gl1 Gl1 Ws3 Ws3 Ws3 which suggests that the diploid number of chromosomes was contributed by the pollen parent.

7. During the harvesting of the fields in the Iowa Corn Yield Test several ears were found which had, to the writer, the appearance of triploid ears. Root tip counts of the progeny substantiated this hunch.

8. Half the plants in a small F1 progeny of an R-g-li stock x Florida teosinte had narrow leaves, an unusual type of chlorophyll striping, and brown midribs. Neither of the parents showed this character. It seems possible that we have here a case of factor interaction between Zea and Euchlaena genes. Several crosses were made between the R-g-li stock and Florida teosinte and only one of the F1 progenies showed this new character.

9. In the progeny of a plant trisomic for chromosome 6 there occurred an individual with 20 chromosomes plus a fragment composed of the long arm of chromosome 6. The insertion region is apparently terminal. Studies of the disjunction of the two normal chromosomes 6 and the fragment, utilizing the technic of McClintock in studying the number of nucleoli in the quartets of microspores, showed that in 2.4% of the cases the fragment chromosome went to one pole and the two normal chromosomes to the other pole. In the remaining cases the two normal chromosomes underwent disjunction.

10. Studies of some of the Iowa inbred lines showed that in those inbreds which are poor pollen producers there was a considerable number of unpaired chromosomes at Metaphase I. These unpaired chromosomes undoubtedly cause some of the sterility
found in these lines. Fertile inbred lines showed fewer univalent chromosomes. In the "sterile" inbreds the pairing pachytene was perfect and the unpaired homologous chromosomes showed at diakinesis an orientation to each other because of this earlier association.

11. In a selfed line homozygous for all the dominant aleurone factors there occurred seeds with colorless areas of varying size (Anderson had a similar character several years ago. He called it "Bald" aleurone.) The explanation for the appearance of colorless areas in this line is due to the failure of formation of the aleurone layer.

12. New stocks:

\[\text{Tp-$gl_1-v_5-ra} \]
\[a_1-lg_2 \text{ Dt} \]
\[a_1-na-ts_4 \text{ Dt} \]
\[pr-bml_1-a_2 \text{ (probably)} \]

13. Studies with \(P^V\) and \(sm\) indicate that intensity of salmon color in silks depends upon amount of variegation on the ear. The silks have a uniform color, not variegated.

14. Golden-1, \(g_1\), though not identifiable by external appearance, can be classified accurately in the seedling stage by cutting off the seedling stalk just above the ground. Golden-1 seedlings have a distinct golden color in cross section while non-golden ones are clearly green.

M. M. Rhoades

Ag's Experiment Station, New Haven, Conn.

1. We are informed by Eyster that his opaque-3 is the same as our \(o_1\). (Eyster reported \(o_3\) in chrom. 9).

2. A maternal stripe has been obtained from a series of Sweepstakes inbreds. It is more vigorous than those obtained by Demerec and Anderson.

3. The dwarf reported in maize letter of November 24, 1932 is not \(d_1\). It segregates well and is viable but never produces an ear or even pollen at New Haven. Seed available.

4. The adherent reported in the same news letter is not \(a_1\). Viability good.

5. Seed of a stock of trisomic chromosome 4 is available.

6. \(F_2\), 783 individuals, of \(o_2^2 + + \) gave recombination percentages as follows: \(o_2 - gl_1 27, o_2 - ij 37\).

Another \(F_2\), 323 seedlings, of \(o_2^2 + + gl_1\) gave 22% crossing-over. Backcross data, 453 plants, give 17% crossing-over between \(o_2\) and \(r_1\). These data indicate that \(o_2\) is to the left of \(v_5\).

7. We apparently have two complementary factor pairs for yellow endosperm. I have tentatively designated one of them \(Y_4\) and the other \(Y_1\) (intensifier). I have only one stock of \(Y_4 Y_4\) it it, but it is carried by several white stocks, in fact, all so far tested except one \(a_1\)-tester. It might be an allelomorph of \(A\). \(F_1\) seed of the cross \(Y_4 Y_4\) it it \(X Y_4 Y_4\) It is all yellow. The \(F_2\) ears segregate fairly well into a 9:7 ratio for yellow and white, showing several intensities of yellow. I do not think the stock of \(Y_4 Y_4\) it it is the same as \(Y_1\). It is
much lighter in color and shows segregation well only in very flinty corneous stocks. The intensifier stocks, yf yf It It, also intensify the yellow color of Yy.

W. Ralph Singleton

University of Florida, Gainesville, Fla. —

1. A few years ago an inbred ear segregated sharply (3:1) full yellow and pale yellow endosperm. The pale seeds produced almost 100% white seedlings and the others produced nearly all green seedlings. Brunson reported something similar, I think.

2. A first year inbred ear of Cuban Yellow Flint segregated sharply red and green seedlings and a range of intensity of yellow endosperm. The seeds were arranged in order of endosperm color and the darker 3/4 planted separately from the lighter 1/4. On this classification crossovers with anthocyanin were about 20%. The stock was grown through two more generations with selection of ears giving lessor crossing over and the crossovers reduced to about 10%. The reduction was attributed to selection for sharper segregation and more accurate classification of endosperm color. The anthocyanin difference was indicated at the R locus by outcrosses to Cornell aleurone testers.

Fred H. Hull

California Institute of Technology, Pasadena, Calif. —

1. Data on striate and interchanges place sr between P and br.

2. Summary of map positions of interchanges in chromosomes 1, 3, 9 and 10. Part of this is a repetition of what I sent last year.

Chrom. 1 —
Left of P. An undescribed 1-6 interchange gave the order T-P-ar with 6% crossing over between T and P.
Near P, order uncertain, 1-2b, 1-9c.
Between P and br 1-3a, 1-5b, 1-5c, 1-9a.
Near br 1-3d, 1-7b, 1-7c, 1-9b, 1-10a.
Between br and bm2 1-5a, 1-4, 1-7d.

Chrom. 3 —
Between a and na 2-3d, 3-5c, 3-5b.
Nearer ts4 1-3a, 2-3b, 3-7a, 3-8a, 3-9a, 3-10a, 3-10b.
Probably beyond ts4 but order uncertain 3-10a, 2-3c, 1-3d.
Beyond ts4 (27.2%) 3-7b.

Chrom. 9 — all tested are beyond waxy.

<table>
<thead>
<tr>
<th>% crossing over</th>
<th>No. of backcross plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9a</td>
<td>239</td>
</tr>
<tr>
<td>1-9b</td>
<td>505</td>
</tr>
<tr>
<td>1-9c</td>
<td>237</td>
</tr>
<tr>
<td>2-9a</td>
<td>307</td>
</tr>
<tr>
<td>2-9b</td>
<td>505</td>
</tr>
<tr>
<td>3-9a</td>
<td>608</td>
</tr>
<tr>
<td>4-9a</td>
<td>426 (2 groups of data 31.0 and 11.6)</td>
</tr>
<tr>
<td>4-9b</td>
<td>193</td>
</tr>
<tr>
<td>6-9a</td>
<td>610</td>
</tr>
<tr>
<td>6-9b</td>
<td>731</td>
</tr>
</tbody>
</table>
9-10 about 3.5 (estimated from combined wx-T and T-R intervals)

Chrom. 10 — crossing over with golden-1 (left of gl)

<table>
<thead>
<tr>
<th>% crossing over</th>
<th>No. of plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10a</td>
<td>17.0</td>
</tr>
<tr>
<td>2-10</td>
<td>6.2</td>
</tr>
<tr>
<td>3-10a</td>
<td>15.4</td>
</tr>
<tr>
<td>3-10b</td>
<td>20.0</td>
</tr>
<tr>
<td>3-10c</td>
<td>7.0</td>
</tr>
<tr>
<td>6-10</td>
<td>9.7</td>
</tr>
<tr>
<td>8-10a</td>
<td>17.0</td>
</tr>
<tr>
<td>8-10b</td>
<td>14.7</td>
</tr>
<tr>
<td>8-10c</td>
<td>22.8</td>
</tr>
<tr>
<td>14-10b (near gl, order uncertain)</td>
<td></td>
</tr>
<tr>
<td>9-10 (Right of R)</td>
<td></td>
</tr>
</tbody>
</table>

3. Summary of map locations of interchanges on chromosome
2. Combined data of Clokey and Anderson.
   Near B 2-6b, 2-9a.
   Between B and v4 1-2b, 2-3c, 2-8, 2-3d, 2-10, 2-4d, 2-7b, 2-9b.
   Far right of B but not yet tested with v4 2-7c.
   Near v4 2-4a, 2-4b, 2-5b, 2-7a, 2-7b.
   Beyond v4 2-4c (v4 - T = 35).

E. G. Anderson

University of Buenos Aires, Buenos Aires, Argentina

1. In Garrapata corn from the Province of Salta in Argentina and from Bolivia, spotted aleurone is due to a dominant r modifier giving mottled aleurone.
   Mottled x a and c testers gives self color
   Mottled x r testers gives mottled F1,
   but in F2 some colorless kernels appear. The modifier is independent from pr and from a and c but seems to be linked with r.
   The r modifier is designated Mr. The backcross: r Mr Pr/r Mr pr x r Mr pr gave

   Mottled purple 66
   Mottled red 59
   White 251

[Mr has been used by Kvakan for midrib (Linkage Summary, p. 15) but the stock has been lost. Seeds sent look like "stippled", which is either an allelomorph of r or very closely linked with it.]

2. Six "glossies" were obtained from selfed Amargo and other varieties. They are designated temporarily by the following symbols:
   g133a Same as g12
   g133b Different from g11, g12, g13, and g133a.
   g133a From sample of floury corn from Humahuaca (Jujuy, Argentina), different from g11 and g12.
From a yellow flint; being tested with other glossies.

From the Amargo variety; different from gl₂.

3. A barren-stalk type was found in the stock of gl₃⁴c.

4. A liguleless stock was found in Amargo corn. A planting of 100 selfed seeds gave 56 green and 28 lethal white leaf base seedlings. Of the normal green plants that lived to the age of three months, 28 had normal and 20 had liguleless leaves. This is at present designated lg₃⁴a.

5. A selfed plant of Amargo produced, from 50 seeds, 22 normal plants and 7 dwarf plants with bifid leaves and the midrib prolonged into a conspicuous awn, like the flowering glume of Avenaeac. The character is called aristofilia and its genetic symbol is given as af. The aristofilia character is not known in grasses, so far as I am aware, except in a small genus of Mexican grasses (Jouvea), the taxonomic position of which is uncertain.

6. Lazy, la₃⁴a, appeared in the progeny of a selfed plant of the variety, "Maiz Canario de 8 filas", which consisted of 47 normal and 15 lazy plants. Has been crossed with su gl₂.

7. Siamensis, sn, is a recessive character of variable expression obtained from an Amargo strain. Of the double seedlings, the "paracito twin" aborts early in some instances, leaving normal appearing individuals. A homozygous strain of sn exhibited the following types:

- Seedlings with marked duplications - 12
- Seedlings with different abnormalities - 32
- Seedling normal - 1.

8. Male steriles: A male sterile, ms₃⁴a, from a strain of maize from Tabacol (Salta, Argentina) gives a sharp 3:1 segregation. Another, ms₃⁴a, from Humahuaca (Jujuy, Argentina) is linked with aleurone color. The stock is segregating for R r.

9. Tassel seed, ts₃⁴a, has been found in a yellow flint from San Luis, Argentina.

10. Germless seeds, gm₃⁴a, from a selfed ear of Piamontés, a flint corn, had 112 normal and 30 germless kernels.

11. Silky, si₃⁴a, came from the same Piamontés strains.

S. Korovitz

Instituto Agronomico de Campinas, Sao Paulo, Brazil

Attention is called to a bulletin from Brazil: Efeitos da primeira autofecundacao em tres variedades de milho. Technical bulletin #19, p. 19, with 37 photographic illustrations (five colored plates). Published in Portuguese with an abstract in English, as follows:

"The Genetics Department of the Instituto Agronomico started in 1932 a large maize breeding project based on the production of pure lines to be used for hybrid seed production. Over 3000 vigorous plants of 3 main commercial varieties were self-fertilized and part of the seeds of 1812 selected inbred ears was planted out for further selfing. In this paper the author describes some of the more prominent variations found among the selfed ears and also in the progenies. Most of these off-types are compared with similar variations worked out by American geneticists. The variations described here are: (1) premature germination of the seeds on the ears; 2) several cases
of defective endosperm; 3) endosperm color (yellow-white); 4) mealy endosperm; 5) Aleurone colors; 6) Pericarp colors; 7) white seedlings; 8) yellow seedlings; 9) zebra striped seedlings; 10) virescent seedlings; 11) pale green seedlings; 12) zebra striped leaves; 13) several kinds of striped leaves; 14) oily spots; 15) several kinds of dwarfs; 16) narrow leaves; 17) crinkly leaves; 18) ramosa (?); 19) rolled leaves; 20) ragged (?); 21) branched ear; 22) several kinds of abnormal sex distribution: male and female plants, extreme cases of 'tassel-seed', etc. — It is the author's intention to exchange seeds of his genetic material with American geneticists in order that some of the supposed new variations may be conveniently worked out and their genes be located in the maize linkage groups".

C. A. Krug

University of Zagreb, Yugoslavia

1. Attention is called to a recent paper dealing with the inheritance of number of kernel rows in maize (Tavčar, Alois — Beitrag zur Vererbung der Kornreihenanzahl an Maisskolben. Zeit­schrift für Züchtung, Pflanzenzuchtung, 20: 364-376. 1935). A 4-rowed type is described and its genotype is assumed to be Rw₁ Rw₁. Crosses of 4-rowed with 8-rowed forms exhibit monohybrid F₂ and backcross ratios. To the genes differentiating these two forms are assigned the symbols Rw₂ Rw₂. 4-row = Rw₁ Rw₁ Rw₂ Rw₂; 8-row = Rw₁ Rw₁ Rw₂ Rw₂. Rw₁ and Rw₂ are inherited independently of each other and of P and Y₁. [Since, on the author's assumption, Rw₁ is homozygous in both the 4-rowed and 8-rowed types used in these crosses, no evidence is presented for the independence of Rw₁ from Rw₂, P and Y₁. Of course Rw₁ could be used as a symbol for the residual genotype of a 4-rowed form, but there seems no more need for such a symbol here than in many other cases.]

2. Four-rowed ears have two rows of kernels on either side of the cob, the two pairs of rows being separated by smooth areas (rachis without paleae). It is necessary to distinguish between palea and rachis color as well as between these and pericarp color, all of which belong to the P allelomorphic series. Ten genotypes have been found, as follows:

<table>
<thead>
<tr>
<th>Genotype (with A)</th>
<th>Pericarp color</th>
<th>Palea color</th>
<th>Rachis color</th>
</tr>
</thead>
<tbody>
<tr>
<td>pRRR</td>
<td>red</td>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>pRWR</td>
<td>red</td>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>pRWR</td>
<td>white</td>
<td>white</td>
<td>red</td>
</tr>
<tr>
<td>pRWW</td>
<td>white</td>
<td>white</td>
<td>red</td>
</tr>
<tr>
<td>pWRR</td>
<td>colorless</td>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>pWRW</td>
<td>colorless</td>
<td>white</td>
<td>red</td>
</tr>
<tr>
<td>pWWR</td>
<td>colorless</td>
<td>white</td>
<td>red</td>
</tr>
<tr>
<td>pWWW</td>
<td>colorless</td>
<td>white</td>
<td>white</td>
</tr>
<tr>
<td>Porr</td>
<td>orange</td>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>POWW</td>
<td>white</td>
<td>white</td>
<td>white</td>
</tr>
</tbody>
</table>

An account of this series will probably be published in Zeitschrift fur induktive Abstammungs - u. Vererbungslehre.

A. Tavčar
1. There is pronounced indication of linkage between a gene for fasciated ear and white endosperm.

2. In a cross between fasciated-cherry-japonica and golden, the majority of the F1 plants were not-golden not-fasciated but were japonica. F2 segregation was normal for the first genes but gave 89 japonica in a total of 189 plants. When japonica was crossed with dwarf-3 all F1 plants were green, not japonica.

3. In a cross between a line with coloured aleurone and rr lines, four alleles of R could be distinguished by their different effects on aleurone colour. Otherwise the plants were of the constitution AA CC bo F1 F1. At least one of the R alleles involved seems to be a cherry allele. Two alleles were the normals, at present designated R and r. A third may be identical with the allele recently discovered by Rhoades, and designated here r1. The fourth is a very weak dominant called R'. The four heterozygotes when selfed gave

<table>
<thead>
<tr>
<th>Rr</th>
<th>25% colourless</th>
</tr>
</thead>
<tbody>
<tr>
<td>R'r</td>
<td>35%</td>
</tr>
<tr>
<td>R'r</td>
<td>50%</td>
</tr>
<tr>
<td>R'r'</td>
<td>mostly 66%, in one case 75% colourless</td>
</tr>
</tbody>
</table>

It seems possible to obtain colourless R' homozygotes by selection of modifiers. The ratios 63:1 after selfing and 1:7 after backcrossing seem to indicate the presence of at least three complementary recessive modifiers.

4. The intensity of aleurone colour in the crosses mentioned under (3) depends upon two complementary modifiers giving 9 deep to 7 pale after selfing.

5. A large set of data was analysed with the help of efficient statistical methods in order to see how many ratios were disturbed by linked genes for pollen tube competition. Indications of such competition have been found in connection with the following segregations:

- purple-1 and brittle-1 (see 6 below) Brieger
- deep and pale aleurone Tidbury
- yellow-white endosperm Tidbury
- deep-pale yellow endosperm Tseng.

6. The distance between pr1 and bt1 has been found to be 17.5%. The gametophyte factor ga2 is located between pr1 and bt1 about 12.3 units from pr1 and 4.7 units from bt1. The amount of elimination in Ga/ga heterozygotes has been found to vary and has been studied in both types of heterozygotes, i.e.

\[
\text{Pr1 Ga2 Bt1 and Pr1 ga2 Bt1} \\
\text{pr1 ga2 bt1 and pr1 Ga2 bt1}
\]

The data vary round the means 5%, 15% and 40% instead of the expected 50%.

7. Random pollination of unprotected plants has been found to be of rare occurrence in the experimental plots both at Berlin and Merton. Selfing predominated if unrelated lines which, however, flowered nearly simultaneously, were interplanted. Random pollination was found only if the plants were nearly identical in composition.
Experiments on earliness and yield were started in order to find types well suited to the English climate. A number of varieties were tested in randomised blocks. The plants were sown in three lots. The variation within each lot was very small. Plants sown on April 17th and planted out in May were the slowest, those sown on May 21st and planted out on June 14th were quicker and needed about two weeks less. Plants sown in the field on June 5th gained another seven days. The differences between the varieties were partly very significant. I am convinced that part of the failure in the cultivation of maize in Northern Europe is due to the fact that the seeds are sown too early and kept too long in pots.

9. A fairly large coupling F_2 of C Sh/c sh and I Sh/C sh has been produced (9053 grains in the first and 7226 in the second case) to see whether there is any significant difference between the recombination values. All the data from the individual ears as well as the totals form a homogeneous sample around the common mean of 5.1%. A backcross for C Sh/c sh gave 4.3% in 6641. The difference between all F_2's and the backcrosses is just over twice the error. Experiments will be made to test reciprocal backcrosses.

F. G. Brieger

Honan University, Kaifeng, Honan, China

1. A white waxy strain of maize from the province of Szechuan was crossed to al y Pl, white seeded of course. The F_1's were all yellow seeded. F_2 gave 146 yellow and 87 white, a case of complementary factors. Linkage tests are in progress.

2. From selfed strains of corn collected from Honan Province, one ear was found to have prematurely germinated seeds that seem to be linked with y. On selfing again one ear was found to have 159 yellow and 59 white seeds. All the white seeds had germinated on the cob. This may be a case of complete linkage. Progress is being made to ascertain this.

H. W. Li

III. Linkage Data

1. Four-point tests, group 2. I. W. Clokey

\[
\begin{array}{ccccccccc}
+ & + & + & + & \text{gl}_1 & \text{gl}_2 & B & \text{v}_4 \\
124 & 186 & 40 & 29 & 55 & 42 & 101 & 83 & 1 & 10 & 15 & 11 & 13 & 16 & 1 & 5 \\
\text{Total} & 310 & 69 & 97 & 184 & 11 & 26 & 29 & 6 & 732 \\
\end{array}
\]

\[
\begin{array}{ccccccc}
9.4\% & 13.3\% & 25.1\% & 1.5\% & 3.6\% & 4.0\% & 0.8\% \\
\text{gl}_1-\text{gl}_2 & 15.3\% & \text{gl}_2-B & 19.6\% & B-v_4 & 33.5\% \\
\end{array}
\]

2. Trisomic and backcross tests, group 2, involving albescence, liguleless-1, and yellow endosperm. H. S. Perry

F_0 data from the cross of #2 trisome carrying \text{lg}_1 x al show that \text{al} is in chromosome 2.

\[
\begin{array}{cccccc}
+ & + & \text{lg}_1 & \text{al} & + & \text{al} & \text{lg}_1 & \text{lg}_1 & \text{al} \\
81 & 61 & 14 & 0 & 156 & - & 39 & 9 \\
490 & 42 & 47 & 0 & 572 & - & 7 & 8 \\
\text{Total} & - & - & - & 735 & - & - & 8.3 \\
\end{array}
\]
The suggestion of close linkage between al and \( lg_1 \) seems to be confirmed by a diploid F\( _2 \) progeny, as follows:

\[
\begin{array}{c|cccc}
  & + & + & lg_1 & al + al \ lg_1 \\
 101 & 51 & 43 & 0 & = 195 - 26.2 \ 22.1.
\end{array}
\]

Per cent crossing over < 15.

F\( _2 \) progenies involving \( Yx \) and \( al \) have indicated close linkage between these two genes. Backcross counts confirm this linkage, as follows:

<table>
<thead>
<tr>
<th>Yellow</th>
<th>Not yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al al</td>
<td>Al al</td>
</tr>
<tr>
<td>186</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>169</td>
</tr>
</tbody>
</table>

Two seedlings from seeds with yellow endosperm and one from non-yellow, are still too small to classify.

3. Two-point tests, group 7. A. A. Bryan

<table>
<thead>
<tr>
<th>X ( Y )</th>
<th>XY</th>
<th>( xy )</th>
<th>( xY )</th>
<th>( xy )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bd ( GI_1 ) RS</td>
<td>804</td>
<td>254</td>
<td>268</td>
<td>53</td>
</tr>
<tr>
<td>Bd ( Ij ) RS</td>
<td>806</td>
<td>252</td>
<td>282</td>
<td>39</td>
</tr>
<tr>
<td>( GI_1 ) Ij CS</td>
<td>1030</td>
<td>42</td>
<td>58</td>
<td>249</td>
</tr>
</tbody>
</table>

[All three genes involved in the same F\( _2 \) cultures.]

4. Three-point tests, group 7.

<table>
<thead>
<tr>
<th>+ + +</th>
<th>( Tp )</th>
<th>148 133</th>
<th>18 13</th>
<th>16 9</th>
<th>3 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_5 \ ( GI_1 ) +</td>
<td>281</td>
<td>31</td>
<td>25</td>
<td>3</td>
<td>340 M. M. Rhoades</td>
</tr>
<tr>
<td>+ + +</td>
<td>( ra \ ( gl_1 ) ij )</td>
<td>337 423</td>
<td>23 11</td>
<td>113 104 3</td>
<td>1</td>
</tr>
<tr>
<td>( V_5 \ ( ra \ ( gl_1 ) + 2540</td>
<td>114 65</td>
<td>41 2</td>
<td>2721 A. C. Fraser</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ in +</td>
<td>( V_5 \ ( gl_1 )</td>
<td>1535 1537</td>
<td>153 36</td>
<td>143 102 57 40</td>
<td></td>
</tr>
<tr>
<td>( gl_1 )</td>
<td>3122</td>
<td>189 244</td>
<td>97 3653 A. C. Fraser</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Four-point test, group 7. I. W. Clokey

<table>
<thead>
<tr>
<th>( T_3-7a \ + + +</th>
<th>( ra \ ( gl_1 ) ij )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1-2</td>
</tr>
<tr>
<td>1-3</td>
<td>2-3</td>
</tr>
<tr>
<td>1-2-3</td>
<td>1-2-3</td>
</tr>
<tr>
<td>210 222 2 16 5 17</td>
<td>18 22 65 0 0 0 0 0 0 0 0 = 539</td>
</tr>
<tr>
<td>432</td>
<td>3.3% 4.1% 12.1% 0.2% 0.2%</td>
</tr>
<tr>
<td>T-( ra_1 ) 3.5%</td>
<td>( ra_1-( gl_1 ) 4.3% ( gl_1-ij ) 12.4%</td>
</tr>
</tbody>
</table>

Normal and semisterile (T) plants considered separately:
Normal - T-\( ra_1 \) 5.4\%, \( ra_1-\( gl_1 \) 5.8\%, \( gl_1-ij \) 13.6\%
Semisterile - " 1.2\%, " 2.5\%, " 11.1\%.

The large difference in per cent of crossing over in the two cases is unexplained.
6. Three-point test, group 10.  V. Rhoades

\[
\begin{array}{cccccc}
R_0 & + & + & 108 & 107 & 74 & 65 & 20 & 16 & 9 & 8 \\
+ & g_1 & R & 215 & 142 & 36 & 17 & = 410
\end{array}
\]

7. Linkage Data for Chocolate, group 2.  (?)

Ch V_4, CB 71 66 42 76 255 42%  Burnham

I have some later material of the same sort for more data.  With a_2 [Chrom. 5] I had only F_2 material (furnished by Clokey, segregating also for c, r), but it gives absolutely no indication of linkage.  Chas. Burnham.

Some miscellaneous linkage data with Ch are all negative.  The earlier indication of linkage with T_5-7c is washed out with further data.  E. G. Anderson.

[See discussion in Linkage Summary, p. 51.]

IV. Seed Stocks Received

2. H. K. Hayes, St. Paul, Minn.— v_21 (chrom. 8).

[Records Genetics Soc. Amer. No. 4, 1935. Abstract.]


1a. su Tu tu gl_3

Homozygous A_1 C R a_2 bt bv pr (This bt stock gives good field germination.)

Same as above, but segregating V_2 v_2.

Homozygous A_1 C R A_2 bt bv pr

\[
\begin{array}{c}
fr_2 gl_1 ij fr_1 \\
+ & + & + & +
\end{array}
\]

\[
\begin{array}{c}
fr_2 gl_1 ij fr_1 \\
+ & + & + & +
\end{array}
\]

5. W. Ralph Singleton, New Haven, Conn.—

Y_4 Y_4 it it
Y_4 Y_4 It It
Y_4 Y_4 It It x Y_4 Y_4 it it.

6. S. Horowitz, Buenos Aires, Argentina—

su_1 gl_3 Y x la_34a

\[
\begin{array}{c}
\overline{r} + Kr Pr \\
\overline{r} gl_1 + + x r gl mr (R-tester)
\end{array}
\]

af_34a
sn

7. Queensland Agricultural High School and College, Gatton, Australia—

Ten packages of seed, labeled I - X [no letter].
S. Ithaca, N. Y. Stocks grown by Maize Genetics Cooperation. Pollinations by John Shafer:

Inbred strains. Selfed or sib-crossed ears of all the inbred strains in disease resistance test (see V, below), except 07-34, which did not germinate.

Glossies 1, 2, 3, 4, 6, 7, 9; gl5, no germination, glg too late to ripen. Hadjinov's glossies 3, 5, 6, 7, 10 (H3 = gl4, H6 = gl6, H10 = gl3, see II above); H8, all normal seedlings, supposed to be +/g1 but some certainly homozygous normal.

Hadjinov's Rs1, rs2, at, bd, cr3, bs?, vb (variable brachytic).

Perry's Yx and yx, in various combinations with Y1, y1, P1 pl, Al al.

Brunson's pale yellow endosperm.

Wiggans' brittle stalk.

Segregating cultures from W1 W1 x A1 b P1 py su.

Plant colors:-- A1 B P1, a1P B P1, a1 B pl, a1 b P1, a1 b pl.

Tester stocks:

Group 1. -- P-p f1 bm2, P-p br f1 bm2, P-p br f1 an1, p sr an1 bm2, P-p gs1 bm2, p as.

Group 2. -- lg1 gl1 b b v4, lg1 gl2 ts1, sb, al.

Group 3. -- a1 na1 ts4, d1s, d1m, a Rg.

Group 4. -- la su Tu tu gl3.

Group 5. -- ys1 bm1 pr1 v2, A2 a2 bt bv pr1, bm1 bt pr1, bv pr1 v2.

Group 6. -- Y1 P1 sm py, Y1 pl (ag3?), po y.

Group 7. -- v5 ra1 gl1, ra1 gl1 ij, v5 gl1 Bu1.

Group 8. -- j1, ms8.

Group 9. -- c sh wx v1, yg2 c sh wx.

Group 10. -- nl1 g1 R, r zb5, d7, li g1 Rr.

Multiple testers:--

ts2 bm2 lg1 b su1 A1 na1 cr1 pr1 y1 pl in j1 C RE.

bm2 lg1 b A1 su1 pr1 y1 pl In Bu1 j1 c RE.

pvV A1 su pr1 y1 in c sh wx RE.

A1 A2 Pr pr C-sh-wx g1-R-r.

A1 A2 B-lg1 Y-y-P1 Su-su-Tu-tu.

Other stocks previously listed are, for the most part, still available.

New seed stocks listed under general news items (II) in this letter but which have not been sent for the Cooperation collection, should be received as long as possible before planting time (May 15).

V. Tests of Inbred Strains for Disease Resistance

Last spring seed of five inbreds furnished by Professor Hayes and eight by Professor Wiggans were sent to eight cooperators in various parts of this country. All these strains were supposed to be more or less resistant to smut. Some of them were shown to be less smut resistant than expected, several proved very
susceptible to bacterial wilt (Stewart's disease) and a few susceptible to rust.

1. Smut.
I have attempted to present a summary of the observations on smut in tabular form, below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>854</td>
<td>Golden Bantam</td>
<td>7</td>
<td>10.4</td>
<td>0</td>
<td>0</td>
<td>36.4</td>
<td>0</td>
<td>9.4</td>
</tr>
<tr>
<td>842</td>
<td>Northwestern Dent</td>
<td>9</td>
<td>6.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>870-34</td>
<td>Minnesota 13</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8283</td>
<td>Rustler</td>
<td>5</td>
<td>10.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.0</td>
<td>2.9</td>
</tr>
<tr>
<td>833-34</td>
<td>Rustler</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>206</td>
<td>Learning</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td>0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>208</td>
<td>U.S. 204</td>
<td>13</td>
<td>6.5</td>
<td>17.1</td>
<td>30.0</td>
<td>93.7</td>
<td>67.0</td>
<td>42.9</td>
</tr>
<tr>
<td>209</td>
<td>Bloody Butcher</td>
<td>11</td>
<td>31.6</td>
<td>8.5</td>
<td>0</td>
<td>18.7</td>
<td>4.0</td>
<td>12.6</td>
</tr>
<tr>
<td>210</td>
<td>Oil Dent</td>
<td>9</td>
<td>14.3</td>
<td>3.8</td>
<td>3.0</td>
<td>7.1</td>
<td>2.0</td>
<td>6.0</td>
</tr>
<tr>
<td>211</td>
<td>West Branch</td>
<td>9</td>
<td>7.5</td>
<td>0</td>
<td>0</td>
<td>14.3</td>
<td>0</td>
<td>4.4</td>
</tr>
<tr>
<td>212</td>
<td>Silver King</td>
<td>14</td>
<td>31.0</td>
<td>2.3</td>
<td>0</td>
<td>21.1</td>
<td>0</td>
<td>10.9</td>
</tr>
<tr>
<td>213</td>
<td>Onondaga</td>
<td>12</td>
<td>92.9</td>
<td>42.9</td>
<td>0</td>
<td>15.4</td>
<td>0</td>
<td>30.2</td>
</tr>
<tr>
<td></td>
<td>White Dent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>Dutton's Flint</td>
<td>12</td>
<td>0</td>
<td>3.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Minnesota cultures grown under smut-epidemic conditions. Longfellow variety had 65.6% smut. H. K. Hayes.

Iowa season excellent for testing smut resistance; smut infection in general was one of the heaviest in several years. A. A. Bryan.

West Virginia check variety showed 75-80% smut. C. Burnham.

Notes of smut infection --
Line 876-34, no smut reported; 214, little smut at Ames, Ia. only; 206, light smut at Morgantown, W. Va. and Ithaca, N. Y.; 8283, light smut at St. Paul, Minn, and Ithaca, N. Y. only; 8342, light smut at St. Paul, Morgantown, and Ithaca; 211, some smut at St. Paul and New Haven.

Line 208, showed medium to high percentages of smut infection in most tests; at Morgantown, New Haven, and Ithaca, smut with one exception limited to light tassel infection, but at Ames five ears were smutted.

Lines 212 and 213, showed heavy ear-smut infection in some tests.

Line 870-34, little to no germination in all tests.

2. Rust.
Pasadena, Calif. Little smut in 1935, none on strains in test. Lines 208 and 211 very badly rusted; 209 moderately badly rusted; 210, 212, and 213 lightly rusted; 206 and 214 free from rust and easily the most desirable for this locality. E. G. Anderson.
Ithaca, N. Y. Lines $S^42$ and 211 some rust; 208 much rust, but too late to injure plants very seriously. There is some rust present every year at Ithaca, but it usually comes too late to be a serious disease. During two widely separated seasons, however, when rust had been introduced inadvertently with seedlings transplanted from the greenhouse early in summer, a very severe epidemic occurred. Many of the more susceptible stocks were killed before flowering time. If conditions should arise by which early infection were brought about, rust would be our most serious disease. R. A. Emerson.

New Haven, Conn. "Apparently one of our inbreds, Connecticut 2, an inbred out of the Whipple variety of sweet corn, is completely susceptible to rust. We had no rust here during the years that we were inbreeding Whipples from 1925 to 1928. Sometime later, I think in 1929 or 1930, we noticed considerable rust on this one inbred. Aside from rust Connecticut 2 has proved to be our best Whipple inbred and the one we are using in a great many crosses. It is used as the pollen parent and is never damaged so much that it will not make sufficient pollen. It always makes a good crop of seed when planted early. Last year the Eastern States Farmers' Exchange at Springfield, Mass, planted about an acre of Connecticut 2 for increase. They planted this late in order to avoid contamination from the pollen of sweet corn growing near by. This field of Connecticut 2 was so badly damaged that it did not make a single ear. I am doing some convergent improvement on this inbred and using Rhoades method of inoculating the seedlings so I can get a similar inbred resistant to wilt." Of the inbreds in the cooperative test the only one seriously affected by rust was 208 in which about 80% of the leaf area was covered by rust pustules. Somewhat susceptible strains were, in order of susceptibility: 211, 30%; 209, 20%; 206, 213, and $S^2S^3$, 10%, the latter had a few scattered pustules on the leaves of all the plants. W. Ralph Singleton.

3. Bacterial blight (Stewart's disease).
Morgantown, W. Va. Lines $S^54$ and 209 very susceptible to wilt; C66 and $S^42$ poor plants, wilt (?) susceptible. Chas. Burnham.

Washington, D.C. At Arlington Farm, resistance to bacterial wilt is of much greater importance than smut resistance. We seem to have universally heavy infections of wilt and susceptible lines are almost completely wiped out. Such was the case this season. Dr. Wiggans' lines 206, 208, and 210 were outstandingly the most resistant. Merle T. Jenkins.

4. Lodging.
Washington, D.C. Lines 206, 208, and 210 looked better than everything else until late in the season. In the heavy storm we had in September, 206 and 210 lodged somewhat, whereas 208 remained erect. Merle T. Jenkins.
Morgantown, W. Va. Lines $S^2S^3$ and 211 no lodging; 206, 203, and 214 some lodging; 210 and 212 badly lodged. Chas. Burnham.
 Ames, Iowa. Lodging recorded by grade: 1 = little or none, and 5 very much lodging. Roots and stalks noted separately to determine whether lodging due to weak roots or weak stalks.
5. Firing.

Ames. Line 209, top leaves burned badly just prior to tasseling. A. A. Bryan.

6. Ear notes.

Ames.

<table>
<thead>
<tr>
<th>Line</th>
<th>Seed set</th>
<th>Quality</th>
<th>Line</th>
<th>Seed set</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>S51/2</td>
<td>poor</td>
<td>poor</td>
<td>209</td>
<td>excellent</td>
<td>fair</td>
</tr>
<tr>
<td>S42</td>
<td>fair</td>
<td>good</td>
<td>210</td>
<td>good</td>
<td>good</td>
</tr>
<tr>
<td>S283</td>
<td>fair</td>
<td>fair</td>
<td>211</td>
<td>good</td>
<td>good</td>
</tr>
<tr>
<td>C86-34</td>
<td>fair</td>
<td>fair</td>
<td>212</td>
<td>poor</td>
<td>fair</td>
</tr>
<tr>
<td>206</td>
<td>good</td>
<td>fair</td>
<td>213</td>
<td>fair</td>
<td>poor</td>
</tr>
<tr>
<td>208</td>
<td>good</td>
<td>fair</td>
<td>214</td>
<td>very poor</td>
<td>poor</td>
</tr>
</tbody>
</table>

H. K. Hayes.

St. Paul. Line 211, rather undesirable ears at harvest.

Ithaca.

<table>
<thead>
<tr>
<th>Line</th>
<th>Ears</th>
<th>Line</th>
<th>Ears</th>
</tr>
</thead>
<tbody>
<tr>
<td>S51/2</td>
<td>good</td>
<td>209</td>
<td>good</td>
</tr>
<tr>
<td>S42</td>
<td>good</td>
<td>210</td>
<td>poor</td>
</tr>
<tr>
<td>S283</td>
<td>good</td>
<td>211</td>
<td>good</td>
</tr>
<tr>
<td>C86-34</td>
<td>fair</td>
<td>212</td>
<td>good</td>
</tr>
<tr>
<td>206</td>
<td>fair</td>
<td>213</td>
<td>fair</td>
</tr>
<tr>
<td>208</td>
<td>poor</td>
<td>214</td>
<td>good</td>
</tr>
</tbody>
</table>

Obviously these inbreds differ widely in ability to produce sound and well filled ears at Ames and Ithaca. R. A. Emerson.

7. Summary.

The lines most generally resistant to smut are, in order of greatest resistance: C86-34, 214, 206, S283, S42, 211. Line 206 showed the highest percentage of smut, but in most instances the infection was light and in the tassel only.

In rust susceptibility, line 208 showed the most infection, 209 and 211 much rust, and 206, 210, 212, 213, S42, and S293 some rust.

Bacterial blight was most injurious to lines S54, 209, C86, and S42. Lines 206, 208, and 210 were most resistant.

At both Ames and St. Paul, line 209 showed bad firing.

In set of seed, quality of ear, amount of lodging, there was little uniformity.
The following comments are of interest:

Line 211, "excellent". A. A. Bryan, Ames. Under Arlington Farm conditions, I don't think there is any question but that 208 is by far the best line of the whole lot. M. T. Jenkins. [Lines 206 and 210 were good except for lodging.]

The starred lines [206, 208, 211, 214] I consider good enough for use in crosses with genetic testers. C. R. Burnham*

My choice of these lines would be about as follows, starting with the best: 214, 206, 210, 213, 211, 208, 212. E. G. Anderson.

Line 208, very nice strain, vigorous. Lines S42, S283, 206, 210, 211, 212, 214 desirable types. 086-34 fair, 209 and 213 undesirable. H. K. Hayes.

From all these comments, it would seem that lines 206, 210, 211, 214 have rather wide adaptability and that, where rust and smut are not troublesome, line 208 may prove satisfactory. Sprague, however, reports that at Columbia, Mo., none of the lines have value.

8. Some cooperators have indicated a willingness to test these lines further and to include some of their own. Any of you, whether or not you helped in the test in 1935, who are willing to conduct a test in 1936, will be furnished seed in so far as it is available or can be obtained. If any of you have other inbred strains, thought to be highly resistant to diseases and which might be adapted to a relatively wide range of climatic conditions, I shall be glad to arrange for tests. We shall probably be unable, however, to handle any large number of strains.

VI. Special Notices

1. Manuscripts for inclusion in the proposed collective publication of papers on Linkage in Maize must reach me not later than March 31. (See I, above). Some of the data included in this news letter might well form the basis of short papers.

2. New seed stocks should be received at an early date - certainly by May 1 - so that plans can be made for their multiplication in the Cooperation garden.

3. Those having disease resistant inbred strains of possibly wide adaptability which they desire to have tested this year should indicate the fact at once and send seed by April 1. Those willing to cooperate in making the tests will please communicate with me at once.

R. A. Emerson,
Secretary
MAIZE GENETICS COOPERATION

NEWS LETTER

March 23, 1937

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
November 21, 1936

To Maize Geneticists:

Contributions of material for the Maize Genetics Cooperation letter are hereby requested. These should include anything that you think will be of value to other maize geneticists. The deadline is January 15.

Seed stocks of many of the genes reported have never been sent to the Co-op to be kept on file for use by other cooperators. This winter a special effort will be made to bring this collection up to date. Your prompt cooperation will be very much appreciated.

Sincerely yours,

Derald Langham
Secretary
To Maize Geneticists:

The information in this letter was contributed by a number of individuals, and has been organized into the following divisions:

I. General news items.
II. Collective publication of linkages.
III. Seed stocks grown in 1935.
IV. Seed stocks received for propagation in 1937.
V. List of genes not in Co-op.
VI. Tests of inbred strains for disease resistance.

Most of these reports are given almost verbatim but are not put in quotation marks because in numerous instances they have been somewhat condensed.

I. General News Items

Maize Genetics Cooperation, Ithaca, N. Y. —

1. Backcross data show that Hadjinov's barren stalk (bax) is allelomorphic to ba2.

2. Seed received from L. C. Raymond, Quebec, labelled "Sweet Brittle", produced plants with brittle stalks and leaves. These plants differed from brittle stalk (bkl Wiggans, unpub.) in that they were normal size, and greenhouse tests show that "Sweet Brittle" and bkl are not alleles.

3. Backcross data show that Hadjinov's branched silkless (bdx) is allelomorphic to Kempton's bd1 (chrom. 7).

D. G. Langham

Cornell University, Ithaca, N. Y. —

1. Data sent by Anderson, with supplementary data of mine, show that sr (chrom. 1) is to the left of P, rather than between P and br as previously announced, and suggest that ts2 is to the right of P. The following table includes the available data from three-point backcrosses:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>P + br</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Tl-5b +</td>
<td>242</td>
<td>71</td>
<td>108</td>
<td>28</td>
<td>449</td>
<td>Anderson</td>
</tr>
<tr>
<td></td>
<td>15.8%</td>
<td>24.1%</td>
<td></td>
<td>6.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P + br</td>
<td>195</td>
<td>60</td>
<td>58</td>
<td>19</td>
<td>332</td>
<td>Anderson</td>
</tr>
<tr>
<td>+ Tl-5c +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18.1%</td>
<td>17.5%</td>
<td></td>
<td>5.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ + Tl-5b</td>
<td>178</td>
<td>89</td>
<td>88</td>
<td>20</td>
<td>375</td>
<td>Anderson</td>
</tr>
<tr>
<td>sr P +</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23.7%</td>
<td>23.5%</td>
<td></td>
<td>5.3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There is some question about the locus of what is here designated Tl-10b. If it is between P and br as previously announced, then ts2 must be to the right of P. It is certain that sr is to the left of P, thus adding about 25 units to the length of the known linkage map of chrom. 1 and making it now approximately 150 units.

R. A. Emerson

2. Piebald (pbx), found in Emerson's cultures, seedlings and plants with large, indefinite patches of white and yellow. Classification good, viability fair. Chrom. 6. Linkage data from F2 crosses:

<table>
<thead>
<tr>
<th>Genes Phase</th>
<th>Xy</th>
<th>Xy</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>% recombinant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1 PbX CS</td>
<td>402</td>
<td>50</td>
<td>40</td>
<td>122</td>
<td>614</td>
<td>15.5</td>
</tr>
<tr>
<td>Pl PbX CS</td>
<td>239</td>
<td>14</td>
<td>29</td>
<td>34</td>
<td>316</td>
<td>16.5</td>
</tr>
</tbody>
</table>

These data indicate that pbx is located between Y1 and Pl in chrom. 6.

G. A. Lebedeff

3. I have just returned from Canal Point, Florida, where two weeks were spent in the examination of corn sporocyte material. A brief statement about the winter planting of corn in Florida, arranged for and supervised by Dr. Jenkins, may be of some general interest. It was an unusually warm winter down there. Corn planted at Canal Point from October 25 to 28 began shedding pollen in late December and Mr. Garrison had finished making most of the crosses in this material by January 20, some 2 or 3 weeks ahead of last year. A later planting on November 24 was beginning to reach the sporocyte stage January 10, and an abundant supply of sporocyte material equal in quality to that obtained during the summer here at Ithaca was
available during the following two weeks. Tassels were beginning to show in this planting on January 25.

The location at Canal Point is well-protected from frosts, the soil is well-adapted to corn, and corn smut which often does so much damage, especially to plants from which sporocyte samples are taken, seems to be entirely absent from that region. Birds, the ear worm, sugar cane borer, and other pests caused considerable damage this year, but it looked to me as if it should be possible to get at least a reasonably good winter crop down there most every year. A stunted condition possibly due to a length of day effect was noted in some lines, but other lines looked about as good down there as they do at home here in the north.

4. Studies on induced polyploidy and other genetic effects induced by heat treatments were continued during the past year. My stocks of tetraploid corn looked much better last year than ever before in spite of the generally unfavorable weather conditions; good vigor, and a very sturdy growth habit characterized a number of lines which were also highly fertile and in other respects looked very promising. Tetraploidy was induced in both the Durango and Florida types of annual teosinte. These experimentally induced tetraploids were entirely annual with no trace of the perennial habit which characterizes the tetraploid Euchlaena perennis from Mexico. One octoploid was also obtained and it wasn't perennial either, but was dwarfed and sterile like the corn octoploids.

5. Chemical analyses of the carotinoid content of tetraploid corn are under way in cooperation with Professor D. B. Hand, a biochemist, with a growing interest in the chemical basis of heredity. Preliminary results indicate that the meal from the tetraploid yellows has appreciably more of the active provitamin A carotinoids, cryptoxanthin and beta carotin, than the comparable diploid yellows. The diploid yellows differ widely in the amount of carotinoids present in the meal, and from some "non-yellows" yellow pigment has been extracted. With what we now know about the genetics of yellow endosperm from Perry and Sprague's recent paper and from the earlier work, and with the method which Professor Hand has perfected for separating chemically the various yellow pigments in corn meal, it should be possible to find out something about the chemistry of gene action.

6. Some progress was made last summer in the improvement of my multiple tester stocks with markers in each of the ten linkage groups. Stocks similar to those tested last year with one or more genes added are available for distribution in limited amounts.

L. F. Randolph

Connecticut Agricultural Experiment Sta., New Haven, Conn.

1. The character previously listed as threaded (th) has been found to be allelomorphic to striate (sr). An F2 population segregating for f1, bm2, and sr gave a recombination per cent of 25 for bm2 and sr, 25.5 for sr and ts2. The recombination percentage for sr and f1 was 59, or no linkage. This seems puzzling since ts2 and bm2 are 128 units apart. However, the population was small consisting of but 59 plants.
2. Trisomic stocks with chrom. 4 as the extra chrom. are available.

3. Unreported linkage of \( o_2 \) and \( r_{a1} \), and \( g_{l1} \) and \( ij \):

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xY</th>
<th>xy</th>
<th>Total</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>( o_2 ) R(a_1 )</td>
<td>RB</td>
<td>116</td>
<td>597</td>
<td>554</td>
<td>109</td>
<td>1376</td>
<td>225</td>
<td>16</td>
</tr>
<tr>
<td>( o_2 ) R(a_1 )</td>
<td>CB</td>
<td>127</td>
<td>15</td>
<td>15</td>
<td>112</td>
<td>269</td>
<td>30</td>
<td>11</td>
</tr>
<tr>
<td>( o_2 ) ( g_{l1} )</td>
<td>RS</td>
<td>3148</td>
<td>1595</td>
<td>1487</td>
<td>64</td>
<td>6294</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>( o_2 ) ( i_j )</td>
<td>RS</td>
<td>405</td>
<td>169</td>
<td>184</td>
<td>30</td>
<td>688</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>( o_2 ) ( v_{5} )</td>
<td>RS</td>
<td>758</td>
<td>353</td>
<td>328</td>
<td>13</td>
<td>1452</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

* These plants were grown in a warm greenhouse and hence the classification for \( v_{5} \) was difficult. All questionable plants were classified as \( v_{5} \). This percent is probably not reliable.

4. A three-point test involving \( o_2 \), \( g_{l1} \), and \( i_j \) gave the following counts:

<table>
<thead>
<tr>
<th>F(_1) genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>( o_2 ) + +</td>
<td>467</td>
<td>513</td>
<td>115</td>
<td>150</td>
<td>94 23</td>
</tr>
<tr>
<td>( + g_{l1} i_j )</td>
<td>980</td>
<td>17.5%</td>
<td>265</td>
<td>217</td>
<td>14.3%</td>
</tr>
</tbody>
</table>

The recombination percentages of \( o_2 \) and \( r_{a1} \) (repulsion phase), also \( o_2 \) and \( g_{l1} \) indicate that \( o_2 \) is to the left of \( v_{5} \) and within 2 or 3 units of \( v_{5} \). The percentages between \( o_2 \) and \( i_j \) indicate that \( o_2 \) is 2 or 3 units to the right of \( v_{5} \).

Stock of \( o_2 \) is available.

5. By wrapping developing ears of the composition of A B pl with different colored cellophane we found that the sun-red color will not develop when all but red light is excluded, Science 27, Vol. 84, No. 2187, pages 488 and 489. More selective filters have been obtained and we will try to locate definitely in 1937 the wave lengths of light responsible for the production of the sun-red pigment.

W. R. Singleton

6. Paired mosaics (twin spots) have been found to involve \( g \), \( g^{l} \), \( Pr \), \( P \), \( Wx \) and some unknown aleurone color modifiers. \( Wx \) twin spots are very faint and show only in certain material with light iodine staining. The evidence indicates that some unpaired spots start as paired mosaics but one or the other altered cell is non-viable or fails to produce tissue that reaches the surface. Unpaired \( c \) mosaic areas are usually larger and more numerous than twin spots involving the same gene in the same seeds. Many of these unpaired spots probably do not start as twin spots.

In \( G Wx \) heterozygous seeds both genes go together in about 60% of both twin spots and single spots and \( G \) alone in about 40%. A shift of \( Wx \) without \( G \) has not been observed. The dark part of a \( G Wx \) twin spot may also show a further change to colorless, normal or
still darker cells. In some cases these are twin spots within twin spots. Wx may shift with C the first time and not the second, or neither or both times.

Obviously these results can not all be accounted for by mutation, non-disjunction or deletion. Some kind of interchange between homologous or non-homologous chromosomes is indicated. Proof of an exchange between the C and Pr chromosomes is at hand in white and red paired mosaics in heterozygous C Pr seeds. Such mosaics are rare. Chromosomal aberration does not seem to be adequate to account for the frequent twin spots in which the two parts are equal in size and outline and crossing-over, between homologous chromosomes as shown by Stern for Drosophila (GENETICS 21:625-730) seems probable.

Proof of somatic crossing-over in plants will have to await further evidence. It may be found in 2N tissue where dominant linked genes are contributed from each parent. The 3N endosperm mosaics are not satisfactory for this purpose.

Translocation stocks having either Su or Pr with C and Wx are desired. Seed will be appreciated if such stocks are available.

Aleurone and endosperm mosaics vary in frequency in different families from none in a thousand seeds to thousands of mosaics on a single seed. They are easily seen with a low power binocular microscope. A Bausch and Lomb BKT5 microscope with a revolving drum and .7, 1 and 2x objectives and 10x eyepieces has been found convenient. The light is also important. In addition to the well-known plain spots and the twin spots that are frequent in some families, large cells, giant cells, depressions and outgrowths are easily seen. The growth changes may accompany color and other known gene changes and clearly result from somatic segregation. Depressions and outgrowths are sometimes paired, alone or with color changes. Somatic segregation has an important bearing on the cancer problem and any evidence should be put on record.

D. F. Jones

California Institute of Technology, Pasadena, Calif.

1. Chromosome 1. Striate (sr) seems to be definitely to the left of P, making the order sr-P-br-bm2. One interchange seems to be 2 units still further to the left.

2. Chromosome 2. Backcrosses involving Ch and a long inversion in chrom. 2 gave 136 recombinations out of a total of 447, or a recombination percentage of 30.4.

3. Chromosome 3. Three interchanges show close linkage with d1. The data are:

<table>
<thead>
<tr>
<th>% recombination with d1</th>
<th>Number of backcross plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-3d</td>
<td>0</td>
</tr>
<tr>
<td>T2-3c</td>
<td>0.2</td>
</tr>
<tr>
<td>T3-7b</td>
<td>0.4</td>
</tr>
</tbody>
</table>

4. Chromosome 4. Most interchanges show little crossing-over with su1. Of those tested the following are furthest away:
% recombination

T1-4a 0 with Ts
T1-6b 1.5 " 5
T2-4a 0.2 " Tu
Beyond g13
T2-4b 16.7 " "
T2-6b 15.0 " g13
T4-9b 22.0 " "


T8-10a 25.0 " J1
T8-10b 40.0 " J1

Distance from msg

Order

T -msg -J1 3-8a 7 139
" " 3-8b 33 182
4-8 34 114
(uncertain) 5-8 0.4 276
5-8 6-8 5 115
5-9b J1 27 95
8-10c " 27 11

(Distance between msg and J1 about 10 units in all these tests; data varies from 8.1 to 10.9).

E. G. Anderson

Iowa State College, Ames, Iowa


<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ts4 Gs1</td>
<td>CB</td>
<td>128</td>
<td>37</td>
<td>46</td>
<td>113</td>
<td>324</td>
<td>83</td>
</tr>
</tbody>
</table>

2. Chromosome 10.

<table>
<thead>
<tr>
<th>Og R</th>
<th>RB</th>
<th>55</th>
<th>193</th>
<th>178</th>
<th>62</th>
<th>488</th>
<th>117</th>
<th>24.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 genotype</td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1,2</td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Og + +</td>
<td>266</td>
<td>225</td>
<td>31</td>
<td>33</td>
<td>21</td>
<td>34</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>+ e1 e1</td>
<td>491</td>
<td>64</td>
<td>55</td>
<td>10.3%</td>
<td>8.9%</td>
<td>5</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>Og + r</td>
<td>68</td>
<td>77</td>
<td>17</td>
<td>25</td>
<td>10</td>
<td>21</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>+ e1 +</td>
<td>145</td>
<td>42</td>
<td>31</td>
<td>18.3%</td>
<td>13.5%</td>
<td>12</td>
<td>5.2%</td>
<td></td>
</tr>
</tbody>
</table>

3. Chromosome 4. Order of three linked genes is established by F2 data of small magnitude as: la-sup-w1.

E. W. Lindstrom

4. Further studies with plants hyperploid for the short arm of chrom. 5 show that secondary trisomes, involving the fragment chrom.,
are found in the progeny of hyperploid individuals. The breeding behavior of the fragment of hyperploid plants is as follows:

<table>
<thead>
<tr>
<th>Type of offspring in %</th>
<th>Fragment plant as female</th>
<th>Fragment plant as male</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N</td>
<td>70.0%</td>
<td>98.9%</td>
</tr>
<tr>
<td>2N + fragment</td>
<td>29.7%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Secondary trisomes</td>
<td>0.3%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

The above data show that the fragment chrom. is readily transmissible through the female side but only rarely do male gametophytes hyperploid for the fragment chrom. function. The frequency of secondaries, however, through the male side is as great, at least, as through the female side. Pollen from secondary trisomes gave only disomic offspring in the limited backcross tests made which indicates that pollen hyperploid for the "secondary" chrom. can not successfully compete with haploid grains. Among the questions to be answered are (1) How do the secondaries arise and (2) How do those male gametophytes from fragment plants which bring in the "secondary" chrom. manage to successfully compete with haploid pollen when pollen hyperploid for the fragment chrom. is rarely successful.

5. Hayes recently reported a new virescent linked with \( j_1 \) and therefore belonging in chrom. 3. This virescent was designated \( v_2 \). Trisomic tests showed that \( v_1 \) was in chrom. 8. Crosses made between \( v_1 \) and \( v_2 \) show them to be allelic.

6. \( v_{10} \) is linked with an endosperm color gene with \( 43\% \) recombination as shown by the following data:

<table>
<thead>
<tr>
<th></th>
<th>XY</th>
<th>Xy</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>% recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>816</td>
<td>241</td>
<td>226</td>
<td>108</td>
<td></td>
<td>1391</td>
<td>43</td>
</tr>
</tbody>
</table>

Tests are in progress to see whether \( v_{10} \) is in chrom. 2 or 6.

7. A new viable pale green is in chrom. 9 on the basis of trisomic tests.

8. \( F_2 \) linkage data places \( w_3 \) ten units to the left of \( l_2 \). The locus of \( l_2 \) has been shown by McClintock to be near the end of the short arm of chrom. 2, so \( w_3 \) must occupy a nearly terminal position in this arm.

9. A second occurrence of a chrom. fragment consisting of the short arm of chrom. 5 was found among the progeny of a disomic plant. This fragment is apparently identical with the one mentioned in item 4.

10. A new annual form of teosinte, resembling the Durango variety, was crossed by \( sh-wx \) maize. Five \( F_1 \) plants had approximately normal amounts of crossing-over in the \( sh-wx \) region while one \( F_1 \) plant showed no recombinations in this interval. The \( F_1 \) ears had 8-10 rows of seeds as contrasted with the usual 4-rowed ears found for \( F_1 \) hybrids of the other annual forms of Euchlaena. No segregation into types occurred when selfed and sibbed seed of the pure Euchlaena was grown. No admixture with maize was evident as the tassels had no main spikelet.
11. Small pollen (sp2) and lg are probably between $g_1$ and $l_i$ with the order $l_i$-sp2-lg-$g_1$-R. Plants trisomic for chrom 10, and having the constitution Sp2 Sp2 sp2 had about 20% small pollen (sp2) and about 80% normal pollen. This indicates that n+1 pollen of Sp2 sp2 constitution is of normal size and that sp2 is recessive to Spn in such gametophytes.

12. More data have been obtained on the dosage relation of Dt and $a_1$. Three levels of dosage for $a_1$ show a linear effect while increasing the dosage of the Dt gene, as shown by three dosage levels results in a non-linear effect. The genes Dt and $a_1$ interact to produce the dotted aleurone character.

13. Linkage data for chrom. 2.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>XY</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$l_g 1$</td>
<td>$W S_2$</td>
<td>RS</td>
<td>480</td>
<td>252</td>
<td>253</td>
<td>3</td>
<td>968</td>
</tr>
<tr>
<td>$G l_2$</td>
<td>$W S_3$</td>
<td>RS</td>
<td>251</td>
<td>100</td>
<td>85</td>
<td>9</td>
<td>414</td>
</tr>
<tr>
<td>$L g 1$</td>
<td>Al</td>
<td>RS</td>
<td>361</td>
<td>161</td>
<td>182</td>
<td>0</td>
<td>702</td>
</tr>
<tr>
<td>$G l_2$</td>
<td>Al</td>
<td>RS</td>
<td>128</td>
<td>66</td>
<td>50</td>
<td>2</td>
<td>246</td>
</tr>
</tbody>
</table>

14. Linkage data for chrom. 10.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>XY</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rp l_g</td>
<td>CS</td>
<td>1368</td>
<td>179</td>
<td>702</td>
<td>575</td>
<td>2824</td>
<td>18</td>
</tr>
<tr>
<td>*+sp2+</td>
<td>CB</td>
<td>529</td>
<td>130</td>
<td>223</td>
<td>314</td>
<td>341</td>
<td>1393</td>
</tr>
<tr>
<td>$l_g + l_i$</td>
<td>CB</td>
<td>657</td>
<td>33</td>
<td>48</td>
<td>314</td>
<td>341</td>
<td>1393</td>
</tr>
</tbody>
</table>

*(could not classify for sp2 because of drouth and heat damage). Previous data have shown about 3% recombination for sp2 and lg, and sp2 to be fairly close to $g_1$. These facts together with the above data indicate the order is $l_i$-sp2-lg-$g_1$.

M. M. Rhoades

15. Linkage data for chrom. 10.

<table>
<thead>
<tr>
<th>$F_1$ genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rp + r</td>
<td>179</td>
<td>161</td>
<td>109</td>
<td>114</td>
<td>31</td>
</tr>
<tr>
<td>+ $g_1$</td>
<td>340</td>
<td>223</td>
<td>340</td>
<td>223</td>
<td>61</td>
</tr>
<tr>
<td>+ 1l $g_1$</td>
<td>223</td>
<td>90</td>
<td>40</td>
<td>13</td>
<td>366</td>
</tr>
</tbody>
</table>

*(seedlings inoculated in flats and only resistant individuals transplanted to field, to prevent spreading the rust to other cultures).
Singleton reported 35% recombination between D7-G1 and 27% between D7-R. This suggests the order is G1-R-D7, but might be different. However, if D7 falls to the left of R it should show fairly strong linkage with R, but it does not. Therefore the order in chrom. 10 is:

\[
\begin{array}{cccc}
\text{R} & \text{1} & \text{G1} & \text{R} \\
0 & 28 & 43 & 57 \\
\end{array}
\]

V. H. Rhoades

16. The following data were obtained from three-point tests involving g1l, l1, and bd7:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ + bd</td>
<td>344</td>
<td>271</td>
<td>37</td>
<td>26</td>
<td>1167</td>
</tr>
<tr>
<td>g1l l1 +</td>
<td>615</td>
<td>63</td>
<td>5.4%</td>
<td>38.8%</td>
<td>3.1%</td>
</tr>
</tbody>
</table>

17. Data were obtained on a dominant or partially dominant character which we have been calling knotted leaf and designating by the symbol Kn kn. A full description has not been published. Superficial observations indicate a more rapid growth of the vascular tissue, resulting in a kinking or knotting of the veins. Plants known to be heterozygous for this character usually make normal growth with only an occasional knot on the leaf blade and a slight knotting of the leaf sheath. Other plants proven to be homozygous were so badly knotted that the tassels could not make their appearance without assistance.

Backcross data were obtained in 1933 on 531 plants and in 1936 on 252 plants involving the genes f, ts2, and Kn. The combined data for the two years are as follows:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ + Kn</td>
<td>171</td>
<td>125</td>
<td>101</td>
<td>161</td>
<td>783</td>
</tr>
<tr>
<td>ts2 f1 +</td>
<td>296</td>
<td>262</td>
<td>125</td>
<td>16.0%</td>
<td>12.8%</td>
</tr>
</tbody>
</table>

A marked deficiency of f1 plants in 1933 made interpretation of the data doubtful. The results in 1936, however, were very similar to those in 1933.

Backcross stocks involving the genes for br, f1, bm2, and Kn were obtained this year for classification in 1937.

A. A. Bryan

University of Missouri, Columbia, Missouri

1. G16 and G1g have become mixed some time in the past and the stocks of G1g which have been distributed are G16. An ultra-violet induced glossy is tentatively assigned the symbol G1g.
The linkage relations of \( G_{16} \) are listed below:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>St G16</td>
<td>RS</td>
<td>339</td>
<td>175</td>
<td>77</td>
<td>1</td>
<td>592</td>
<td>10.0</td>
</tr>
<tr>
<td>Fr G16</td>
<td>RS</td>
<td>305</td>
<td>169</td>
<td>154</td>
<td>0</td>
<td>638</td>
<td>8.5 (if 1 xy)</td>
</tr>
<tr>
<td>V12 G16</td>
<td>RS</td>
<td>148</td>
<td>74</td>
<td>93</td>
<td>1</td>
<td>316</td>
<td>10.5</td>
</tr>
</tbody>
</table>

2. \( G_{10} \) (not the one reported by Emerson) is in the 9th linkage group. A small \( F_2 \) repulsion gave no double recessives with \( wx \).

3. Intercrosses were made between 16 newly-acquired glossies and glossies 1-10 inclusive. Due to the unfavorable season, seed was not obtained from many of the crosses. However, crosses were complete enough to suggest that this group included some new glossies.

4. Intercrosses have been made between Hadjinov's and the writer's glossies. The following identities have been established: \( H \times g_3 = g_{14} \); \( H \times g_{10} = g_{13} \); \( H \times g_{15} = g_{10} \); \( H \times g_{16} = g_{16} \) (see News Letter of March 4, 1935, page 3). His stock designated \( G_{12} \) did not segregate and his stock \( g_{19} \) has been lethal under conditions at Columbia.

5. Seed has been sent of a new dominant character tentatively designated "vestigial glume" with symbol \( V_g \). In the presence of the dominant allele \( V_g \) there is almost complete suppression of glumes in both the staminate and pistillate inflorescence.

G. F. Sprague

6. The following list of mutants is submitted as a sample of the types of mutant observed following treatment of pollen with ultra-violet radiation. The list includes the seed and seedling character mutations observed in experiments recently reported (Proc. Nat. Acad. Sci. 22:572-576) in which unfiltered radiation from a commercial quartz mercury vapor arc was used. Similar mutants have been observed in later experiments.

Many of the mutants listed are of little value for general genetic purposes, because of lethality or low viability, or in a few cases, because of overlapping the normal type. In (2), (15), and (33) the parent \( F_1 \) plant had defective pollen, but the mutant appeared to be unrelated to the factor causing the pollen defect. In all other cases the parent \( F_1 \) plant had normal pollen so far as could be determined by pollen examination. It is possible that among the mutant seed characters reported there may be included instances of small seed due to heterozygous deficiencies not manifested by defective pollen development. Tests against this possibility have not yet been completed.

<table>
<thead>
<tr>
<th>Mutant</th>
<th>Description (seedling character)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) red leaf</td>
<td>dark to faint red coloration in seedling leaves</td>
<td>not distinct on mature plants</td>
</tr>
<tr>
<td>(2) virescent yellow-green</td>
<td>some seedlings virescent yellow green, others near white</td>
<td>possibly two separate mutants; may be associated with small seed</td>
</tr>
</tbody>
</table>

184
<table>
<thead>
<tr>
<th>Mutant</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) glossy-a</td>
<td>glossy seedling with possibly some normal overlap</td>
<td>occurred with a small seed, unlinked</td>
</tr>
<tr>
<td>(4) yellow green-a</td>
<td>clear yellow green, later develops necrotic areas and dies</td>
<td></td>
</tr>
<tr>
<td>(5) virescent yellow green-b</td>
<td>nearly pure yellow at emergence; turns green</td>
<td>probably a usable mutant</td>
</tr>
<tr>
<td>(6) rolled</td>
<td>early seedling leaves tightly rolled and adherent</td>
<td>many die but a few survive to produce normal mature plants</td>
</tr>
<tr>
<td>(7) dwarf</td>
<td>dwarf seedling and plant</td>
<td>not induced; possibly a recurrence of dwarf 3; closely linked with wx</td>
</tr>
<tr>
<td>(8) corrugated</td>
<td>leaves narrow with well marked corrugation</td>
<td>occurred with aleurone spot; original material showed complete association with aleurone spot</td>
</tr>
<tr>
<td>(9) virescent yellow green-c</td>
<td>nearly pure yellow on emergence, gradually turns a greenish yellow</td>
<td>probably a usable mutant</td>
</tr>
<tr>
<td>(10) speckled</td>
<td>seedling leaves prominently speckled and semi-dwarf</td>
<td></td>
</tr>
<tr>
<td>(11) yellow green-b</td>
<td>seedlings distinct yellow green; do not green up in seedling stage</td>
<td>may be viable</td>
</tr>
<tr>
<td>(12) glossy-b</td>
<td>clear glossy</td>
<td>indication of linkage with pr; tentatively designated as glg</td>
</tr>
<tr>
<td>(13) virescent yellow</td>
<td>seedlings appear luteus with slight greening</td>
<td>lethal</td>
</tr>
<tr>
<td>(14) yellow green-c</td>
<td>segregates for yellow green and white seedlings</td>
<td>occurred with a germless, unlinked</td>
</tr>
<tr>
<td>(15) white tip</td>
<td>seedling leaves have a distinct white tip; present also on some mature plants</td>
<td>occurred with an unassociated pollen segregation</td>
</tr>
<tr>
<td>Mutant</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>(16) germless-a</td>
<td>1/8-1/4 normal size</td>
<td>deficiency of small seeds</td>
</tr>
<tr>
<td>(17) small-a</td>
<td>1/10-3/4 normal size; very irregular shape</td>
<td>occurred with a virescent yellow green, unlinked</td>
</tr>
<tr>
<td>(18) small-b</td>
<td>very small and poorly developed</td>
<td>all aborted seeds are germless, but some normal size germless seeds present</td>
</tr>
<tr>
<td>(19) aborted</td>
<td>clear separation, approximately 25% recessive type</td>
<td>many small seeds are germless</td>
</tr>
<tr>
<td>(20) small-c</td>
<td>seeds normal in height and width, reduced in thickness</td>
<td>occurred with a glossy seedling, unlinked</td>
</tr>
<tr>
<td>(21) small-d</td>
<td>seeds reduced in size and characteristically scarred</td>
<td>occurred in check, not induced</td>
</tr>
<tr>
<td>(22) miniature-a</td>
<td>variable in size with probable normal overlap</td>
<td>occurred with seedling character corrugated</td>
</tr>
<tr>
<td>(23) miniature-b</td>
<td>seed size reduced but with probable normal overlap</td>
<td>continued deficiency of small seeds</td>
</tr>
<tr>
<td>(24) miniature-c</td>
<td>aaleurone layer absent in scattered areas over the seed</td>
<td>small seeds are germless</td>
</tr>
<tr>
<td>(25) aaleurone spot</td>
<td>aaleurone layer absent in scattered areas over the seed</td>
<td>small seeds are germless</td>
</tr>
<tr>
<td>(26) small-e</td>
<td>seeds normal width and 1/4 -3/4 normal height and thickness</td>
<td>only slight deficiency of small</td>
</tr>
<tr>
<td>(27) germless-b</td>
<td>seeds normal in size</td>
<td>marked deficiency of germless seeds</td>
</tr>
<tr>
<td>(28) miniature-d</td>
<td>seeds about 1/2 normal size, some normal overlap</td>
<td>all miniature seeds are germless</td>
</tr>
<tr>
<td>(29) small-f</td>
<td>seed reduced in size</td>
<td>small seeds are germless</td>
</tr>
<tr>
<td>(30) gnarled</td>
<td>seeds small and variously mis-shapen</td>
<td></td>
</tr>
<tr>
<td>(31) shriveled</td>
<td>seeds poorly developed and shriveled</td>
<td>shriveled are also germless</td>
</tr>
</tbody>
</table>
Further information regarding these mutants will be included in a research bulletin of the Missouri Agricultural Experiment Station. C. F. Sprague and L. J. Stadler.

**Agricultural Experiment Station, College Station, Texas**

1. Several years ago we reported a new type of sugary, "amylaceous sugary," the inheritance of which depends upon two factors, one of which, su$_{am}^1$, is allelomorphic to su$_1$, the other du being located in chromosome 10. The genotype su$_{am}^1$ su$_1$ Du Du is indistinguishable from pure starchy, while the genotype su$_{am}^1$ su$_1$ su$_{am}^1$ du du is a good sugary though not as wrinkled and translucent as ordinary sugary. Since the presence of the du gene in homozygous condition can convert su$_{am}^1$ su$_1$ from starchy to sugary, it occurred to us that this same gene might have a similar effect on ordinary sugary, su$_1$ su$_1$, converting it to a "super sugary." Chemical analyses of ordinary sugary, su$_1$ su$_1$ Du Du and "super sugary," su$_1$ su$_1$ du du, have been made which confirm this assumption. The former has 48.7 per cent total sugars, the latter 62.6 per cent. Several commercial sweet corn varieties are now being converted to "super sugary" by introducing the du gene through repeated backcrossing to determine whether this gene will have any value in practical sweet corn breeding.

2. In a stock derived from a cross of Tripsacum and Zea, comprising 20 Zea and 1 Tripsacum chromosomes, the extra Tripsacum chromosome carries the allelomorph of the sugary gene. This chromosome shows regular, though not complete pairing with the first chromosome of Zea and not with fourth on which the sugary$_1$ gene is located in Zea.

3. Tripsacum is apparently homozygous for the A factor. Its composition with regard to the C, R, and Pr factors is being determined.
4. Corn seedlings left in refrigerator for brief periods showed frequent islands of tetraploid tissue in root tips. Treatment of ears with dry ice soon after pollination has not produced any tetraploid plants.

5. A new gene for premature germination, or vivipary, is linked with su1. A new gene which causes a peculiar mottling of the endosperm appears to be a usable endosperm character. Linkage tests are being made.

6. Observations for several years have indicated that B factor causes plants to bloom earlier. Extensive data this season on date of anthesis in B and b plants from same segregating progenies show no significant difference.

7. A study has been in progress for several years to determine whether the marked differences between Euchlaena and Zea are genic and whether the genes which differentiate the two genera can be located on definite chromosomes. Four chromosomes have been studied, using marker genes from corn, and it has been found that the V-P1 genes are definitely linked with genes for number of tassel branches, B-lg1 genes are linked with genes for height of stalk, number of tillers, number of leaves, number of ears, and number of tassel branches. Waxy gene is linked with genes for number of tillers, number of leaves, and number of ovules per ear. su1Tu genes are linked with genes for height of stalk, number of leaves, number of ears, number of tassel branches, length of ear, number of rows of ovules and number of ovules. So far as the results go they indicate that the genes which differentiate Zea and Euchlaena are scattered at random over all the chromosomes.

P. C. Mangelsdorf and R. G. Reeves

University of Wisconsin, Madison, Wisconsin -

1. Linkage data on Chrom. 3:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xx</th>
<th>xy</th>
<th>Total</th>
<th>% recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G2-D1</td>
<td>RS</td>
<td>241</td>
<td>89</td>
<td>85</td>
<td>13</td>
<td>428</td>
</tr>
<tr>
<td>Rs-Ra2</td>
<td>CB</td>
<td>61</td>
<td>12</td>
<td>41</td>
<td>77</td>
<td>197</td>
</tr>
</tbody>
</table>

Severe drought injury made accurate classification of or and g2 impossible. The g2-d1 results, however, indicate that g2 may be in chrom. 3.

<table>
<thead>
<tr>
<th>Genes</th>
<th>% recombination</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Lg2</td>
<td>39</td>
</tr>
<tr>
<td>A - Ra2</td>
<td>45</td>
</tr>
<tr>
<td>Lg2-Ra2</td>
<td>54</td>
</tr>
</tbody>
</table>

The data of these two tables (together with earlier findings) indicate that the ra2 locus is in the neighborhood of d1, probably between d1 and or.

R. A. Brink
University of West Virginia, Morgantown, W. Va. -

1. Linkage data on Chromosome 2:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>XY</th>
<th>% recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL-E</td>
<td>CB</td>
<td>30</td>
<td>15</td>
<td>15</td>
<td>43</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>RB</td>
<td>50</td>
<td>127</td>
<td>118</td>
<td>57</td>
<td>34</td>
</tr>
</tbody>
</table>

2. Linkage test with su2:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ P1 +</td>
<td>189</td>
<td>64</td>
<td>118</td>
<td>33</td>
<td>352</td>
</tr>
<tr>
<td>Y1 + su2</td>
<td>352</td>
<td>116</td>
<td>66</td>
<td>6</td>
<td>486</td>
</tr>
</tbody>
</table>

(sSeparation of Y1-y1 poor, especially in su2 class)

C. R. Burnham

Bureau of Plant Industry, Washington, D.C. -

1. Recent morphological studies of the chromosomes of strains of Indian corn and of teosintes from the experiment station at Chapingo near Mexico City have shown several strains in which chromosome 10 is abnormal. This chromosome has a piece attached to the end of the long arm about the length of its short arm. This piece is much knobbed and at present nothing definite can be said concerning its origin.

A small quantity of both corn and teosinte seed carrying this abnormality are available for distribution.

A. E. Longley

2. In connection with making the corrections in the linkage summary pointed out on page 3 of the March 4 Maize Genetics Letter, I note on page 43 that w is listed as reported by Demerec 1923B. I assume that this should be changed to Lindstrom as on page 25.

F. D. Richey

II. Collective Publication of Linkages

Some of the linkage data presented in this News Letter would seem suitable material for a general linkage paper to be published. (see News Letters of March 6 and November 30, 1935, and March 4, 1936).

If the authors of these data will signify their desire to have it published as presented in this News Letter or will rewrite it in the form they prefer, we will attempt to make arrangements for having it published this summer. If others of you with similar data will send it to the Co-op. not later than April 10, we shall be glad to include it in this publication.

In the News Letter of March 4, 1936, Dr. Emerson gave some very good suggestions regarding the manner of arranging the linkage data: "Manuscripts should be typed and ready for publication without change. When new genes are involved, a short, concise description of the characters differentiated by them might well be included."
Well-known genes should not require such treatment. Tables should be presented in summary form. Different cultures involving the same kind of data should not be listed separately unless that is essential in order to demonstrate significant differences between them. Of course $F_2$ and backcross data for coupling and repulsion must be entered separately in the tables. A single frequency distribution may often be displayed in the text to better advantage than in a table. Tables of data should be accompanied by such discussion only as is essential to make clear any points not obvious from an examination of the tabular data themselves, or as is necessary to indicate the relation of the unreported observations to other linkage tests, etc. The tabular arrangement and headings used in the Linkage Summary are convenient and I, naturally, think them good. No limit can be set now to the length of the individual contributions, but, unless a very considerable amount of data are presented, individual papers might well be kept to not over one or two pages of printed matter, and it is my hope that some may be not more than half that long".

III. Seed Stocks Grown, 1936

Inbred strains. Selfed or sibbed ears of all the inbred strains in disease resistance test.

\[ su_1 g_1^3 Y_1 l a_1 x a_1^4 \] (allel to la$_1$)

r Pr$_1$ mr (mottled aleurone–Horovitz) may seg. g$_1$

Homo. A$_1$ C R a$_2$ bt$_1$ bv pr$_1$

Homo. A$_1$ C R a$_2$ bt$_1$ bv pr$_1$ seg. v$_2$

Homo. A$_1$ C R A$_2$ bt$_1$ bv pr$_1$

Inbred line of supergold pop corn (Jenkins)

seg. cultures of y$_4$ y$_4$ It It x Y$_4$ Y$_4$ it it

y$_4$ y$_4$ It It a$_1$ c r pr$_1$ i

Trisomics 3, 5, and 6

Sweet Brittle (L. C. Raymond)

seg. cultures of l$_1$ g$_1$ s$_2$ b x l$_1$ g$_1$ s$_2$ b v$_4$

" " " yt x a$_1$ na ts$_4$

" " " a$_1$ Dt x a$_1$ l$_g_2$ B Pl

" " " a$_2$ x v$_2$ pr$_1$ bm$_1$ A$_1$ C R

" " " R g$_1$ n$_l$ l x zb$_5$
No germination:

d7 g1 x glg
A1C r sh wx y1 prl Su/su1 x dx

Too late:

val

10 pkges. of seed from Australia

(Note: this seed from Australia is of various inbred strains, developed at Queensland Agricultural High School and College, which show seedling characters such as fine-stripe and virescent. These characters ought to be studied in a region with a longer growing season than at Ithaca. A small amount of this seed is available for distribution.)
IV. Seed Stocks Received for Propagation in 1937

1. A. A. Bryan, Ames, Iowa:--
   \[br_1 \text{bm}_2 \text{kn} x \frac{+ + + \text{Kn}}{br_1 \text{bm}_2 +} \]
   \[+ + \text{bd} x \text{gl}_1 \text{ij} \text{bd} \]

2. R. A. Brink, Madison, Wisconsin:--
   \[A_1 \text{lg}_2 \times A_1 \text{lg}_2 \text{ts}_4 \text{d}_1 \]
   \[a_1 \text{lg}_2 \text{ra}_2 \]
   \[a_1 \text{lg}_2 \text{d}_1 \times A_1 \text{lg}_2 \text{d}_1 \text{ts}_4 \]

3. G. F. Sprague, Columbia, Missouri:--
   \[b \text{gs}_2 \text{lg}_1 \]
   \[\text{Vg} x \text{vg} \]
   \[\text{vg} \]

4. J. Shafer, Pasadena, California:--
   (inbred x sb)#
   (sb x A b pl Y\text{M} su_2)#
   \[vl \text{su}_2 \]

5. A. E. Longley, Washington, D.C.:--
   Indian maize carrying an extra piece attached to chrom. 10.
   Teosinte (Tecubaya) carrying an abnormality similar to that
   found in the Indian maize stock.

   Teosinte from Mexico-
   Novocayan, from the hacienda of that name near Durango City
   (from the same place as the original Durango seed).
   Nobogame, from the town of that name in Southwestern Chihuahua.
   Represents the farthest north for teosinte.
   Trampas, from near northern border of Durango.

7. G. A. Lebedeff, Ithaca, New York:--
   \[pb_1 \text{wx} \text{yl} \]
   \[pl \text{sm} x \text{pb}_1 \]

8. S. Horowitz, Buenos Aires, Argentina:--
   \[J_{33a} \text{ (dominant japonica)} x A_1 \text{c R} \text{sh} \text{wx} \text{B pl} \]

   Chlorophyll types -
   Yellowish green seedlings
   Dark green
   Rather light green
   Medium to light green
   Good foliage, leaves broad, excellent in general appearance
   Yellow stripe
10. R. A. Emerson, Ithaca, N. Y.:
\[ \begin{align*}
+ & \frac{gl_3 +}{su_1 +} (X) \\
+ & \frac{Ts_5}{wl +} su_1 (X) \\
+ & \frac{su_1 gl_3}{wl +} (X) \\
+ & \frac{Ts_5}{la +} su_1 (X)
\end{align*} \]

11. C. A. Krug, Sao Paulo, Brazil:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Numbers</th>
<th>Characteristics</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amarello</td>
<td>41B-1B</td>
<td>segregating mealy endosperm</td>
<td>(3:1)</td>
</tr>
<tr>
<td>&quot;</td>
<td>47-1</td>
<td>&quot;brown pericarp&quot; bp ?</td>
<td>(3:1)?</td>
</tr>
<tr>
<td>Crystal</td>
<td>83-1-4</td>
<td>seg. dwarf plants</td>
<td>(3:1)?</td>
</tr>
<tr>
<td>&quot;</td>
<td>96-4-1</td>
<td>seg. tassel seed</td>
<td>(3:1)?</td>
</tr>
<tr>
<td>&quot;</td>
<td>97-1</td>
<td>&quot;ragged&quot; Rg ?</td>
<td>(3:1)?</td>
</tr>
<tr>
<td>&quot;</td>
<td>111-2-3</td>
<td>&quot;oily spots&quot; (blotched leaf)?</td>
<td>3:1</td>
</tr>
<tr>
<td>&quot;</td>
<td>119-6</td>
<td>branched ear (homozygous)</td>
<td></td>
</tr>
<tr>
<td>Amarello</td>
<td>129-1-1</td>
<td>striped leaves</td>
<td>3:1</td>
</tr>
<tr>
<td>Crystal</td>
<td>134-2-1</td>
<td>semi-dwarfs</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>137-1-3</td>
<td>seg. zebra seedling leaves</td>
<td>3:1</td>
</tr>
<tr>
<td>Amarello</td>
<td>146-1</td>
<td>semi-dwarfs (homozygous)</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>149-2</td>
<td>&quot;rolled leaves&quot; ro ?</td>
<td>3:1</td>
</tr>
<tr>
<td>Crystal</td>
<td>150-1-1a</td>
<td>seg. defective endosperm</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>156</td>
<td>&quot;rolled leaves&quot; ro? (homo.)</td>
<td>3:1</td>
</tr>
<tr>
<td>Negro</td>
<td>164-2-1</td>
<td>colored pericarp and aleurone</td>
<td></td>
</tr>
<tr>
<td>Morango</td>
<td>189 A</td>
<td>variegated pericarp</td>
<td></td>
</tr>
<tr>
<td>Amparo</td>
<td>242</td>
<td>seg. defective endos. sh ?</td>
<td>3:1</td>
</tr>
<tr>
<td>Crystal</td>
<td>256</td>
<td>bracts in the tassel</td>
<td></td>
</tr>
<tr>
<td>Amarello</td>
<td>254-1</td>
<td>male sterility</td>
<td>3:1</td>
</tr>
<tr>
<td>&quot;</td>
<td>256-1</td>
<td>zebra-striped leaves (homo.)</td>
<td></td>
</tr>
<tr>
<td>Hickory King</td>
<td>267</td>
<td>defective cob Rw1, Rw2 (?)</td>
<td></td>
</tr>
<tr>
<td>Crystal</td>
<td>280-1</td>
<td>&quot;crinkly&quot; or ? (homo.)</td>
<td></td>
</tr>
</tbody>
</table>

V. List of Genes Not in Co-op

The genes that have been reported and are not in the Cooperative Collection are listed below. If you have any of these genes in your seed stocks, will you kindly send us a few seeds so that we may get a stock for the Co-op? Your cooperation will be greatly appreciated by all who are interested in having available in a central repository a complete set of maize genetic seed stocks.

\[ \begin{align*}
& a_3 \\
& gl_{10} \\
& gm_e \\
& gm_1 \\
& ad_2 \\
& gm_2 \\
& gm_3 \\
& gm_4 \\
& an_2 \\
& Rs \\
& l_1 \\
& l_5
\]
VI. Tests of Inbred Strains for Disease Resistance

Last spring seed of five inbreds furnished by Wiggans, one by Hayes, one by Kvakan, three by Bryan, and five by Singleton were sent to eight cooperators in various parts of the United States. The severe drouth and heat in some areas made possible a good comparison of the inbred lines in regard to resistance to firing.

The following tables and supplementary notes on the inbreds are received by the Co-op.:
Arlington Experiment Farm, Rosslyn, Virginia -

<table>
<thead>
<tr>
<th>Line</th>
<th>Date Silked</th>
<th>Total No. Plants</th>
<th>Erect No. Plants</th>
<th>Smutted No. Plants</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 206</td>
<td>7/30</td>
<td>27</td>
<td>3</td>
<td>0</td>
<td>Very little pollen</td>
</tr>
<tr>
<td>Co 206</td>
<td>7/26</td>
<td>34</td>
<td>13</td>
<td>0</td>
<td>Good line</td>
</tr>
<tr>
<td>Co 210</td>
<td>7/30</td>
<td>36</td>
<td>1</td>
<td>2</td>
<td>Pollen 5 or 6 days later than silks</td>
</tr>
<tr>
<td>Co 211</td>
<td>7/26</td>
<td>33</td>
<td>21</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Co 214</td>
<td>7/26</td>
<td>29</td>
<td>17</td>
<td>0</td>
<td>Very good line</td>
</tr>
<tr>
<td>S283</td>
<td>7/30</td>
<td>14</td>
<td>12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>I 234</td>
<td>8/10</td>
<td>29</td>
<td>17</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Dr 276 A</td>
<td>8/10</td>
<td>30</td>
<td>9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>WD 456 A2</td>
<td>8/2</td>
<td>23</td>
<td>22</td>
<td>1</td>
<td>Light green &amp; spotted</td>
</tr>
<tr>
<td>Kvakan 6991</td>
<td>7/30</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>Too early. Entirely unsuited to Arlington</td>
</tr>
<tr>
<td>Singleton C2</td>
<td></td>
<td>25</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>C6</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>C13</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>C85</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>C78</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ames, Iowa -

The season in Iowa was so unfavorable that observations must not be taken too seriously. Early lines were more affected by these conditions than the later lines. No attempt was made to hand-pollinate any ears. Under open-pollination the set of seed was fair on some lines and poor on others.

The season was good for testing smut resistance, the smut infection being about as heavy as in 1935. The following notes were made on the inbred lines:

C 206: Free from smut; no firing of leaves, tassels good, ear shoots good but poorly filled; roots weak; plants about 5' high; ears about 1 1/2 to 2' high; not very promising.

C 208: Smutted ears on about 30% of the plants; tassels good; one or two top leaves fired; plants erect; ear shoots good but not very well filled; tendency toward 2-eared condition and some multiple earing; rather promising stock except for the smutting of the ears.

C 210: One smutted plant in a total of 36; roots weak, badly lodged; not at all promising.

C 211: No smutted plants; extremely early, very short plants; produced considerable seed; a useful stock.

C 214: No smut; roots very weak; unproductive; not promising.

S 283: No smut; early; lodging-resistant, at least until late in the season when a tendency toward stalk-breaking became apparent; produced a fair amount of seed for the season; probably a useful line.

Kvakan 6991: About one-third of the plants had bud smut; stalks weak, broke badly; not promising.

I 234: Rather late compared to others in this group but also relatively good; only two smutted plants in a total of 33 (bud smut); good set of seed; promising but possibly rather late for general use.
Dr 2764: Two suckers with ear smut and one plant with stalk smut just below the ear; short, thick, well-filled ears; very weak roots; not especially promising.

WD 456A2: Four plants with small bud smut galls near the base of the plant; no lodging; ears fairly well-filled with seed of excellent quality; poor pollen producer; relatively late; an excellent line for Iowa conditions but probably too late for general use.

Sweet Corn Lines: All of these lines were so extremely early and made such poor growth under the prevailing conditions that fair judgment can hardly be passed upon them. They were nearly or quite smut-free. Numbers C6, C13, C78, and C85 had a fair set of seed. They are not promising for our conditions.

A. A. Bryan

Columbia, Missouri -

<table>
<thead>
<tr>
<th>Line</th>
<th>Firing Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 214</td>
<td>yellow green in color; no ear shoots</td>
</tr>
<tr>
<td>S 283</td>
<td>tassels were blasted on 7/6; first silk appeared 7/9</td>
</tr>
<tr>
<td>Co 206</td>
<td>wilted badly followed by firing and tassel blasting; tassels blasted 7/15</td>
</tr>
<tr>
<td>Co 208</td>
<td>little firing but tassels blasted 7/15</td>
</tr>
<tr>
<td>Co 210</td>
<td>little firing but tassels blasted 7/16</td>
</tr>
<tr>
<td>Co 211</td>
<td>upper leaves fired; tassels blasted 7/9</td>
</tr>
<tr>
<td>Kvakan 6991</td>
<td>very slender stalk; yellow green color; tassels blasted 7/9; first silks 7/11</td>
</tr>
<tr>
<td>Dr 276 A</td>
<td>lower leaves fired 7/17; pollen shed 7/17</td>
</tr>
<tr>
<td>WD 456 2A</td>
<td>silked 7/13; all tassels blasted by 7/17</td>
</tr>
<tr>
<td>Bryan 234</td>
<td>upper leaves fired 7/15; first silks 7/20</td>
</tr>
</tbody>
</table>

No rust, bacterial blight or smut was noticed in these cultures. None of the strains produced ears.

G. F. Sprague
Durham, North Carolina –

<table>
<thead>
<tr>
<th>Approximate order of adaptability</th>
<th>Number of diseased plants observed</th>
<th>Maturity</th>
<th>Miscellaneous observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (good)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.*Dr 276-A</td>
<td>0 Smut, 0 Rust</td>
<td>late</td>
<td>general appearance</td>
</tr>
<tr>
<td>2.*Co 208</td>
<td>0 Smut, 13(50%) Rust</td>
<td>med.</td>
<td>sturdy</td>
</tr>
<tr>
<td>3.*S 283</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>Rust injury negligible</td>
</tr>
<tr>
<td>4.*WD 456-A2</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>two plants runty</td>
</tr>
<tr>
<td>Group 2 (fair)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Co 210</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>seg. small plants</td>
</tr>
<tr>
<td>6. Kvakan 6991</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td></td>
</tr>
<tr>
<td>7. I 234</td>
<td>1(5%) Smut, 0 Rust</td>
<td>late</td>
<td></td>
</tr>
<tr>
<td>Group 3 (poor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(not in order)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 85</td>
<td>1(5%) Smut, 0 Rust</td>
<td>med.-late</td>
<td>Two &quot;F1 hybrids&quot; ruled out.</td>
</tr>
<tr>
<td>#Co 211</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>General appearance</td>
</tr>
<tr>
<td>Co 214</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>satisfactory</td>
</tr>
<tr>
<td>Co 206</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>Very few seeds on</td>
</tr>
<tr>
<td>C 13</td>
<td>0 Smut, 0 Rust</td>
<td>early</td>
<td>open-pol. ears</td>
</tr>
<tr>
<td>C 2</td>
<td>0 Smut, 0 Rust</td>
<td>med.</td>
<td>Not much pollen; probably protandrous</td>
</tr>
<tr>
<td>C 6</td>
<td>0 Smut, 0 Rust</td>
<td>med.-early</td>
<td></td>
</tr>
</tbody>
</table>

* eight to 20 hand-pollinations in each of these inbreds.

# all pollination failures were of same date. This inbred may deserve better rating.

Conditions prevailing here last summer were in general too favorable to afford a rigorous test. The weather was consistently hot but rainfall was adequate (for late plantings which included these inbreds). No firing, no lodging, and no bacterial blight was observed. The infrequency of smut and rust infection in the inbred lines may not mean much, since my cultures generally suffered little from smut and rust.

I had occasion to use some of these inbreds in crosses and also made a few self and sib pollinations in each line. The rating as to adaptability is based largely on the results of these pollinations. The proportion of successful pollinations and the yield of grain resulting provided a basis for rating.

H. S. Perry
Morgantown, West Virginia -

<table>
<thead>
<tr>
<th>Line</th>
<th>Height (inches)</th>
<th>% lodging bent</th>
<th>No. lodged</th>
<th>% lodging system</th>
<th>% Smut</th>
<th>No. Plants</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryan 276 A</td>
<td>44</td>
<td>24</td>
<td>12</td>
<td>fair</td>
<td></td>
<td>39</td>
<td>Very short ears</td>
</tr>
<tr>
<td>&quot; 274 X</td>
<td>70</td>
<td>0</td>
<td>0</td>
<td>v. good</td>
<td>0</td>
<td>25</td>
<td>#1 of Iowa lines, late</td>
</tr>
<tr>
<td>&quot; 456 A2</td>
<td>65</td>
<td>0</td>
<td>0</td>
<td>v. good neck 10.3</td>
<td>29</td>
<td></td>
<td>#2 of Iowa lines,</td>
</tr>
<tr>
<td>Co 206</td>
<td>53</td>
<td>72</td>
<td>9</td>
<td>fair neck 7.7</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co 208</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>v. good neck 7.7</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smut check</td>
<td></td>
<td></td>
<td></td>
<td>gen'l 26.3</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co 210</td>
<td>60</td>
<td>0</td>
<td>33</td>
<td>fair</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Co 211</td>
<td>42</td>
<td>0</td>
<td>0</td>
<td>poor</td>
<td>0</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Co 214</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>poor</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>S 283</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>good</td>
<td>0</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Wiggins 206-32(X)*</td>
<td>65</td>
<td>90</td>
<td>0</td>
<td>fair+ ear 3.8</td>
<td>52</td>
<td></td>
<td>stalks break down early</td>
</tr>
<tr>
<td>&quot; 211-10(X)</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>good</td>
<td></td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>&quot; 212-18(X)</td>
<td>54</td>
<td>20</td>
<td>15</td>
<td>fair below ear 1.5</td>
<td>66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot; 210-11(X)*</td>
<td>64</td>
<td>15</td>
<td>10</td>
<td>fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot; 209-13(X)</td>
<td>46</td>
<td>70</td>
<td>0</td>
<td>----</td>
<td>0</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Smut check</td>
<td></td>
<td></td>
<td></td>
<td>gen'l 54.9</td>
<td>51</td>
<td></td>
<td>stalks break down early</td>
</tr>
<tr>
<td>Wiggins 206-9(X)</td>
<td>58</td>
<td>5</td>
<td>5</td>
<td>good</td>
<td>0</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Hayes S-42</td>
<td>58</td>
<td>0</td>
<td>10</td>
<td>fair</td>
<td>0</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Singleton C78,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 13, 0 85,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 2, 0 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Planted late and on different plot, no smut. May be able to run this 1938

* These are considered the best lines.

C. R. Burnham
<table>
<thead>
<tr>
<th>Pedigree</th>
<th>Date of Pollination</th>
<th>Erectness</th>
<th>No. plants</th>
<th>Smut plants</th>
<th>Good ears</th>
<th>Rust 1-10</th>
<th>Row No.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 206</td>
<td>8/15</td>
<td>/</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>1</td>
<td>14-16</td>
</tr>
<tr>
<td>Co 208</td>
<td>8/13</td>
<td>/</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>6</td>
<td>12-14</td>
</tr>
<tr>
<td>Co 210</td>
<td>8/20</td>
<td>(</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>* Co 211</td>
<td>8/15</td>
<td>(</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>5?</td>
<td>12</td>
</tr>
<tr>
<td>** Dr 276 A</td>
<td>8/21</td>
<td>/</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>* WD 456 A2</td>
<td>8/20</td>
<td>/</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td>24</td>
<td>0</td>
<td>14-16</td>
</tr>
<tr>
<td>I 234</td>
<td>?</td>
<td>/</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>16-18</td>
</tr>
<tr>
<td>** Co 214</td>
<td>?</td>
<td>/</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>** S 283</td>
<td>8/13</td>
<td>/</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>0</td>
<td>12-16</td>
</tr>
<tr>
<td>Kvakan 6991</td>
<td>8/15</td>
<td>(</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>2</td>
<td>14-16</td>
</tr>
</tbody>
</table>

* good ** very good
Inbred line | Smut | Rust | Ears | Maturity | Plant Type
---|---|---|---|---|---
Co 206 | Some ear smut | 1 | fair | med. | weak stalk
Co 208 | Badly smutted | 2 | poor | med. | very desirable
Co 210 | Moderate amt. | 2 | poor | med. | slender stalk
Co 211 | Trace | 1 | good | med. | sturdy plants
Co 214 | 0 | 2 | good | early | sturdy plants
S 283 | 0 | 3 | fair | med. | very weak
WD 456-A2 | Trace | 1 | good | late | rel. sturdy
Dr. 276A | 0 | 1 | good | late | short, sturdy
I 234 | Trace | 1 | good | late | rel. sturdy
Kvakan 6991 | Moderate amt. | 4 | v.poor | med. | lodged badly

(Rust notes taken latter part of Sept., rating is 1-5)

No bacterial blight and very little firing.

Inbred Co 211 is the most desirable one of this group for Ithaca. It excels in the favorable combination of suitable maturity, resistance to smut, good plant type, good ears, and vigor. It did show some top firing, however.

Co 206 has excellent plant type and proper maturity, but it has much tassel and ear smut. Bryan's inbreds Dr 276A, I 234, and W.D. 456A2 are eliminated only because of maturity. They are too late for Ithaca.

D. G. Langham

Summary

A general summary of the above tables approaches impossibility, and may not be desirable, anyway, because certain inbreds are best adapted to certain localities. We note, however, that inbreds WD 456-A2, Co 208, Co 211, and S 283 met with the greatest approval and should be included in the test another year. Perhaps inbreds Dr 276A, I 234, Co 210, and Co 206 should also be tested further.

Several of the cooperators in this test of inbred lines for disease resistance have suggested that a uniform system of taking notes on the different inbreds be established. What is your opinion in the matter? If those of you who are interested will send to the Co-op. the type of form that you prefer for this purpose, we will attempt to combine the best suggestions into one blank to be used in 1937.

Any of you who would like to conduct this test on disease resistance in 1937 will please notify us soon. If you have some inbreds that are quite resistant to disease and have desirable plant type, we should like to include them in the test this year. There is, of course, a limit to the number of inbreds we can handle properly.

D. G. Langham

Secretary
March 6, 1938

The data presented here are not to be used in publications without the consent of the authors.

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
November 17, 1937

To Maize Geneticists:

Contributions of material for the annual Maize Genetics Cooperation news letter is hereby requested. Any new linkage data, methods, hypotheses, suggestions, or anything else that you think may be of interest to other maize workers will be incorporated in this news letter. Since it is desirable to have the information presented in a somewhat uniform system, it is suggested that you refer to some of the previous Co-op News Letters for ideas concerning the nature of your write-up. In order to be included in this News Letter your material must be received by the Co-op not later than January 15, 1938.

Several years ago when a number of maize geneticists found that they were unable to get their linkage data published in some of the leading journals, they conceived the idea of combining their relatively small papers into one larger paper and publishing collectively. This suggestion was approved by the Editor of Genetics, and the Secretary of the Maize Genetics Cooperation signified his willingness to collect the individual papers for the publication. But to date only one paper has been received by the Co-op. Perhaps the reason for this lack of response from maize workers has been due to some misunderstanding of the plan. With this possibility in mind, it may be advisable to quote from a recent letter to Dr. Dunn, Editor of GENETICS:

"The Maize Genetics Cooperation circular letter does not constitute publication and none of the material in it may be quoted except by permission of the author. Much of the material in this Co-op News Letter is not complete, but rather is merely some ideas and indications which the men have obtained in their studies and are willing to pass on to other workers in this field to speed up progress with maize. Some of the material, however, is more complete and should be published so that it will be more readily available to other geneticists. This latter type of material will be included in the Co-op News Letter in the same form as in previous circular letters. But it will also be written up in a different manner to be included in the collective publication."
"The details of the method of handling the material in the proposed collective publication of linkage studies in maize will, of course, have to be worked out cooperatively between the publisher and the Maize Genetics Cooperation. During the several years that this idea of collective publication has been discussed among maize workers, the following plan has been formulated. Each cooperator who has linkage data which he considers useful and of permanent value to other geneticists, shall write a short paper in the same manner as he would if he were to publish independently. Then each of these papers will be sent to the Secretary of the Maize Genetics Cooperation, who will group them into one larger paper with an introduction, etc., and will serve as author of the collective paper. The important point is that each short paper will be an individual and separate unit within this larger paper, with the name and address of the author affixed to it. The Secretary of the Maize Genetics Cooperation shall be responsible for the organization and composition of the whole collective paper, but the respective authors of the 'unit papers' shall be responsible for their data. This means that any citation from the collective publication must include the name of the maize worker who furnished that particular data."

Dr. Dunn has written:

".....there is nothing in the policy of GENETICS to interfere with publication of maize linkage data in the form you suggest. Our numbers early in the year are likely to be the heaviest so May or July publication would fit our schedule best. Submission of the first paper in February would be most convenient for us."

It is suggested that you write your contribution to the News Letter first; then excerpt certain linkage data from it and write a separate paper(s) to be included in the collective publication. The particular data which you select for publication will appear in both the News Letter and the group publication. For further information concerning the general form of a linkage paper, see the Co-op News Letter of March 4, 1936, page 2; or March 23, 1937, page 15.

Sincerely yours,

D. G. Langham
D. G. Langham, Secretary
To Maize Geneticists:-

A number of maize geneticists have already sent in their items for the annual Co-op News Letter, and many of you probably have your contributions in the mail now. The final date for the receipt of material for this 1938 Letter is January 31st.

In the circular letter of November 17, 1937, I discussed the proposed collective publication of linkage data in such detail that the cardinal points were apparently lost in the shuffle. In brief, the plan is that linkage papers, any one of which in itself would not be sufficient for separate publication, will be sent to the Secretary of the Maize Genetics Cooperation who will group them in much the same manner as in BIOLOGICAL ABSTRACTS and send them to the Editor of GENETICS for publication. Each unit paper must be written as if it were to be published independently. No alterations or additions will be made by the Secretary of the Co-op.

In order to be included in this collective publication, your paper must be received by the Co-op not later than March 31, 1938.

Sincerely yours,

D. G. Langham
To Maize Geneticists:

The material in this letter was obtained from many sources, and has been organized under the following heads:

I. General News Items.
II. Seed Stocks Grown in 1937.
III. Seed Stocks Received For Propagation in 1936.
IV. Miscellaneous Co-op Items.
V. Gene Index of all the Co-op letters.
VI. Chromosome Maps of Maize.
   A. Regular map: few genes, loci fairly definite.
   B. Working map: many genes, loci not well established.

Most of the information in this letter is given as it was received by the Co-op, but a few changes were made in some of the tables to conform to the accepted system of arrangement.

I. General News Items

University of Minnesota, St. Paul, Minn. -

1. Zebra seedling, \( z_{B_4} \), has been located in chromosome 1 by the following studies.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xY</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( z_{B_4} ) Br</td>
<td>RS</td>
<td>448</td>
<td>142</td>
<td>152</td>
<td>12</td>
<td>754</td>
<td>31.1</td>
</tr>
<tr>
<td>( z_{B_4} ) F_1</td>
<td>RS</td>
<td>455</td>
<td>135</td>
<td>158</td>
<td>9</td>
<td>757</td>
<td>28.0</td>
</tr>
<tr>
<td>( z_{B_4} ) Bm_2</td>
<td>RS</td>
<td>487</td>
<td>103</td>
<td>144</td>
<td>23</td>
<td>757</td>
<td>46.0</td>
</tr>
<tr>
<td>( z_{B_4} ) P</td>
<td>CS</td>
<td>266</td>
<td>24</td>
<td>5</td>
<td>64</td>
<td>359</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Progeny of 1 ear indicated that the P parent was heterozygous giving the following segregation:

| CS | 63 | 30 | 2   | 24  | 199 | 6.7 |

2. A culture of \( r_{a_2} \) received from Dr. Brink at Wisconsin proves to be similar to the one I have studied for many years. There is some variability in type of ear, some cultures showing rudimentary male flowers on the tips of some ears, irregularity of rows on the cob but no division of the cob as in \( r_{a_1} \). Other cultures have a divided cob on the tip of the ear but a solid cob at the base. \( R_{a_1} \) can be separated from \( r_{a_2} \) in the F_2 of a cross.

H. K. Hayes
3. Virescent seedling. A virescent seedling in Minn. #13 corn was found to be linked with japonica and given the symbol \( v_{21} \). Rhoades (Co-op News Letter, March 23, 1937) has found \( v_{16} \) and \( v_{21} \) to be allelic after trisomic tests had placed \( v_{16} \) also in chromosome 8. Further linkage data of \( j_{1}, mg \) and \( v_{16} \) are as follows:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( J_{1} V_{16} )</td>
<td>RB</td>
<td>82</td>
<td>565</td>
<td>542</td>
<td>71</td>
<td>1260</td>
</tr>
<tr>
<td>( J_{1} V_{16} )</td>
<td>RS</td>
<td>354</td>
<td>149</td>
<td>154</td>
<td>4</td>
<td>661</td>
</tr>
<tr>
<td>( J_{1} M_{sg} )</td>
<td>CS</td>
<td>464</td>
<td>39</td>
<td>23</td>
<td>135</td>
<td>661</td>
</tr>
<tr>
<td>( M_{sg} V_{16} )</td>
<td>RS</td>
<td>337</td>
<td>150</td>
<td>171</td>
<td>3</td>
<td>661</td>
</tr>
</tbody>
</table>

The order of the genes appears to be \( j_{1} - mg - v_{16} \).

4. Zebra striped. Emerson et al. list five cases of zebra striping that have been reported. There are two types, one that is expressed in the seedling stage and which may completely disappear in partly grown plants. The type reported here was obtained from an inbred line of Del Maiz sweet corn furnished by J. D. Barnard of the Minnesota Valley Canning Company. The season in 1936 was very hot and dry. Germination of sugary seeds was much lower than normal. Zebra striping could not be classified until late summer when the weather was cooler. Classification was difficult in some cultures. The results given in the summary indicate \( zb_{6} \) is located in group 4.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( zb_{6} Tu )</td>
<td>CS</td>
<td>410</td>
<td>64</td>
<td>64</td>
<td>90</td>
<td>628</td>
</tr>
<tr>
<td>( zb_{6} Gl_{3} )</td>
<td>RS</td>
<td>326</td>
<td>148</td>
<td>135</td>
<td>19</td>
<td>628</td>
</tr>
<tr>
<td>( Tu Gl_{3} )</td>
<td>RS</td>
<td>314</td>
<td>160</td>
<td>147</td>
<td>7</td>
<td>628</td>
</tr>
<tr>
<td>( zb_{6} Su_{1} )</td>
<td>CS</td>
<td>4227</td>
<td>259</td>
<td>175</td>
<td>361</td>
<td>5022</td>
</tr>
</tbody>
</table>

The order of the genes appears to be \( Su_{1} - zb_{6} - Tu - Gl_{3} \).

H. K. Hayes and M. S. Chang

University of Missouri, Columbia, Missouri

1. Of the unknown glossies grown in 1937, tests were completed on one which was found to be different from the other ten and has been assigned the symbol \( gl_{11} \). This was an X-ray induced mutant. One of the ultra-violet induced glossies proved upon test to be \( gl_{2} \). Tests on three others have not been completed.
In a previous report it was stated that somewhere along the line $g_{16}$ and $g_{18}$ had been confused and the present stocks of these are identical. Since the symbol $g_{18}$ has been used in print for the glossy on the 5th chromosome, this designation has been retained and a new glossy assigned the symbol $g_{16}$.

2. Glossy 7 has been tested with $J_1$ msg with no indication of linkage:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$g_{17} J_1$</td>
<td>CS</td>
<td>159</td>
<td>22</td>
<td>40</td>
<td>9</td>
<td>230</td>
<td>43</td>
</tr>
<tr>
<td>$g_{17}$ msg</td>
<td>CS</td>
<td>148</td>
<td>23</td>
<td>51</td>
<td>8</td>
<td>230</td>
<td>50</td>
</tr>
</tbody>
</table>

3. The inheritance of yellow endosperm color is more complex than has been generally believed. Evidence is available for the presence of at least one gene in addition to $Y_1$ and $Y_3$ which is concerned with the presence or absence of yellow endosperm pigment. Ratios of 3:1, 9:7, 15:1, 45:19 and others possibly more complex have been obtained.

The yellow scutellum gene $sy$ is able to produce its effect in the presence of $Y_1 Y_1$, but in the presence of other recessive whites the development of pigment (carotin) is completely suppressed. The factor or factors involved have not been completely identified.

G. F. Sprague

John Innes Horticultural Institution, London, England —

1. Experiments on the inheritance of quantitative characters commenced by Dr. Brieger were continued during the summers of 1936 and 1937. The ultimate aim is to produce varieties of sweet corn which are early enough for the English climate and yet satisfactory in yield. In a comparison of F1 families and their parents it was found that the application of a pseudo-factorial method of analysis (Yates, 1936) is not warranted for field trials with maize. The efficiency of the experiment when treated as a 3 x 3 x 3 pseudo-factorial arrangement was about 60% of that when treated as a simple randomised block lay-out.

C. D. R. Dawson

Connecticut Agricultural Experiment Station, New Haven, Conn. —

1. The evidence so far obtained indicates that mosaics in maize are due to losses or rearrangements of chromosome segments rather than to somatic crossing over as Stern finds for Drosophila. Paired mosaics involving different chromosomes have been found for nearly all of the easily identified endosperm characters. In seeds heterozygous for $C$ and $Pr$ the following results have been obtained:

<table>
<thead>
<tr>
<th>White Spots</th>
<th>Red Spots</th>
<th>Red and White Paired Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>8409</td>
<td>1061</td>
</tr>
<tr>
<td>Ratio</td>
<td>227</td>
<td>29</td>
</tr>
</tbody>
</table>

   37  1
These figures indicate a more or less random exchange between the 60 chromosome arms in this triploid tissue.

The secondary paired mosaics (twin spots within the dark part of primary twin spots) can not be accounted for by somatic crossing over but are understandable on the basis of translocation followed by further breaking at other places. Variegated waxy tissue in areas that have previously lost the C gene show an unstable condition that would not be expected from somatic crossing over. Similar variegation has been found involving C, Pr, and Su.

In seeds resulting from the pollination of C wx by c Wx light and dark aleurone twin spots were found indicating a shift of one C allele. If this resulted from an exchange of homologous segments the endosperm underlying the dark part of the twin spot should be waxy. In many such twin spots examined no waxy areas were found.

D. F. Jones

Agricultural Experiment Station, College Station, Texas

1. The most important development in Texas during the past year is the discovery that the essential differences between Zea and Euchlaena are not due to numerous genes scattered at random over all the chromosomes as we first thought, but are due to four chromosome segments which are transmitted in inheritance in almost the same manner as single genes. The fact that these segments all carry genes similar to those possessed by Tripsacum, and the simultaneous discovery that short segments of the chromatin arc interchanged between Zea and Tripsacum in hybrids of these two genera, has led us to the conclusion that teosinte is nothing more than maize with several translocation segments from Tripsacum superimposed upon the maize germplasm; the product of a natural hybrid between Zea and Tripsacum.

Two of these translocation segments have been located by linkage studies. They occur at opposite ends of chromosome 4 and both show linkage with Su and Tu. These translocation segments from Tripsacum are probably the cause of the unpaired terminal segments which Longley has observed in his cytological studies of the hybrid of maize and teosinte. We have verified his observations on the occurrence of these segments but we are not yet certain that they occur in every case on the chromosomes which he has designated.

The differences between the various kinds of teosinte which have been collected in Guatemala and Mexico may be attributed partly to the differences in the maize to which these translocation segments have been added, and partly to a loss of portions of one or more segments as the result of repeated hybridization with maize.

These new facts reopen the entire question of the origin of
maize. With teosinte as a recent development out of the picture, it is reasonable to assume that maize originated from pod corn, which in the homozygous condition is frequently a perfect flowered plant similar to the Andropogonae, and which has the essential characteristics of a plant adapted to survival in the wild. The place of origin was probably in South America, either in Peru or Bolivia.

We suspect that the crossing of South American types of maize with Tripsacum to produce the new genus Euchlaena, has also resulted in some new types of maize previously not in existence, such as the pointed pop corns and the long slender flint and flour corns, neither of which are known in Peru or Bolivia. If this is the case most of our North American maize varieties, with the possible exception of the Southern Courd-seed types, carry Tripsacum genes in their germplasm. It is possible that the knobs which many of our North American corn exhibit on the chromosomes have been received from Tripsacum via Euchlaena, in which case we are quite likely to find some South American varieties which are lacking in knobs.

These hypotheses suggest a number of genetic and cytological tests which will keep us well occupied for a number of years. We are having some difficulty in locating viable seed of Bolivian and Peruvian maize and if any of the readers of this letter have such seed available we should appreciate receiving some of it.

P. C. Mangelsdorf and R. G. Reeves

The following linkage data were obtained from the backcross:

\[
+ + \frac{Kn}{br} f_1 + \frac{bm_2}{br} f_1 kn bm_2 \]

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>1,2</th>
<th>1,3</th>
<th>2,3</th>
<th>1,2,3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>165</td>
<td>182</td>
<td>14</td>
<td>4</td>
<td>50</td>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>347</td>
<td>18</td>
<td>100</td>
<td>2.8%</td>
<td>15.6%</td>
<td>15.5%</td>
<td>2.7%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Recombination percentages: \(br-f_1 7.2\), \(br-Kn 26.1\), \(br-bm_2 35.2\), \(f_1-Kn 27.0\), \(Kn-bm_2 24.1\).

These data do not agree completely with the present accepted location of \(br\) and \(f_1\). On the basis of these data \(Kn\) is located closer to \(br\) than to \(f_1\) but it must be between \(f_1\) and \(bm_2\). After more extensive tests in 1937 the writer is doubtful that homozygous knotted plants can be distinguished from the heterozygous plants.

2. A tall late type of plant with about 50 per cent more nodes than the normal was discovered among the plants from an \(F_2\) selfed
ear from the Krug variety. Plants of this type were crossed with several normal stocks in 1936 and the F1 progenies were grown in 1937. All of the F1 plants were normal. A similar type was found in 1936 among the plants from another F2 selfed ear from the Krug variety.

A. A. Bryan

California Institute of Technology, Pasadena, Calif.

1. Correlation between cytology and map position in chrom. 1.

<table>
<thead>
<tr>
<th>Cytological Position</th>
<th>Linkage Map Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI-2c</td>
<td>S .7</td>
</tr>
<tr>
<td>TI-9c</td>
<td>S .6</td>
</tr>
<tr>
<td>TI-2b</td>
<td>S .4</td>
</tr>
<tr>
<td>TI-6c</td>
<td>S .3</td>
</tr>
<tr>
<td>TI-3a</td>
<td>S .25</td>
</tr>
<tr>
<td>TI-9a</td>
<td>L .25</td>
</tr>
<tr>
<td>TI-5b</td>
<td>L .25</td>
</tr>
<tr>
<td>TI-5c</td>
<td>L .25</td>
</tr>
<tr>
<td>TI-6b</td>
<td>L .25</td>
</tr>
<tr>
<td>TI-6a</td>
<td>br - 13.4 - T</td>
</tr>
<tr>
<td>TI-3d</td>
<td>near br</td>
</tr>
<tr>
<td>TI-7c</td>
<td>L .3</td>
</tr>
<tr>
<td>TI-7a</td>
<td>L .4</td>
</tr>
<tr>
<td>TI-10a</td>
<td>L .4</td>
</tr>
<tr>
<td>TI-7b</td>
<td>L .6</td>
</tr>
<tr>
<td>TI-9b</td>
<td>L .6</td>
</tr>
<tr>
<td>TI-2a</td>
<td>L .6</td>
</tr>
<tr>
<td>TI-5a</td>
<td>L .6</td>
</tr>
<tr>
<td>TI-4a</td>
<td>L .6</td>
</tr>
<tr>
<td>TI-7d</td>
<td>L .6</td>
</tr>
</tbody>
</table>

2. Chocolate. In the distal part of long arm of chrom. 2. Homozygous long inversion gave the linkage order:

lg1-44-vl4-32-B-25-Ch

As the inversion includes about 4/5th of the long arm, Ch must be very near the end.

E. G. Anderson

3. Ms20. Backcross tests with the following chromosome alterations show no obvious linkage:

Inversion of chrom. 2 (near B and beyond vl4)
T2-4b (2 near vl4, 4 beyond e13)
T2-3c (2 near sk, 3 near d1)
T4-8a (4 near su, 8 near spindle attachment)
4. Correlation between cytology and map position in chromosome 2.

<table>
<thead>
<tr>
<th>Cytological Position</th>
<th>Linkage Map Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2-3a</td>
<td>S .75</td>
</tr>
<tr>
<td>T2-6b</td>
<td>S .65</td>
</tr>
<tr>
<td>T2-9a</td>
<td>S .6 (?)</td>
</tr>
<tr>
<td>T1-2b</td>
<td>B + 2.2</td>
</tr>
<tr>
<td>T2-3c</td>
<td>B - 2.7 - T = 23.7 - v4</td>
</tr>
<tr>
<td>T2-3d</td>
<td>B - 5.3 - T = 30.9 - v4</td>
</tr>
<tr>
<td>T2-4d</td>
<td>B - 6.0 - T = 28.0 - v4</td>
</tr>
<tr>
<td>T2-9b</td>
<td>B - 13.3 - T = 12.4 - v4</td>
</tr>
<tr>
<td>T2-5a</td>
<td>B - 18.0 - T = 6.0 - v4</td>
</tr>
<tr>
<td>T2-7b</td>
<td>B - 22.5 - T = 7.2 - v4</td>
</tr>
<tr>
<td>T2-10a</td>
<td>B - 25.0 - T = 7.0 - v4</td>
</tr>
<tr>
<td>T2-6c</td>
<td>B - 28.2 - T = 14.6 - v4</td>
</tr>
<tr>
<td>T2-7a</td>
<td>B - 36.5 - T = 6.0 - v4</td>
</tr>
<tr>
<td>T2-4a</td>
<td>v4 + 1.1</td>
</tr>
<tr>
<td>T2-7c</td>
<td>v4 + 1</td>
</tr>
<tr>
<td>T2-5b</td>
<td>v4 + 1.6</td>
</tr>
<tr>
<td>T2-4b</td>
<td>v4 + 5.3</td>
</tr>
<tr>
<td>T2-4c</td>
<td>v4 + 7.7</td>
</tr>
<tr>
<td></td>
<td>v4 + 35.0 - T</td>
</tr>
</tbody>
</table>

I. M. Clokey and E. G. Anderson

5. Linkage of sb. Slit blade is probably not on chromosome 6 where first reported:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>Xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1 Sb</td>
<td>RS</td>
<td>930</td>
<td>249</td>
<td>306</td>
<td>84</td>
<td>1569</td>
<td>50</td>
</tr>
<tr>
<td>F1 Sb</td>
<td>RS</td>
<td>478</td>
<td>135</td>
<td>154</td>
<td>49</td>
<td>816</td>
<td>48</td>
</tr>
<tr>
<td>Su2 Sb</td>
<td>RS</td>
<td>896</td>
<td>265</td>
<td>340</td>
<td>68</td>
<td>1569</td>
<td>43</td>
</tr>
<tr>
<td>P1 Sb</td>
<td>RS</td>
<td>1165</td>
<td>328</td>
<td>352</td>
<td>68</td>
<td>1913</td>
<td>50</td>
</tr>
</tbody>
</table>

The Y was not certainly, but probably, Y1. In any case, sb is not between Y1 and py.

6. Sb is not on chromosome 2.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>Xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lg1 Sb</td>
<td>RS</td>
<td>288</td>
<td>95</td>
<td>76</td>
<td>35</td>
<td>494</td>
<td>50</td>
</tr>
<tr>
<td>Gl2 Sb</td>
<td>RS</td>
<td>288</td>
<td>92</td>
<td>78</td>
<td>36</td>
<td>494</td>
<td>50</td>
</tr>
</tbody>
</table>

sb x trisome 2:

| Culture 1 | 6  |
| Culture 2 | 187|
| Culture 3 | 126|
|           | 319|
If \( s_b \) were on chromosome 2 there should be about 30 \( s_b \) plants; if on some other chromosome, about 100.

Notes: \( S_b \) is generally readily classifiable, though quite variable. Many of the plants are fully fertile. Usually the ratio is about as expected, though in two of my cultures the ratio was about 3:1 (\( F_2 \) seed). This was not due to lethality of \( s_b \), for nearly all of the seeds grew. In \( A \) \( B \) \( F_1 \) plants the slitting of the blades seemed less developed than in green plants.

J. Shafer

University of Wisconsin, Madison, Wisconsin

1. Linkage of \( r_{a2} \).

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_r ) ( r_{a2} )</td>
<td>( R_B )</td>
<td>14</td>
<td>26</td>
<td>22</td>
<td>3</td>
<td>65</td>
<td>26.1</td>
</tr>
</tbody>
</table>

This is further evidence indicating that the \( r_{a2} \) locus may be near that of \( d_1 \).

R. A. Brink

Arlington Experiment Farm, Arlington, Virginia

1. The dominant \( D t \) gene has been reported (1936) to produce dots of aleurone color on \( a_1 \)-tester seeds. The nature of the interaction between \( D t \) and \( a_1 \) was unknown at that time. It has now been established that \( D t \) causes \( a_1 \) to become unstable and to mutate at a rate thousands of times greater than normal. Mutations of \( a_1 \) in the presence of \( Dt \) can be detected in aleurone, husks, and leaves i.e. plant color, and pericarp tissue. Recessive \( a_1 \) mutates to the \( A_1 \) allele a thousand times as frequently as to the \( a_1^D \) allele. There is no chromosome abnormality present in the \( Dt \) line. The \( a_1 \) gene is in chromosome 3 while \( Dt \) may belong to chromosome 9. Mutations of \( a_1 \) to \( A_1 \) or \( a_1^D \) occur late in development in all tissues. It is not possible, at least by the writer, to reconcile these data with any of the hypotheses advanced by Schultz, Stern or Patterson to explain variegation. They seem, however, to agree with Demerec's conception of increased mutability being caused by a chemical or physiological condition produced in the cell. Recessive \( a_1 \) is highly stable in the presence of \( dt \). The \( Dt \) gene is specific in its effect on \( a_1 \). No other recessive locus including \( a_2 \), \( c \), \( f \), \( l_{e1} \), \( wx \) and \( su \) is affected. A dominant modifying gene reducing the frequency or rate of mutation has been isolated. There is some evidence of a recessive gene affecting the time of mutation.

2. The following data on the location of \( w_{s3} \) show the order to be as follows:

\[
\begin{align*}
\text{w}_{s3} & \quad \text{l}_{e1} & \quad \text{g}_{12} & \quad \text{B} \\
0 & \quad 1 & \quad 1 & \quad 4 & \quad 9
\end{align*}
\]

These four genes are all located in the short arm of chromosome 2 and if the \( R_S \) or \( r_S \) alleles are used with \( B \) all of them can be classified in the seedling stage.
Trisomic tests show \( V_{10} \) is in chromosome 6. Since \( V_{10} \) gave 43% recombination with \( V_1 \) it will fall near the end of either the long or short arm. Tests with \( PV \) will be made this spring.

Preliminary results indicate that the pollen tube is not parasitic but is dependent for its growth in the silk upon the starch stored in the pollen grain.

There is a highly significant increase in crossing over in the \( A_2-Bt \) and \( Bm_1-Pr \) regions of chromosome 5 in microsporocytes as compared with megasporocytes. In a "low" line there was 7.6% recombination between \( A_2-Bt \) in the female gametes contrasted with 12.2% in the male gametes. Similar differences between the frequency of crossing over in the two sexes is the explanation of the inexplicable difference found by the writer (1936) in crossing over for the \( Bm_1-Pr \) region in plants hyperploid for the short arm of chromosome 5 as compared with diploid sibs. The hyperploid individuals had been used as the male parent while the diploid sibs had been used as the female.

M. M. Rhoades

Cornell University, Ithaca, New York

1. In the News Letter of March 23, 1937, pp. 1, 2, it was shown by means of three-point tests involving the genes \( sr, P, \) and \( br \) and the translocations \( Tl-5a \) and \( Tl-5c \), that the order of the genes is \( sr - P - br \) with the translocation breaks between \( P \) and \( br \). Backcross data from 476 individuals were also presented suggesting that \( ts_2 \) is between \( P \) and what was then called \( Tl-10b \) but now designated \( Tl-2c \).

Records of the past summer presented below show that \( Tl-2c \) is to the left of \( P \) very near \( sr \), that \( ts_2 \) is to the left of \( P \) with \( m_{37} \) presumably to the left of \( ts_2 \), and that \( Tl-3a \) and \( Tl-9c \) are probably to the right of \( P \). The data are as follows:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>( XY )</th>
<th>( Xy )</th>
<th>( xy )</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Sr ) ( Tl-2c )</td>
<td>CB</td>
<td>151</td>
<td>1</td>
<td>1</td>
<td>144</td>
<td>297</td>
</tr>
</tbody>
</table>
Two of the cultures reported above involving Tl-2c with B of chromosome 2 and P and ts₂ of chromosome 1, gave the following data from B Tl-2c + P + + ts₂ + +

<table>
<thead>
<tr>
<th>F₁ genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ts₂ P + + Tl-5b</td>
<td>76</td>
<td>93</td>
<td>1</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>+ +</td>
<td>169</td>
<td></td>
<td></td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td>ms₁₇ P + + Tl-5b</td>
<td>26</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>+ +</td>
<td>51</td>
<td></td>
<td></td>
<td>5</td>
<td>5.7%</td>
</tr>
<tr>
<td>ts₂ P + + Tl-3a</td>
<td>106</td>
<td>140</td>
<td>3</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>+ +</td>
<td>246</td>
<td></td>
<td></td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>ms₁₇ P + + Tl-3a</td>
<td>54</td>
<td>33</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>+ +</td>
<td>87</td>
<td></td>
<td></td>
<td>2</td>
<td>2.0%</td>
</tr>
<tr>
<td>sr P + + Tl-9c</td>
<td>38</td>
<td>32</td>
<td>24</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>+ +</td>
<td>70</td>
<td></td>
<td></td>
<td>41</td>
<td>35.0%</td>
</tr>
<tr>
<td>From '37 News Letter</td>
<td>97</td>
<td></td>
<td></td>
<td>24</td>
<td>26.4%</td>
</tr>
<tr>
<td>Tl-2c + P + ts₂ +</td>
<td>156</td>
<td>138</td>
<td>51</td>
<td>29</td>
<td>2</td>
</tr>
<tr>
<td>+ +</td>
<td>294</td>
<td></td>
<td>80</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>+ + ts₂ P Tl-2c + +</td>
<td>204</td>
<td>276</td>
<td>50</td>
<td>49</td>
<td>3</td>
</tr>
<tr>
<td>+ +</td>
<td>1175</td>
<td></td>
<td></td>
<td>309</td>
<td>480</td>
</tr>
<tr>
<td>From '37 News Letter</td>
<td>401</td>
<td></td>
<td></td>
<td>70</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>169</td>
<td></td>
<td></td>
<td>17</td>
<td>18.7%</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td></td>
<td></td>
<td>249</td>
<td>1.4%</td>
</tr>
<tr>
<td>+ + ms₁₇ P Tl-2c + +</td>
<td>152</td>
<td>157</td>
<td>29</td>
<td>31</td>
<td>3</td>
</tr>
<tr>
<td>+ +</td>
<td>309</td>
<td></td>
<td></td>
<td>60</td>
<td>15.7%</td>
</tr>
</tbody>
</table>

Two of these cultures also segregated lg₁ as in F₂. Using only lg₁ plants, the records for lg₁ B Tl-2c + P + + + ts₂ + +

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>1, 3</th>
<th>2, 3</th>
<th>1, 2, 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>122</td>
<td>27</td>
<td>34</td>
<td>30</td>
<td>21</td>
<td>2</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>233</td>
<td>61</td>
<td>51</td>
<td>30</td>
<td>26</td>
<td>2</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>16.2%</td>
<td>13.5%</td>
<td>0.5%</td>
<td>7.7%</td>
<td>0.3%</td>
<td>0</td>
<td>0</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

One of these cultures also segregated lg₁ as in F₂. Using only lg₁ plants, the records for lg₁ B Tl-2c + P + + + ts₂ + +

214
One of the cultures reported above to show close linkage between Tl-2c and sr also involved B of chromosome 2 but no marker other than sr of chromosome 1. The data are:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>B $\quad$ Tl-2c + sr</td>
<td>63</td>
<td>44</td>
<td>28</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>+ $\quad$ + sr</td>
<td>107</td>
<td>37</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Since no crossover between Tl-2c and sr appeared in this culture, the orientation of these two markers with respect to the rest of chromosome 1 cannot be told.

2. Among 2052 $F_2$ plants of crosses of $Ad_1$ with $an_1$, no double recessive appeared, but $F_3$ cultures from 220 $F_2$ $an_1$ and $Ad_1$ plants indicated a crossover value of 4.1% (Linkage Summary, 1935, p. 32). Backcross cultures of last summer gave the following results:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xr</th>
<th>Xy</th>
<th>Xr</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad_1 An_1</td>
<td>CB</td>
<td>247</td>
<td>7</td>
<td>10</td>
<td>199</td>
<td>463</td>
<td></td>
</tr>
<tr>
<td>$Ad_1 An_1$</td>
<td>RB</td>
<td>4</td>
<td>36</td>
<td>31</td>
<td>1</td>
<td>72</td>
<td>535</td>
</tr>
</tbody>
</table>

R. A. Emerson


<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>in + + $v_5$ gl_1</td>
<td>880</td>
<td>30</td>
<td>99</td>
<td>8</td>
<td>1017</td>
</tr>
<tr>
<td>+ $v_5$ gl_1</td>
<td>3.4%</td>
<td>11.3%</td>
<td>0.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A number of seedlings in the latter cross were destroyed by mice in early stages. Counts are not dependable for distances but they are consistent with the order in the first cross.

A. C. Fraser
Doubling the number of chromosomes in yellow corn increased the carotinoid content 43 per cent as determined by chemical analysis of 2N and 4N stocks having a common origin. The volume of the endosperm cells of the tetraploid was more than 3.5 times as great as that of the diploid. Thus the individual endosperm cells of the tetraploid contained more than 5 times as much carotinoid as did those of the diploid and in terms of gene concentration within the endosperm tissue the amount of carotinoid was increased 2.5 times as a result of chromosome doubling. Chemical analyses by D. B. Hand.

5. The following results have been obtained to date on haploid frequencies in seedling progenies from untreated and x-rayed (1500 r-units) pollen:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>2N</th>
<th>(\frac{N}{1000})</th>
<th>(\frac{2N}{1000})</th>
</tr>
</thead>
<tbody>
<tr>
<td>From untreated pollen</td>
<td>66</td>
<td>126,308</td>
<td>0.52/1000</td>
<td>1.25/1000</td>
</tr>
<tr>
<td>From x-rayed pollen</td>
<td>31</td>
<td>24,619</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The haploids were identified with the aid of recessive seedling genes, staminate examination and root-tip chromosome counts.

L. F. Randolph

6. The following characters have appeared in inbred lines:
- \(c_{0}\) - Corrugated leaf. Raised striations of tissue in seedling and mature leaves. Classification good. Viability normal.
- \(b_{k}\) - Brittle stalk. Similar to brittle stalk-1. Classification good. Viability normal.
- \(d_{e}\) - Defective endosperm. Seed similar to \(d_{e}\).
- \(d_{e}^2\) - Defective endosperm. Seed similar to \(d_{e}\).
- \(d_{e}\) - Defective endosperm. May be a new sugary. Classification good. Viability good in germinator, but hasn't been tested under field conditions.
- \(f_{x}\) - Fine stripe. Plant striped in seedling stage and throughout development. Classification good. Viability normal.
- \(P_{u}\) - Purple plumule. Similar to \(P_{u}\).
- \(w_{x}\) - White seedling. Similar to \(w_{1}\).
- \(w_{x}\) - White sheath. Similar to \(w_{3}\).

R. G. Wiggins

7. White seedling-1 (\(w_{1}\)) has been known to be loosely linked with the \(Y_{1}\) gene of the sixth chromosome (Linkage Summary, 1935). To place \(w_{1}\) more accurately in the chromosome seedling counts were made of the \(F_{2}\) cross between \(w_{1}\) and pigmy (\(p_{y}\)). Seeds were taken from the Co-op stocks. The results indicate a very close linkage between \(p_{y}\) and \(w_{1}\).
Segregation in autotetraploid maize. To determine the nature of segregation of some genes in autotetraploid maize, backcrosses were made involving the genes B (plant color booster) and Su (sugary endosperm).

<table>
<thead>
<tr>
<th>Cross</th>
<th>B</th>
<th>b</th>
<th>No. of Plants</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBbb x bbbb</td>
<td>437</td>
<td>135</td>
<td>572</td>
<td>3.25 : 1</td>
</tr>
</tbody>
</table>

Some difficulty was encountered in classifying the progeny of the backcross, sun red (BBbb) x green (bbbb), since there was a great deal of variation in degree of coloration. Some plants were distinctly sun red, others resembled dilute sun red, while still others showed a tinge of color on and around the ligules. Undoubtedly errors were made in classification, there being an excess of green plants. However, the backcross ratio approaches 3.67 : 1. Since the type of segregation is a function of cross over distance between the gene locus and the spindle fiber attachment region, this would indicate that the gene B is located fifty or more units from the spindle fiber attachment region and that chromatid segregation had occurred.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Su</th>
<th>su</th>
<th>No. of plants</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su Su su su x</td>
<td>2877</td>
<td>645</td>
<td>3522</td>
<td>4.46 : 1</td>
</tr>
<tr>
<td>su su su su x Su Su su su</td>
<td>369</td>
<td>87</td>
<td>456</td>
<td>4.24 : 1</td>
</tr>
</tbody>
</table>

There was no difficulty in classifying sugary segregates in a backcross of autotetraploids. The ratio of 4.43 Su : 1 su indicates that this gene has segregated on a basis intermediate between the random distribution of four chromosomes and random distribution of eight chromatids, and suggests that the gene Su is located about 20 cross over units from the spindle fiber attachment region.

H. E. Fischer

9. It has been observed by many investigators that the F₁ ears of maize–teosinte hybrids are 4-rowed (paired spikelets, two-ranked). This indicates that the paired spikelet condition
of the maize ear is dominant to the single spikelets of teosinte. Collins and Kempton, 1920, showed that in an F2 population, paired and single spikelets segregated 3:1. Data obtained by the writer in the summer of 1937 have confirmed their findings.

It has not been pointed out, however, that the two-ranked condition of teosinte, which appears in the F1 of maize-teosinte hybrids, segregates as a unit character in the F2 population. The combined 3:1 segregation of the dominant two-ranked condition of teosinte (as contrasted with the many-ranked condition of maize) and the 3:1 segregation of paired vs single spikelets, gave a 9:3:3:1 ratio, indicating that these two genes are independent of each other. This independence makes possible the combination of the recessive many-ranked condition of maize with the recessive single spikelets of teosinte, giving two kinds of ears: some with an even number of rows and others with an odd number of rows. Thus, 3-, 4-, and 5-rowed ears with single spikelets have been found. With paired spikelets these would presumably have been 6-, 8-, and 10-rowed ears, respectively.

10. Preliminary F2 and reciprocal backcross data on maize-teosinte hybrids indicate that response to short-day may be due to one, or a few, genetic factors.

11. New characters.


cz - Cuzcoaid. Plant too late to shed pollen under field conditions at Ithaca.

1a4 - Lazy teosinte. Similar to 1a1 in maize. Has not been tested for allelism.

D. G. Langham

II. Seed Stocks Grown, 1937

1. Testers.

Chromosome 1:

\( p \ ad_1 \ seg. \ an_1 \)

\( (p \ ad_1 \ x \ p \ ad_1 \ an_1) \) self

\( br \ f_1 \ bm_2 \ x \ (Kn \ x \ br \ f_1 \ bm_2) \)

Chromosome 2:

\( l_2 \ gl_2 \ B \ ts_1 \ v_4 \ A \ Pl \ x \ l_2 \ +/gl_2 \ B \ +/ts_1 \ v_4 \ A \ Pl \)

\( l_2 \ b \ gs_2 \ v_4 \ y ? \ gl_2 / \ ? \ x \ Inbred \ II \)

\( l_2 \ gl_2 / \ ? \ b \ v_4 \ gs_2 \ x \ Inbred \ I \)
Chromosome 2 (cont'd):
Inbred x $l{g}_1$ $g{t}_2$ b $v_4$ A pl

$lg_1$ $gl_2$ b $v_4$ A1 Y

Chromosome 3:

a1 $lg_2$ Dt/?

a1 Dt/?

a1 +/na +/lg2 +/ts4 x a1 na +/lg2 +/ts2

a1 $lg_2$ $d_1$ x A1 $lg_2$ $d_1$ $ts_4$

a1 $lg_2$ ra2

a1 yt seg. na

a1 ts4 +/na Dt/? x a1 +/ts4 na Dt/? Trisome #3

Chromosome 4:

(su1 x dH) x (Tu su1 x dH)

suam du

(+/w4 +/su1)self

(Ts5 su1 x w1)self

(Ts5 su1 x la) x la su1

Chromosome 5:

Homo. A1 C R a2 bt bv pr1

v2 a2 A1 C R b pl

Trisome #5

Chromosome 6:

Pl sm +/py A b x Pl py A b

Y1 Pl sm seg. py

Chromosome 7:

Inbred x ra1 gl1 ij blx

ra1 gl1 ij x gl1 ij fr1 +/fr2

v5 gl1 Tp seg. ra1 tp

ra1 gl1 v5 x Tp gl1 v5

ra1 gl1 ij x bd1

ra1 gl1 ij

(bd1 x gl1 ij) x gl1 ij bd1

Trisome #7
Chromosome 8:

\[ \text{v}_{16} \text{ ms} \text{g} \text{ j}_{1} \text{ x (ms} \text{g} \text{ j}_{1} \text{ x v}_{16}) \]

\[ \text{msg} \text{ x msg/}+ \]

Chromosome 9:

Inbred I x \( \text{g}_{4} \text{ wx} \)

\[ \text{g}_{4} \text{ wx x (gl}_{4} \text{ x yg}_{2} \text{ c sh wx)} \]

\[ \text{au}_{1} \text{ au}_{2} \text{ sh} \]

\[ \text{wx da ar sal} \]

Trisome #9

Chromosome 10:

\[ \text{r zb}_{5} \text{ seg. n} \text{l}_{1} \]

\[ \text{Og}+/\text{ Y Pwr} \]

Inbred x \( \text{OgOg} \)

\[ \text{r A}_{1} \text{ C y}_{1} \text{ seg. } \text{G}_{1} \]

2. Miscellaneous

U. S. 204 (Inbred I)

Inbred I x \( \text{bm}_{3} \)

\[ \text{A}_{1} \text{ C R Pl B y}_{1} \text{ a}_{2} \]

\[ \text{g}_{2} \text{ A}_{1} \text{ b Pl} \]

seg. \( \text{v}_{12} \)

\[ \text{v}_{13} \]

\[ \text{va}_{2} \text{ x va}_{2}/+ \]

\[ \text{wa} \text{ x wa/}+ \]

\[ \text{ms}_{5} \text{ x ms}_{5}/+ \]

\[ \text{ms}_{6} \text{ x ms}_{6}/+ \]

\[ \text{ms}_{7} \text{ x ms}_{7}/+ \]

\[ \text{ms}_{9} \text{ x ms}_{9}/+ \]

\[ \text{ms}_{10} \text{ x ms}_{10}/+ \]

\[ \text{ms}_{12} \text{ x ms}_{12}/+ \]

msg \( \text{j}_{1} \text{ x msg/}+ \text{ j}_{1} \)

Trisome #8

Inbred I x ar \( \text{wx} \)

c sh \( \text{wx} \text{ bp} \)

\[ \text{ms}_{2} \text{ x ms}_{2}/+ \]

\[ (\text{gl}_{4} \text{ x yg}_{2} \text{ c sh wx)self} \]

\[ \text{l}_{1} \text{ seg. w}_{1} \]

\[ \text{Og Og} \]

seg. \( \text{l}_{1} \)

Trisome #10

West Branch (Inbred II)

seg. hf

\[ \text{Kn} \text{ A}_{1}+/\text{ b Pl x A}_{1}+/\text{ b Pl} \]

\[ \text{A}_{1} \text{ C R A}_{2} \text{ Pr}_{1} \]

\[ (\text{bm}_{3} \text{ x yg}_{3})\text{self} \]

\[ \text{A}_{1} \text{ C R A}_{2} \text{ pr}_{1} \text{ i} \]

\[ \text{Vg}/+ \text{ x Vg} \]

\[ \text{an}_{2} \text{ x Inbred} \]

\[+/\text{na}_{2} \text{ x na}_{2} \]

\[ \text{r pr}_{1} \text{ x A}_{1} \text{ C Rst B} \]

\[ \text{A}_{1} \text{ B pl Rst x r pr}_{1} \]

\[+/\text{bk}_{1} \text{ x bk}_{2} \]

\[ (+/\text{bk}_{1})\text{self} \]

\[+/\text{de +/mi x de mi} \]
ms₁₃ x ms₁₃/+  
ms₁₄ x ms₁₄/+  
ms₃₇ x ms₃₇/+  
ms₃₉ x ms₃₉/+  
ms₄₂ x ms₄₂/+  
v₁₂ x v₁₂ pr₁  
seg. g₁₁₀  
(sb x A₁ b pl +/+₁ su₂)sib  
y₁ su₂ seg sb  
pb₁₄  
Sₓ  
sy  
Pcₓ  
Ch/₁ seg. g₁₁  
Ts₃/+ v₁₁/+ x Rg/+  
Ts₃/+ v₁₁/+ x R g₁ C sh wx  

Chlorophyll types—  
Yellowish green  
rather lt. green  
medium to lt. green  
dark green  

Seed stocks from Australia grown by Shafer in Calif. for the  
Co-op:  
3 different stocks of yellow-striped seedling.  
5 different stocks of virescent seedling.  
3. Stocks too late to mature at Ithaca.  

From Krug:  
brown pericarp  
branched ear  
seg. dwarf  
oily spots  
seg. mealy  
variegated pericarp  
ragged  
seg. zebra seedling  
crinkly  
black pericarp  
seg. tassel seed  
bract in tassel  
seg. defective endosperm  
rolled leaf  
semi-dwarf  
striped leaves  
ms x ms/+  
zebra leaves  
From Mangelsdorf  
mottled dwarf  
seg. vpx
III. Seed Stocks Received For Propagation in 1938

1. J. Shafer, Ithaca, N. Y.:—
   \[V_{19}\]
   \[T^{1-2b} \times T^{1-2b}\]
   \[T^{2-4b}\]

2. R. A. Brink, Madison, Wisconsin:—
   \[(pm \times lg_{2} d_{1}) \text{ sib}\]
   \[(A_{1} pm \times a_{1} lg_{2}) \text{ sib}\]

   \[fs\]

4. A. Tavcar, Zagreb, Jugoslavia:—
   \[Hs\]

5. M. M. Rhoades, Arlington, Virginia:—
   \[(ws_{3} lg_{1} A_{1} pl \times gl_{2}) \times (ws_{3} lg_{1} b A_{1} pl \times gl_{2})\]

6. W. R. Singleton, New Haven, Connecticut:—
   \[ra_{2}\]
   \[su_{1} x +/-lo\]
   \[v_{5}\]
   \[yellow \times yellow\]
   \[z_{b} x f \times ys\]
   \[+/ba_{x}\]
   \[gl_{3} v_{4} \times lg_{1} gl_{2} b v_{4} \text{ r}^{g} ACYSu\]
   \[ys_{x} (7 \text{ cultures})\]

7. R. C. Wiggans, Ithaca, N. Y.:—
   \[de_{c}\]
   \[f_{x}\]
   \[Pu_{x}\]

IV. Miscellaneous Co-op Items

1. Seed stock inventory. In March, 1937, an inventory of the genetic seed stocks in the Co-op collection showed that 148 of the genes reported in the Linkage Summary, 1935, were not in the seed trays here. A list of those 148 genes was included in the News Letter, March 23, '37, and several maize geneticists responded by sending in 16 genetic stocks.
In January, 1938, personal requests were sent to each of the 25 geneticists who, collectively, had first reported the remaining 132 stocks. We have learned that about 75% of those genes have been lost due to inviability of seed stocks.

2. Assignment of linkage groups. One of the topics discussed at a special meeting of maize geneticists at the A A A S meetings in Indianapolis, was the problem of linking workable genes and developing more desirable tester stocks. This is an important question because there are more than 50 suitable genes that haven't been linked and some of the chromosomes are poorly marked.

The plan previously outlined for linking new genes has not been fundamentally changed, but it may well be reviewed here. Each of the ten linkage groups in maize has been assigned to one, or more, cooperator who is charged with testing unplaced characters with his particular chromosome and building up suitable tester stocks. The following assignments have been made:

Chromosome 1. Emerson.
Chromosome 2. Rhoades and Clokey.
Chromosome 4. Singleton and Brunson.
Chromosome 5. Burnham.
Chromosome 7. Jenkins and Fraser.
Chromosome 8. Sprague and Perry.
Chromosome 10. Lindstrom, Wentz, and Bryan.

When a new gene is found, a few seeds involving it should be sent to the secretary of the Maize Genetics Cooperation who will grow them in an increase block and obtain a liberal supply of seed for the central repository. Then the secretary will send a few seeds to each of the above geneticists who will test for linkage in his particular chromosome.

This system has been devised not to limit the number of workers who are trying to link new genes, but rather to insure the linkage of every workable gene.

3. More vigorous genetic stocks. During the summers of 1935 and 1936, a number of maize geneticists tested a group of inbred strains for disease resistance and general desirability. The two inbreds, U.S. #204 and West Branch Sweepstakes, seemed best suited to Ithaca conditions and have been selected for use in the Co-op. They have been designated as Inbred I and Inbred II, respectively, and are being used in crosses with weak genetic stocks to increase vigor and, by repeated backcrossing of the segregates to the
inbreds, to obtain a more nearly homozygous chromosome complement. Later, the segregates from each inbred line may be crossed to get hybrid vigor.

Last summer 17 genetic stocks were crossed with both Inbred I and Inbred II.

4. Linkage maps. The linkage maps attached to this Letter were prepared from the data in the Linkage Summary and the data which appeared in the Co-op News Letters since the Linkage Summary was published.

Sincerely yours,

D. G. Langham

D. G. Langham
Secretary
V. Gene Index of Co-op News Letters

This gene index of the Co-op News Letters was made so that the information in the Letters which might be of value in connection with linkage studies could be more readily found. It includes mainly those genes about which some statement of linkage has been made in the Letters, and does not include those that are merely mentioned without any supplementary information. John Shafer.

a1:
1-25-34, p. 5
(January 25, 1934, page 5)
11-24-34, pp. 13, 18, 11
1-23-33, pp. 3, 6
3-6-35, p. 3
3-4-36, pp. 7, 10, 11
3-23-37, pp. 8, 13, 14
3-6-38, pp. 8, 15

a2:
12-18-33, p. 5
1-25-34, p. 6
11-24-34, pp. 2, 14
1-23-33, p. 6
3-4-36, pp. 7, 17
3-6-38, pp. 9, 15

a3:
11-24-34, p. 10

ad1:
1-23-33, p. 6
1-25-34, p. 4
3-6-35, pp. 3, 15
3-4-36, p. 9
3-6-38, pp. 6, 11, 14

ad2 ( = ad1 ):
3-6-35, p. 3

ad2 (first called ad2 ):
3-6-35, pp. 3, 15

ad3 (now ad2 )
3-6-35, p. 3

ag (= i j ):
12-18-33, p. 6
9-13-34, p. 8
1-23-33, p. 6

al:
12-18-33, pp. 3, 5
1-23-33, pp. 3, 6
3-6-35, pp. 3, 6
3-4-36, pp. 15, 16
3-23-37, pp. 8, 15

an:
1-25-34, p. 4
11-24-34, p. 5
1-23-33, p. 6
3-6-35, p. 1
3-36-38, pp. 6, 11, 14

ar:
9-13-34, p. 2

ar:
12-18-33, p. 2
1-25-34, p. 8
1-23-33, p. 3
3-6-38, p. 16

as:
1-23-33, p. 6

an1:
12-18-33, p. 2
1-25-34, p. 8
1-23-33, p. 3
3-6-38, p. 16
bm₂ (cont.):
3-6-35, pp. 1, 4, 9, 10, 11
3-6-35, pp. 3, 7
3-6-35, pp. 9

bm₃:
1-25-34, p. 4
11-24-34, p. 6
1-23-33, pp. 3, 6
3-6-35, pp. 1, 3
3-4-36, p. 10
3-23-37, pp. 3, 5
3-6-38, pp. 1, 5, 6, 14

bn₂:
9-13-34, p. 8

bp:
1-25-34, p. 8
1-23-33, p. 7
3-6-38, p. 16

br:
1-25-34, p. 4
11-24-34, p. 5
1-23-33, pp. 3, 7
3-6-35, p. 3
3-4-36, p. 10
3-23-37, pp. 1, 2, 5
3-6-38, pp. 1, 5, 6, 9, 14

bt₁:
12-18-33, pp. 3, 5
1-25-34, p. 6
11-24-34, pp. 2, 4, 4, 6
1-23-33, p. 7
3-6-35, p. 3
bt_1 (cont.):
3-4-36, pp. 7, 14
3-23-37, p. 10
3-6-38, pp. 9, 15

bt_4 (= bt_1):
3-6-35, p. 3

bv:
12-18-33, p. 5
1-25-34, p. 6
11-24-34, p. 4
1-23-33, p. 7
3-6-38, p. 15
c:
12-18-33, pp. 2, 6
1-25-34, p. 8
9-13-34, p. 8
1-23-33, pp. 3, 7
3-6-38, pp. 12, 14
3-4-36, pp. 11, 15
3-6-38, p. 16
cb:
1-23-33, p. 7

Ch:
12-18-33, p. 3
11-24-34, pp. 6, 7
3-14-36, pp. 3, 17
3-23-37, p. 5
3-6-38, p. 6
cr:
3-6-35, p. 15
crx_1:
1-25-34, p. 5
1-23-33, pp. 3, 7
3-4-36, p. 7
3-23-37, p. 14
3-6-38, pp. 8, 15
cr_2:
1-23-33, p. 7
da:
9-13-34, p. 2
db:
9-13-34, p. 2
d_H:
3-6-38, p. 15
d_7:
3-23-37
d_1:
1-25-34, p. 5
11-24-34, p. 12
1-23-33, p. 7
3-6-35, p. 5
3-4-36, p. 9
3-23-37, pp. 5, 14
3-6-38, pp. 6, 8, 15
d_2:
12-18-33, p. 1
1-25-34, p. 5
d_3:
1-25-34, p. 8
1-23-33, p. 7
d_5:
1-23-33, p. 7
d_6:
1-23-33, p. 7
d_7:
12-18-33, p. 1
\(d_7\) (cont.):

1-25-34, p. 8
9-13-34, p. 8
3-23-37, pp. 8, 9

d_{a1}:

1-25-34, p. 8
1-23-33, p. 7
3-6-35, p. 12
3-6-38, p. 16

d_{a2}:

12-18-33, p. 6
9-13-34, p. 8

d_{e1}:

3-6-35, p. 12

d_{e2}:

1-23-33, p. 8

d_{e3}:

1-23-33, p. 7

d_{e5}:

1-23-33, p. 8

d_{e6}:

1-23-33, p. 8

d_{l1}:

12-18-33, p. 4

D_{t}:

11-24-34, p. 1
3-4-36, p. 7
3-23-37, p. 8
3-6-38, pp. 8, 15

d_{u}:

11-24-34

d_{u} (cont.):

3-23-37, p. 13
3-6-38, p. 15

e_{t}:

3-6-35, p. 5

f_{1}:

1-25-34, p. 4
11-24-34, pp. 5, 18
1-23-33, pp. 3, 8
3-6-35, p. 1
3-23-37, pp. 3, 9
3-6-38, pp. 1, 5, 14

f_{2}:

1-23-33, p. 8

f_{3}:

1-23-33, p. 8
3-6-35, pp. 9, 13

f_{i_{a}}:

9-13-34, p. 3

f_{i}:

1-23-33, p. 8

f_{l_{1}}:

1-25-34, p. 4
1-23-33, p. 8
3-4-36, p. 7

f_{r_{1}}:

1-25-34, p. 7
1-23-33, p. 8
3-6-38, p. 15

f_{r_{2}}:

1-25-34, p. 7
1-23-33, p. 8
3-6-38, p. 15
$g_1$:
12-18-33, p. 5
11-24-34, pp. 5, 10
1-23-33, pp. 3, 8
3-6-35, p. 4
3-23-37, pp. 8, 9, 11, 16
3-23-37, pp. 6, 8, 9
3-6-38, p. 16

$g_2$:
12-18-33, p. 5
11-24-34, p. 6
3-23-37, p. 14

$g_3$:
1-23-33, p. 8

$g_4$:
1-23-33, p. 8
1-25-34, p. 8
3-6-38, p. 16

$g_{a_1}$:
1-23-33, p. 8
3-6-38, p. 15

$g_{a_2}$:
3-4-36, p. 14

$g_{b_1}$:
9-13-34, p. 3

$g_{b_2}$:
9-13-34, p. 3

$g_{d_1}$:
9-13-34, p. 3

$g_{1}$:
12-18-33, pp. 2, 5
1-23-33, pp. 3, 9
12-18-33, pp. 2, 5
1-25-34, p. 7

$g_{1}$ (cont.):
11-24-34, pp. 5, 7, 14
3-6-35, p. 1
3-4-36, pp. 3, 9, 16
3-23-37, pp. 4, 9
3-6-38, pp. 11, 15

$g_{2}$:
1-23-33, pp. 3, 9
1-25-34, p. 10
3-6-35, p. 1
3-4-36, p. 15
3-23-37, p. 8
3-6-38, pp. 2, 6, 15

$g_{3}$:
1-23-33, pp. 3, 9
12-18-33, p. 5
1-25-34, p. 10
3-6-35, p. 1
3-23-37, pp. 6, 10
3-6-38, pp. 2, 6, 15

$g_{4}$:
12-18-33, p. 6
1-23-33, p. 9
3-23-37, p. 10
3-6-38, p. 16

$g_{6}$ (= old $g_{1g}$):
3-23-37, pp. 9, 10
3-6-38, p. 3

$g_{6}$ (new):
3-6-38, p. 3

$g_{7}$:
3-6-38, p. 3

$g_{8}$:
3-6-35, p. 2
3-23-37, p. 9
3-6-38, p. 3
<table>
<thead>
<tr>
<th>Symbol</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>(g_{10}) (=(g_{l1}))</td>
<td>12-18-33, p. 1, 1-25-34, p. 4, 9-13-34, p. 8, 11-24-34, p. 18, 3-4-36, p. 3</td>
</tr>
<tr>
<td>(g_{10}) (new)</td>
<td>3-23-37, p. 10</td>
</tr>
<tr>
<td>(g_{11})</td>
<td>3-6-38, p. 2</td>
</tr>
<tr>
<td>(g_{m})</td>
<td>3-6-35, p. 6</td>
</tr>
<tr>
<td>(g_{m1})</td>
<td>1-23-33, p. 9</td>
</tr>
<tr>
<td>(g_{m2})</td>
<td>1-23-33, p. 9</td>
</tr>
<tr>
<td>(g_{m2'})</td>
<td>3-6-35, p. 13</td>
</tr>
<tr>
<td>(g_{m3})</td>
<td>3-6-35, p. 13</td>
</tr>
<tr>
<td>(g_{m4})</td>
<td>1-23-33, p. 9</td>
</tr>
<tr>
<td>(g_{s})</td>
<td>12-18-33, p. 5</td>
</tr>
<tr>
<td>(g_{l1})</td>
<td>1-23-33, p. 9, 1-25-34, p. 4, 3-23-37, p. 6</td>
</tr>
<tr>
<td>(g_{s2})</td>
<td>12-18-33, p. 6</td>
</tr>
<tr>
<td>(g_{s2}) (cont.)</td>
<td>11-24-34, p. 5, 9-13-34, p. 8, 3-6-38, p. 14</td>
</tr>
<tr>
<td>(h)</td>
<td>11-24-34, p. 8</td>
</tr>
<tr>
<td>(I)</td>
<td>1-23-33, p. 9, 1-25-34, p. 8, 3-4-36, p. 15, 3-6-38, p. 16</td>
</tr>
<tr>
<td>(ij)</td>
<td>1-23-33, p. 9, 12-18-33, p. 6, 1-25-34, p. 7, 11-24-34, pp. 5, 6, 7, 10, 14, 3-6-35, p. 1, 3-4-36, pp. 3, 7, 9, 16, 3-23-37, pp. 4, 9, 3-6-38, pp. 11, 15</td>
</tr>
<tr>
<td>(in)</td>
<td>1-23-33, p. 9, 12-18-33, p. 6, 1-25-34, p. 7, 3-4-36, p. 16, 3-6-38, p. 11</td>
</tr>
<tr>
<td>(it)</td>
<td>3-4-36, p. 9</td>
</tr>
<tr>
<td>(j_{1})</td>
<td>1-23-33, pp. 3, 9, 1-25-34, p. 7, 3-6-35, p. 4, 3-4-36, p. 14, 3-23-37, p. 6, 3-6-38, pp. 2, 3, 15</td>
</tr>
<tr>
<td>(j_{2})</td>
<td>12-18-33, p. 1, 1-25-34, p. 5, 9-13-34, p. 8</td>
</tr>
</tbody>
</table>
j2 (cont.):
3-6-35, p. 2
3-6-38, p. 15

Kn:
3-23-37, p. 9
3-6-38, pp. 5, 14

l7:
3-6-35, p. 14

l1:
1-23-33, p. 10
3-6-38, p. 16

l2:
1-25-34, p. 8
1-23-33, p. 10

l4:
1-23-33, p. 10
1-25-34, p. 8

l5:
1-23-33, p. 10

l6:
1-23-33, p. 10

l7:
1-23-33, p. 10

l8:
11-24-34, p. 2
3-4-36, p. 8
3-23-37, p. 8

la1:
12-18-33, pp. 3, 5, 6
1-25-34, p. 5
11-24-34, p. 10
3-23-37, p. 6
3-6-38, p. 15

le:
9-13-34, p. 8
3-6-35, p. 14

lg1:
1-23-33, pp. 3, 10
12-18-33, p. 5
1-25-34, p. 4
11-24-34, p. 5
3-6-35, pp. 1, 2, 4
3-4-36, pp. 15, 16
3-23-37, pp. 7, 8, 14
3-6-38, pp. 7, 8, 9, 10, 14

lg2:
1-23-33, p. 10
1-25-34, p. 5
11-24-34, p. 12
3-23-37, p. 14
3-6-38, p. 15

li:
1-23-33, p. 10
1-25-34, p. 8
3-23-37, pp. 8, 9

lo1:
12-18-33, p. 4
1-25-34, p. 5
11-24-34, p. 8
9-13-34, p. 8
3-6-35, p. 1

lo2:
3-6-35, p. 11

lp:
1-23-33, p. 10

mc:
12-18-33, p. 4
11-24-34, p. 8

Mi:
3-4-36, p. 11
ms1:
1-23-33, p. 10

ms2:
1-23-33, p. 10
1-25-34, p. 8
3-6-35, p. 12
3-6-38, p. 16

ms3:
1-23-33, p. 10
1-25-34, p. 5

msg:
1-23-33, pp. 3, 11
1-25-34, p. 7
3-23-37, p. 6
3-6-38, pp. 2, 3, 16

ms17:
1-23-33, p. 11
11-24-34, p. 3
3-6-38, p. 10

ms18:
1-23-33, p. 11

ms20:
1-23-33, p. 11
3-6-38, p. 6

Mt:
1-23-33, p. 11

n1a:
1-23-33, pp. 3, 11
1-25-34, p. 5
11-24-34, pp. 11, 12
3-6-35, p. 3
3-4-36, pp. 7, 10
3-6-38, p. 15

n11:
1-23-33, pp. 3, 11

n1 (con't.):
1-25-34, p. 8
3-6-38, p. 16

n12:
12-18-33, p. 2
11-24-34, p. 18

o1:
12-18-33, p. 4
11-24-34, p. 8
3-4-36

o2:
12-18-33, p. 4
11-24-34, p. 8
3-4-36, p. 9
3-23-37, p. 4

o3 (=o1):
12-18-33, p. 6
9-13-34, p. 8
3-4-36, p. 9

oG:
11-24-34, p. 10
3-23-37, p. 6
3-6-38, p. 16

oy:
1-23-33, p. 11
3-6-35, p. 10

p:
1-23-33, pp. 3, 11
12-18-33, p. 4
1-25-34, p. 4
11-24-34, pp. 3, 5, 8
3-6-35, pp. 1, 3
3-4-36, pp. 9, 10
3-23-37, pp. 1, 2, 5
3-6-38, pp. 1, 6, 9, 10, 14

pb:
3-23-37, p. 2
3-6-38, p. 15
Pe2:
11-24-34, p. 5

Pe3:
9-13-34, p. 3

Pe4:
9-13-34, p. 3
3-6-35, pp. 12, 13
3-23-37, p. 7

Pe1:
1-23-33, p. 12
1-25-34, p. 8

Pe2:
1-23-33, p. 12
1-25-34, p. 5

Pe3:
1-23-33, p. 12

Pe6:
1-23-33, p. 12

Pe7:
1-23-33, p. 12

pk:
1-23-33, p. 12
1-25-34, p. 8

P1:
1-23-33, p. 3
1-25-34, p. 6
9-13-34, p. 8
11-24-34, pp. 10, 14
3-6-35, pp. 4, 5
3-23-37, pp. 2, 14, 15
3-6-38, pp. 7, 15

pm:
12-18-33, p. 5
9-13-34, p. 8
11-24-34, p. 12

po:
1-23-33, p. 12
1-25-34, p. 6

pr1:
1-23-33, pp. 3, 12
12-18-33, p. 5
1-25-34, p. 6
11-24-34, pp. 2, 4, 5, 6, 7
3-6-35, pp. 1, 2, 4, 10, 11
3-4-36, pp. 7, 11, 14
3-23-37, p. 10
3-6-38, pp. 9, 15

Pr2:
3-6-35, p. 12

py1:
1-23-33, pp. 3, 12
1-25-34, p. 6
11-24-34, p. 14
3-6-35, p. 4
3-4-36, p. 7
3-6-38, pp. 12, 13, 15

py2:
12-18-33, p. 1

R:
1-23-33, pp. 3, 12
12-18-33, pp. 1, 5
1-25-34, p. 8
11-24-34, pp. 5, 10, 3
3-6-35, pp. 3, 4, 9
3-4-36, pp. 8, 11, 14, 16
3-23-37, pp. 6, 8, 9
3-6-38, p. 16
ra_1:
3-4-36, p. 7

ra_2:
1-23-33, pp. 3, 12
12-18-33, pp. 2, 3, 5
1-25-34, p. 7
11-24-34, pp. 5, 6, 7, 8, 10, 14
3-6-35, pp. 1, 4
3-4-36, pp. 7, 9, 16
3-23-37, p. 4
3-6-38, p. 15

ra_3:
3-6-35, p. 13

ra_4:
9-13-34, p. 8

ra_5:
9-13-34, p. 9
3-6-35, p. 10

ra_6:
3-6-35, pp. 13, 14

Ra_1:
1-23-33, p. 12
12-18-33, pp. 3, 5
1-25-34, p. 5
11-24-34, pp. 10, 11, 12, 13
3-4-36, p. 7
3-23-37, p. 14

Rg_2:
12-18-33, pp. 3, 4

Rp:
3-6-35, p. 3
3-4-36, p. 17
3-23-37, pp. 8, 9

rt:
11-24-34, p. 10

S_1:
1-23-33, p. 13

sa_1:
1-23-33, p. 13
3-6-38, p. 16

sa_2:
1-23-33, p. 13

sb:
3-6-38

sc_1:
3-6-35, p. 5

sc_2:
3-6-35, p. 5

sc_3:
3-6-35, p. 5

sc_4:
1-23-33, p. 13

sc_5:
12-18-33, p. 6
sf:
3-6-35, p. 11

sh:
1-23-33, pp. 3, 13
12-18-33, pp. 2, 6
1-25-34, p. 8
3-6-35, pp. 12, 13
3-23-37, p. 7
3-6-38, p. 16

si:
1-25-34, p. 6
1-23-33, p. 13

sk:
1-23-33, p. 13
1-25-34, p. 4
3-6-38, p. 6

sl:
1-23-33, p. 13
1-25-34, p. 7

sm:
1-23-33, p. 13
1-25-34, p. 6
11-24-34, p. 14
3-6-35, p. 4
3-4-36, p. 9
3-6-38, p. 15

so1:
12-18-33, p. 6

sp1:
1-23-33, p. 13
12-18-33, p. 4
1-25-34, p. 5
11-24-34, p. 8
9-13-34, p. 8
3-6-35, p. 1

sp2:
11-24-34, p. 2

sp2 (con't.)
3-4-36, p. 8
3-23-37, p. 8

sr:
1-25-34, p. 4
1-23-33, p. 13
3-4-36, p. 10
3-23-37, pp. 1, 2, 3, 5
3-6-38, pp. 6, 9, 10, 11, 14

st1:
3-6-35, p. 12

st:
1-23-33, p. 13
1-25-34, p. 5

su1:
1-23-33, pp. 3, 13
12-18-33, pp. 3, 4, 5, 6
1-25-34, p. 5
11-24-34, pp. 8, 9, 10
9-13-34, p. 9
3-6-35, pp. 1, 2, 3, 11
3-23-37, pp. 5, 6, 13, 14
3-6-38, pp. 2, 4, 6, 13, 15

su2:
12-18-33, p. 6
3-6-35, p. 11
3-23-37, p. 15
3-6-38, p. 7

su3:
3-6-35, pp. 11, 12

sy:
3-6-38, p. 3

th (=sr):
12-18-33, p. 4
3-23-37, p. 3
I-23-33, p. 13
3-6-35, p. 10

Tl-2a:
3-6-38, p. 6

Tl-2b:
3-6-35, p. 3
3-4-36, pp. 10, 11
3-6-38, pp. 6, 7

Tl-2c (see I-10b):
3-6-38, pp. 6, 9, 10, 11

Tl-3a:
3-6-35, p. 3
3-4-36, p. 10
3-6-38, pp. 6, 7, 10

Tl-3b:
3-6-35, p. 3

Tl-3d:
3-6-35, p. 3
3-4-36, p. 10
3-23-37, p. 5
3-6-38, p. 6

Tl-5a:
3-6-35, p. 3
3-4-36, p. 10
3-6-38, p. 6

Tl-5b:
3-6-35, pp. 3, 4
3-4-36, p. 10
3-23-37, p. 1
3-6-38, pp. 6, 10

Tl-5c:
3-6-35, p. 4
3-4-36, p. 10
3-23-37, pp. 1, 2
3-6-38, p. 6

Tl-6a:
3-6-38, p. 6

Tl-6b:
3-6-38, p. 6

Tl-6c:
3-6-38, p. 6

Tl-7a:
3-6-38, p. 6

Tl-7b:
3-6-35, pp. 3, 4
3-4-36, p. 10
3-6-38, p. 6

Tl-7c:
3-6-35, p. 3
3-4-36, p. 10
3-6-38, p. 6

Tl-7d:
3-6-35, p. 3
3-4-36, p. 10
3-6-38, p. 6

Tl-9a:
3-6-35, pp. 3, 4
3-4-36, p. 10
3-23-37, p. 2
3-6-38, p. 6

Tl-9b:
3-6-35, pp. 3, 4
3-4-36, p. 10
3-6-38, p. 6
T1-9c:
3-6-35, p. 3
3-4-36, p. 10
3-23-37, p. 2
3-6-38, pp. 6, 9, 10
T1-10a:
3-6-35, pp. 3, 4
3-4-36, pp. 10, 11
3-6-38, p. 6
T1-10b (see 1-2c):
3-6-35, p. 3
3-23-37, p. 2
3-6-38, p. 9
T2-3a:
3-6-38, p. 7
T2-3b:
3-4-36, p. 10
T2-3c:
3-6-35, p. 3
3-4-36, pp. 10, 11
3-23-37, p. 5
3-6-38, pp. 6, 7
T2-3d:
3-4-36, pp. 10, 11
3-6-38, p. 7
T2-4a:
3-4-36, p. 11
3-6-38, p. 7
T2-4b:
3-6-35, p. 3
3-4-36, p. 11
3-23-37, p. 6
3-6-38, pp. 6, 7
T2-4c:
3-6-35, p. 3
3-4-36, p. 11
3-6-38, p. 7
T2-4d:
3-6-35, p. 3
3-4-36, p. 11
3-23-37, p. 6
3-6-38, p. 7
T2-5a:
3-6-38, p. 7
T2-5b:
3-6-35, p. 4
3-4-36, p. 11
3-6-38, p. 7
T2-6a:
3-6-35, p. 4
3-4-36, p. 11
3-6-38, p. 7
T2-6c:
3-6-38, p. 7
T2-6d:
3-6-35, p. 4
3-4-36, p. 11
3-6-38, p. 7
T2-7a:
3-6-35, p. 4
3-4-36, p. 11
3-6-38, p. 7
T2-7b:
3-6-35, p. 4
3-4-36, p. 11
3-6-38, p. 7
T2-7c:
3-6-35, p. 4
3-4-36, p. 11
3-6-38, p. 7
T2-9a:
3-4-36, pp. 10, 11
3-6-38, p. 7
T2-9b:
3-4-36, pp. 10, 11
3-6-38, p. 7
T3-5b:
3-6-35, p. 3
3-4-36, p. 10

T3-5c:
3-6-35, p. 3
3-4-36, p. 10

T3-6a:
3-6-35, p. 4

T3-7a:
3-6-35, p. 4
3-4-36, pp. 10, 16

T3-7b:
3-6-35, pp. 3, 4
3-4-36, p. 10
3-23-37, p. 5

T3-8a:
3-6-35, p. 4
3-4-36, p. 10
3-23-37, p. 6

T3-8b:
3-6-35, p. 4
3-23-37

T3-9a:
3-6-35, pp. 3, 4
3-4-36, p. 10

T3-9b:
3-6-35, p. 3

T3-10a:
3-6-35, pp. 3, 4
3-4-36, pp. 10, 11

T3-10b:
3-6-35, p. 4
3-4-36, pp. 10, 11

T3-10c:
3-6-35, p. 4
3-4-36, p. 11

T4-5a:
11-24-34, pp. 6, 7

T4-5d:
3-6-35, pp. 3, 4

T4-6a:
3-6-35, pp. 3, 4

T4-6b:
3-6-35, pp. 3, 4
3-23-37, p. 6

T4-6c:
3-6-35, p. 3

T4-9a:
3-6-35, pp. 3, 4
3-6-36, p. 10

T4-9b:
3-4-36, p. 10
3-23-37, p. 6

T4-10a:
3-6-35, p. 3

T4-10b:
3-6-35, pp. 3, 4
3-4-36, p. 11

T5-7a:
11-24-34, pp. 6, 7

T5-7c:
3-4-36, p. 17
T6-9a:

3-6-35, p. 4
3-4-36, p. 10

T6-9b:

3-6-35, p. 4
3-4-36, p. 10

T8-9b:

3-4-36, p. 11
3-23-37, p. 6

T8-10a:

3-6-35, p. 4
3-4-36, p. 11

T8-10b:

3-6-35, p. 4
3-4-36, p. 11

T8-10c:

3-6-35, p. 4
3-4-36, p. 11
3-23-37, p. 6

T8-10d:

3-6-35, p. 4

ts1:

1-23-33, p. 14
1-25-34, p. 4
3-6-35, p. 1
3-6-38, p. 14

ts2:

1-23-33, p. 14
1-25-34, p. 4
11-24-34, pp. 3, 5
3-6-35, p. 1
3-23-37, pp. 1, 2, 3, 9
3-6-38, pp. 9, 10

ts4 (cont.):

1-25-34, p. 5
11-24-34, p. 11
3-6-35, p. 3
3-4-36, p. 10
3-6-38, p. 15

Ts5:

1-23-33, p. 14
1-25-34, p. 5
11-24-34, p. 8
3-6-35, p. 1
3-23-37, p. 6
3-6-38, p. 15

Ts6:

3-23-37, p. 6

Tu:

1-23-33, pp. 3, 14
12-18-33, pp. 5, 6
1-25-34, p. 5
11-24-34, pp. 6, 10
3-6-35, pp. 1, 2, 3
3-23-37, p. 14
3-6-38, pp. 2, 4, 15

va:

9-13-34, p. 3

v1:

1-23-33, p. 14
12-18-33, pp. 2, 6
1-25-34, p. 8
3-4-36, p. 3

v2:

1-23-33, pp. 3, 14
12-18-33, p. 5
1-25-34, p. 6
11-24-34, pp. 2, 6, 7
3-6-35, p. 1
3-4-36, p. 7
3-6-38, p. 15
v3:
1-23-33, p. 14
1-25-34, p. 6
11-24-34, p. 4
3-4-36, p. 7

v4:
1-23-33, pp. 3, 14
1-25-34, p. 4
3-6-35, pp. 1, 4
3-4-36, pp. 11, 15, 17
3-6-38, pp. 6, 7, 14

v5:
1-23-33, pp. 3, 14
12-18-33, pp. 2, 5
1-25-34, p. 7
11-24-34, pp. 7, 18
3-6-35, p. 1
3-4-36, pp. 9, 16
3-23-37, p. 4
3-6-38, p. 15

v6:
1-23-33, p. 14
1-25-34, p. 6

v7:
1-23-33, p. 14
1-25-34, p. 6

v8:
1-23-33, p. 14

v10:
3-23-37, p. 7
3-6-38, p. 9

v12:
1-23-33, p. 14
1-25-34, p. 6
3-4-36, p. 7
3-23-37, p. 10

v14 (=vg2):
1-23-33, p. 14

v15:
1-23-33, p. 14
1-25-34, p. 8

v16:
3-23-37, p. 7
3-6-38, pp. 2, 15

v18:
1-23-33, p. 15

v20:
1-23-33, p. 15

v21 (=v16):
3-4-36, p. 17
3-23-37, p. 7

v21:
1-23-33, p. 15
1-25-34, p. 7

vp1:
1-23-33, p. 15

vp2:
1-23-33, p. 15
11-24-34, pp. 6, 7
3-6-35, p. 10

vp3:
1-25-34, p. 5

vp4:
1-23-33, p. 15
3-6-35, p. 13

w1:
1-23-33, p. 15
3-6-38, pp. 12, 13

w2:
1-23-33, p. 15
\[ w_1 (= v_{12}?) : \]
\[ 1-24-34, \text{ p. } 10 \]
\[ 2-4-36, \text{ p. } 3 \]
\[ 3-23-37, \text{ pp. } 6, 15 \]

\[ w_5 : \]
\[ 1-23-33, \text{ p. } 15 \]

\[ w_6 : \]
\[ 1-23-33, \text{ p. } 15 \]

\[ w_{11} : \]
\[ 1-23-33, \text{ p. } 15 \]
\[ 1-25-34, \text{ p. } 8 \]

\[ w_{12} : \]
\[ 9-13-34, \text{ p. } 9 \]

\[ w_{n} : \]
\[ 1-23-33, \text{ p. } 15 \]
\[ 1-25-34, \text{ p. } 7 \]

\[ w_1 : \]
\[ 1-23-33, \text{ p. } 15 \]
\[ 1-25-34, \text{ p. } 5 \]
\[ 11-24-34, \text{ p. } 8 \]
\[ 3-6-35, \text{ p. } 1 \]
\[ 3-6-38, \text{ p. } 15 \]

\[ w_{a3} : \]
\[ 11-24-34, \text{ p. } 2 \]
\[ 3-6-35, \text{ p. } 2 \]
\[ 3-23-37, \text{ pp. } 7, 8 \]
\[ 3-6-38, \text{ pp. } 8, 9 \]

\[ wx : \]
\[ 1-23-33, \text{ pp. } 3, 15 \]
\[ 12-18-33, \text{ pp. } 2, 6 \]
\[ 1-25-34, \text{ p. } 8 \]
\[ 9-13-34, \text{ p. } 8 \]
\[ 3-6-35, \text{ pp. } 4, 12, 13, 14 \]
\[ 3-4-36, \text{ pp. } 3, 10, 11 \]
\[ 3-23-37, \text{ pp. } 7, 10, 11, 14 \]
\[ 3-6-38, \text{ p. } 16 \]

\[ x_{n_1} : \]
\[ 1-23-33, \text{ p. } 15 \]

\[ Y_x (= y_3) : \]
\[ 3-6-35, \text{ pp. } 3, 5, 14 \]
\[ 3-4-36, \text{ p. } 16 \]

\[ Y_1 : \]
\[ 1-23-33, \text{ pp. } 3, 16 \]
\[ 12-18-33, \text{ p. } 6 \]
\[ 1-25-34, \text{ p. } 6 \]
\[ 3-6-35, \text{ pp. } 4, 5, 14 \]
\[ 3-4-36, \text{ p. } 9 \]
\[ 3-23-37, \text{ pp. } 2, 15 \]
\[ 3-6-38, \text{ pp. } 3, 7, 9, 15 \]

\[ Y_{1_4} : \]
\[ 3-4-36, \text{ p. } 9 \]

\[ y_d : \]
\[ 1-23-33, \text{ p. } 16 \]
\[ 12-18-33, \text{ p. } 4 \]

\[ y_f : \]
\[ 12-18-33, \text{ p. } 6 \]
\[ 9-13-34, \text{ p. } 9 \]

\[ y_{g?} : \]
\[ 3-6-35, \text{ p. } 14 \]

\[ y_{g^a} : \]
\[ 9-13-34, \text{ p. } 3 \]

\[ y_{g_1} : \]
\[ 1-23-33, \text{ p. } 16 \]
\[ 11-24-34, \text{ pp. } 6, 7 \]
\[ 3-6-35, \text{ p. } 11 \]
\[ 3-4-36, \text{ p. } 3 \]

\[ y_{g_2} (= v_{14}) : \]
\[ 1-23-33, \text{ pp. } 3, 16 \]
\[ 12-18-33, \text{ p. } 2 \]
\[ 1-25-34, \text{ p. } 8 \]
\[ 3-6-35, \text{ p. } 14 \]
\[ 3-6-38, \text{ p. } 16 \]
ys₁:
1-23-33, pp. 3, 16
1-21-33, p. 5
1-25-34, p. 6
1-24-34, pp. 2, 6, 7
3-4-36, p. 7

ys₂:
1-23-33, p. 16

yt:
1-23-33, p. 16
3-6-38, p. 15

zb₁:
3-6-38, p. 1

zb₂:
11-24-34, p. 1
3-6-38, p. 16

zb₃:
3-6-38, p. 2

z (={}gs₁):
1-23-33, p. 16
3-6-35, pp. 3, 12

zs₁ (={},gs₂):
1-23-33, p. 16
3-6-35, pp. 3, 12

zs₂ (={},gs₃):
11-24-34, p. 1
9-13-34, p. 9

zs₃:
3-6-35, p. 3

zl:
1-23-33, p. 16
11-24-34, p. 3
Linkage map of the ten chromosomes of pea maps showing the approximate loci of many genes. (Working map. More 3-point tests needed to establish exact loci of genes.)
Linkage map of the ten chromosomes of sea urchins showing the loci of those genes whose position can be determined with reasonable certainty.
April 15, 1939

The data presented here are not to be used in publications without the consent of the authors.

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
January 21, 1939

To Maize Geneticists: -

The call for material for the 1939 Co-op News Letter has purposely been delayed to allow you more time to analyze last summer's results. Since it is desirable to have the Letter available not later than the first part of March, however, the individual contributions must be received by the Co-op by February 15, 1939.

In order to insure a more uniform system of presentation, please refer to previous News Letters for suggestions concerning the form of your write-up.

Sincerely yours,

D. G. Langham

D. G. Langham, Secretary
April 15, 1939

To Maize Geneticists:

The material in this letter was obtained from many sources, and has been organized under the following heads:

I. General News Items.
II. Seed Stocks Grown in 1938.
III. Seed Stocks Received For Propagation in 1939.
IV. Maize Publications.
V. Maize Genetics Cooperation Mailing List.

I. General News Items

University of Buenos Aires, Buenos Aires, Argentina -

1. The Argentine varieties of commercial corn are all flint and can be classified in three groups according to endosperm color:
   a. Varieties with orange endosperm.
   b. " yellow " .
   c. " white " .

Genetical analysis shows that both groups a and b carry the genes $Y_1Y_2Y_3Y_3$. In the first group the varieties Colorado Cuarenton were tested; in the second group the varieties Amarillo Comun and Amarillo Enans. The difference in color between groups a and b is due to modifying factors. Long White Flint, the only variety of white endosperm tested, has the genotype $Y_1Y_1Y_1Y_3$.

2. The gene al, besides the known effects upon the development of chlorophyll, reduces the intensity of the endosperm color. In ears segregating AlAl, Alal, and alal, most kernels which have the last combination may be recognized because they have a lighter yellow color. Plants alal give ears with light yellow endosperm. In numerous F$_2$, no plants of homozygous al and deep yellow or orange endosperm have been found.

T. M. Andres

University of Minnesota, St. Paul, Minn. -

1. Linkage relations of $gl_4$ with $wx$ and $sh$. The sample of $gl_4$ was found in Minnesota in one of our cultures and was being studied at the time of Dr. Sprague's report on $gl_4$. 

247
Order of genes sh-wx-gl

2. Linkage of zebra seedling-1 (zb) with P in chromosome 1. Results are similar to those obtained with F₂ data.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>Recomb. No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>sh Wx</td>
<td>CB</td>
<td>213</td>
<td>66</td>
<td>39</td>
<td>172</td>
<td>490</td>
<td>105</td>
</tr>
<tr>
<td>sh Gl₄</td>
<td>CB</td>
<td>202</td>
<td>77</td>
<td>55</td>
<td>156</td>
<td>490</td>
<td>132</td>
</tr>
<tr>
<td>wx Gl₄</td>
<td>CB</td>
<td>235</td>
<td>17</td>
<td>22</td>
<td>216</td>
<td>490</td>
<td>39</td>
</tr>
</tbody>
</table>

3. An upright habit of the tassel characteristic of inbred line 19 used in 1st cross K (15 x 19) proved recessive in crosses with normal tassel but dominant in the F₁ of the cross between upright and ts₄.

4. I believe it is possible now to arrange the linkage groups in our linkage map still further, so that the linkage groups are oriented in a still more uniform scheme in relation to the chromosomes. In the linkage map sent out with the last corn letter, they are oriented so that the upper end corresponds to, or is in the direction of the short arm end of the chromosome with the exception of #3 and probably #8. My evidence on #3 indicates that this group should be reversed with or at the zero point or in the direction of the short arm end. For #8, the only data I have are those given below. The numbers are too small, but they suggest that this group should be reversed also, placing 1₃ at the zero point. This means that the zero point will be moved as new data come along, but that will be true of several other groups as they stand now.

5. The series of r and R alleles listed in the corn linkage summary does not include the one designated in the original paper on plant colors (pp. 111-113) as r²⁸. This allele was there described as giving in the dilute types (A b P₅ and A b p₅) green anthers with red color at the base of the plants, whereas the ordinary r² allele gave green anthers and green base plants. One suggestion is that the superscript for the r-series may need to be a tri-letter one (anther color, silk color, and base color).
1. Linkage data on chromosome S:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>xY</th>
<th>xY</th>
<th>xy</th>
<th>Total</th>
<th>Recomb. No.</th>
<th>Recomb. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms3 J1</td>
<td>CB</td>
<td>35</td>
<td>1</td>
<td>3</td>
<td>41</td>
<td>80</td>
<td>4</td>
<td>5.0</td>
</tr>
<tr>
<td>Ms3 T8-9a</td>
<td>CB</td>
<td>54</td>
<td>16</td>
<td>16</td>
<td>24</td>
<td>120</td>
<td>42</td>
<td>35.0</td>
</tr>
<tr>
<td>J1 T8-9a</td>
<td>CB</td>
<td>56</td>
<td>18</td>
<td>26</td>
<td>31</td>
<td>131</td>
<td>44</td>
<td>33.6</td>
</tr>
</tbody>
</table>

Indicating the order: T8-9a - J1 - ms3 - end of long arm.

2. Sterilizing seeds for germination. A hypochlorite solution sold under the trade name "Chlorox" is easier to use than the bleaching powder solution. Field corn soaked in Chlorox solutions at 5% and stronger for 1/2 hour completely controlled the molds but reduced germination. There was very little mold and normal germination at 3% and also at 2%. For genetic material a solution of 2 cc. of commercial Chlorox to 100 cc. of water is recommended, soaking the grains for 1/2 hour. Other hypochlorite solutions are on the market but may vary in the % of the active ingredient.

Connecticut Agricultural Experiment Station, New Haven, Conn. -

1. In seeds treated with X-rays shortly after fertilization numerous paired mosaic areas are found associated with losses of all of the easily identified marker genes such as C, Wx, Pr, Su. In many cases areas showing losses of any of these markers are paired with areas that are either lighter or darker than normal in varying shades of aleurone color. Not all of these can be due to shifts of aleurone color genes and it seems likely therefore that breaks and rearrangements of chromosome fragments may alter the cell metabolism and indirectly affect aleurone color. In the same way other activities of the cell are altered, notably in starch formation, viability, and growth control.

2. Fine mottling of rrR seeds. In 1937 an ear of Connecticut 720 y Su A C r when pollinated by C697 (a C R) gave seeds that were all mottled. There were 94 regular or coarse mottled kernels, 86 with very fine mottling, color often limited to a few patches of from one to a few cells each, and 5 colorless. (These probably were fine mottling where no color was visible, or were contaminations. They are being tested).

In 1938 seeds of the two classes were planted in separate rows and selfed or again crossed by 697 A-tester. Two ears of
the fine mottled stock selfed produced only whites, solid, and fine mottling. One ear crossed by 697 gave 180 white, 92 solid color, and 82 fine mottled kernels. Three ears from the coarse mottled stock when crossed by 697 gave 534 white, 250 solid color, 132 coarse mottling and 94 fine mottled kernels. This is not a great deviation from a $h : 2 : 1$ ratio expected if the fine mottled factor shows independent inheritance with Mt.

Does anyone have any convincing evidence that Mt is not an allele of the R r gene? Kempton's (GENETICS 4: 261-274) data can be interpreted on an allelic basis as well as assuming 12.5% of the colored seeds should have been mottled. He incorrectly states he expected 25% whereas 33 1/3% was the correct proportion of the colored kernels. Selfed ears are rather unsatisfactory for determination of this point. We plan to test this by back-crossing if it has not been done.

3. White seedling classification. White seedlings can be classified satisfactorily soon after the seeds have germinated if they are germinated in the light. We use an old glass incubator for a germinator and keep the temperature about 75°F. Seeds are sterilized for 1 minute in a 1% solution of Hg Cl$_2$ and put in petri dishes, 100 to a dish. Under these conditions chlorophyll develops rapidly and classification can usually be completed within a week after planting.

4. Seedling classification for red or green base. Seedlings germinated by the above method can be classified accurately for the green base ($R^E$ or $R^e$), or red base ($R^T$ or $R^t$). The tip of the first true leaf has been found the most reliable place for classification. If any antho-cyanin color is present it will appear at the tips of the leaves. Seedlings so germinated and classified can still be planted without injury or setback. (This method of classification is not new. It is used by Dr. Stadler and his students at the University of Missouri. It is cited here as it may be helpful to some unfamiliar with it).

5. Seeds germinated in the germinator produce pollen and silks early. Last spring one lot of 050, a sweet corn inbred, was planted in the field on June 1. Another lot of the same stock was put into the germinator. As soon as the seedlings were well started they were put into four inch pots and kept in the greenhouse for about two weeks before transplanting to the field. The plants so treated produced pollen a week ahead of those planted in the field and there was a difference of nine days in the silking dates. This method may be utilized for securing early tassels and silks of stocks, without planting early.

6. $sp_1$ and $lo$ not allelic. We now have definite proof that $sp_1$ and $lo$ on chromosome 4 are not alleles of the same gene. In
fact they are located on opposite sides of su1. Complete evidence will be published shortly.

W. R. Singleton

7. A hybrid between a Lancaster inbred (696-3c) and Parnunkey in 1936 produced all semi-sterile ears. Cytological examination of the hybrid in 1938 showed the presence of a heterozygous translocation involving chromosomes 1 and 2. The point of interchange in chromosome 1 is in the short arm, at approximately 6/10 of the distance from the spindle fiber attachment region to the end of the chromosome. The break was between the spindle fiber and a knob on the short arm. The point of interchange on chromosome 2, on the long arm, is approximately halfway between the spindle fiber and the end of the chromosome. Chromosome 2 also has a knob. Seed of the homozygous translocation is available.

8. A subterminal knob was found on the long arm of chromosome 9 in 38-1174 (segregating sp1 and le). This knob is similar in appearance to the chromosome 4 knob, but examination of crosses with unrelated stocks showed no evidence of a translocation involving chromosomes 9 and 4. The knob is quite close to the end of the chromosome with about 1/5 of the long arm beyond it. Seed of this is available.

F. J. Clark

University of North Carolina, Raleigh, N. C.

1. Opaque endosperm-H. Endosperm similar to O and O2. Classification good in white dent stocks. Seed segregate 75% normal (OH), 25% opaque (oH). All OH seeds produce normal plants while all oH seeds produce dwarfish, yellow-green striped, abnormal-leaved plants which die in four weeks under field conditions. Some seedlings of oH lived two months in greenhouse but never got over 5 inches tall. Germination of oH seed approximately 50%.

Paul H. Harvey

2. Red leaf tip (rl). Appears when plants are 8 to 12 inches high under field conditions. Red color gradually extends from tip to cover approximately one-half of blade. Classification good in F2. Segregates 75% normal (RL) to 25% red (rL). All RL plants smaller than normal.

3. Burned leaf (Bu). Tissue in leaf tips begins to die and turn brown when plants are 10-18 inches high under field conditions. Condition spreads to one-half or more of leaf. Somewhat resembles conditions caused by certain plant food deficiencies. Classification fair, though a few heterozygous plants show some evidence of burning along leaf margins. Segregates 75% normal (Bu) to 25% burned (Bu). All Bu plants smaller than normal.

G. K. Middleton
With further reference to our hypothesis that (1) maize originated from a wild form of pod-corn, (2) that teosinte is the product of natural hybridization between maize and Tripsacum, and (3) that most North American varieties of maize are contaminated with Tripsacum, we have spent a good share of the past year in reviewing the archaeological and historical evidence which has a bearing on this problem. We have found nothing seriously in conflict with the hypothesis and a great deal of evidence in support of it.

In the last News Letter we made the suggestion that the knobs on the chromosomes of maize may have come originally from Tripsacum, in which case pure South American varieties might be found in which the chromosomes were knobless. This has proved to be the case. Of 17 lots received from Peru, all but two had knobless chromosomes. Collections from other parts of South America, however, all had knobbed chromosomes, the average numbers being as follows:

<table>
<thead>
<tr>
<th>Country</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venezuela</td>
<td>5.50</td>
</tr>
<tr>
<td>Uruguay</td>
<td>5.00</td>
</tr>
<tr>
<td>Brazil</td>
<td>4.08</td>
</tr>
<tr>
<td>Paraguay</td>
<td>3.50</td>
</tr>
<tr>
<td>Dutch Guiana</td>
<td>3.00</td>
</tr>
<tr>
<td>Argentina</td>
<td>2.00</td>
</tr>
<tr>
<td>Peru</td>
<td>0.83</td>
</tr>
</tbody>
</table>

If the knobs on maize chromosomes have come originally from Tripsacum, it is evident that Tripsacum-infected varieties have replaced pure maize varieties in all parts of North and South America except the Andean region, which we regard as the primary center of domestication. Bolivian varieties have not yet been studied from the standpoint of chromosome knobs, but we anticipate that the majority of them will be found to be knobless.

The objection most frequently raised to the hypothesis that maize originated from pod-corn is that pod-corn is sterile in the homozygous condition and a sterile form could scarcely have served as a progenitor. We have attributed pod-corn's sterility to the fact that it has been maintained in a heterozygous condition for so many generations it is now a monstrosity when homozygous. We have suspected, however, that a fertile, homozygous form might still be developed by selection since there is great variation in the expression of the glumes and other characteristics of pod-corn. During the past season we have found that the $T_s$ gene apparently is a strong modifier of fertility of $TuTu$ plants. Homozygous tunicate plants carrying the $T_s$ gene are highly fertile on the pistillate side and exert a few good anthers. Self-pollination is impossible because the silks are dried up before anthesis occurs. Sib-pollinations can be made, however, and we expect to have true-breeding stocks of pod-corn available in the near future.

P. G. Mangelsdorf and R. G. Reeves
1. \( \text{LE}_3 \) (dominant liguleless) is in chromosome 3 as shown by the following summary of data from six small cultures:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xY</th>
<th>xy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rg ( \text{LE}_3 )</td>
<td>RB</td>
<td>3</td>
<td>138</td>
<td>124</td>
<td>0</td>
<td>265</td>
</tr>
</tbody>
</table>

\( p = .011 \)

A greater portion of the ligule is present in \( \text{LE}_3 \) plants than in either \( \text{LE}_1 \) or \( \text{LE}_2 \) plants. But for the characteristic "liguleless" appearance of the plant as a whole the character might more appropriately be called "defective ligule". Classification (except for seedlings), viability, and fertility (except perhaps for homozygotes) are satisfactory.

A test for allelism with \( \text{LE}_2 \) and three-point tests are being made.

H. S. Perry

California Institute of Technology, Pasadena, Calif. -

1. List of translocations involving chromosome 3:

Near left end (i.e., short arm):-
- T3-6b  S  \( d_1 \pm 0.5 \)
- T3-7b  S  \( d_1 \pm 0.4 \)
- T2-3c  S  \( d_1 \pm 0.3 \)
- T1-3d  \( d_1 \pm 0.6 \)

Middle region -
- T3-9a  ts\(_4\) \( t - 2.9 - d_1 - 34.0 \) T \( - 25.0 - \text{lg}_2 \)
- T3-7a  ts\(_4\) \( t - 5.0 - d_1 - 20.2 \) T \( - 15.9 - \text{lg}_2 \)
- T3-8b  L .1  ts\(_4\) \( t - 0 \) \( - d_1 - 17.6 \) T \( - 14.8 - \text{lg}_2 \)
- T3-9c  L .1  \( \text{lg}_2 \)
- T3-10a L .1  ts\(_4\) \( t - 10.4 \) \( - d_1 - 11.2 \) T \( - 11.7 - \text{lg}_2 \)
- T2-3b  ts\(_4\) \( t - 1.1 \)
- T3-10b ts\(_4\) \( t - 0.8 \)
- T3-10c ts\(_4\) \( t - 0.7 \)
- T3-6a  \( d_1 - 18.0 \) T \( - 12.0 - \text{lg}_2 \)
- T3-5a  \( d_1 - 24.5 \) T \( - 7.9 - \text{lg}_2 \)
1. The Linkage Summary suggests a possible allelism of $E_4$ and $YE_2$. They are distinct genes, as an F$_1$ between them contained only green plants. In F$_2$ both $E_4$ and $YE_2$ segregated.

2. Dull endosperm, $du$, which intensifies $su$$_{sm}$ and $su$$_1$ (see Corn Letter of March 23, 1937, p. 13) has no distinctly visible effect on $su$$_2$. Three separate crosses of $du$ x $su$$_2$ were made and F$_1$'s selfed. Six ears from each F$_2$ showed no definite effect of

---

**Cornell University, Ithaca, N. Y.**

E. G. Anderson
du on su2. Any such effect is very slight if existent at all. Therefore, the mechanisms by which the su1 and su2 genes act must be different, at least in part.

3. Slit blade, sb, has shown various abnormalities. Sometimes F2 ratios are atypical in crosses involving sb. Last year an 8:1 ratio of sb was reported. This year one plant of 90 F2s was a dwarf, resembling mi sh. Various genes have appeared following sb crosses (see below); some of these, at least, seem to be new. In the progeny of an open pollinated mi sh sb plant there was one very abnormal plant. It was ms, striped, bm, with a silkless ear, possessing much enlarged glumes. Slit blade itself is variable, ranging from almost normal-appearing plants to small "deficiency-like" plants with narrow, thick leaves. Many sb plants are nearly or completely sterile. In the light of these divers abnormalities, it is suggested that sb is, or is closely accompanied by, some chromosomal abnormality.

4. Possible new genes from sb crosses:
   - tw sh -- an adherent showing in both the seedling (causing it to be twisted) and the tassel. Viability good. Classification good.
   - mi sh -- a semi-dwarf with compact tassel, rather stiff leaves, small seeds. Viability good. Fertility good. Classification good except with lg.
   - g sh -- a vigorous golden, showing golden late. May be g2, for it showed about 30% recombination with a.

   John Shafer

5. F2 data (News Letter, March 23, 1937) indicated that pbx is located between Y1 and Pl in chromosome 6. Backcross data obtained last summer, however, suggest rather close linkage of Y1 and pbx.

Backcross data:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>xy</th>
<th>Total</th>
<th>% Recombination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1 Pb x</td>
<td>CB</td>
<td>187</td>
<td>2</td>
<td>139</td>
<td>326</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Three-point test:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1</th>
<th>2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1 + Pl pbx</td>
<td>170</td>
<td>132</td>
<td>-</td>
<td>2</td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td>+ pbx +</td>
<td>302</td>
<td>0.5%</td>
<td>2</td>
<td>82</td>
<td>0.5%</td>
<td>2</td>
</tr>
</tbody>
</table>
Whether \( p_{pb} \) is located to the right or to the left of \( Y_1 \) can not be decided from these data. The white and yellow patches on plants obtained from backcrosses are considerably larger than those found on piebald plants from the \( F_2 \), and are found not only on the leaves but also on the husks. This is attributed to the effect of modifiers rather than to environment.

G. A. Lebedeff

6. Sterility in tetraploid maize. An investigation of the possible causes of the variation in degree of sterility observed in different lines of tetraploid maize was made both from the cytological and genetic angles. In a study of microsporogenesis, both self-sterile and self-fertile lines showed a large number (8-10) of quadrivalents at diakinesis. This indicates that quadrivalent formation is not an important factor in causing sterility in tetraploid maize.

The chromosome number of the microspores varied from 14 to 24. Much of this variation was found to be due to the lagging of univalents and non-disjunction of chromosomes resulting in the formation of micronuclei, and to a lesser extent to the three to one separation of quadrivalents. From one to six chromosomes, usually in univalent groups, were seen to lag in sporocytes showing lagging. Gametes having 18 to 22 chromosomes are considered to be functional, since the chromosome numbers of the progeny of a tetraploid maize plant \( (4n = 40) \) has been shown to range from 37 to 42. The frequency of microspores having between 18 and 22 chromosomes agreed very well with the percentage of apparently good pollen in the fertile and sterile lines in which this was studied.

Four \( F_1 \) populations resulting from crosses between lines with a high degree of pollen abortion (25%) and lines with a low degree of pollen abortion (10%), showed a low mean percentage of aborted pollen, suggesting a possible genic basis for this.

The coefficient of correlation between degree of pollen abortion and percentage of aborted ovules, when only fertile lines were considered, was found to be \(-0.651 \pm 0.025\), indicating that factors causing pollen abortion are also operative in causing ovular abortion.

Evidence was obtained indicating that genetic factors for incompatibility were also involved in causing sterility in tetraploid maize. Some self-compatible lines were found to be cross-incompatible with other self-compatible lines when used as the pollen parent. This relationship was true even when the effect of different pollen was compared on two ears from the same plant, one ear being self-pollinated and the other cross-pollinated. In crosses between self-compatible and self-incompatible stocks a unimodal distribution was obtained for the \( F_1 \) and a bimodal
distribution for the $F_2$ population, indicating the existence of at least one dominant or epistatic gene for self-compatibility. A study of reciprocal crosses between self-compatible and self-incompatible lines showed that self-incompatible lines were cross-compatible only when used as the pollen parent. No evidence of pollen tube competition was found in a compatible cross between a self-compatible and a self-incompatible line when mixed pollinations were made to determine this.

Some evidence was obtained indicating that the chromosome number of the plant was not very important with respect to degree of fertility since a 38 chromosome plant was found to be 75% fertile (seed set) when self pollinated. This supports the conclusion that much of the sterility in tetraploid maize is due to genic rather than chromosome number difference.

If genes for self and cross-incompatibility are concerned in causing sterility in tetraploid maize, it is necessary to assume that these genes were present but inhibited in diploids, but became effective because of a genic unbalance resulting from chromosome doubling, i.e. upon doubling some genes increase in effectiveness and others remain static as far as their activity is concerned.

Harold E. Fischer

7. A sib cross between two iojap plants in a culture obtained from A. A. Bryan gave an ear which is homozygous for white seedlings. Forty seeds from this ear were planted. Thirty-eight germinated; all the seedlings were white and died within two weeks. This is interpreted as a case of extreme variation in the expression of iojap.

8. In a tester stock of 11 plants with the genetic constitution $\text{pr} v_2 A b pl O R$ eight plants were dilute sun red, as expected, but three showed occasional red sectors in the leaves, husks, and tassel. When the leaves were stripped down and the stalk exposed to the sunlight, red sectors appeared on it, too. Apparently $b$ is unstable and mutates to $B$.

9. Linkage of $e_4$ and thin kernels. In a cross of Inbred II $x e_4 w x$, three $F_2$ ears segregated 25% thin kernels and the other four $F_2$ ears were normal. Seed was taken from an ear segregating thin kernels, and the normal kernels planted separately from the thin ones. Theoretically, $e_4$ should have segregated 3:1 in each group. All 14 plants obtained from the kernels of normal thickness were green, while the 10 plants from the thin kernels were $e_4$. This behavior suggests that the gene (or small deficiency?) for thin kernels is closely linked with $e_4$. 

257
10. New characters in maize, teosinte, and maize-teosinte hybrids:

Maize —

*adL* -- adherent plant. Can be classified in early seedling stage; tips of leaves stick together. Plant becomes almost normal until anthesis, when anthers, tassel branches, and silks become sticky and tend to adhere. Viability and fertility good. Chrom. unknown.

Teosinte —

Several plants each of Nobogame, Huixta, Novocayan, and Durango teosinte were selfed and progeny tests made for genetic characters. The following characters segregated in 3:1 ratios:

- *zb* — zebra seedling.
- *ad* — adherent leaves.
- *dt* — dwarf.
- *pg* — pale green (two cultures).
- *ft* — fine stripe.
- *gl* — glossy.
- *wt* — white seedling (two cultures).
- *co* — corrugated leaf (three cultures).
- *gst* — green stripe (three cultures).
- *yst* — yellow stripe.
- *l* — lazy teosinte (reported in 1938 News Letter).

These genes will be crossed with similar maize genes to test for possible allelism.

Maize-Teosinte hybrids —

- *sd* — response to short day. Recessive to "weak" response to length of day in maize. Mendelian character.
- *tr* — two-ranked ear and two-ranked central branch of the tassel. Recessive to the many-ranked ear and many-ranked central branch of the maize tassel. Mendelian character.
- *pd* is linked with *tr* with 20% recombination. Chromosome unknown.

11. Brittle stalk-X (*bk*) reported by R. G. Wiggans in the News Letter, March 6, 1938, p. 12, is an allele of *bk*.

Fine stripe-X (*fx*) from the same report is an allele of *fx*.

D. G. Langham
II. Seed Stocks Grown, 1938

1. Testers.

Chromosome 1:
(P br f_1 bm_2 x P zb_4) x zb_4 br f_1
 zb_4

Chromosome 2:
+/d_5
(lg_1 gs_2 b v_4 x Inbred I)self
(ws_3 lg_1 x gl_2) x (ws_3 lg_1 x gl_2)
lg_1 gl_2 v_4 x fl_1
lg_1 ts_1 +/gl_2 +/v_4 x lg_1 gl_2 +/ts_1 +/v_4
lg_1 +/sk_1 x lg_1 sk_1
+/ba_2 x ba_2

Chromosome 3:
(pm x lg_2 d_1) x (pm x lg_2 d_1)
+/d_1 x d_1
d_2 +/ba_1 x ba_1
lg_2 d_1 +/ts_4
a_1 lg_2 ra_2
(ts_4? Rg x d_1) x lg_3/

Chromosome 4:
su_1 gl_3 +/wl
sp_1 su_1

Chromosome 5:
bm_1 bv pr
bm_1 bt

Chromosome 6:
v_7
P_1 sm +/py x P_1 sm py
Y_1 P_1 sm A b
Inbred II x pb_x
Inbred I x pb_x
Chromosome 7:

\[ \text{Hs} \]

\[ \text{v5} \]

Chromosome 8:

\[ \text{msg} \text{j1 v16 x (msg} \text{j1 x v16) } \]

Chromosome 9:

\[ +/\text{vp4} \]

\[ \text{ms2 x ms2/+} \]

\[ \text{ms20 x Ms20} \]

\[ \text{sh} +/\text{d3} \]

Chromosome 10:

\[ +/\text{vp1} \]

\[ \text{rst} \]

\[ \text{Rmb} \]

\[ \text{Rnj A1 C Pr} \]

\[ \text{Rg A1 C pr PVV} \]

\[ \text{r'} y \text{su1} \]

2. Miscellaneous:

\[ \text{fx Pu} \text{x} \]

\[ \text{de} \]

\[ \text{v20} \]

\[ \text{a1 C Rg pr in wx y} \]

\[ \text{a1 C R Y pr in} \]

\[ \text{ms11+/} \]

\[ +/\text{ws3} \]

\[ \text{v9} \]

\[ \text{A a Rg su1+/v9 x v9} \]

\[ +/\text{v13} \]
T56 0g
Inbred I x bm3
Lo/
hf x +/-hf
T56/+ x al
+/ tw3
+/ bx (Singleton)
+/ ra (Singleton)
zb f x ys

3. No germination:
Inbred II x Sx
lo su1
wsx
bt3
aP B Pl P
Ms3/? sh g3
ms4 x ms1/+ 

4. Too late:
gigas

III. Seed Stocks Received for Propagation in 1939
1. P. C. Mangelsdorf, College Station, Texas:-
du2 du2 seg. da1 suam
Du2du2 seg. du1 suam
2. P. H. Harvey, Raleigh, N. C.:
oH oH
oH oH
3. J. Shafer, Ithaca, N. Y.:-
wx v1 gl4
sh wx v1 gl4
yg2 sh wx seg. gl4 lg1
IV. Some Recent Papers on the Cytogenetics of Maize

During the past year several maize geneticists have written to the Co-op for a list of recent publications in maize. In view of this demand, what do you think of the idea of making such a list a part of the annual Maize Genetics Cooperation News Letter? Most of the maize literature to 1935 is included in the combined bibliographies of "Genetics of Zea Mays" by W. H. Eyster, and "A Summary of Linkage Studies in Maize" by Emerson, Beadle, and Fraser. If these bibliographies were brought up to date, a list of all the papers published between February, 1939, and February, 1940, could be included in the 1940 News Letter, and all those to February, 1941, in the following News Letter.

If your reaction to this suggestion is favorable, will you help bring the following list of papers up to date (I have more than likely missed some)?


V. Maize Genetics Cooperation Mailing List

Anderson, Dr. Edgar, Washington University, St. Louis, Mo.
Anderson, Dr. E. C., Institute of Technology, Pasadena, Calif.

Beadle, Dr. G. W., Biology Dept., Stanford Univ., Stanford Univ., Calif.

Bennett, Dr. L. S., Agronomy Dept., Agric. Exp. Sta., Fayetteville, Ark.

Brieger, Dr. Friedrich, Escola Luiz de Queiroz, Piracicaba, Sao Paulo, Brazil.

Brink, Dr. R. A., Genetics Dept., Univ. of Wisconsin, Madison, Wisc.

Bryson, Dr. A. M., Agronomy Dept., Purdue Univ., LaFayette, Ind.

Bryson, Dr. W. W., Queensland Agric. College, Lewes, Q., Australia.

Burnham, Dr. C. R., Agronomy Division, University Farm, St. Paul, Minn.

Cartledge, Dr. J. L., Agronomy Dept., Univ. of West Virginia, Morgantown, W. Va.

Clokey, Mr. Ira M., 1635 Laurel St., South Pasadena, Calif.

Cooper, Dr. D. C., University of Wisconsin, Genetics Dept., Madison, Wisc.

Creighton, Dr. Harriet B., Conn. College for Women, New London, Conn.


Demerec, Dr. M., Carnegie Inst., Cold Spring Harbor, Long Island, N.Y.

Dorsey, Dr. E., Plant Breeding Dept., Cornell University, Ithaca, N. Y.

Doxtator, Mr. C. W., Div. of Agronomy, University Farm, St. Paul, Minn.

Eckhardt, R. C., Farm Crops Dept., Iowa State College, Ames, Iowa.

Emerson, Dr. R. A., Plant Breeding Dept., Cornell University, Ithaca, N. Y.

Eyser, Dr. W. H., Botany Dept., Bucknell University, Lewisburg, Pa.

Fraser, Dr. A. C., Plant Breeding Dept., Cornell University, Ithaca, N. Y.
Garber, Dr. R. J., U.S.D.A. Regional Pasture Research Lab., State College, Penn.
Gurney, Dr. H. C., Waite Research Inst., Adelaide Univ., Adelaide, Aust.
Hadjinov, Dr. M. I., Inst. of Plant Industry, Detskoe Selo (near Leningrad), U.S.S.R.
Harvey, Dr. Paul H., Agronomy Dept., University of North Carolina, Raleigh, N. C.
Hayes, Dr. H. K., Agronomy Division, University Farm, St. Paul, Minn.
Hofmeyr, Dr. J. D. J., P.O. Marabastad, Pietersburg, South Africa.
Holbert, Dr. J. R., Federal Building, Bloomington, Illinois.
Horovitz, Mr. S., Instituto de Santa Catalina, Llanalol, F.C.O., Argentina.
Hull, Dr. Fred, Agronomy Dept., Agric. Exp. Sta., Gainesville, Florida.
Jenkins, Dr. M. T., Bureau of Plant Industry, U.S.D.A., Washington, D. C.
Johnson, Dr. I. J., Agronomy Division, University Farm, St. Paul, Minn.
Jones, Dr. D. F., Genetics Dept., Agric. Exp. Sta., New Haven, Conn.
Kopf, Mr. Kenneth, F. H. Woodruff & Sons, Milford, Conn.
Krug, Mr. Carlos A., Inst. Agronomica do Estado Campinas, Sao Paulo, Brazil.
Kvakan, Dr. Paul, Dobricevo Cuprija, Yugoslavia.
Langham, Dr. D. C., Plant Breeding Dept., Cornell Univ., Ithaca, N. Y.
Lebedeff, Dr. G. A., Plant Breeding Dept., Cornell Univ., Ithaca, N. Y.
Li, Dr. H. W., Wu-Han University, Wuchang, Hupeh, China.
Lindstrom, Dr. E. W., Genetics Dept., Iowa State College, Ames, Iowa.
Longley, Dr. A. E., Bureau of Plant Industry, U.S.D.A., Washington, D. C.
McClintock, Dr. Barbara, Botany Dept., Univ. of Missouri, Columbia, Mo.
Mains, Dr. E. B., Botany Dept., University of Michigan, Ann Arbor, Mich.
Mangelsdorf, Dr. P. C., Agronomy Dept., Agric. Exp. Sta., College Station, Texas.
Miles, Dr. L. G., Dept. of Agric. & Stock, Brisbane, Queensland, Aust.
Mumm, Mr. W. J., Agronomy Dept., University of Illinois, Urbana, Ill.
Neal, Dr. Norman P., Genetics Dept., Univ. of Wisconsin, Madison, Wisc.
Perry, Dr. H. S., Botany Dept., Duke University, Durham, N. Caro.
Peto, Dr. F. R., National Research Council, Ottawa, Ontario, Canada,

Randolph, Dr. L. F., Botany Dept., Cornell University, Ithaca, N. Y.
Reeves, Dr. R. G., Biology Dept., Agric. Exp. Sta., College Station, Texas.
Rhoades, Dr. M. M., Arlington Exp'1 Farms, Arlington, Virginia.
Richey, Mr. F. D., P.O. Box 23, Ashville, Ohio.

St. John, Mr. R. R., Botany Dept., Purdue University, Lafayette, Indiana.
Sando, Dr. Chas. E., Bureau of Chemistry and Soils, U.S.D.A.,
Washington, D. C.

Sansome, Dr. F. W., Botany Dept., Univ. of Manchester, Manchester 13, England.

Shafer, Dr. John I., Botany Dept., Cornell Univ., Ithaca, N. Y.
Singh, Dr. S., Botanical Section, Imperial Inst. of Agric. Research, Pusa, Behar, India.
Singleton, Dr. W. R., Genetics Dept., Agric. Exp. Sta., New Haven, Conn.

Sokoloff, Prof. Dmitri, Escuela de Ciencias Biologicas, Instituto Politecnico Nacional, Mexico City, Mexico.

Sprague, Dr. G. F., Field Crops Dept., Univ. of Missouri, Columbia, Mo.
Stadler, Dr. L. J., Field Crops Dept., Univ. of Missouri, Columbia, Mo.

Stringfield, Mr. G. M., Agronomy Dept., Agric. Exp. Sta., Wooster, Ohio.

Tavcar, Dr. A., Dept. of Plant-Breeding, Univ. of Zagreb, Zagreb, Jugoslavia.

Thomas, Dr. H. C., Genetics Dept., University Farm, St. Paul, Minn.

van Overbeck, Dr. J., Institute of Technology, Pasadena, Calif.
Viegas, Claudio P., Agronomica do Estado Campinas, Sao Paulo, Brazil.

Weatherwax, Dr. Paul, University of Indiana, Bloomington, Indiana.
Wellhausen, Dr. E. J., Genetics Department, University of West Virginia, Morgantown, W. Va.

Wernham, Mrs. G. C., 229 West Beaver Ave., State College, Penn.
Wiggans, Dr. R. G., Plant Breeding Dept., Cornell University, Ithaca, N. Y.

Woodworth, Prof. C. M., Agronomy Dept., Univ. of Illinois, Urbana, Ill.

Yasui, Prof. K., Plant-Morphology Division, Tokyo Imperial University, Tokyo, Japan.

Andres, Dr. Jose M., Director Del Instituto De Genetica, Facultad De Agronomia Y Veterinaria, Buenos Aires, Argentina.

Hill, Mrs. H. H., Arlington Experiment Station, Arlington, Va.
MAIZE GENETICS COOPERATION

NEWS LETTER

March 5, 1940

The data presented here are not to be used in publications without the consent of the authors.

Department of Plant Breeding
Cornell University
Ithaca, N. Y.
October 31, 1939

To Maize Geneticists:

Call for material for the 1940 issue of the Maize Genetics Cooperation News Letters. Dead line is January 15th at Ithaca, New York.

The next issue of the News Letters will contain a revised list of all the Co-op stocks. Please send us your material which in your opinion would be desirable to include in the Co-op list. Also include anything that will be of value to other maize geneticists, such as your new linkage data, etc.

Members who attended the Genetical Congress at Edinburgh last summer are particularly requested to send in comments which might be of interest to maize geneticists.

Sincerely yours,

G. A. Lebedeff
Secretary
To Maize Geneticists:—

Dr. G. A. Lebedeff, secretary of Maize Genetics Cooperation has accepted a position at the Agricultural Experiment Station of the University of Puerto Rico, Rio Piedras, Puerto Rico. I am, therefore, for the present acting as secretary.

This News Letter is presented under the following headings:—

I. Maize gene symbols in publications.
II. General news items.
III. Maize publications.
IV. Inventory of Cooperation seed stocks.
V. Index to seed stocks.
VI. Historical Notes on Maize Genetics Cooperation.

It is understood that data presented here are not to be used in publications except on permission of the authors.

I. MAIZE GENE SYMBOLS IN PUBLICATIONS

The following statement is quoted from a letter written by Dr. L. C. Dunn, managing editor of Genetics, to Dr. L. J. Stadler, a member of the board of editors:—

"The chief difficulty from the standpoint of publisher and printer comes from the frequent employment of subscripts which as you know have to be set in by hand and sometimes require special characters to be cast. This represents extra cost to the journals. If it is absolutely essential it must be done, but I'm not convinced that it is essential. In the present paper $A_1$ would serve as well as $A_1$ etc., except that the habit of subscripts has crept in through use. Jones had a rule against them but I notice that he didn't enforce it in Emerson's papers and I haven't either. There's no avoiding superscripts for multiple allelic series, but subscripts aren't generally essential and when both are required, e.g. $A_1^b$, the system approaches physical limits for the compositor and looks rather absurd. I don't propose any sudden revolution. I do suggest it might be discussed by the maize group,
keeping in mind that a system needn't necessarily be frozen by the first ten years of use and that economies in publication, if done without harm to clarity and preciseness, give our journals greater stability and security for the future."

Dr. Dunn's example illustrates the confusion which might often result from following his suggestion. Arabic figure "1" in typed manuscript cannot be distinguished from l.c. letter "1". The symbol "al" might be read "a-one" or "albescent". If the literal part of the symbol were always italicized and the numerical part not italicized, there need be no confusion. Or, if the numeral is joined to the letter by a hyphen, there should be no trouble. Again, if the numeral could be set in smaller type than the literal part of the symbol, the printer's problem might be solved, but certainly not the typist's. It seems likely, however, that two sizes of type might be as bad as subscripts for the compositor. In a recent personal conference with Dr. Dunn, he suggested omitting the numeral "1" in all cases. No numeral would then indicate either that there is only one gene with that literal symbol or that it is the first one reported. Thus, we would have a (= a1) a2, a3, etc. In order that you may see how you like it, the latter plan is followed throughout this News Letter. Let me know what you think of it. The principal difficulty noted in its use here appears first in Anderson's Table (p. 3) where gl3 = glossy 3 not golden 13. In the inventory of seed stocks 17 is not seventeen but luteus 7. Perhaps a period would help, thus: gl.3 and l.7.

R. A. Emerson

II. GENERAL NEWS ITEMS

California Institute of Technology, Pasadena, California

1. Translocations involving the left end of chromosome 1.

<table>
<thead>
<tr>
<th>Translocation</th>
<th>Cytological position</th>
<th>Linkage map position</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-2c</td>
<td>S .7</td>
<td>T 1 sr ts2</td>
</tr>
<tr>
<td>1-9c</td>
<td>S .6</td>
<td>ts2 P 1</td>
</tr>
<tr>
<td>1-2b</td>
<td>S .4</td>
<td>ts2 P 4</td>
</tr>
<tr>
<td>1-6c</td>
<td>S .3</td>
<td>ts2 P 9</td>
</tr>
<tr>
<td>1-3a</td>
<td>S .25</td>
<td>ts2 P 21</td>
</tr>
<tr>
<td>1-9a</td>
<td>S</td>
<td>ts2 P 20</td>
</tr>
<tr>
<td>1-5b</td>
<td></td>
<td>ts2 P 21.4</td>
</tr>
<tr>
<td>1-5c</td>
<td></td>
<td>ts2 P 23.6</td>
</tr>
</tbody>
</table>

T1-9a is known to be in the short arm from tests with homozygous T.
Location of br is probably about L .3.
The spindle attachment may be near the map position of as or between as and br.
2. Translocations involving chromosome 4.

<table>
<thead>
<tr>
<th>Translocation</th>
<th>Cytological position</th>
<th>Linkage map position</th>
</tr>
</thead>
<tbody>
<tr>
<td>T4-6b</td>
<td>S .8</td>
<td>Near Ts5; T 9 su</td>
</tr>
<tr>
<td>4-7</td>
<td>S .6</td>
<td>su ± 1.5</td>
</tr>
<tr>
<td>4-8</td>
<td>S .6</td>
<td>Near Ts5 and su</td>
</tr>
<tr>
<td>1-4</td>
<td></td>
<td>su ± 1</td>
</tr>
<tr>
<td>4-5c</td>
<td></td>
<td>su ± 5.5</td>
</tr>
<tr>
<td>4-10b</td>
<td></td>
<td>su 1 T Tu</td>
</tr>
<tr>
<td>4-5d</td>
<td>L .2+</td>
<td>su 4.5 T 14.6 Tu</td>
</tr>
<tr>
<td>4-6a</td>
<td>L .2</td>
<td>su 3.6 T 13.9 Tu</td>
</tr>
<tr>
<td>2-4a</td>
<td>L .4</td>
<td>su 9.1 T 30 Tu</td>
</tr>
<tr>
<td>2-4c</td>
<td></td>
<td>Near Tu</td>
</tr>
<tr>
<td>2-4d</td>
<td></td>
<td>su Tu gl3 1.5 T</td>
</tr>
<tr>
<td>2-4b</td>
<td></td>
<td>su Tu gl3 21.9 T</td>
</tr>
</tbody>
</table>

Not listed above T4-5a, 4-5b, 4-6c, 4-9a
The spindle attachment is probably somewhere near su.

E. G. Anderson

3. Translocations involving chromosome 2.

<table>
<thead>
<tr>
<th>Translocation</th>
<th>Cytological position</th>
<th>Linkage map position</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2-3a</td>
<td></td>
<td>close to lg</td>
</tr>
<tr>
<td>2-3e</td>
<td></td>
<td>close to lg</td>
</tr>
<tr>
<td>2-6b</td>
<td>L .75</td>
<td>gl12 4.2 T 1.4 B</td>
</tr>
<tr>
<td>2-3c</td>
<td>S .65</td>
<td>gl12 B 0.5 T sk</td>
</tr>
<tr>
<td>2-9a</td>
<td>S .6</td>
<td>Near sk</td>
</tr>
<tr>
<td>1-2b</td>
<td></td>
<td>Near sk</td>
</tr>
<tr>
<td>2-8</td>
<td></td>
<td>B 4.7 T 6.0 ts</td>
</tr>
<tr>
<td>2-3d</td>
<td>sk 8.5 T 12.6 v4</td>
<td></td>
</tr>
<tr>
<td>2-4d</td>
<td>sk 28.4 T 8.8 v4</td>
<td></td>
</tr>
<tr>
<td>2-6a</td>
<td>B 43 T</td>
<td></td>
</tr>
<tr>
<td>1-2a</td>
<td>T 11 v4 (Brink &amp; Cooper)</td>
<td></td>
</tr>
<tr>
<td>2-9b</td>
<td>S .1</td>
<td>ts 5.3 T 7.8 v4</td>
</tr>
<tr>
<td>2-5a</td>
<td>L .1</td>
<td>sk 17.1 T 7.5 v4</td>
</tr>
<tr>
<td>2-5b</td>
<td></td>
<td>ts T v4</td>
</tr>
<tr>
<td>2-10</td>
<td>L .2</td>
<td>ts 11.4 T 6.6 v4</td>
</tr>
<tr>
<td>2-7b</td>
<td>L .25</td>
<td>ts 15.3 T 5.4 v4</td>
</tr>
<tr>
<td>2-7a</td>
<td>L .3</td>
<td>ts 7.2 T 1.1 v4</td>
</tr>
<tr>
<td>2-6 (78)</td>
<td>sk T 1.5 v4</td>
<td></td>
</tr>
<tr>
<td>2-6c</td>
<td>L .3</td>
<td>ts 11.4 T 1.6 v4</td>
</tr>
<tr>
<td>1-2c</td>
<td>L .3</td>
<td>ts 8.3 T 1.1 v4</td>
</tr>
<tr>
<td>2-4a</td>
<td>L .3</td>
<td>v4 ± 1.5</td>
</tr>
<tr>
<td>2-6d</td>
<td>L .4</td>
<td>v4 ± 5.0</td>
</tr>
<tr>
<td>2-7c</td>
<td>L .3 +</td>
<td>ts 17.5 v4 1.1 T</td>
</tr>
<tr>
<td>2-3b</td>
<td></td>
<td>ts 4v 4.0 T</td>
</tr>
<tr>
<td>2-4b</td>
<td>L .6</td>
<td>ts 4v 5.6 T</td>
</tr>
<tr>
<td>2-4c</td>
<td></td>
<td>ts v4 19.0 T 29.2 Ch</td>
</tr>
</tbody>
</table>

The spindle attachment appears to be about half way between ts and y4.

E. G. Anderson and I. W. Clokey
1. Crosses were made in which pollen was collected from individual flowers located in white and green sectors, respectively, of the tassels of iojap plants. The pollen from each flower was used individually on the silks of a plant of an inbred line. The F2 progenies of these crosses were obtained and grown to determine whether pollen from flowers of the two types of tassel tissue differed with respect to transmission of the iojap character. No differences of any kind could be observed between the F2 progenies from crosses made with pollen from the two kinds of sectors.

2. Data obtained on a 4-point backcross involving 3039 individuals indicate the following order of the chromosome 7 genes involved:

\[ q_2 \quad 8.2 \quad v_5 \quad 8.0 \quad r_a \quad 2.4 \quad g_1 \]

Data obtained on a 3-point backcross involving only 192 individuals indicate the order of the three loci involved to be as follows:

\[ i_1 \quad 18.8 \quad B_n \quad 37.5 \quad b_d \]

3. In 1938 one of the selfed ears obtained from a selfed line previously inbred for 6 generations was segregating for sugary seeds. Since there was no evidence of out-crossing and none of the ears from numerous sister plants selfed in 1938 and in the same progeny replanted in 1939 from remnant seed segregated for sugary seeds, it seems certain that the sugary gene arose as a mutation. Crosses made in 1939 identified the mutant gene as su.

M. T. Jenkins

4. Deficiencies. A v2 deficient plant from X-rayed pollen had a small internal deficiency in the long arm of chromosome 5 near the knob probably proximal to it. A B deficient plant from ultraviolet treated pollen had an apparently terminal deficiency of 2/3 to 3/4 of the short arm of chromosome 2.

5. Translocations from ultraviolet. In a population from pollen treated with ultraviolet 9 decidedly off-type plants (in addition to marked deficiencies) were examined. Presumably all were deficient, though the deficiencies were not marked. The diakinesis configurations were as follows:

- 5 plants had 10 II, 2 with obvious deficiencies.
- 1 plant had 8 II and a ring of 4, a typical interchange complex.
- 1 plant had 7 II and an open complex of undetermined number.
- 2 plants had 8 II and a 3 chromosome open complex.
In each of these last two plants with a 3 chromosome complex a chromosome bridge was frequently seen at anaphase I, and segregations of 9-10, 10-10, and 9-11 were observed. The diakinesis configurations and anaphase segregations can be explained on the hypothesis that two chromosomes with terminal deficiencies have united to form a single chromosome with two adjacent centromeres, the terminal portions having been lost. This hypothesis depends on the assumption that such a chromosome could persist through the life of the plant.

Lillian Hollingshead Hill

6. Summary of Ws3 - Lg - Gl2 backcross data.

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ + +</td>
<td>787</td>
<td>808</td>
<td>82</td>
<td>88</td>
<td>2061</td>
</tr>
<tr>
<td>ws3 Lg Gl2</td>
<td></td>
<td></td>
<td>8.2%</td>
<td>14.9%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

These three loci are all in the short arm of chromosome 2. A high degree of interference is indicated by the coincidence value 0.15.

7. Summary of Bm Bt Pr backcross data

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ bt pr</td>
<td>135</td>
<td>462</td>
<td>8</td>
<td>3</td>
<td>972</td>
</tr>
<tr>
<td>bm + +</td>
<td></td>
<td></td>
<td>1.13%</td>
<td>37.04%</td>
<td>0.41%</td>
</tr>
</tbody>
</table>

Bm-Bt = 1.5%  Bt-Pr = 37.5%

The inequality of the complementary classes is due to the poor germination of bt seed.

8. Summary of Bm Bt backcross data

<table>
<thead>
<tr>
<th>Linkage Genes Phase</th>
<th>Bm Bt</th>
<th>Bm Bt</th>
<th>bm Bt</th>
<th>bm Bt</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bm Bt</td>
<td>R B</td>
<td>11</td>
<td>359</td>
<td>900</td>
<td>1278</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The inequality of the complementary classes is due to poor germination of bt seed.

9. Linkage of Dt with loci in chromosome 9. Data published in 1938 suggested that Dt was linked with C. To test this indication the following data were obtained:

<table>
<thead>
<tr>
<th>Linkage Genes Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>Xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dt Wx</td>
<td>C S</td>
<td>1663</td>
<td>525</td>
<td>690</td>
<td>118</td>
<td>2996</td>
</tr>
<tr>
<td>Dt Wx</td>
<td>C B</td>
<td>682</td>
<td>462</td>
<td>472</td>
<td>677</td>
<td>2296</td>
</tr>
<tr>
<td>Dt Sh</td>
<td>C S</td>
<td>679</td>
<td>100</td>
<td>156</td>
<td>138</td>
<td>1073</td>
</tr>
</tbody>
</table>
These data definitely prove that Dt is in chromosome 9 and further indicate that Dt should lie close to yg2. Tests with yg2 have been handicapped by the fact that all available yg2 stocks are homozygous for recessive c and it has been necessary to extract a yg2 C stock.

10. Effect of varying dosages of Dt. Previous data have shown that a non-linear effect was obtained when different dosages of Dt were present in the aleurone. However the demonstration of several modifying factors affecting the a-Dt reaction made it necessary to secure data bearing on this relationship in an iso-genic stock. Such an iso-genic stock was obtained through repeated self-fertilization of a Dt dt stock — heterozygous Dt dt seed being used in every generation to further the inbreeding. After 5 years of selfing the F6 seed was classified into Dt Dt, Dt dt and dt dt classes. For the dosage relation between 1 and 2 Dt genes exact reciprocals were made between DtDt and dt dt plants. It was necessary to self DtDt individuals to obtain data on the effect of 3 Dt genes. The following data were obtained:

<table>
<thead>
<tr>
<th>Pedigree</th>
<th>Mean number of mutations in Dt dt dt class (1 Dt)</th>
<th>Mean number of mutations in DtDt dt class (2 Dt)</th>
<th>Mean number of mutations in DtDt Dt class (3 Dt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6134-13 x 6131-7</td>
<td>6.8</td>
<td>19.5</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6134-6 x 6131-14</td>
<td>5.9</td>
<td>19.6</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6134-1 x 6131-2</td>
<td>7.8</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6134-2 x 6131-9</td>
<td>9.1</td>
<td>23.9</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6385-24 x 6386-13</td>
<td>6.7</td>
<td>24.9</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6385-9 x 6386-19</td>
<td>8.3</td>
<td>26.6</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6385-11 x 6390-17</td>
<td>8.4</td>
<td>24.1</td>
<td></td>
</tr>
<tr>
<td>reciprocally</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean ratio for 1 Dt : 2 Dt = 1 : 3

| 6131-18 selfed    | 110.1                                         |
| 6131-8 selfed     | 126.7                                         |
| 6386-2 selfed     | 128.7                                         |

In each determination at least 50 seeds were used. The figures represent the average number of mutations (i.e. dots of color) in the aleurone layer. The mutation frequency in the 3 Dt class is too low. With such large numbers of dots per seed there is considerable overlapping of the mutant areas. Error also enters from the fact that an earlier mutation of one a allele will obscure a latter mutation of a second allele. In the case of 1 and 2 dosages of Dt this is
an insignificant matter but it must be taken into account in considering the data from 3 doses of Dt. Due to the extreme difficulty in counting the dots on the 3 Dt class only 3 ears were counted. They were in no way different from the numerous uncounted ears of the same constitution. These data confirm the earlier conclusion that the effect of varying doses of the Dt allele is a non-linear one.

11. Effect of temperature on mutation rate of a allele when plants were matured at two levels of temperature after fertilization. Plants of a Dt constitution were grown at a temperature of approximately 70 degrees F. until flowering. Immediately after pollination they were divided at random into two lots and one placed in a greenhouse maintained around 60 degrees F. and the second lot placed in an adjoining house maintained at or near 80 deg. F. The two lots of plants were left at the two temperature levels until seed was ripened. The mutation rates at the two temperatures were determined by counting the number of aleurone dots. The average mutation rate was determined by counting the number of dots on fifty seeds of each ear except for those ears marked by asterisks where less than fifty seeds were available. The data obtained are given below:

<table>
<thead>
<tr>
<th>Pedigree</th>
<th>Mutations per seed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60 deg. F.</td>
</tr>
<tr>
<td>6279 x 6329-2</td>
<td>50.2</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>47.2</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>37.5</td>
</tr>
<tr>
<td>&quot; x 6329-3</td>
<td>41.2</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>44.9*</td>
</tr>
<tr>
<td>&quot; x 6329-1</td>
<td>29.5*</td>
</tr>
<tr>
<td>Total</td>
<td>250.6</td>
</tr>
<tr>
<td>Mean</td>
<td>41.8</td>
</tr>
</tbody>
</table>

The results listed above are somewhat astonishing and to the writer entirely unexpected. A similar experiment is being conducted this year on a more extensive scale. If the same effect is found it should be possible to determine the critical period at which the temperature change has its effect. It also will permit inferences, or if you wish, guesses, as to the nature of the a-Dt reaction.

12. Mutation of a to different alleles. The frequency of mutation of recessive a in the presence of Dt to the a^B allele as compared to the frequency to the A and A^B alleles can be ascertained by the classification of the aleurone dots into pale and deep colored. However in the aleurone it is impossible to differentiate between the A and A^B alleles and to determine the relative frequency of mutation to these two alleles it is necessary to test the relatively rare
germinal mutations against the P gene. To date twelve germinal mutations giving deep colored aleurone and purple plants, with B PI, have been tested. Eleven proved to be identical to the A allele while the remaining one gave brown pericarp. Since \( A^b \) produces a dominant brown pericarp it will be necessary to test this allele against \( A \) in order to find if the brown pericarp color is dominant to the red of \( A \) before one can draw the conclusion that it is a mutation to \( A^B \). Irrespective of the outcome of this test it is an allele different from \( A \) and \( A^P \) and mutations of \( a \) to three different alleles have occurred.

There are only two \( a \) alleles of different origin. Both of these are mutable in the presence of Dt. It is of some interest that on four occasions mutations of an \( a \) allele unstable with Dt have apparently occurred to an \( a \) allele which is stable with Dt. Stadler has found an \( a \) allele stable with Dt which arose as a mutation in his ultra-violet treatments.

13. Linkage of reverted A alleles with \( lg^2 \). Four different germinal mutations to A have been tested for linkage against \( lg^2 \). As expected all four showed approximately 30 percent recombination with \( lg^2 \). All evidence available indicates that the changes occurring at the \( a \) locus are true gene mutations.

14. Effect of Dt on \( P^vV \). Plants heterozygous for Dt and carrying the variegation allele for pericarp color were backcrossed by dt p individuals. The F1 seed was classified into Dt and dt classes and the ensuing ears graded for variegation in a way similar to that employed by Emerson in his studies on variegation. The data are as follows:

<table>
<thead>
<tr>
<th>Dt seed</th>
<th>Number</th>
<th>Mean variegation grade</th>
<th>dt seed</th>
<th>Number</th>
<th>Mean variegation grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ears</td>
<td></td>
<td></td>
<td>ears</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>4.09</td>
<td></td>
<td>34</td>
<td>4.12</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>4.09</td>
<td></td>
<td>19</td>
<td>4.05</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>3.82</td>
<td></td>
<td>31</td>
<td>3.87</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>4.18</td>
<td></td>
<td>11</td>
<td>4.36</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>4.06</td>
<td></td>
<td>35</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>3.67</td>
<td></td>
<td>38</td>
<td>3.68</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>4.67</td>
<td></td>
<td>28</td>
<td>4.68</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
<td>Mean 4.08</td>
<td>Total</td>
<td>196</td>
<td>Mean 4.11</td>
</tr>
</tbody>
</table>

These data show there is no effect of the Dt allele on the unstable pericarp gene.
15. Further studies with chromosome 10. Longley (1937, 1938) discovered that certain strains of maize as well as teosinte have an abnormal type of chromosome 10. It differs from the normal in that it has a very considerable piece of chromatin attached to the end of the long arm. Since the locus of R is known to be in the distal 22 percent of the long arm (Stadler, 1933) it should be possible to determine the amount of recombination between R and the end of the long arm if the extra piece is used as a marker. Dr. Longley was kind enough to furnish a strain with the abnormal tenth. His strain proved to be homozygous for recessive r and a ratio of 1 R : 1 r resulted when pollen from two different strains of R r constitution was applied. Plants from the colored seeds of each F1, heterozygous for both R and the abnormal tenth, were backcrossed reciprocally by r testers with normal chromosomes 10. The following results were obtained (since the two F1's gave similar results they are considered together): When the F1 plants were used as the female parent the ratio of R : r was 2676 : 7214 while the reciprocal gave close to the expected 1 : 1 ratio. The shortage of R seeds suggests that the normal chromosome 10 fails to be included in the functioning megaspore. There are at least two possible explanations: (1) competition among the megaspores so that one with the abnormal tenth develops into the embryo sac irrespective of its position in the linear tetrad of megaspores or (2) selective segregation at meiosis so that the basal megaspore receives an abnormal tenth. On either basis, if there are no exceptions, the R class represents crossovers. There was no sterility on the ear proving that the abortion of r megaspores cannot be accepted as an explanation. Studies are under way to determine the cause of this unusual ratio as well as to ascertain the recombination value between R and the end of the long arm. In connection with the latter problem it is apparent that the true length of a genetic map can never be had from ordinary linkage studies because one never knows how much crossing over occurs beyond the most distally placed locus studied. It is only when cytological markers are used, such as terminal knobs, that the total map length can be measured. This has already been accomplished for the short arm of chromosome 9 by Creighton. This investigation is being conducted by Virginia H. Rhoades.

16. Crossover values in male and female flowers. Studies on the frequency of crossing over for different regions of chromosome 5 in mega- and microsporocytes have been continued. Earlier work by Emerson and Hutchison, Stadler, Eyster, Collins and Kempton, and Rhoades and Rhoades have shown no consistent difference in crossing over for chromosomes 2, 4, 9, and 10 in the male and female flowers. However, a considerable amount of data have been accumulated which show that this does not hold for chromosome 5. These data prove that in the male flowers the frequency of crossing over is greater than in the female. Because of ease in
classifying most of the data are for the a2-bt region. Two different stocks have been used. In one of them a relatively high amount of recombination occurs while in the second stock a much lower value was found. The difference between the high and low stocks is not known but in both higher crossover values in the male flowers was found. Exact reciprocals were made in obtaining male and female crossover percentages.

### Summary of high a2-bt line (10 pairs of reciprocals)

<table>
<thead>
<tr>
<th></th>
<th>A2 Bt</th>
<th>A2 bt</th>
<th>a2 Bt</th>
<th>a2 bt</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1156</td>
<td>420</td>
<td>414</td>
<td>1103</td>
<td>27.0</td>
</tr>
<tr>
<td>Female</td>
<td>1284</td>
<td>256</td>
<td>278</td>
<td>1290</td>
<td>17.2</td>
</tr>
</tbody>
</table>

### Summary of low a2-bt line (16 pairs of reciprocals)

<table>
<thead>
<tr>
<th></th>
<th>A2 Bt</th>
<th>A2 bt</th>
<th>a2 Bt</th>
<th>a2 bt</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2348</td>
<td>373</td>
<td>410</td>
<td>2590</td>
<td>13.7</td>
</tr>
<tr>
<td>Female</td>
<td>1902</td>
<td>110</td>
<td>120</td>
<td>1827</td>
<td>5.8</td>
</tr>
</tbody>
</table>

In addition to the above data on the a2 bt region, data have been obtained on the a2 bm, bm Fr and bt Fr regions. There is a consistent and highly significant increase in crossover in the male flowers for all of these regions. The data also suggest that the greatest reduction occurs in those regions adjacent to the centromere, i.e., there is a proportionately greater reduction in the a2 bm and a2 bt regions than in the bm Fr and bt Fr regions but, owing to the difference in length of these regions, this point has not been statistically established as yet.

In order to determine if the crossover difference for the two sexes found for chromosome 5 is a cellular characteristic affecting all chromosomes indiscriminately or is peculiar to chromosome 5, tests were made involving the c wx region in 9 and the bm Pr region in 5 simultaneously. No difference in crossover in the two sexes was found for the c wx region.

M. M. Rhoades

Connecticut Agricultural Experiment Station, New Haven, Conn.

1. Further evidence indicating a physiological change in cell activity resulting from breaks and rearrangements of chromosome parts has been obtained from the paired mosaics in the endosperm. In the majority of cases of paired losses of C and Pr, C and Su, Pr and Su, no change in size, arrangement or numbers of cells is apparent. In a few cases marked changes in some or all of these respects are noted. In the same material one part of the paired mosaic area may be affected, in other cases the other part is affected. This means that many chromosomal rearrangements are without any effect upon cell activity other than the subtraction of the
usual action associated with the dominant allele. In the few cases where profound physiological alterations occur it seems apparent that specific places of breakage and reattachment are involved. If the alteration resulted from a shift of growth-controlling regions of the chromosomes or a general unbalance in amount or kind of chromatin material, paired alterations showing the changes in growth would be expected more frequently and both parts of the paired mosaic areas would be affected. A few cases of this latter type are noted but they are not general.

2. Height of plant is noticeably affected by shading. Short plants grown between tall plants at the time of rapid elongation are usually taller than when grown in an unshaded location. Several lots of hybrid sweet corn grown under tobacco shade cloth were taller than the same lots grown in the open. Some inbreds seem to respond to shading more than others. Iowa Kr (Osf) (from Lindstrom) grown between two first generation hybrids was taller in the middle of the row than at either end. Height graduated evenly from both ends toward the center where there was the most shading. Height is also affected by time of planting. Plantings of the same lots of seed at weekly intervals usually show the second planting to be taller than the first. This also may be due in part to the shading of the later plantings by the earlier.

D. F. Jones

3. Recessive sun red. A sun red that segregates as a recessive was obtained from a Whipple sweet corn inbred, 850-17. The color is intense, is sun limited, and the stock has wine colored silks, and red glumes and anthers.

4. Sectorial sun red (Genetics 24:106) induced by ultraviolet pollen treatment, is changed to sectorial purple when crossed by dilute purple A b PI. Also sectorial sun red shows a linkage (F2 data) with gl2 and v. C.C. percent gl2 and sectorial sun red = 19; between v and sectorial sun red = 32%. These values approximate the crossover values with B, 19 and 21 percents respectively. This is evidence the recessive sun red represents a change from the original factor that was treated and is not another independent factor acting upon the B gene. This character is being studied further.

5. Effect of female stock on the functioning of sp pollen. In 1938 pollen of sp su/ + + plants was put on two su inbreds Purdue 39 and Connecticut 81. The su seeds obtained (the crossover class with no sp survival) were 39 percent for P39 and 17% for C81. These figures are both too high for the crossover value (6%), and suggested the possibility that the two sweet inbreds had influenced differently the functioning of sp male gametes. Pollen examination of plants produced by these two pollinations verified this assumption. The su seeds from the P39 cross produced plants, 87% of which
were segregating for sp. There was only 56% of segregating plants from the C61 cross. By correcting the original "crossover" percents for su and sp in order to eliminate sp survival in the pollen, the true crossover values of 5.1 and 7.4 are obtained. These are both close to the 6% value previously found. These results are soon to be published in the Proc. Nat. Acad. Sci.

6. Fine mottling may completely inhibit color. On an ear segregating for coarse and fine mottling (Maize Coop. 1939 letter) there were six colorless seeds. These produced 5 plants in 1939. One was a contamination, a self-pollination. The other four were segregating for color. In the case of these four seeds the fine mottling factor completely inhibited color production.

W. R. Singleton

7. A method has been developed for studying mitoses in developing endosperm, particularly to correlate types of figures observed with the occurrence of endosperm and aleurone mosaics. Collections made six days after pollination usually had many divisions. Material was fixed according to Randolph's chromo-acetic formula (Randolph, L. F. J. Agr. Res. 53:881-916). Whole mounts or free hand sections were stained by the usual Feulgen method with the omission of destaining or washing off excess fuchsin in SO2 water (by putting the tissue from the fuchsin-sulphurous acid directly to water and, as the nuclei become stained, changing the water several times before the usual dehydrating and mounting). Preliminary observations show 4-10 percent abnormal divisions in endosperms collected from stocks giving high rates of mosaic formation.

8. In connection with a determination of the germinating ability of sp in competition with normal pollen it was found that pollen could be germinated by placing it on sucrose-agar (10% sucrose and .7% agar from Andronescu, 1915) in depression slides. The method seemed to be applicable, however, only if the humidity is low, since trials in the early summer when the humidity was very high resulted in failure as the pollen grains would burst before germination started.

F. J. Clark

9. A distinctive defective endosperm character was found in an open-pollinated variety that had been selfed one generation. The defectiveness is different from other defective endosperm characters on which histological work has been reported in that it does not result from arrested development but from a breaking down of the endosperm tissue after it has formed. A cavity is formed in the upper central part of the endosperm by the disintegrating process, and the mature seeds are smaller and have a dull mottled milky appearance. The defective seeds also show a tendency to germinate while still on the ear. This character, disintegrated endosperm, (di),
1. In tetraploid maize unimodal curves were obtained from hybrids between self-fertile and self-sterile lines back-crossed to the self-fertile parent; in the back-cross to the self-sterile parent a bimodal curve was obtained, 250 or more individuals being involved in each population. In the F2 population of the same crosses unimodal or very weakly bimodal curves were obtained.

The F1 of the incompatible matings between the self-compatible lines (B lg and su) of tetraploid maize reported in the last News Letter was found to be self-fertile, and the back-crosses to the parent lines were also compatible, as indicated by observations on 50 or more ears from each cross. An incompatible mating between the cross-sterile B lg line and a self-sterile B Lg line showed an intermediate degree of self-fertility (37%) in F1. The backcross to the B lg parent was 37% compatible (26 ears) while the back-cross to the B Lg parent was only 15 percent compatible.

Harold E. Fischer

2. Monosomic Maize. A plant monosomic for one of the shorter chromosomes (undetermined) appeared as a parthenogenetic diploid in a tetraploid stock of maize. A detailed study of meiosis with special reference to the behavior of the univalent was made. The univalent in fifty percent of the 770 cases observed was found to go to one of the poles in division I. In the remaining cases the univalent was not included in the daughter nuclei of division I but remained in the cytoplasm forming a micro-nucleus. Most (74%) of these free dyad univalents were apparently reincorporated into the spindle of division II. This was indicated by a marked reduction in number of free dyad groups in metaphase II as compared with the frequency of micronuclei at inter-kinesis. Such cells produce microspores with a normal chromosome complement. In cases where the dyad univalent fails to be reincorporated in the spindle of division II, it often forms an independent spindle and divides. As a result of this, microspores containing a micronucleus in addition to the macronucleus are formed (in 1.8% of the microspores). The univalent was observed to divide in 10% of the first division figures. The resultant chromatids do not divide again in the following division but lag or move to one of the poles giving a 10-9 distribution in anaphase II. Pollen examination shows that 54% of the grains are abortive, due presumably to lack of a full chromosome complement. Selfing of the monosomic plant resulted only in diploid progeny and
the same result was obtained when it was used as a pollen
parent with normal diploid plants.

Harold E. Fischer and John Einset

3. Vivipary designated as vp5, found in Dr. Wiggans’
cultures, is closely linked with yellow endosperm, as can be
seen from the $F_2$ data presented below. If it is $Y$, which it
probably is, then vp5 is located in chromosome 6. Classifi-
cation of vp5 is good. In cultures where germination has
gone too far resulting in discoloration of kernels, classifi-
cation of endosperm color is difficult.

Last summer’s data in regard to pb-x confirm the previ-
ous observation of its close linkage to $Y$, as shown below.
Four pb genes are listed in the Linkage Summary, all of them
have been lost. Therefore pb-x will be designated as pb5
although it has not been tested for allelism with the other
four.

Backcross data for vp5 and Pb5 follow:

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>vp5</td>
<td>Y</td>
<td>1489</td>
<td>35</td>
<td>33</td>
<td>482</td>
<td>2039</td>
<td>3.3</td>
</tr>
<tr>
<td>Pb5</td>
<td>Y</td>
<td>231</td>
<td>1</td>
<td>2</td>
<td>250</td>
<td>484</td>
<td>0.6</td>
</tr>
</tbody>
</table>

G. A. Lebedeff

4. Backcross data involving chromosome 7. Of the three
cultures included in the three-point test, the first was
grown in the greenhouse in the winter of 1938-39, the second
in the garden in the summer of 1939, and the third in the
greenhouse in 1939-40.

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1,2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$+ v5 g1$</td>
<td>1690-1661</td>
<td>137-48</td>
<td>254-298</td>
<td>71-21</td>
<td>4180</td>
</tr>
<tr>
<td>in $+ +$</td>
<td>1258-1258</td>
<td>72-36</td>
<td>137-134</td>
<td>81-6</td>
<td>2982</td>
</tr>
<tr>
<td>1426-1362</td>
<td>87-53</td>
<td>220-230</td>
<td>17-6</td>
<td>3401</td>
<td></td>
</tr>
<tr>
<td>4374-4281</td>
<td>296-137</td>
<td>611-662</td>
<td>169-33</td>
<td>10563</td>
<td></td>
</tr>
<tr>
<td>8655</td>
<td>433</td>
<td>1273</td>
<td>202</td>
<td>1.9%</td>
<td></td>
</tr>
</tbody>
</table>

The marked difference between complementary classes of
region 1 and double crossovers are not to be accounted for
by differential viability of recessives; for, of the total,
in plants constitute 48.4%, v5 plants 48.8%, and gl plants
50.1%. A comparison of frequencies of double recessives
with those of corresponding double dominants shows that the
one double recessive, in v5, is principally responsible for
the differences between complementary classes. The frequency
relations of double recessives to corresponding double dom-
inants are as follows:
In view of the approximate equality of \( V_5 \) and \( v_5 \) plants in this back-cross progeny, it is hard to account for the deficiency of \( v_5 \) plants either on the basis of errors in classifying or a suppressing effect of \( v_5 \) upon the expression of \( v_5 \), like that of \( R \) upon \( j \). A further study will be made of this second possibility.

A two-point back-cross gave the following:

<table>
<thead>
<tr>
<th>Phase</th>
<th>In Tp</th>
<th>In tp</th>
<th>In Tp</th>
<th>In tp</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB</td>
<td>147</td>
<td>65</td>
<td>60</td>
<td>124</td>
<td>396</td>
<td>31.6</td>
</tr>
</tbody>
</table>

The order of these genes is:

\[
\text{in} \quad 6 \quad \text{v}_5 \quad 14 \quad \text{gl} \quad \text{Tp}
\]

A. C. Fraser

5. The \( G_h \) reported last year is allelomorphic with \( g^4 \).

6. \( m_g \) often is completely germless. \( F_2 \)s of one cross contained many germless or even completely empty seeds and few truly \( m_g \) ones. \( F_2 \)s of another cross had many fewer non-viable seeds and many truly \( m_g \) ones. \( m_g \) seeds are definitely slower to germinate (many never germinate) than normal seeds, and their plants seem to mature 7 to 10 days later than plants from normal seeds. However, the \( m_g \) seeds produce normal sized plants.

7. Several crosses have produced seeds with purple plumules. From \( F_2 \) counts it seems that at least 3 and perhaps 4 dominant complementary genes are involved. Classification of \( F_4 \) seems satisfactory in yellow or white seeds.

8. \( s_b \) continues to be abnormal. Many \( s_b \) plants last summer had stiff, very narrow leaves. In some cases these consisted of little but midrib. Plants with such leaves were usually sterile. Pollen was obtained from two for crosses. Ratios in \( s_b \) crosses were again atypical. One \( F_2 \) contained \( 177N:34s_b \) (5:1). Several back-cross cultures contained:

<table>
<thead>
<tr>
<th>Culture</th>
<th>( s_b )</th>
<th>( s_b )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>46</td>
<td>36</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>31</td>
</tr>
<tr>
<td>4</td>
<td>53</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>234</td>
<td>173</td>
</tr>
</tbody>
</table>

John Shafer, Jr.
My presence in Europe last summer had, it turns out, a deleterious effect on my summer's work at Ithaca—a result not unforeseen. For such results as I am able to report, I am indebted to Dr. Lebedeff who did my work in addition to his own.

9. Tassel-seed 3 and tassel-seed 6. — In the News Letter of March 23, 1937 (p. 6), Lindstrom reported Ts6 as about 26 units from gs. At about that time I had found that Ts3 and an were closely linked. Since an and gs are about 27 units apart and since both Ts3 and Ts6 are dominant genes, it seemed possible that the two were alleles. Data obtained during the past summer though not wholly satisfactory indicate that Ts3 and Ts6 are not allelic. The data follow. (See also Lindstrom's report in this News Letter.)

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Ts3 + an + gs</td>
<td>62-70</td>
<td>17-0</td>
<td>5-22</td>
<td>7-0</td>
<td>183</td>
</tr>
<tr>
<td>+ Ts6 + an + gs</td>
<td>56-37</td>
<td>16-6</td>
<td>13-7</td>
<td>10-5</td>
<td>152</td>
</tr>
<tr>
<td>+ Ts3 + an + bm2</td>
<td>59-26</td>
<td>10-1</td>
<td>18-24</td>
<td>2-1</td>
<td>141</td>
</tr>
<tr>
<td>+ Ts6 + an + bm2</td>
<td>81-41</td>
<td>23-4</td>
<td>5-0</td>
<td>0-0</td>
<td>154</td>
</tr>
</tbody>
</table>

If taken as they stand, these data indicate that Ts3 is between an and gs, while Ts6 is to the right of gs and probably to the right of bm2. It will be noted, however, that homologous recombination classes are far from equal. The first entry of the table shows a considerable deficiency of Ts3 plants and the second entry exhibits a similar deficiency of an plants. In the third and fourth entries, respectively, Ts3 and Ts6 are in excess of 50 percent, while an and bm2 are deficient. But such evidence as is available, if any, suggests that Ts3 is near an and Ts6 near bm2.

10. Locus of knotted. — In the News Letter of March 26, 1938 (p. 5), Bryan reported Kn 26 units from br and 24 units from bm2. These data suggest that Kn is between an and gs. The few data obtained last summer are in agreement with this indication, as follows:
If, as is suggested above, Kn and Ts3 are between an and gs and Ts6 near bm2, Kn should show much closer linkage with Ts3 than with Ts6. This is borne out only in part by the following back-cross data.

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Kn an + gs</td>
<td>49-32</td>
<td>5-14</td>
<td>0-8</td>
<td>2-1</td>
<td>115</td>
</tr>
<tr>
<td>+ Kn an + bm2</td>
<td>56-44</td>
<td>26-7</td>
<td>24-14</td>
<td>7-0</td>
<td>178</td>
</tr>
</tbody>
</table>

If, as is suggested above, Kn and Ts3 are between an and gs and Ts6 near bm2, Kn should show much closer linkage with Ts3 than with Ts6. This is borne out only in part by the following back-cross data.

XY XY XY XY
Kn Ts3 3 9 16 2 = 16/30 = 16.7%
Kn Ts6 8 27 47 13 = 21/95 = 22.1%

II. The order of br f an. - There were published in the Linkage Summary 1935 (p. 35), three-point tests involving 960 individuals which indicated that the order is as given above. Bryan, in the 1938 News Letter (p. 5), reported four-point tests with 293 individuals involving br, f, Kn, and bm2 which indicated that f is to the left of br. An attempt was made last summer to check this situation. A total of 1352 individuals were noted, but only 34 per cent of them were recorded as f. Moreover both orders of the genes indicated double crossovers as more numerous than singles in one region and equal to singles in the other region. It is obvious that many f plants were recorded as normal. This is not unlikely in cultures such as these in which f was poorly expressed. It seems likely that plants recorded as f were certainly of that nature. The following data, therefore, include only the f plants.

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1, 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ + + br f an</td>
<td>347</td>
<td>22</td>
<td>77</td>
<td>7</td>
<td>453</td>
</tr>
</tbody>
</table>

12. Further data on chromosome 1 translocations. In my paper on zl (Genetics 1939, p. 362), in which many previously unpublished data from Anderson were used, it was shown that Tl-5b, l-5c, and l-3a have their breaks between p and br, and that the Tl-2c break is near sr. A few further data are now available, and are presented in the accompanying table.
Although these data are not wholly consistent, they indicate that Tl-2c is near sr and to its left, that Tl-9c is near P and to its right, and that Tl-9b is near br and probably to its left.

13. Tests of miscellaneous genes with chromosome 1 markers. - Six genes, not previously linked, have been tested with several loci of chromosome 1. On the next page are shown the number of individuals and per cent of recombination in each F2 test.
These tests, though mostly quite inadequate, are suggestive of one and perhaps two linkages (Relatively little seed was obtained from the Florida plantings last spring; adequate material is available for tests next summer.) Suggestion of linkage of ms43 with either sr or an is probably of no significance because of the great deficiency of ms43 in the one instance and of an in the other. There were few ye3 plants in the test with sr. It seems likely that vl9 may be linked with bm2. The \( F_2 \) distribution was 12-25-21-0.

14. Differential dominance in number of kernel rows. — One of the \( F_1 \)'s used by Dr. Wiggans in the production of double-cross 29-3 is a cross of a 12-row inbred line #2 (Onondaga White) with an 8-row line #1 (Luce's Favorite). The \( F_1 \) plants show a high percentage of 8-row ears. Golden Cross Bantam, on the other hand, has a considerable percentage of 12-row ears, though also a cross of a 12-row line (Purdue 39) with an 8-row line (Purdue 51). This striking difference suggested a comparison of \( F_1 \)'s from crosses of the two 8-row lines, 1 and 51, noted above, with ten 12-row lines, including 2 and 39 noted above. The results of one season's test are given in summary form in the accompanying tabular statement which shows the mean number of kernel rows in \( F_1 \) of crosses between 8-row and 12-row inbred lines.

<table>
<thead>
<tr>
<th>Inbred lines</th>
<th>( F_1 ) crosses with Line 1</th>
<th>Mean</th>
<th>Line 51</th>
<th>Mean</th>
<th>Difference in rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation</td>
<td>Number plants</td>
<td>Number rows</td>
<td>Mean number plants</td>
<td>Mean number rows</td>
<td>Mean number rows</td>
</tr>
<tr>
<td>1</td>
<td>57</td>
<td>7.84</td>
<td>82</td>
<td>6.76</td>
<td>10.34 1.58</td>
</tr>
<tr>
<td>51</td>
<td>88</td>
<td>7.95</td>
<td>92</td>
<td>9.07</td>
<td>10.58 1.51</td>
</tr>
<tr>
<td>2</td>
<td>49</td>
<td>12.04</td>
<td>92</td>
<td>9.16</td>
<td>10.95 0.79</td>
</tr>
<tr>
<td>3</td>
<td>59</td>
<td>12.27</td>
<td>86</td>
<td>9.77</td>
<td>11.36 1.59</td>
</tr>
<tr>
<td>4</td>
<td>63</td>
<td>12.38</td>
<td>56</td>
<td>9.57</td>
<td>9.93 0.36</td>
</tr>
<tr>
<td>39</td>
<td>95</td>
<td>12.02</td>
<td>71</td>
<td>9.28</td>
<td>9.53 0.25</td>
</tr>
<tr>
<td>II</td>
<td>59</td>
<td>12.34</td>
<td>66</td>
<td>9.90</td>
<td>9.89 0.99</td>
</tr>
<tr>
<td>III</td>
<td>69</td>
<td>11.80</td>
<td>75</td>
<td>9.30</td>
<td>10.13 0.98</td>
</tr>
<tr>
<td>VI</td>
<td>50</td>
<td>12.04</td>
<td>70</td>
<td>9.15</td>
<td>9.35 1.00</td>
</tr>
<tr>
<td>VII</td>
<td>107</td>
<td>12.28</td>
<td>120</td>
<td>9.15</td>
<td>9.35 1.00</td>
</tr>
<tr>
<td>B</td>
<td>97</td>
<td>12.10</td>
<td>85</td>
<td>9.04</td>
<td>10.41 1.37</td>
</tr>
<tr>
<td>G</td>
<td>74</td>
<td>12.11</td>
<td>93</td>
<td>9.05</td>
<td>10.05 1.03</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>12.14</td>
<td>9.18</td>
<td>10.21</td>
<td>1.03</td>
</tr>
</tbody>
</table>

In every case the \( F_1 \) row number was higher (0.25 to 1.59) where line 51 was the 8-row parent than where line 1 was used; and the average difference was one kernel row. Of the twenty \( F_1 \) lots, the lowest row number was in the cross of 1 with 2 and the highest in 51 with 39. The frequency distribution of the four \( F_1 \) lots from crosses of these four lines are as follows:
Inbred lines Frequency distribution for row number

<table>
<thead>
<tr>
<th>Inbred lines</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>Total</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>31</td>
<td>1</td>
<td>82</td>
<td>8.76</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>47</td>
<td>8</td>
<td>1</td>
<td>71</td>
<td>9.77</td>
</tr>
<tr>
<td>51</td>
<td>14</td>
<td>45</td>
<td>29</td>
<td>2</td>
<td>88</td>
<td>10.34</td>
</tr>
<tr>
<td>51</td>
<td>1</td>
<td>29</td>
<td>58</td>
<td>2</td>
<td>90</td>
<td>11.36</td>
</tr>
</tbody>
</table>

Not only do the two 8-row lines differ, #1 tending more strongly than #51 to give low row number in F1, but #39 tends more strongly to give high row number than does #2.

15. Heterosis of number of kernel rows. - In every one of the crosses of the #1 8-row line with the ten 12-row lines, the average row-number of the two parent lines is greater than that of the corresponding F1. Of the ten F1's involving the same 12-row lines with 8-row line 51, four have mean row-numbers greater than four less than, and two equal to the average of the two parental lines. It is perhaps noteworthy that the F1 mean of the 1-2 cross differs from the parental average by -1.3 rows, of the 1-39 cross by -0.16, of the 51-2 cross by +0.35, and of the 51-39 cross by +1.38. If the last of these crosses alone had been under observation the result might well have been termed heterosis - and perhaps correctly so. There is certainly nothing in the general averages to suggest heterosis of row-number. The average of all F1's involving line 1 is less than the average of parental means by 0.81 rows and of those involving line 51 is greater than the parental averages by one 0.17 rows.

Records were also obtained last season from F1 cultures whose parental lines had approximately equal numbers of kernel-rows. The data are given in the accompanying table showing the mean number of kernel rows of inbred lines and their F1 progenies.

<table>
<thead>
<tr>
<th>Inbred lines</th>
<th>Mean number of rows</th>
<th>Average</th>
<th>F1 progenies</th>
<th>Mean number of rows</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7.84</td>
<td>7.90</td>
<td>8.10</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>7.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12.04</td>
<td>12.21</td>
<td>12.41</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12.38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12.04</td>
<td>12.19</td>
<td>12.61</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>12.34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12.04</td>
<td>12.03</td>
<td>12.37</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>12.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12.02</td>
<td>12.20</td>
<td>12.58</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12.38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Individually, most of these differences in number of kernel rows are not statistically significant. They are, however, all positive and, as a whole, are definitely significant. In general it appears, therefore, that some, though slight, heterosis is shown in number of kernel rows.

16. Influence of soil fertility on kernel-row number. Some years ago two 12-row inbred lines and the F1 cross were grown on sand of extremely poor fertility and on very rich soil. The test was carried on during two seasons and the number of plants involved were 281 on rich soil and 287 on poor. The row-number means are compared in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Rich soil</th>
<th>Poor soil</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inbred A</td>
<td>12.6</td>
<td>11.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Inbred B</td>
<td>12.3</td>
<td>10.6</td>
<td>1.7</td>
</tr>
<tr>
<td>F1 A-B</td>
<td>12.4</td>
<td>11.5</td>
<td>0.9</td>
</tr>
<tr>
<td>All</td>
<td>12.4</td>
<td>11.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>

The effect of extreme differences in soil fertility on number of kernel rows is obviously greater than that shown as heterosis. Neither effect is sufficient seriously to mask genetic differences in studies of kernel-row numbers.

R. A. Emerson

17. Brittle stalk-2 (bk2). Plant appears normal, but the leaves, stalk, ear, and all parts break easily under pressure. Viability good. Classification good at all stages of development by bending the leaves sharply.

The seed was originally received by the Maize Genetics Cooperation from L. C. Raymond, of Quebec. A test for allelism with bk was negative (News Letter, March 23, 1937, p. 1). Brittle stalk-x (bk-x) reported by Wiggans (News Letter, March 6, 1938, p. 12) proved to be an allele of bk2 (News Letter, April 15, 1939, p. 12).

Bk2 is linked with sh and wx in chromosome 9 as shown by the following F2 data:
F₁ genotype  

| sh wx + | + bk2 | sh wx bk2 | 1 |
| + + bk2 | 37    | + + +     | 95 |
| sh + bk2 | 3     | sh + +     | 11 |
| + wx +   | 28    | + wx bk2   | 0 |

Total = 204

sh - wx = 22%  
wx - bk2 = 15%  
sh - bk2 = 35%

18. Chromosome 9. - Linkage of G₄ and wx:

<table>
<thead>
<tr>
<th>Genes Linkage Phase</th>
<th>G₄ Wx</th>
<th>G₄ Wx</th>
<th>G₄ Wx</th>
<th>G₄ Wx</th>
<th>Total % Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G⁺ Wx</td>
<td>379</td>
<td>4</td>
<td>11</td>
<td>32</td>
<td>426</td>
</tr>
</tbody>
</table>

19. Vestigial glume (Vg) and Tunicate (Tu). The two dominant genes Vg (Sprague, 1939) and Tu (Collins, 1917) have opposite effects on the length of the glumes in both the staminate and pistillate inflorescences of maize. Vestigial glume, as the name implies, exposes the anthers and removes most of the glumes from the ear; whereas Tunicate incloses the anthers in long glumes and the individual kernels in husk-like structures. In view of these differences, would a plant with the genetic constitution Vg Tu be like Vg? or Tu? or neither of them? In the progeny of a cross of Vg/vg x Tu/tu four types of plants were observed:

<table>
<thead>
<tr>
<th>Phenotype (length of glumes)</th>
<th>Staminate Inflorescence</th>
<th>Pistillate Inflorescence</th>
<th>Probable Genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestigial</td>
<td>Long like Tu, but more</td>
<td>Vg vg Tu tu</td>
<td></td>
</tr>
<tr>
<td></td>
<td>narrow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vestigial</td>
<td>Vestigial</td>
<td>Vg vg tu tu</td>
<td></td>
</tr>
<tr>
<td>Tunicate</td>
<td>Tunicate</td>
<td>vg vg Tu tu</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Normal</td>
<td>vg vg tu tu</td>
<td></td>
</tr>
</tbody>
</table>

Since ordinarily the length of the glumes in the tassel is directly correlated with the length of those on the ear, it is difficult to explain why, in plants with the genetic constitution Vg vg Tu tu, Vg shows epistasis to Tu in the tassel and not on the ear. It has been noted, however, that some times plants heterozygous for Tu do not have exceptionally long glumes in the tassel. Perhaps there is an upper limit to the length of glume that Vg is able to reduce to a miniature size. Further tests should be made to note the appearance of plants with the genetic constitutions Vg Vg Tu Tu, Vg Vg Tu tu, and Vg Vg Tu Tu. This material would not be easy to obtain as plants homozygous for Tu are usually male and female sterile. Likewise, Vg Vg plants are difficult to produce as Vg Vg must be grown under very favorable greenhouse conditions to obtain viable pollen.

D. G. Langham, Estacion Experimental, El Valle, D. F. Venezuela
1. In an $F_2$ population of perennial teosinte obtained from seed brought from the original station in Mexico, an aberrant individual appeared in which the meiotic chromosome behavior was similar to Beadle's "asynaptic." Synapsis was essentially normal up to early diakinesis. Thereafter desynapsis caused an almost complete disappearance of quadrivalents and bivalents at metaphase. The scattered arrangement of univalents in the meta-anaphase stage strikingly resembled incompatible hybrid chromosome behavior. The mutant is highly cross- and self-sterile although the pollen was approximately 35% well filled. Fortunately, it can be maintained easily for further tests by vegetative propagation.

L. F. Randolph and Harold E. Fischer

2. Attempts to produce true breeding, highly self-fertile and highly self-sterile lines of tetraploid maize by inbreeding and selection thus far have not been very successful. Lines inbred 5-8 years continue to segregate for varying degrees of self-fertility. However, relatively high levels of fertility can be maintained by selecting the most fertile ears in each generation, and self-sterile ears tend to produce mostly self-sterile progeny.

3. Haploid frequencies reported in the News Letter of March, 1938, from untreated and X-rayed pollen involving 150,000 seedling counts indicated that X-raying the pollen materially increased haploid frequencies in maize. Since then additional counts have been made and the numbers at this time are sufficiently large to warrant a comparison not only of frequencies from X-rayed and untreated pollen, but also frequencies in different stocks. These stocks included an inbred line, designated A in the table; a 3-way hybrid involving this same inbred line as one of the 3 inbred parents (B); a commercial strain of Golden Bantam sweet corn (C); a genetic tester stock (D); and a group of miscellaneous stocks (E), no one of which was large enough for significant comparison. Haploid frequencies per thousand plants in the several stocks from untreated and from X-rayed pollen (1500 r) are given in the following table:

<table>
<thead>
<tr>
<th>Stock</th>
<th>Number of plants</th>
<th>Frequency per 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>untreated</td>
<td>X-rayed</td>
</tr>
<tr>
<td></td>
<td>2N</td>
<td>N</td>
</tr>
<tr>
<td>A</td>
<td>23,230</td>
<td>24</td>
</tr>
<tr>
<td>B</td>
<td>21,010</td>
<td>13</td>
</tr>
<tr>
<td>C</td>
<td>51,845</td>
<td>27</td>
</tr>
<tr>
<td>D</td>
<td>53,427</td>
<td>6</td>
</tr>
<tr>
<td>E</td>
<td>21,922</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>171,434</td>
<td>90</td>
</tr>
</tbody>
</table>
There was a consistent increase in the frequency of haploids among the X-ray progenies, the average increase being 50 per cent. The dosage used (1500 r) decreased the yield of viable seed approximately 50 per cent and also materially increased the difficulty of making classifications. If odds of 40:1 be taken to indicate significance, the least significant difference in frequency of haploids per thousand between untreated and X-rayed pollen in any one stock is 0.18. The least difference observed (stock A) is 0.23 with odds of 66:1 against such a difference being due to errors of random sampling. By the same criterion, the least significant difference for the five stocks together is 0.11, while the observed mean difference is 0.32. The odds here are many thousands to one against so consistent a difference being due to chance alone.

A similar comparison of the different stocks shows that stock A is not significantly different from stock E, and B not different from C. Stock C, and possibly stock B, differs significantly from stock A, and stock D differs from all the others. (See also Stadler, this News Letter). It was expected that the haploid frequency in inbred lines and their hybrids would be relatively high, due to the elimination during inbreeding of deleterious genes which might be lethal in the haploid state; but there is no obvious explanation of the extremely low frequency noted in the a-tester stock (D). The haploids which did appear in this stock were as vigorous on the average as those in the other stocks with the exception of the inbred line and the 3-way hybrid whose haploids were uniformly more vigorous than those of the other stocks.

The identification of the haploids was made with the aid of recessive endosperm and seedling genes, stomate examination in the seedling stage, and final verification with root tip chromosome counts. The frequencies thus obtained are to be interpreted as minimum frequencies, since it is unlikely that all of the haploids were identified. Only seeds with hybrid (presumably triploid) endosperms were included in the study. All of the haploids obtained were maternals, although paternal haploids were looked for in some of the crosses which involved easily recognizable recessive seedling characters contributed by the pollen parent.

L. F. Randolph

Duke University, Durham, North Carolina

Lg3 is not an allele of Lg2. This has been shown by the presence of normal plants in backcross and F2 from the cross Lg2 x Lg3. The following three-point data indicate that Lg3 lies about two points to the left of Rg. (The linkage map for chromosome 3 should have cr at the left end and a at the right. The Linkage Summary was in error. R. A. E.)
Iowa State College, Ames, Iowa

1. Three point test on chromosome 1, involving a new dominant tassel-seed, Ts6, originating from a 'freak ear' in the Iowa Corn Show about 9 years ago:

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1.2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ + + Ts6</td>
<td>93</td>
<td>83</td>
<td>176</td>
<td>128</td>
<td>332</td>
</tr>
<tr>
<td>br bm2 +</td>
<td>176</td>
<td>153</td>
<td>176</td>
<td>128</td>
<td>332</td>
</tr>
</tbody>
</table>

Ts6 is recommended as a first class, useful marker exhibiting sharp segregation and producing good normal ears (rows characteristicirregular) when tassel is pulled early.

2. Two point tests on chromosome 1.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ts6 F</td>
<td>CB</td>
<td>21</td>
<td>17</td>
<td>20</td>
<td>32</td>
<td>90</td>
<td>41.1</td>
</tr>
<tr>
<td>Ts6 Gs</td>
<td>CB</td>
<td>128</td>
<td>37</td>
<td>113</td>
<td>324</td>
<td>324</td>
<td>25.6</td>
</tr>
</tbody>
</table>

Order of genes in chromosome 1 would then be: br f ge bm2 Ts6. (See also Emerson, this News Letter)

3. Natural mutation of Y gene from Yy to yy in one kernel among 12 crossed ears (totaling over 7200 kernels). Female parent in crosses was a standard long-time inbred yellow dent line; male parent a white, Hickory King inbred.

E. W. Lindstrom

Iowa State College and Division of Cereal Crops and Diseases, U.S.D.A.

4. The first group of F2 data, below, suggests that g2 is on chromosome 7. Mumm's soft starch character, hh, carries an inhibitor for japonica. Neither bm3 nor vl3 show close linkage with i.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Phase</th>
<th>XY</th>
<th>Xy</th>
<th>XY</th>
<th>xy</th>
<th>Total</th>
<th>% Recomb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G2 Lg</td>
<td>RS</td>
<td>353</td>
<td>102</td>
<td>116</td>
<td>40</td>
<td>611</td>
<td>47</td>
</tr>
<tr>
<td>G2 Wx</td>
<td>RS</td>
<td>371</td>
<td>109</td>
<td>98</td>
<td>33</td>
<td>611</td>
<td>48</td>
</tr>
<tr>
<td>G2 Rg</td>
<td>CB</td>
<td>75</td>
<td>69</td>
<td>62</td>
<td>74</td>
<td>280</td>
<td>47</td>
</tr>
<tr>
<td>G2 Ij</td>
<td>RS</td>
<td>310</td>
<td>118</td>
<td>101</td>
<td>3</td>
<td>532</td>
<td>20</td>
</tr>
<tr>
<td>Bd G2</td>
<td>RS</td>
<td>221</td>
<td>94</td>
<td>89</td>
<td>13</td>
<td>417</td>
<td>35</td>
</tr>
<tr>
<td>J Bm3</td>
<td>RS</td>
<td>216</td>
<td>81</td>
<td>65</td>
<td>13</td>
<td>377</td>
<td>41</td>
</tr>
<tr>
<td>J VL3</td>
<td>RS</td>
<td>168</td>
<td>74</td>
<td>38</td>
<td>12</td>
<td>292</td>
<td>45</td>
</tr>
</tbody>
</table>

G. F. Sprague
1. University of Minnesota, St. Paul, Minnesota

1. I have tested yellow green-3 with a trisomic for chromosome 8, and have found evidence that yg3 is not in that chromosome.

2. The gl4 which was reported by Dr. Hayes to be linked with wx; is genetically different from the one that Sprague is calling glossy-1, as shown by an intercross between the two. Since the linkage relations of this one are known, may I suggest that this one be called gl4 and the one of Sprague's given a new number; unless there are some reasons why this is not feasible.

3. I spent most of my time last summer recuperating my stocks, some of which had reached such an age that I had difficulty in getting them to germinate. However, we had an extremely favorable season and in most cases I was able to get material established. I used a few of the trisomic stocks from the Coop last year. While I did not study them intensively, it did seem that certain of them needed further checking to be certain that they are still satisfactory for linkage work. One of the difficulties seems to be the presence of B types which was mentioned by Dr. Langham at the time he sent them to me. However, one or two of the other stocks also seemed to have some other difficulties. The stock of No. 5, for example, did not seem to behave as usual; in fact I was unable to recognize any trisomic plants in the field.

C. R. Burnham

Burnham is not alone in having trouble with the trisomics. It's a job for some cytogeneticist—which I am not. R.A.E.

University of Missouri, Columbia, Missouri and Division of Cereal Crops and Diseases. U.S.D.A.

1. Etched endosperm-virescent seedling. This character symbol et, arose as a mutant in an X-ray progeny, and the endosperm and seedling effects are very closely if not completely linked. The endosperm is similar to some of the scarred endosperms previously reported but is more distinctly marked and usually permits a good separation. The seeds are sometimes reduced in size but have good viability. The seedling type is an excellent one, both for sharpness of segregation and for viability. Data from a three-point test, as given below, indicate the order of genes to be $lg^2$ a et, with et the outermost gene on the long arm of chromosome 3, about 12 units beyond a.

<table>
<thead>
<tr>
<th>F1 genotype</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>1.2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ a et</td>
<td>126</td>
<td>60</td>
<td>20</td>
<td>4</td>
<td>261</td>
</tr>
<tr>
<td>$lg^2$ ++</td>
<td>261</td>
<td>115</td>
<td>26.9%</td>
<td>10.5%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>
2. Notes on haploids. In seedling progenies grown from X-rayed pollen and ultraviolet treated pollen, a large number of haploids was found. The frequency of haploids in the ultraviolet progenies was somewhat higher than in the X-ray progenies, though in both cases the frequency was not very greatly increased over the control. An interesting feature was a distinct tendency for haploids to occur more frequently in progenies of certain female parents than of others; in fact, the untreated female parent had a greater influence on the haploid frequency than the treated male parent. This suggests that the factor limiting haploids may be their inability to survive to the seedling stage, and that a considerable number of haploids may be included among the "germless seeds" resulting from the use of irradiated pollen. (See also Randolph, this News Letter)

Fifty-five haploids were transplanted to the field and grown to maturity. They showed rather surprising fertility. Forty-one of them produced silks, several from two ears, and all of the ears were pollinated. Twenty-seven of the forty-one plants set seed, and ten of these yielded ten or more seeds per plant. The highest numbers of seeds harvested per plant were 97, 47, and 43 respectively, in each case from a two-sired plant.

L. J. Stadler

North Carolina Experiment Station, Raleigh, N. C.

1. Last spring a total of 1203 first generation selfed ears were examined for deficient kernels. Out of this lot 84 ears were found which appeared to be segregating for deficient kernels. This means that on the average 6.98% of all plants selfed in the eighteen Southern varieties were heterozygous for some deficient kernel character. Chi-square applied to these data proved definitely that these varieties do not have the same gene frequency for deficient kernels. Indian Chief has significantly fewer heterozygous plants (0.7%), Mathewson's Golden Prolific and Wood's Golden Prolific approached significance in having fewer than average heterozygous plants. Golden Queen (20.0%) and Biggs' TwoEar (10.5%) have significantly more heterozygous plants than the average of all varieties.

2. In an inbred strain of Yellow Horsetooth two selfed ears were found to be segregating for rootless. Dr. Jenkins pointed out this character last June in our breeding field. The rootless segregates have all the characteristics of plants of rt rt type (Jenkins, 1930; Cornell Memoir 180, p. 20, 1935). If crosses with rt stock prove it to be the same mutant it will be the second occurrence of this distinct root mutation. Our strain has never been grown in close proximity to any rt stock.

Paul H. Harvey
Agricultural and Mechanical College of Texas, College Station, Texas

1. Further studies on chromosome knobs of South American varieties have shown that the majority of varieties from Peru, Bolivia, and Ecuador have knobless chromosomes. This supports our previous suggestion that the Andean region, which we regard as the primary center of domestication of maize, is the only region where pure maize has not been largely replaced by Tripsacum-infected varieties. If this is true most of the stocks of North American maize with which the majority of genetic and cytological studies are conducted are probably polyploid for certain regions of the chromatin. This may account for the fact that some very minute deficiencies are quite deleterious while other larger deficiencies have no appreciable effect.

2. There seems to be a possibility that a wild or feral type of maize is still in existence in Paraguay. A botanical collector in Paraguay with whom we have been in correspondence has sent us a specimen of a maize plant which he claims to have found growing in a colony in a clearing in the forests miles away from human habitation. The specimen was small and earless but bore at the base of the unbranched tassel, pistillate spikelets enclosed in glumes. It differed from any stunted corn which we have previously seen in having the staminate and pistillate portions of the inflorescence distinctly separated. Seed of this peculiar type has not yet been obtained but seed from a variety cultivated by the Guarany Indians in the same general locality gave rise to plants with knobless chromosomes. This is the first variety of maize with knobless chromosomes which we have received from the lowlands of South America. We should, of course, on the basis of our hypothesis expect wild maize to have knobless chromosomes.

3. Additional linkage studies in crosses of Florida teosinte with various genetic stocks show that translocation segments A and C are located at opposite ends of chromosome 4, as indicated by our previous data. Both show linkage with su and G13. Segment B is located on chromosome 1 showing fairly close linkage with P and a slight indication of linkage with bm2. Segment D appears to be located on chromosome 9 and shows linkage with wx.

4. When Chalco and New teosinte are crossed the F1 hybrid has paired pistillate spikelets although both parents have unpaired spikelets.

Florida, Durango, Nobogame, and New teosinte have been crossed with a uniform inbred strain and the F1 hybrid backcrossed to the same strain to obtain populations in which all the genetic variation is due to segregation of genes from teosinte. These populations show that the major part
of the segregation is due to the four blocks of genes or translocation segments which we assume to have been derived from Tripsacum. Durango has the same four segments found in Florida, but they have less effect which suggests that they may be smaller and contain fewer Tripsacum genes. Nobogame teosinte contains only three of the four segments found in Florida and Durango teosinte. The New teosinte hybrids have not yet been classified. All of the data support our assumption that the Guatemalan teosintes represent the primary products of the hybridization of Zea and Tripsacum, while the Mexican teosinte are secondary or tertiary products.

P. C. Mangelsdorf and R. G. Reeves

III. MAIZE PUBLICATIONS

Maize publications that have appeared since the 1939 News Letter was issued together with a few earlier papers are listed below.


Cooper, D. C. and Brink, R. A. - Chromosome homology in races of maize from different geographical regions. Amer. Nat. 71: 582-587. 1937.


- New developments that may affect the corn industries. The importance of corn hybrids to the corn industry. Contr. Iowa Corn Res. Inst. 1: 208-212. 1939.


Mather, K. - Competition for chiasmata in diploid and trisomic maize. Chromosoma 1: 119-129. 1939.


IV. INVENTORY OF COOPERATION STOCKS

The following is a complete list of all seed stock now in the possession of Maize Genetics Cooperation. The labels on the ears, in many instances, give no indication of the genotype concerned. In such cases, the record cards were examined for such information as they afford. This list was compiled and the index made by Dr. Lebedeff. The symbol (x) = selfed and # = sib crossed.

R. A. E.

1934 crop

<table>
<thead>
<tr>
<th>Co</th>
<th>1</th>
<th>(x) y, segregating g3, 3 ears</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>(x) seg. d5, 4 ears</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>(x) seg. d5, may seg. gl2 py, few seeds</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>(x) b gs2 lg, 7 ears</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>(x) y lg gl2 v4 in various combinations, 28 ears</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>(x) and # seg. Y pg2 d, 6 ears</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>(x) Y, g, may seg., pg d, 1 ear</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>(x) y, seg. d2 lg, 7 ears</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>(x) seg. d2 lg Pr, 6 ears</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>(x) and # seg. yt, 2 small ears</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>(x) y a C R pr wx 1g, 1 small ear</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>(x) and # y a C R pr, seg. 1g, 9 ears</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td># a ts4 or lg in various combinations, 20 ears</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>mostly # a ts4 sr lg in various combinations, 15 small ears</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>(x) and # a pr, seg. lg ts4 C R, 5 ears</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>(x) and # a wx, seg. cr 1g ts4, 4 small ears</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>(x) and # a lg, seg. g na ts4, 3 small ears</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td># a na cr gl v5 Y, 2 small ears</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td># a na or Y, seg. lg v5, 2 small ears</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>(x) sh or ms3 pk in various combinations, also seg. v and g, 8 ears</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>(x) Y seg. sp su Pr, 6 ears</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>(x) seg. Y sp su, 4 ears</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>(x) Y y +/- 1o su, 5 ears</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>(x) y 1o +/- + su, 9 ears</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td># pr, seg. bm tn, 2 ears</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td># pr, seg. bm tn, 3 ears</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>(x) bm, seg. pr sh bv v, 10 ears</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>(x) pr wx sh bm, seg. cr, 2 ears</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>(x) and # pr bt, seg. v2, 3 ears</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>(x) and # v2 pr, seg. ys sh, 6 ears</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td># pr bv v2, 3 ears</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td># A C R pr bm sh wx su, 6 ears</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>(x) seg. v3 Pr ys, 8 ears</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>(x) bm bt, seg. pr, 2 small ears</td>
</tr>
<tr>
<td></td>
<td>39</td>
<td>(x) and # A C R pr bm sh wx seg. su, 2 ears</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>(x) and # A a2 C R B Pl Y, 7 ears</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>(x) seg. v3 Pr ys, 8 ears</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>(x) bm bt, seg. pr, 2 small ears</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>(x) and # A C R pr bm sh wx seg. su, 2 ears</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>(x) and # A C R pr bm sh wx seg. su, 3 ears</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>(x) and # pr sh bm, seg. ys, 4 ears</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>(x) pr seg. v bm vp2, 2 ears</td>
</tr>
</tbody>
</table>
49 (x) Pr seg. vp2, 2 small ears
50 (x) and # A C R Pr, seg. v3, 7 ears
51 (x) A C R pr, seg. v3 su, 2 ears
52 (x) pr bv bm, may seg. v2, ms, 5 ears
53 (x) pr bm, seg. bv lg, 7 ears
54 (x) pr bm bv, seg. su, 2 ears
55 (x) seg. bm Pr ms18, pg, lg, 3 ears
56 (x) white aleurone, seg. pg, lg, 4 ears
57 (x) and # y pl sm, seg. b py, 3 ears
58 (x) and # Y pl sm, seg. b py, 5 ears
59 (x) and # Y A, seg. b pl sm py, 6 ears
60 (x) and # B pl sm, seg. py lg, 7 ears
61 (x) and # pl sm, seg. b py, 7 ears
62 (x) and # Y ra gl sl, 1 ear
63 (x) ra sl, 2 ears
64 (x) Tp/gl v5 x pr ra gl v5, 3 ears
65 (x) gl, seg. Y, 5 ears
66 (x) Y y gl, seg. fr fr2, 4 ears
67 (x) g+ sh ar En, seg. Y, 4 ears
68 (x) c sh wx bp, 6 ears
69 (x) P bp, 6 ears
70 (x) seg. c sh wx d3, 7 ears
71 (x) su, may seg. v14, d3, 1 ear
72 (x) wx g+ or, seg. sh lg, 5 ears
73 (x) and # seg. ms2, 17, and brachytic-like plants, 7 ears (1/ = ell 7 = luteus 7)
74 (x) and # Y seg. ms2, 17, sh aleurone color and brachytic-like plants, 9 ears
75 (x) and # seg. Y, sh, ms2, 17, and aleurone color, 8 ears
76 (x) and # seg. Y sh ms2 17, 13 ears
77 (x) wx may seg. sh 16, 8 ears
78 (x) pk sh fl, seg. v, 4 ears
79 (x) A C R pr wx, homo for term. knob on 9, 1 ear
80 (x) sh wx, seg. w11, 1 ear
81 (x) seg. sh wx w11, 2 ears
82 (x) C sh wx, 5 ears
83 (x) C sh, seg. wx w11, 2 ears
84 (x) sh wx, seg. c, 2 ears
85 (x) sh, seg. c wx w11, 2 ears
86 (x) cr seg. Y vp4, 5 ears
87 (x) A C Rr Pr seg. vp, 8 ears
88 (x) y Pr pr, may seg. 14, 6 ears
89 (x) Pr pr may seg. 14, 8 ears
90 (x) Pr, seg. pg, R, 8 ears
91 (x) mottled aleurone, seg. R v18, may carry 14, 8 ears
92 (x) y, seg. v18, 14, 5 ears
93 (x) seg. Pr, v18, 14, 7 ears
94 (x) lg, seg. v20, 6 ears
95 (x) and # pr. seg. Y, g, R, 6 ears
96 (x) pr, seg. Y, g, R, 5 ears
97 (x) pr, seg. 12, g, su, R, 6 ears
98 (x) seg. g, R Y Pr, 3 ears
99 (x) Y, seg. ms20, v, 5 ears
100 (x) Y, seg. ms20, gl v or, 8 ears
Co 105 (x) and # A b pl Rg pr pv, may seg. C, 10 ears
" 106 (x) y su yv, 3 ears
" 107 (x) and # A, seg. Rg Rg Pr pg, 10 ears
" 108 (x) Pr Rg, 6 ears
" 110 # A C Rg Pr, 1 small ear
" 111 (x) A C Rmb r Pr, may seg. j, 6 ears
" 112 (x) and # A C Rg, 5 ears
" 113 (x) A C Rmb r Pr, seg. gl, 5 ears
" 114-115 (x) A B pl pr bv, seg. v4, 20 ears
" 116-118 (x) and # bm, lg, sk in various combinations, also seg. Pr A B Pl Y, 50 ears
" 119 (x) B lg v2 pr, seg. Pl su, 6 ears
" 120 (x) and # A B lg v2, seg. Pr
" 121 (x) Pl su, 40 ears
" 122 # a Bb lg Y pl R c wx pr su, 3 ears
" 123 # a j lg B C r pr Y pl, 9 ears
" 124 # A or C Rg pr su y pl b lg j, 5 ears
" 125 (x) and # a B Pl C Pr Y, 7 ears
" 126 (x) a pr in Y C R, 7 ears
" 127 (x) a B lg Pl C sh wx pr su, 1 small ear
" 128 # a B lg Pl Y c sh wx pr su, 1 small ear
" 129 (x) a pr in wx C Rg, seg. su, 10 ears
" 130 # A B lg y pl C Rg Pr Sox, 5 ears
" 131 # A C R Pr B Pl Y or, 2 small ears
" 132 # A Rg c wx pr su P seg. sh, 3 ears
" 133 # a B Pl C R Pr Y lg, 7 ears
" 134 # A b pl C r pv lg bm2, seg. su, Bu j, 9 ears
" 135 # A Rg y pl b lg bm2 j, seg. C Pr In su Ts2 v, 11 ears
" 136 (x) and # A c Rg g pr In Y pl b lg, bm2, j, seg, su ts2, 12 ears
" 137 (x) and # a C R pr in y j lg, 9 ears
" 138 (x) a P sh wx f, seg. su, lg, 7 ears
" 139 (x) a P sh wx su lg f, 5 ears
" 140 # a B Pl lg v4 Y, 8 ears
" 141 (x) and # ts4 lg B Pl in various combin., also seg. a Y or na, 20 ears
" 142 (x) su pr ts4, seg. Y and white aleurone, 6 ears
" 143 # a P B P, seg. Pl and striped, 2 ears
" 144 (x) Y bl, 3 ears
" 145 (x) Y seg. fl2, su, gl, 9 ears
" 146 (x) and # Y fl2, seg. gl, 13 ears
" 147 (x) and # y gl2, 5 ears
" 148 (x) Y h, 8 ears
" 149 (x) and # Y o A B Pl, 4 ears
" 150 (x) y 02, 4 ears
" 151 (x) F1 of rs x A B Pl Kn, 3 ears
" 152 (x) Pr, seg. v8 and d, 5 ears
" 153-156 (x) seg. v8 su d and de, 10 ears
" 157 (x) A c Rg su, seg. Pr, may seg. v9, 14 ears
" 158 (x) seg. Pr su, may seg. v9, 9 ears
" 159 (x) Y, seg. v7 striped, 6 ears
Co 162 (x) seg. Y v6 cr d, 10 ears
163 (x) y, seg. v6 d, 5 ears
164 (x) my seg. v6, seg. striped, 2 ears
165 (x) y, seg. v7, 6 ears
166 (x) and # Y, seg. sk, 8 ears
167 (x) and # seg. sk, v 9 ears
168 (x) and # Y, seg. sk d bl, 7 ears
169 (x) and # Y, seg. sk d bl, 12 ears
170 (x) and # Y, seg. sk, striped, 6 ears
171 (x) seg. bk v ts, 8 ears
172 (x) Y seg. bd, 10 ears
173 (x) ys x new ys, seg. Pr sh, 9 ears
175 # bt2, seg. gl, 5 ears
176-189, Stadler's X-ray mutants
176 (x) seg. Y d wx v, 20 ears
177 (x) seg. A R d j b 1 g gl d, 10 ears
178 (x) seg. d wx Pr R Y v, 10 ears
179 (x) seg. A R6 r Y wx y6, 12 ears
180 (x) pr, seg. A R6 r Y wx new d, 6 ears
181 (x) pr, seg. A 0 R6 r Y wx new d, 11 ears
182 (x) seg. A R B 1 g j new fi, 15 ears
183 (x) seg. R Fr Y d wx gl c, 15 ears
184 (x) seg. Pr R Y wx gl b, 12 ears
185 (x) seg. A B j 1 g R d, new pg, 10 ears
186 (x) seg. su j 1 g Y, new pg, 10 ears
187 (x) seg. new pg, 7 ears
188 (x) seg. A R6 r Y wx su, new ar-like striping, 7 ears
189 (x) seg. A R6 r Y wx su, new pg, 12 ears
190 (x) seg. w w2 w3, 5 ears
191 (x) seg. w3 R C, 2 ears
192 (x) seg. w3 R C Pr, 6 ears
193 (x) seg. w2 R, few seeds
194 (x) seg. w2 R Pr, 1 ear
197 (x) Pr Ts-8, 10 ears
198 (x) Y Ts-9, 8 ears
199 (x) Y T3-5, seg. su, 4 ears
200 (x) y Ts-7 b, seg. Pr, 10 ears
201 (x) Ts-10, seg. Y Pr, 11 ears
202 (x) Ts-2, 9 ears
203-214, Inbreds for smut resistance tests
203 (x) Cornell 11, 9 ears
204 (x) " inbred 10 years, 10 ears
205 (x) " inbred 11 years, 10 ears
206 (x) Leaing dent, inbred 8 years, 5 ears
207 (x) " inbred 11 years, 10 ears
208 (x) U.S. # 204 dent, inbred 12 years, 3 ears
209 (x) Bloody Butcher, inbred 10 years, 12 ears
210 (x) Oil Dent, inbred 8 years, 7 ears
211 (x) West Branch dent, inbred 8 years, 7 ears
212 (x) Silver King inbred 13 years, 14 ears
213 (x) Onondaga White dent, inbred 11 years, 6 ears
214 (x) Dutton's flint, inbred 11 years, 4 ears
215 (x) Y cr, seg. pg2 1 g wx, 7 ears
Co 216 (x) seg. as ms17 zl pr, 9 ears
   " 217 (x) and # may seg. bm v2 ya pr, 25 ears
   " 220 (x) and # seg. A B Fl lg gl2 v4 ts, 6 ears

1935 crop

Co 225 (x) gl13, also x gl16 and gl1c, 4 ears
   " 226 (x) gl15, also x gl, gl14, gl16, gl19, glb, 9 ears
   " 227 (x) gl16, also x gl12, gl13, gl14, gl16, gl17, gl19, 13 ears
   " 228 (x) gl17, also x gl, gl13, gl14, gl16, gl19, glc, glb, 17 ears
   " 229 (x) gl18, also x gl, gl13, gl14, gl17, gl19, glc, glb, seg. w wx, 14 ears
   " 231 (x) gl10, also x other glossies, seg. Bn s1, 9 ears
   " 234 lg gl12 b v4 x gl15, gl16, gl10, 3 ears
   " 236 gl13 su x other glossies, 3 ears
   " 237 gl13 su Tu tu x other glossies, 4 ears
   " 239 lg gl14 # and x other glossies, 13 ears
   " 242 g16 # and x other glossies, 5 ears
   " 243 gl17 v17 x other glossies, 5 ears
   " 246 # g16, 5 ears
   " 248 glc (x) and x other glossies, 4 ears
   " 249 glc (x) " " " 4 ears
   " 250 glc (x) " " 5 ears
   " 251 glb (x) " " 5 ears
   " 252 glb (x) " " 6 ears
   " 253 glb (x) " " 2 ears
   " 255 # seg. rs2 g1, 5 ears
   " 256 (x) seg. Rs g1, 4 ears
   " 258 # seg. at v gl1, may seg. bv, 6 ears
   " 259-260 # seg. bd, 12 ears
   " 261 (x) cr3, very few seeds
   " 262 (x) # bs (Hadjinov) similar to bs (Woodworth), seg. v.
   " 263 # seg. ba v, 2 ears
   " 264 # seg. ba2 v, 3 ears
   " 266 (x) seg. variable bv, 6 ears
   " 267 # f bm2, seg. P v5, 5 ears
   " 268 (x) and # f bm2, seg. br, 6 ears
   " 259-270 (x) and # seg. sr an bm2, few seeds
   " 271 (x) bm2, seg. P, 4 ears
   " 272 (x) lg, seg. gs2 B v4, 8 ears
   " 273 # A B lg gl12 v4 pl, 1 ear
   " 274 # A b pl lg gl12 v4, 6 ears
   " 275 # A b pl lg gl2 v4, 2 ears
   " 276 # lg gl12 v4, seg. ts, 2 ears
   " 277 # lg gl12, seg. v4 ts, 4 ears
   " 278-279 # lg gl12, seg. v4 ts, 3 ears
   " 280 (x) sb and x testers, 8 ears
   " 281 (x) al " " " 8 ears
   " 282 (x) al " " " 8 ears
   " 283 # seg. yt, may seg. a na ts4, 6 ears
   " 284 (x) and # seg. a ts4 lg cr g, 5 ears
   " 285 # a, seg. lg2 Dt su Y, 8 ears
   " 286 # a, seg. Dt su Y, may seg. na ts4, 7 ears

309
Co 287  #  d8, 7 ears
  288-289  #  d9, 11 ears
  290  #  d8, 3 ears
  291  # la su, 2 ears
  292  # la su, seg. Tu gl3, 1 ear
  293  # la su, seg. Tu gl3 pr, 1 ear
  294  (x)  pr bm, seg. ys v2, 7 ears
  295  # A a2 C R, seg. pr Y, 9 ears
  296  # v2 pr bm, 3 ears
  297  # bm, seg pr bt, 5 ears
  298  # A C R A2 a2 bv pr bt, 2 ears
  299  # A A2 C R bv bt pr, 5 ears
  301  # A A2 C R bv pr v2, 5 ears
  302  # A A2 C R bv bt pr, 2 ears
  304  # A B seg. Pl Y py sm, 1g, 12 ears
  305  (x)  A B pl Y sm, 1 ear
  306  (x)  B pl Y zg3, 2 ears
  307  (x)  B Pl zg3, 1 ear
  308  # ra gl ij, 2 ears
  309-310  # gl ij, 12 ears
  313  # gl ij ra, 1 ear
  314  (x)  seg. vp4, 3 ears
  315  (x)  lg gl4, seg. v, 5 ears
  317  (x)  seg. c sh wx v gl4, 4 ears
  318  (x)  wx, hetero. for large internal knot on long arm
         of chrom. 9, 3 ears
  319  (x)  R g nl x zb5 cross, 8 ears
  320  (x)  lg g colorless aleurone, may seg. d7, 6 ears
  321  (x)  r zb5 colorless aleurone, 1 ear
  322  (x)  A C Rr g li, 1 ear
  323  (x)  li, seg. gl vl8, su, 1 ear
  324  (x)  y li, seg. gl vl8 su, 4 ears
  326  (x)  A B Pl Y3, seg. Y, 6 ears
  327  (x)  A B Pl, seg. Y, 4 ears
  328  (x)  A B pl Y, seg. Y3 al, 6 ears
  330  (x)  A B pl Y, seg. Y3, 6 ears
  331  (x)  A B pl, seg. Y3 al, 1 ear
  332  (x)  Y3, seg. Y Pl, 1 ear
  334  (x)  Y Y3, seg. Pl, 6 ears
  336  (x)  deep yellow endosperm, 8 ears
  337  (x)  and # A bm2 su y pl b lg j C R5 Pr in seg. ts2, 2 ears
  338  (x)  and # A bm2 su y pl lg b j C R5, seg. v Ts2, 4 ears
  339  (x)  and # A bm2 pr in su y pl lg b j seg. cr na, 4 ears
  340  # A c R5 g pr in y pl lg b j, bm2 PVV Bn su, seg.
         ts, 3 small ears
  342  (x)  and # A c R5 g pr in Bn su y pl lg b j bm2, seg.
         ts, 5 ears
  343  # A c R6 cr pr Bn y pl lg b j bm2, seg. g in su
         ts2 d, 5 ears
  344  (x)  A c R6 g pr Bn y pl b lg j bm2, seg. d in ts2, 2 ears
Co 345 (x) and # Y a C R^6 pr in b pl Bn, 5 ears
  346 # A C r^6 sh wx, seg. su, 5 ears
  347 # a C r pr wx y, seg. ys, 10 ears
  348 (x) and # A c R^6 P^V wx pr su y in, seg. sh, 7 ears
  349 (x) and # a C R^6 pr in wx su, 5 ears
  350 (x) and # a j lg B C r^7 pl Y, 6 ears
  351 (x) and # seg. bt vp, 10 ears
  352 (x) # seg. bt, 4 ears
  353 (x) seg. tiny plants, 2 ears
  354 (x) o.p. Y Caspe Flint, few seeds
  355 (x) and # (ws x P br f bm2), 6 ears
  356 (x) and # (a Pr 1g2 x ws), 5 ears
  357 (x) (su g13 x ws2), 2 ears
  358 (x) (Y Pl Py py x ws2), 2 ears
  359 (x) and # seg. pr Y ws py, 7 ears
  360 (x) (Br g1 v5 x ws2), 8 ears
  361 (x) and # (j ms8 x ws2), 6 ears
  362 (x) (ws x c sh + wx gl4), 2 ears
  363 (x) and # (R g 11 x ws2), 6 ears
  364 (x) and # (P br f bm2 x n12), 6 ears
  365 (x) and # (A/+ n12 x a B Pl 1g2), 7 ears
  366 (x) and # (Pr n12 x pr bm A or d), 6 ears
  367 (x) and # (su gl13 x n12), 7 ears
  368 (x) and # (bm pr v2 x n12), 4 ears
  369 (x) and # (g1 v5 x n12), 6 ears
  370 (x) # (A c R su x A c R n12), 6 ears
  371 (x) # (A c r j x n12), 6 ears
  372 (x) # A a n12 x A R g n1), 3 ears
  373 (x) seg. j ms8, 2 ears
  374 (x) seg. j R^6 ms8, 3 ears
  375 (x) seg. j R^7 ms8, 2 ears
  376 (x) seg. j R^7 ms8, 3 ears
  377 (x) seg. j R^7 ms8, 3 ears
  378 (x) seg. j R^8 ms8, 3 ears
  379 (x) seg. j R^8 ms8, 3 ears
  380 (x) and # Learning inbred 9 yrs., 4 ears
  381 (x) and # Oil Dent inbred 9 years, 3 ears
  382 (x) and # Bloody Butcher inbred 11 years, 6 ears
  383 (x) and # Silver King inbred 14 years, 6 ears
  384 (x) and # Onondaga White inbred 12 years, 6 ears
  385 (x) and # West Branch inbred 9 years, 9 ears
  386 (x) and # Rustler (S44 x S46) F6, 6 ears
  387 (x) and # Hays and Johnson S283, 6 ears
  388 (x) and # Hays and Johnson 7 years, inbred Gold.
  389 (x) Bantam, 9 ears
  390 (x) A Bb Pl x lg g12 b v4, 5 ears
  391 (x) lg g12 b v4 x A B pl, 3 ears
  392 (x) seg. j or ij and lg, 3 ears
  393 (x) seg. po, 5 ears
  394 (x) may seg. st, 6 ears
  395 (x) a c r A^2 pr y, 6 ears
  396 (x) and # ap B Pl, few seeds

311
Co 406  #  a B pl, 2 ears
407  #  a b Pl, 3 ears
408  #  A B pl, 7 ears
409  open poll. a b pl, 6 ears
410-411 (x) a b pl, few seeds
412-415 F2 involving A B Pl sm py W, 75 ears
416 (x) seg. 13, 2 ears
420 (x) F2 involving A B lg gl2 v4 Pl ts, 5 ears
422 (x) F2 involving A B pl lg gl2 v4 lg gs2, 5 ears
424 (x) and # a yt na ts4 in various combinations, 6 ears
425 (x) a lg2 Dt, very few seeds
428 (x) A C R a2 b v2 pl, seg. bm2, 1 small ear
431 (x) and # A Bb Pl sm, 7 ears
432 # seg. ra gl ij bd, 2 ears
433 # seg. j, ms3, few seeds
434 (x) F2 involving gl14 yg2 c sh wx, 9 ears
436 (x) Pr g seg. R nl zb5, 1 ear
437 (x) zb5, may seg. g nl, 1 ear
439 (x) seg. bs vp, 4 ears
441 (x) seg. bs vp and striped, 4 ears
446-448 (x) j r/ rRmb, seg. su, 15 ears
449 (x) j r/ Rmb, 1 ear
450 seg. j r Rmb bm, 2 ears
451 seg. j r Rmb 4 ears
452-454 seg. j r R4 pg, 4 ears
456-457 (x) j/ + r/ R eg, 3 ears
458 (x) j/ + r/ RnJ, 1 ear
459 (x) j/ + r/ RnJ Pl, 4 ears
460 (x) j/ + r/ RnJ, seg. mr
472 (x) may seg. hf, 3 ears
476 # A B Pl, seg. su ba2, 3 ears
479 # may seg. bd, 3 ears
481 (x) Tu su, 1 ear
485 (x) Oil Dent inbred 10 years, 4 ears
486 U.S. # 204 x wx; br wx; bm3; A b pl lg gl2 v4, 4 ears
487 West Branch inbred 10 years, x g4 wx; A b pl lg gl2 v4, 2 ears
488 (x) Dutton's Flint inbred 13 years, 2 ears
489 (x) Rustler inbred 7 years, 1 ear
490 Kvakan's smut resistant x A C R a2 b pl v2, 1 ear
491 Bryan's inbreds, 9 ears
492
493
494 Open pollinated. Au au2 sh, few seeds
495 # du au au2 sh, few seeds
497 (x) Dt, also na lg ts4 g in various combinations, 5 ears
498 # g4 wx, may seg. 16, 2 ears
499 # Tp gl ra v5 in various combinations, 3 ears
500 (x) a, seg. Dt lg C R Pl, 5 ears
501 # ar wx, few seeds
502 open pollinated g2 A b Pl, 1 ear
Co 505 (x) A Bb Pl seg. Kn, 2 ears
507 (x) gi, 2 ears
508 (x) gi5, 2 ears
509 (x) and # gl$, 2 ears
510 (x) seg. Y su gi3 la, 5 ears
514 (x) r, seg. mr Fr Mt, 6 ears
518 (x) seg. f v, 5 ears
522 (x) A C R a2 bt bv pr, few seeds
523 (x) A C R a2 bt pr, v few seeds
524 (x) A C R A2 bt bv pr, few seeds
525-526 # fr2, seg. ij gl fr, 10 ears
528 # Supergold Popcorn inbred, 6 ears
529 # A B pl, seg. Y 4, It, 2 ears
531 # Y 4 It a c r pr i, 3 ears
532 (x) and # Y 4 g4, seg. It, 5 ears
541 (x) Y sk from Australia, 1 ear
544 Open pollinated No. 3 Trisome, 3 ears
545 No. 5 Trisome, 4 ears
546 No. 6 Trisome, 1 ear
552 # P br f bm2, may seg. Ts 2, 3 ears
554 # A B pl 4 seg. Yg 2, 1 small ear
555 A C R 6 x r mr Pr, 1 ear
556 "Sweet Brittle" (x) and x bs, 6 ears
557 (x) Singleton C2 inbred, 3 ears
558 (x) " C6 " , 2 ears
559 (x) " C13 " , 5 ears

1937 crop

Co 37-1 Bryan's inbred (x) and x red pigment in seedling leaves, 7 ears
37-2 West Branch inbred (x) and x g4 wx, 9 ears
37-3 U.S. No. 204 inbred (x) and x g4 wx, 7 ears
37-4 (x) and x ar wx, 4 ears
37-5 (x) and x bm 3, 8 ears
37-6 Oil Dent inbred x bm 3, 1 ear
37-7 U.S. No. 204 inbred x ra gl ij bl, 9 ears
37-8 (x) and # lg B v4 A Pl, seg. gl 2 Ts, 1 ear
37-9 F2 involving g4 gl 4 yg 2 c h wx, 8 ears
37-10 ra gl ij bd, 1 ear
37-11 (x) gl ij, seg. ra fr fr2, 7 ears
37-12 (x) F2 involving ra gl ij bd, 3 ears
37-13 (x) A B Pl, seg. py sm, 2 ears
37-14 (x) F2 involving West Branch inbred and lg b
37-16 Luce's Favorite (x) and x Onondaga White Dent, 10 ears
37-18 Cornell 11 (x) and x Luce's Favorite, 3 ears
37-20 (Luce's Favorite x Onondaga Wh. Dent) x
37-21 (Bl. Butcher x Cornell 11) x
37-23 West Branch (x) and x U.S. no. 204; pbx; Sx Pr;
   p ad an; yg 3; bushy; c sh wx bp; 20 ears
Co 37-26

U.S. no. 204 (x) and x West Branch;
c sh wx bp; zb5; p ad an; Ch; pbx; bushy;

25 ears

" 37-28 (x) c sh wx bp, 2 ears
" 37-49 F2 involving tu su da, 3 ears
" 37-52 (x) a lg2 Dt, few seeds
" 37-54 (x) A C R a2 bt bv pr y, 2 ears
" 37-55 (x) a na cr gl v5 Y, v. few seeds
" 37-57 (x) A C R a2 pl B Y, 2 ears
" 37-58 (x) v zb5 y, seg. nl, 5 ears
" 37-60 (x) A C R a2 bt bv, seg. v2, 2 ears
" 37-62 (x) g2 A b, seg. Fl, 2 ears
" 37-63 (x) a y Dt, v, few seeds
" 37-64 (x) a y Dt, seg. su lg2, 2 ears
" 37-67 (x) v5 gl1, seg. Tp ra, 5 ears
" 37-68 (x) v5 gl1 Tp ra, 1 ear
" 37-69 # a, seg. na lg2 te4, 2 ears
" 37-72 (x) au au2 sh, 2 ears
" 37-73 (x) F2 involving su gl3 j2, 2 ears
" 37-74 (x) and # A C R A2 Pr, seg. Fl, 2 ears
" 37-75 (x) seg. Pr vl2, 1 ear
" 37-77 (x) and # seg. vl3, 3 ears
" 37-80 # seg. va2, 4 ears
" 37-81 (x) and # seg. wa, 2 ears
" 37-82 # Pr Y, seg. ms2, 2 ears
" 37-84 # seg. ms5 reddish yellow, 4 ears
" 37-85 (x) and # seg. ms6 Pr, 2 ears
" 37-86 ms6 x West Branch, 2 ears
" 37-87 (x) and # A B Fl Y, seg. ms8 lg, 3 ears
" 37-88 # Y, seg. ms9, 4 ears
" 37-89 # seg. ms10, 5 ears
" 37-90 (x) and # seg. ms11, 6 ears
" 37-91 (x) and # seg. ms12 white stripes, 4 ears
" 37-92 (x) and # seg. ms13, 6 ears
" 37-93 (x) and # seg. ms14, 7 ears
" 37-96 (x) pvv, may seg ms34, 3 ears
" 37-97 (x) and # seg. ms37, 4 ears
" 37-98 (x) and # seg. ms39 Fl Tu, 7 ears
" 37-99 ms42 x inbred, 2 ears
" 37-100 F2 involving Fl sm pbx Pr, 2 ears
" 37-101 (x) A B Fl j, seg. 1 w, 3 ears
" 37-103 (x) and # seg. yellowish green seedlings, 4 ears
" 37-104 (x) and # rather light green foliage, 10 ears
" 37-105 (x) rather light green foliage, seg. a v, 5 ears
" 37-106 and 107 dark green foliage, 6 ears
" 37-109 (x) vl2, seg. fr, 4 ears
" 37-110 (x) y, seg. gl10, 6 ears
" 37-111 (x) su am du, 2 ears
" 37-114 (x) F2 involving A b pl Y su2 sb, 4 ears
" 37-116 (x) y su2, may seg. sb, 4 ears
" 37-117 (x) y, seg. pbx
" 37-119 (x) Pr wx da ar sa, 3 ears
" 37-120 (x) A B Fl Sx Pr, few seeds
" 37-121 (x) Y b gs2 lg
" 37-122 (x) sy, 10 ears
37-123 (x) y, seg. Pc, 7 ears
37-124 (x) a lg2 d, seg. ts4, 3 ears
37-125 (x) and # A lg2 d, may seg. ts4, 3 ears
37-126 (x) Y a lg2 ra2, 5 ears
37-127 (x) su, silks all over ear, 3 ears
37-128 (x) F2 involving Ga su cross, 5 ears
37-130 (x) Ch, seg. gl v5, few seeds
37-131 (x) p ad, seg. an, 5 ears
37-133 (x) F2 involving Ga su, 5 ears
37-134 (x) F2 involving Ts3 v4 Rg, 2 ears
37-135 (x) F2 involving Ts3 v4 Rg & sh wx, also seg. Pr Y, 4 ears
37-136 (x) p ad, may seg. an, few seeds
37-137 (x) seg. Pr bm3 yg3, 6 ears
37-138 (x) Y P, seg. Og, 5 ears
37-139 (x) Y Og, 3 ears
37-140 (x) su, may seg. w4, 1 ear
37-141 (x) F2 involving Og and La inbred, 4 ears
37-142 (x) A B P1 1, may seg. w, 1 ear
37-143 (x) A C R A2 pr i, 7 ears
37-144 (x) w1 su gl3 in various combinations, 3 ears
37-145 (x) F2 involving w1 Ts5 su, 2 ears
37-146 (x) gl3, seg. su w1
37-147 (x) seg. su gl3 Y, 4 ears
37-148 (x) Ts5 su y, seg. gl1, may seg. la, 3 ears
37-149 (x) a lg2, seg. Dt na, 4 ears
37-150 (x) # na, seg. ts4, 2 ears
37-152 (x) seg. w, 1 ear
37-155 (x) Y gl1, seg. de, 6 ears
37-156 (x) Y, seg. de, 5 ears
37-157 (x) # Y a yt, seg. na, 1 ear
37-158 (x) Y, seg. bushy, 1 ear
37-159 (x) and # ij gl bd in various combinations, 4 ears
37-160 (x) y, seg. ra, 3 ears
37-161 (x) y br f, may seg. bm2, 1 ear
37-162 (x) seg. Y, 2 ears
37-164 (x) y pbx, 2 ears
37-165 (x) # pr, seg. Vg, 2 ears
37-167 (x) an2, 1 ear
37-170 (x) Y fine stripe, 1 ear
37-171 (x) B.C., seg. A b lg gl12 v4, few seeds
37-172 # seg. na2 su Pr, 3 ears
37-175 (x) A lg gl12 b v4 Yx corrugated leaf, few seeds
37-176 (x) y Dt, seg. na ts4 lg2 su, 1 ear
37-177 # su, may seg. la, 1 ear
37-179 (x) y v2 A C R a2 b pl, 7 ears
37-180 (x) A C R A2 bv bt, seg. Pr, 4 ears
37-181 (x) Y A b P1 sm, seg. py, 2 ears
37-184 # j, seg. ms8, 1 ear
37-185 (x) yg g2 lg c sh wx, seg. gl14, few seeds
37-187 (x) A C R a2 b pl v2 y, may seg. bm, 2 ears
37-188 (x) F2 involving A C R st r B (mottled red), 2 ears
37-190 (x) Y, seg. bk, 3 ears
315
Co 37-198 (x) y gl, seg. bk, 1 ear
" 37-199 (x) F₂ involving bk bk2, seg. gl, 4 ears
" 37-200 (x) seg. de, may seg. mi, 1 ear
" 37-201 (x) seg. an² d, 5 ears
" 37-202 (x) F₂ involving Trucker's Favorite and mi, 2 ears
" 37-203 (x) A C R a² bv bt pr, 1 ear
" 37-205 (x) Wc Y, 1 ear
" 37-208 No. 2 trisome x U.S. no. 20⁴, 3 ears
" 37-209 No. 3 " x " 2 ears
" 37-213 No. 6 " x " 1 ear
" 37-214 No. 7 " x " 3 ears
" 37-215 No. 8 " x " 1 ear
" 37-217 No. 10 " x " 3 ears
" 37-219 # seg. js ms8 vl6, 3 ears
" 37-220 and 221 (x) yellow striped seedlings, 1 ear
" 37-222 (x) homo virescant seedlings, 2 ears
" 37-223 # yell. striped seedlings on very dark green base, 3 ears
" 37-224 and 225 (x) virescant seedlings, 2 ears
" 37-226 (x) and # seedlings tiny, virescant and white striped, 3 ears
" 37-227 # crinkly seeding leaves, 2 ears
" 37-228 (x) Amargo from Horowitz, 1 ear
" 37-229 # seg. vl19, 1 ear
" 37-230 # su³ du, 2 ears
" 37-231 T1-2b x T1-2b, 1 ear
" 37-233 Australian x Siamensis, 3 ears

1938 crop

Inbred I = U.S. No. 20⁴ (W-R)
Inbred II = West Branch (W-W)

Co 38- 1 F₂ involving inbreds I and II, 1 ear
" 38- 2 (x) pr, seg. Y ms7, 3 ears
" 38- 3 (x) seg. Y ms12, 2 ears
" 38- 4 (x) Y, seg. ms42 su, 6 ears
" 38- 5 (x) F₂ involving H me, 3 ears
" 38- 6 (x) F₂ involving inbred II and yg³ bm³, 2 ears
" 38- 9 and 10 (x) F₂ of no tillers x many tillers cross, 15 ears
" 38-11 F₂ involving inbred II and c sh bp wx, 5 ears
" 38-12 (x) F₂ involving inbred I and c sh bp wx, 7 ears
" 38-13 (x) " II and p ad an?, 1 ear
" 38-14 (x) " I and " 4 ears
" 38-15 (x) " II and y pb+, 8 ears
" 38-16 (x) " I and " 7 ears
" 38-17 Inbred I x y ra sl; g⁴ wx; bm³, 3 ears
" 38-18 Inbred II x y ra sl; g⁴ wx; bm³, fx? Pu?, 4 ears
" 38-19 (x) In, seg. Pr w, 5 ears
" 38-20 # seg. sk, 2 ears
" 38-21 (x) Pr y sp su, 5 ears
" 38-23 (x) Y d6, 6 ears
" 38-24 (x) a³ g, seg. Pr, 2 ears
" 38-25 (x) y Og, may seg. a³, 3 ears
Co 38-27 (x) Y zb4, 5 ears
38-28 (x) F2 involving inbred I and zb5 and possibly
38-30 (x) Y vs, 2 ears
38-31 (x) Y ms, 2 ears
38-33 (x) y Hs, seg. Tu, 3 ears
38-37 (x) sdc y, 5 ears
38-40 (x) Y v7, 4 ears
38-44 (x) seg. ms, may seg. v19, 3 ears
38-45 (x) Y vs0 lg, 2 ears
38-46 (x) Y o, 6 ears
38-47 (x) y oz, v. few seeds
38-48 (x) Y h, 3 ears
38-49 (x) Y f12 may seg. ms, 7 ears
38-50 (x) Y f12 gl1, seg. su, 7 ears
38-51 (x) a C R6 pr in wx y, seg. su, 6 ears
38-52 (x) a C R Y pr in, 4 ears
38-55 (x) Pr, seg. vp, 4 ears
38-56 (x) Y, seg. vp4, 1 ear
38-58 (x) rSt, 1 ear
38-59 (x) Rmb, 2 ears
38-60 (x) A C Rn pr, 2 ears
38-62 (x) A C Rg pr, 2 ears
38-64 (x) y Rf su, 6 ears
38-65 (x) seg. ms2, 6 ears
38-66 (x) seg. ms2, may seg. 17, 5 ears
38-70 and 71 (x) and # seg. msll and ar-like stripe, 13
38-72 (x) Y, seg. v, 7 ears
38-78 (x) F2 involving lg2 pm d, 5 ears
38-81 (x) y, seg. d2, 1 ear
38-82 (x) Y sh, seg. d3, 7 ears
38-85 (x) Y, seg. d5, 4 ears
38-90 (x) sh wx, may seg. 16, 1 ear
38-92 (x) Y, seg. 17, 6 ears
38-93 (x) Y, seg. w2, 3 ears
38-95 (x) Y, seg. w3, 1 ear
38-96 (x) Y wx, seg. crinkly leaf, 3 ears
38-97 (x) sh wx Pr, seg. wll, 3 ears
38-98 (x) pr, may seg. v5, 4 ears
38-100 (x) seg. v9, 7 ears
38-101 (x) A C R6 su, seg. v9, 4 ears
38-102 (x) seg. v13, 11 ears
38-103 (x) y v18, 1 ear
38-104 (x) y v18, may seg. 14, 1 ear
38-105 (x) and # lg gs2, may seg. gl2 v4 b, 2 ears
38-106 (x) and # ws3 lg, may seg. gl2, 7 ears
38-108 (x) F2 involving Y gl2 lg v4 fl, 10 ears
38-109 # lg gl2 ts v4 in various combinations, 4 ears
38-112 (x) su gl3, seg. w1, 1 ear
38-114 # P Pl sm, seg. py, 2 ears
38-117 # seg. j ms8 v16, 3 ears
38-119 # Ts6 Og, 3 ears
Co 38-122 # wx g4, 6 ears
" 38-123 # wx g4, 1 ear
" 38-126 (x) bm3, 2 ears
" 38-131 # pr sk, 1 ear
" 38-132 # A B Pl Pr bm, seg. sk lg, 2 ears
" 38-133 (x) Pr lg, seg. sk, 2 ears
" 38-134 (x) may seg. lo, 2 ears
" 38-135 # Y, seg. hf, 6 ears
" 38-136 # seg. Pr T6-6 su, 3 ears
" 38-138 # y, seg. lg3 Rg and possibly d, 1 ear
" 38-140 # Y wx, seg. ar, 5 ears
" 38-143 (x) and # Pr, seg. g tw3, 3 ears
" 38-144 (x) seg. bx, 1 ear
" 38-145 # seg. ba, 3 ears
" 38-146 # seg. ba2, 2 ears
" 38-147 (x) may seg. ra2, 2 ears
" 38-148 (x) Y a lg2 ra2, 2 ears
" 38-150 (x) F2 involving pr zb f ys, 4 ears
" 38-153 (x) seg. at, 1 ear
" 38-154 (x) gl1, seg. bk, 2 ears
" 38-155 (x) Y bk2, 3 ears
" 38-159 (x) Y gl f12, 1 ear
" 38-179 (x) zb4 br f, may seg. bm2, few seeds
" 38-187 (x) and # Og g11, 4 ears
" 38-189 (x) a B Pl C R Pr Y, 5 ears
" 38-191 (x) A C r g y, 3 ears
" 38-192 (x) A B pl C Rg Pr Scx y lg, 8 ears
" 38-193 (x) A b Pl Y sm, seg. py, 3 ears

1939 crop

Co 39- 1 (x) F2 involving inbred I and g4 wx, 8 ears
" 39- 2 (x) F2 " " " " and sl ra, 5 ears
" 39- 3 (x) F2 " " " " and bm3, 8 ears
" 39- 4 (x) F2 " " " " II and sl ra, 7 ears
" 39- 5 (x) F2 " " " " and bm3, 10 ears
" 39- 6 (x) F2 " " " " and g4 wx, 8 ears
" 39- 7 Inbred II x Rmb; In? Pr; Y o v2; zb4 br f
bm2; A C Rg pr P; wj lg gl2; sp su Pr;
Rg5; Rmb; r h y su; y g2 sh wx gl lg;
a B Pl P; lg2 d; v7; Y fs; sk; y wx
v gl4; brown striped; zb4; lg gl2 v4 f;
Y o v2; r st, 32 ears
" 39- 8 Inbred I x lg gl2 v4 f1; fs; sk; y wx v gl4;
a B Pl P; A C Rg pr pvv; vil8; brown
striped; Y o v2; zb5 nl7; Rmb; v7; sh
wx v gl4; sp su Pr; Pr In?; ws3 lg gl2;
Y fs; y g2 sh wx gl4 lg; r st; lg2 d; zb4
br f; bm2; y wx v gl4; Rg5; A C Rg J Pr;
v7; a d lg2, 52 ears
" 39-10 In Pr x inbred I, 2 ears
" 39-11 # seg. sk, 3 ears
Co 39-12 (x) and # ap su Pr, also crossed to inbred I and II, 6 ears

- 39-13 # zb4, also crossed to inbred. I and II, 3 ears
- 39-15 rst x inbred I and II, 4 ears
- 39-16 A C R11 Pr x inbred I and II, 5 ears
- 39-17 R88 Pr x inbred I, few seeds
- 39-18 A C R18 pr P x inbred I and II, 4 ears
- 39-19 r y su x inbred I and II, 6 ears
- 39-20 Y v7 x inbred I, 1 ear
- 39-25 (x) and # Y fe, 3 ears
- 39-27 (x) lg Ts v4, 2 ears
- 39-28 (x) lg gl2 ts v4 in various combinations, 3 ears
- 39-31 # ws3 lg gl2, 1 ear
- 39-32 (x) lg gl2 v4 fl, 3 ears
- 39-35 (x) gs2 gl2 b v4, 1 ear
- 39-37 (x) d and lg2 d, 2 ears
- 39-38 (x) lg2 d, 1 ear
- 39-39 (x) lg2 d, 1 ear
- 39-41 # j, seg. ms8 v16, 3 ears
- 39-43 (x) y sh wx v gl4, 2 ears
- 39-44 (x) yg2 sh wx lg gl4, also crossed to inbred II, 3 ears
- 39-45 (x) and # y wx v gl4, 3 ears
- 39-46 # Y, seg. su Ts6 Pr, 3 ears
- 39-47 # y zb5, may seg. nl, 1 ear
- 39-49 (x) zb5, seg. Y, 1 ear
- 39-50 (x) bm7, seg. Pr Y sh, 4 ears
- 39-51 # seg. ms7
- 39-53 # seg. ms42 g1, 5 ears
- 39-55 (x) seg. d2, 5 ears
- 39-60 (x) Y du2, seg. du suam, 1 ear
- 39-61 (x) Y seg. du2 du suam, 1 ear
- 39-67 (x) A b Pl Y sm P, 6 ears

G. A. Lebedeff
### V. INDEX OF SEED STOCKS

<p>| a3 | Co 38-24, 38-25. |
| al | 281, 282, 328-331, 39-47. |
| an2 | 37-167, 37-201. |
| ar | 67, 501, 37-119, 38-140. |
| ara | 188. |
| as | 216, 401. |
| at | 258, 38-153. |
| au | 494, 495, 37-72. |
| au2 | 494, 495, 37-72. |
| bax | Co 263, 264, 38-144. |
| ba | 264, 38-145. |
| ba2 | 265, 38-146. |
| bd | 172, 259, 260, 479, 37-10, 37-12, 37-159. |
| be | 172. |
| bl | 144, 168, 169. |
| bmx | 130, 239. |
| br | 74, 258, 266, 359, 552, 37-161, 38-179. |
| bs | 262. |
| bt2 | 174, 175. |</p>
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>cr</td>
<td>Co 22, 23, 24, 25, 26, 125, 131, 141, 162, 215, 284, 339, 343, 37-55</td>
</tr>
<tr>
<td>da</td>
<td>181</td>
</tr>
<tr>
<td>dh</td>
<td>481, 37-49</td>
</tr>
<tr>
<td>dx</td>
<td>20, 152, 162, 163, 168</td>
</tr>
<tr>
<td>d2</td>
<td>11-12, 38-81, 39-55</td>
</tr>
<tr>
<td>d3</td>
<td>70-72, 38-82</td>
</tr>
<tr>
<td>d5</td>
<td>2-4, 38-85</td>
</tr>
<tr>
<td>d6</td>
<td>38-23</td>
</tr>
<tr>
<td>d7</td>
<td>320</td>
</tr>
<tr>
<td>da</td>
<td>495, 37-119</td>
</tr>
<tr>
<td>dex</td>
<td>37-155, 37-156, 37-200</td>
</tr>
<tr>
<td>f</td>
<td>138-139, 258, 267-269, 359, 368, 401, 552, 37-161, 38-179</td>
</tr>
<tr>
<td>fia</td>
<td>182</td>
</tr>
<tr>
<td>rl</td>
<td>38-108, 39-32</td>
</tr>
<tr>
<td>fl2</td>
<td>145, 146, 38-49, 38-50, 38-159</td>
</tr>
<tr>
<td>fr</td>
<td>and 2 Co 66, 525, 526, 37-11</td>
</tr>
<tr>
<td>fs</td>
<td>Co 38-30, 39-25</td>
</tr>
<tr>
<td>rx</td>
<td>170</td>
</tr>
<tr>
<td>g2</td>
<td>37-62</td>
</tr>
<tr>
<td>g3</td>
<td>1</td>
</tr>
<tr>
<td>g4</td>
<td>67, 73, 498, 37-3, 37-9, 38-17, 38-18, 38-122, 38-123, 39-1, 39-6</td>
</tr>
<tr>
<td>gx</td>
<td>10, 25, 26, 284</td>
</tr>
<tr>
<td>ga</td>
<td>37-128, 37-133</td>
</tr>
<tr>
<td>gl (b, c, d)</td>
<td>Co 177, 183, 184, 248-254</td>
</tr>
<tr>
<td>gl3</td>
<td>224, 236, 237, 291, 293, 37-73, 37-146</td>
</tr>
<tr>
<td>gl (5-10)</td>
<td>Co 147, 242-247, 508-509, 37-110</td>
</tr>
<tr>
<td>glx</td>
<td>Co 23, 104, 113, 175, 255-258, 323-324, 38-50, 38-159</td>
</tr>
<tr>
<td>gl (Hadjinoff's)</td>
<td>Co 225-231</td>
</tr>
<tr>
<td>gs</td>
<td>Co 401, 37-14, 37-15</td>
</tr>
<tr>
<td>gse2</td>
<td>6, 272, 422, 37-121, 38-106, 39-35</td>
</tr>
<tr>
<td>h</td>
<td>148, 38-48</td>
</tr>
<tr>
<td>hr</td>
<td>257, 472, 38-135</td>
</tr>
<tr>
<td>hs</td>
<td>38-33</td>
</tr>
<tr>
<td>Co 176-178, 182-185, 37-143</td>
<td></td>
</tr>
<tr>
<td>&quot; 66, 309-313, 525, 526, 37-7, 37-10, 37-121, 37-159</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Co 529, 531, 532 |
| 37-73, 37-147 |
| 151, 505, 37-161 |
| 83, 198, 318 |
| 37-101, 37-142 |
| 99-102 |
| 416 |
| 92-97, 38-105 |
| 73, 81 |
| 74-78, 38-92 |
| 1, 112 |
| 291-293, 510, 37-148, 37-177 |
| 38-138 |
| 322-324, 367, 38-187 |
| 29, 30, 38-134 |
| 38-5, 38-31 |
| 514 |
| 37-200, 37-202 |
| 37-84 |
| 37-85 |
| 38-2, 39-51 |
| 37-88 |
| 37-89 |
| 38-70, 38-71 |
| 37-91, 38-3 |
| 37-92 |
| 37-93 |
| 216 |
| 55, 56 |
| 103, 104, 38-72 |
| 37-97 |
| 37-98 |</p>
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co</td>
<td>37-99, 38-4, 39-53</td>
</tr>
<tr>
<td>msx</td>
<td>29, 52, 107, 112, 280, 38-44</td>
</tr>
<tr>
<td>na2</td>
<td>37-172</td>
</tr>
<tr>
<td>nl</td>
<td>319, 376, 436, 437, 37-58, 38-28, 38-48</td>
</tr>
<tr>
<td>nl2</td>
<td>368-376</td>
</tr>
<tr>
<td>o</td>
<td>149, 38-46</td>
</tr>
<tr>
<td>o2</td>
<td>150, 38-47</td>
</tr>
<tr>
<td>pb</td>
<td>107</td>
</tr>
<tr>
<td>pbx</td>
<td>37-117</td>
</tr>
<tr>
<td>pc</td>
<td>37-110, 37-164, 38-15, 36-16</td>
</tr>
<tr>
<td>pg</td>
<td>37-123</td>
</tr>
<tr>
<td>pga</td>
<td>9, 215</td>
</tr>
<tr>
<td>pgx</td>
<td>188, 189</td>
</tr>
<tr>
<td>pk</td>
<td>55, 92, 107, 185, 187</td>
</tr>
<tr>
<td>po</td>
<td>28, 82</td>
</tr>
<tr>
<td>f1</td>
<td>38-78</td>
</tr>
<tr>
<td>pr</td>
<td>3, 4, 57-61, 303-305, 362, 363, 412-415, 463, 38-13, 38-114, 38-193</td>
</tr>
<tr>
<td>ra2</td>
<td>37-126, 38-148</td>
</tr>
<tr>
<td>rax</td>
<td>38-147</td>
</tr>
<tr>
<td>rg</td>
<td>37-134, 38-138</td>
</tr>
<tr>
<td>rs</td>
<td>151, 256</td>
</tr>
<tr>
<td>rs2</td>
<td>355</td>
</tr>
<tr>
<td>s</td>
<td>130</td>
</tr>
<tr>
<td>sx</td>
<td>37-120</td>
</tr>
<tr>
<td>sa</td>
<td>37-119</td>
</tr>
<tr>
<td>sb</td>
<td>280, 417, 37-114, 37-116</td>
</tr>
<tr>
<td>sbx</td>
<td>38-192</td>
</tr>
<tr>
<td>sc</td>
<td>130</td>
</tr>
<tr>
<td>sh</td>
<td>26, 34, 36, 38, 44, 45, 67, 68, 70-73, 75-79, 81, 82, 84-89, 128, 132, 138, 139, 149, 224, 315, 317, 323</td>
</tr>
</tbody>
</table>

si 258


sl 62, 63, 232, 38-17, 38-18, 39-2, 39-4


sp 27, 28, 38-21, 39-12

sr 269, 270

st 403


su2 37-114, 37-116

su3 37-230

sy 37-122

tn 31, 32, 357

Tp 64, 499, 37-67, 37-68


ts 276-279, 37-8, 39-27, 39-28

ts2 131-136, 258, 337-340, 342-344, 552

ts3 37-134, 37-135


Ts5 37-145, 37-148, 37-177

Ts6 38-119, 38-136, 39-46, 39-47

tsx 23, 171, 220

Tu 236, 237, 292, 293, 361, 481, 37-49

tw3 38-143

va 178


v 317, 39-43, 39-45


v3 41, 50, 51


v6 157-158, 38-40

v7 152-156

v8 157, 158, 38-100, 38-101

v12 37-75, 37-109

v13 37-77, 38-102, 38-103
v14 Co 72
  " 37-219, 38-117, 39-41
v16  " 243
v17  " 95-97, 323, 324, 38-104, 38-105
v18  " 37-229
v19  " 98, 38-45
v20  " 37-50
va2  " 266
Vg  " 37-165
vp  " 31, 38-55
vp2  " 48, 49
vp4  " 90, 314, 38-56
wx  " 134, 229, 263, 310, 313, 336, 337
w  " 190, 412-415, 37-101, 37-142
w2  " 190, 193, 194, 38-93
w3  " 190-192, 38-95
w4  " 137-140
w11  " 38-89, 38-97
wa  " 37-81
Wc  " 37-205
Wh  " 65
wl  " 37-144, 37-145, 38-112
ws  " 361, 362, 363, 366
ws2  " 361, 362, 364, 365, 367
ws3  " 38-107, 39-3
wx  " 14, 15, 18, 19, 34, 38, 44, 45, 68, 70, 71, 73,
  79, 81, 83-89, 123, 128, 129, 132, 138, 139, 176,
  178-181, 183, 184, 188, 189, 215, 224, 229, 257,
  315, 317, 318, 346-349, 366, 434, 498, 501, 37-2,
  37-3, 37-4, 37-9, 37-26, 37-119, 37-135, 37-185,
  38-11, 38-12, 38-51, 38-96, 38-97, 38-122, 38-123,
Y  Co 22-26, 40, 57-61, 66, 75-78, 103, 104, 123-137,
  140-142, 144-149, 160-166, 175-189, 198-199, 206-215,
  224, 231, 234, 238, 239, 255-263, 303-307,
  39-47, 39-67
Y3  Co 326, 328-334
  " 529, 531, 532
yga  " 179
yg2  " 315, 434, 554, 37-9, 37-185, 39-44
yg3  " 37-137, 38-6
ys  " 36, 39, 41, 46, 47, 173, 217, 294
ysx  " 173, 347
yt  " 13, 283, 424, 37-157
zb4  " 38-27, 38-179, 39-13
zb5  " 319, 321, 436, 37-58, 38-28, 39-49
zbx  " 107, 36-150
zg3  " 306, 307
zl  " 216
Translocations Co 19g-202, 37-231, 37-232

G. A. Lebedeff
VI. HISTORICAL NOTES ON MAIZE GENETICS COOPERATION

I. Mimeographed letter of April 12, 1929 mentions "Cornfab" held in Dr. Emerson's room in N.Y. hotel at the time of the Christmas meetings, 1928. Long folder of linkage information issued with this letter, considered News Letter 1.

II. Second folder of mimeographed information issued some time after the first one, perhaps late in 1929 or in 1930.

Cooperation of maize geneticists planned at Sixth International Congress of Genetics, at Ithaca, N.Y., August, 1932.


Correspondence by Dr. Emerson about possible grant of money for Maize Genetics Cooperation, January 1933.


Letter of Nov. 13, 1933 gave samples of news items and asked for news contributions.


April 1, 1934. Rockefeller Grant available.


IX. News Letter - March 6, 1935. 20 pages.


XII. News Letter - March 6, 1938. 38 pages, 2 maps.

XIII. News Letter - April 15, 1939. 22 pages.

XIV. News Letter - March 5, 1940. 56 pages.
Ithaca, New York  
February 5, 1941

Dear Colleague,

As you may know, Dr. Emerson reaches retirement age this coming June, and at that time will have completed 27 years of active service at Cornell. While there is no indication whatever that retirement is going to affect in any way the active continuance of his corn genetics research here at Cornell, it does seem that this coming summer is an appropriate time to hold a reunion of his former students and coworkers in corn genetics.

Preliminary arrangements are now being made for such a reunion to be held at Ithaca in late August or early September, either just before or just after the summer meeting of the Genetics Society at Cold Spring Harbor. It is being planned as an informal family affair to last for at least a couple of days. No formal program is being arranged but there will most certainly be a picnic at Taughannock, and you may rest assured there will be ample opportunity for reminiscences and much good talk. If the group is interested in having one or more informal round-table discussions of recent developments in corn genetics or an inspection trip to the Plant Breeding gardens, they will be arranged. And it is possible we may be able to handle a small amount of live plant material for exhibit purposes, if anyone has something new and exciting that he would like to have on exhibit.

The names of the persons to whom this invitation to participate in the reunion is being sent are given below. The word was passed around at the recent Philadelphia meetings that plans were under way for a get-together of this sort, and the response was 100 percent favorable. The names of those who indicated that they would plan to attend are starred. If this preliminary poll is any indication of the final trend, most everyone will be on hand, and this should be a memorable occasion for Dr. and Mrs. Emerson.

Another announcement will be issued later on when a definite date has been selected and other plans have materialized. Meanwhile, any suggestions you may have will be welcomed.

Cordially yours,

[Signature]

Anderson (*); Beadle (*); Brink; Brunson; Burnham (*); Clark, Frances; Creighton (*); Demerec (*); Emerson, Sterling; Eyster (*); Fischer; Hayes; Jenkins; Jones; Kempton; Langham; Lebedeff; Lindstrom (*); Longley; McClintock (*); Mangelsdorf; Perry; Reeves; Richey; Rhoades (*); Sharp (*); Singleton; Sprague; Stabler (*); Weatherwax
An Appreciation

At the close of the academic year in June, 1941, Dr. R. A. Emerson will have reached the age of retirement for university professors and will officially set down his old box of records after 27 years of service to Cornell University. Actually his corn genetics investigations began at Nebraska about 1911, so the present summer will mark over 30 years of research on maize. It seems highly proper at this time for The News Letter to call to the attention of the cooperators the services which Dr. Emerson has rendered to genetics in general, and to Maize Genetics Cooperation in particular.

One of his outstanding accomplishments in this long period has of course been his highly productive research in the field of maize genetics. A long series of publications testifies to his activity here. Younger men who are working with maize should remember that they have more tools to work with and they can go farther because of the foundation laid by R. A. Emerson. His researches would stand as a signal contribution even if he had done nothing else in the advancement of science.

Most men in university positions have an opportunity to influence students, to stimulate their interest in research and to instill in them certain ideals. The list of graduate students who have majored with R. A. Emerson and gone on to important positions in science is an impressive one. Many of these men are still corn geneticists, as they were in their graduate-student days, and most of them are maize cooperators along with us. One man retires, but several dozen carry on the work, with much of the same industry and high regard for the scientific approach.

By the late 1920's, the number of corn geneticists had grown considerably. Dr. Emerson began about that time to get these men together in his hotel room at the time of the A.A.A.S. meetings for so-called "cornfabs". These informal meetings served to keep the corn workers informed on what others were doing and helped them to plan for the future. They were the beginnings of Maize Genetics Cooperation. Not only has our own organization grown from these informal meetings, but corn geneticists have set an example in mutual confidence and cooperation which has been copied by several other groups.

We think that we are safe in saying that R. A. Emerson was the first to call the attention of plant geneticists to the advantages of the maize plant for genetic research, and that he did much to stimulate the present widespread interest in this plant. His writings have probably "converted" a number who did not come more directly under his influence as a teacher.
When you stop to think of it, he has done a thorough job. He has made many excellent contributions of his own, he has trained graduate students to "carry on", he has stimulated wide interest in corn genetics, and finally, he has insured, for sometime at least, the maintenance of maize stocks and a cooperation in maize research. These things will have far-reaching effects.

But this is not a eulogy. There seems to be "plenty of mileage in the old car yet", and the old record box still holds cards. The Dean of our Agricultural College has promised that office and garden space will still be available for Dr. Emerson's use, and perhaps if our New York winters get too monotonously disagreeable, southern California or Florida will come to the rescue.

Dr. Emerson, as the Maize Genetics Cooperation News Letter goes to press, your fellow cooperators take off their old straw hats to you in affectionate regard. We wish you years of real enjoyment in doing the things you most want to do.
ANNOTATED BIBLIOGRAPHY


Cook R.C. 1932. The Genetics Congress. Journal of Heredity, Vol. 23 (No. 9, 1 Sept.), pp. 355-360 [includes three figures, 10, 11 & 12, the latter is the numbered group photo and IDs] (Cook’s summary of the 1932 meeting; not free access).

Crow, J.F. 1992. Sixty Years Ago: The 1932 International Congress of Genetics. Genetics Vol. 131 (August): 761-768. http://www.genetics.org/content/genetics/131/4/761.full.pdf [Note that Fig. 2, The Executive Council, is not from Cook 1932, J of Heredity.] [Attendees in the group photo are identified in Figure 3; See Maize Genetics Cooperation Newsletter, eCommons, for image scanned from a photo salvaged from NCSU by Ed Buckler].


Maize Genetics Cooperation News Letter [1-21]. eCommons: https://ecommons.cornell.edu/handle/1813/58745 Three images are also included at this webpage: Sixth International Congress of Genetics (ICG), 1932 group photo; T.H. Morgan and R.A. Emerson, at ICG 1932, Willard Straight Hall; and 1932 ICG Executive Council. All images were scanned from photos rescued from a storage closet at NCSU, by Edward Buckler. The photos are believed to have been originally owned by C.H. Bostian (see Introduction).

Maize Newsletter Archives, MaizeGDB, https://www.maizegdb.org/mnl; Many MNLs available here were retyped from originals; many items, especially of early volumes, are not verbatim, e.g., page numbers and contributors’ affiliations are not listed. [Also, some volumes and dates on the website are not consistent with hard copy cover dates.]

Morgan, T.H. 1932. The Rise of Genetics, Excerpts from the Address of the President of the Sixth International Congress of Genetics at Ithaca. Journal of Heredity Vol. 23 (No. 9, 1 Sept.), pp. 337-343 [Not free access; pdf of this article includes the Volume's frontispiece, titled “At Ithaca”; a photo of Morgan and Emerson at the 1932 International Congress of Genetics, is included in this MNL Anniversary book-see frontispiece].

APPENDIX I


The following reprinted article provides a perspective on the origins and beginnings of the founding of the Maize Genetics Cooperation and its subsequent Cooperation News Letter. It describes how in the early 1920s, the Maize Genetics Cooperation (MGC) began in an informal way among R.A. Emerson and his students at Cornell University. Emerson’s ethical and cooperative spirit paved the way for an expanded network of maize researchers who freely shared their materials and unpublished research, thus resulting in rapid progress in fundamental genetic research.

The Maize Genetics Cooperation News Letter early volumes reprinted in this book provide documentation for the story told in this historical perspective.
In the early 1920s, the Maize Genetics Cooperation (MGC) began in an informal way among R.A. Emerson and his students. His ethical and cooperative spirit paved the way for an expanded network of maize researchers who freely shared their materials and unpublished research, thus resulting in rapid progress in fundamental genetic research (Coe 2001; Kass and Bonneuil 2004).

The first letter summarizing both published and unpublished maize linkage data was compiled by Emerson and his student George Beadle and sent to students of maize genetics on April 12, 1929. This communication was an outcome of a “cornfab” held in Emerson’s hotel room in December 1928, during the annual American Association for the Advancement of Science (AAAS) meetings. The “Historical Notes on Maize Cooperation” identifies Emerson’s 1929 communication as the first Maize Genetics Cooperation News Letter (MNL; Emerson 1940). Beadle was the first secretary of the MGC and he solicited material for additional summaries of linkage data, which were distributed in two parts in 1930. Rhoades succeeded Beadle as secretary and continued to summarize and publish the reports of cooperators in the MNL, which continues to be published annually.

The cooperators met at the Sixth International Congress of Genetics (ICG) at Ithaca in 1932 and organized a committee to establish the maize stock center at Cornell University and to seek funding for their enterprise. Emerson’s grant application to the National Research Council (NRC) was denied and he was encouraged to apply immediately to the Rockefeller Foundation (RF), who granted him funds to support his information and supply network in 1934. The work of Barbara McClintock in cooperation with Beadle, Rhoades, Creighton, Burnham, and others at Cornell between 1928 and 1934 resulted in a definitive correlation of chromosomes and linkage groups in maize—ultimately published in 1935 by Emerson et al. The cytogenetics of maize was also reviewed in that year (Rhoades and McClintock 1935).

The exhibit that Emerson submitted to support his Rockefeller Foundation grant included a historical summary of the MGC and MNL. These documents allowed us to reconstruct the events that established these important resources for the maize genetics community. Emerson’s legacy lives on in the cooperative spirit of maize researchers and in the News Letter he founded 75 years ago.

At the 1932 ICG held in Ithaca, New York, Rollins Adams Emerson (Nelson 1993), Head of the Department of Plant Breeding at Cornell University, gave an opening address titled, “The Present Status of Maize Genetics.” In his introduction he declared, “I cannot refrain from noting here a very real advantage experienced by students of maize genetics . . . I am aware of no other group of investigators who have so freely shared with each other not only their materials but even their unpublished data. The present status of maize genetics, whatever of noteworthy significance it presents, is largely to be credited to this somewhat unique, unselfishly cooperative spirit of the considerable group of students of maize genetics” (Emerson 1932, p. 141; Kass 2001).

During this Congress, Emerson called a meeting of ~45 students of maize genetics and formalized what would soon be called the Maize Genetics Cooperation. Following their meeting Emerson and his graduate student Marcus Rhoades issued on October 5, 1932, what has long been considered the first Maize Genetics Co-
operation News Letter (Rhoades 1932a). Our research (Bonneuil and Kass 2001; Coe 2001; Kass and Bonneuil 2004; E. H. Coe and L. B. Kass, unpublished results), which we offer in keeping with the long tradition of maize cooperation, provides a historical perspective on the actual origin of the MGC and the beginnings of the MNL, which was first issued in 1929. We present here the history of Emerson’s successful negotiations with the Rockefeller Foundation to fund his cooperative enterprise at Cornell University following his unsuccessful attempt to obtain funding from the NRC. Future Nobel laureates George Beadle, Emerson’s student, and Barbara McClintock, Lester W. Sharp’s student and Beadle’s collaborator, freely submitted their results to the MNL; this laid the groundwork for a similar publication, the Drosophila Information Service, for the Drosophila geneticists in March 1934 (Bridges and Demerec 1934) and for the Worm Breeders Gazette, the community newsletter of the roundworm biologists (Edgar 1975; Cohen 1995), among others. We rejoice in the founding of Emerson’s ideal and celebrate the 75th anniversary of the MNL.

EARLY COOPERATION

Cornfests—a cooperative enterprise to map maize:
As early as November 1918, Emerson wrote to Donald F. Jones at the Connecticut Agricultural Experiment Station that he was “hoping that all the men in this country who are working on related problems with corn may cooperate to such an extent that we can cover the field more quickly” [Emerson to Jones, November 8, 1918, Division of Rare and Manuscript Collections, Carl A. Kroch Library, Cornell University (CU) Library, Ithaca, NY]. Soon afterward, Emerson arranged informal “cornfests” in conjunction with the AAAS meetings. It seems that Emerson organized these ~10 years before the famous “cornfab” held in his hotel room in New York City in December of 1928, as recalled by Rhoades (1984). Emerson much earlier had invited Paul Weatherwax of Indiana University to attend a “second cornfest” along with the “general genetics section” he had planned for the AAAS meetings in Toronto in 1921. Weatherwax apologized for not being able to attend (Weatherwax to Emerson, November 22, 1921, CU) but Emerson’s former and current students and colleagues joined him there and, following the meeting, held a reunion on January 1, 1922, at Cornell (Figure 1).

The following winter, Emerson emphasized the importance of agreeing on uniformity for factor notation (gene symbols) and he set the tone for cooperating on this problem in a letter on March 7, 1923 (Emerson 1923, p. 147), “To Students of Corn Genetics: . . . . It seems wise to follow the notation used by the Drosophila workers, tho, in some respects, their usage is perhaps no more nearly consistent than our own.” Emerson also asked his colleagues for assistance with numbering the maize linkage groups and requested advice on using bilateral gene symbols:

Shall priority of publication of any linkage determine the numerical order? Or shall the order be determined arbitrarily? . . . . I suggest . . . . that we number the groups in the order given by [William H.] Eyster and by [Claude B.] Hutchison as follows: 1-Glex; 2-g-R; 3-su-Tu; 4-B-Lg; 5-Y-Pl; 6-Pf . . . . It may be wise, however, to assign no numbers to groups other than the six listed above until the newer groups have been tested further. Another prob-

Problem is bothering us. Shall we continue to use bi-literal symbols for genes as we have usually done in the past [i.e., bl, blotched leaf], or adopt the recommendations of the Naturalist’s committee to use single letter symbols [i.e., b]? If the corn men desire to stick to the use of bi-literal symbols, we shall probably have to refrain from publishing in Genetics . . . but if the corn men think best to adopt the plan followed by Genetics [using single letter symbols], I shall use it (p. 149).

Emerson ended his five-page review with words for continued cooperation, “I am sending this to a considerable number of corn genetics workers. When I have received replies from the majority, I may want to refer some of our problems to the Chairman of the Naturalist’s committee with the suggestion that he consider the advisability of referring it to the committee for consideration” (p. 149).

Two of Emerson’s former students at Nebraska, Ernest G. Anderson (Figure 1) and Ernest W. Lindstrom, had followed him to Cornell in 1914 and continued to work on corn problems after graduating. Students and established researchers from around the country and throughout the world soon joined Emerson’s group and studied corn breeding and genetics at Cornell. C. B. Hutchison (Figure 1), a former Cornell graduate, was appointed Professor of Plant Breeding in 1916. By 1921, he continued Emerson’s unpublished study of C-Sh linkage and established that Sh was part of the C-Sh-Wx linkage group (Hutchison 1921, 1922). When Allan C. Fraser (Figures 2 and 3) succeeded Hutchison, he turned (from wheat) to maize (Fraser 1924). In addition to Anderson and Lindstrom, several other students pursued graduate work with Emerson on corn genetics (including women and students from abroad, Figures 2 and 3): William H. Eyster, Milislav Demerec (Figure 1), Helen A. Trajkovich, Pavao Kvakan, Thomas Bregger, Ivan F. Phipps, George W. Beadle, Hsien W. Li, George F. Sprague, Johannes D. J. Hofmeyr, Marcus Rhoades, Swarn Singh, Sylvia Allen, and others (R. P. Murphy, unpublished results; CU).

During the period 1918–1920, Emerson realized that he could not avoid investigating the linkage of maize, which was crucial both to closing the gap with Drosophila workers and to providing a deeper basis for the breeding work on corn. Whereas from 1913 to 1928 Drosophila linkage mapping remained the concern of a few laboratories (Wagner and Crow 2001), Emerson promoted the idea that maize genetic mapping should be a larger cooperative enterprise (Kass and Bonneuil 2004), which would allow individuals to devote the best of their research time to more fundamental research projects. Furthering this end, Emerson also developed a regular collaboration and acted as advisor to the U.S. Department of Agriculture (USDA) program in corn research from 1920 onward [U.S. National Archives and Records Administration (NARA), College Park, MD]. Several graduate students, including Barbara McClintock, George Beadle, and Marcus Rhoades, were supported at Cornell by USDA funds, and some graduates obtained jobs with the USDA, including Arthur M. Brun-
son, Thomas Bregger, Lowell F. Randolph, Marcus Rhoades, and George Sprague, all of whom contributed to the cooperative endeavors.

Following Emerson’s early work on multiple factor inheritance (Emerson and East 1913), his maize genetics school contributed concurrently to the progress of corn breeding and to general knowledge in genetics. In this respect, Emerson’s program may be considered a parallel to Thomas Hunt Morgan’s group [at Columbia University and later at The California Institute of Technology (Caltech)]. Emerson’s students had close scientific associations with the Drosophila geneticists and with geneticists and cytologists at other institutions. Concepts, methods, standard nomenclatures, along with students (including E. G. Anderson, M. Demerec, G. Beadle, and M. Rhoades) who were trained in corn genetics and later also worked on Drosophila, circulated between the two communities. Maize geneticists maintained strong relations with Drosophila geneticists during the 1920s (e.g., C. Metz, C. Bridges; Figure 1). This connection was due primarily to Emerson and his students, who kept Emerson informed about the exciting work that was progressing in these laboratories. Consequently, Cornell maize geneticists were aware that the use of cytogenetics by Drosophalists had opened a fertile second front to tackle problems.

**Linkage groups:** By 1928, however, significant general contributions to genetics from corn were quite limited (McClelland 1930). Furthermore, maize linkage studies and genetic mapping stood nearly a decade behind Drosophila. The 10 linkage groups in corn were not all clearly identified and the mapping work in each group was still very rough, as illustrated by the “rainbow maps” drawn by Beadle and Emerson in April 1929 (Figure 4) (Emerson 1929).

Within the year, however, Barbara McClintock’s identification of the morphology of the corn chromosomes (McClintock 1929) and her unpublished research on trisomic ratios correlating genes with specific chromosomes were major contributions to Beadle’s “Summary of Data on the Independence of the Linkage Groups in Maize,” which Emerson distributed “To Students of Maize Genetics” on April 17, 1930 (Emerson 1930a). McClintock, then an instructor at Cornell, collaborating with students George Beadle, Henry Hill, Harriet Creighton, and Marcus Rhoades, and with Charles Burnham, a visiting scientist, and others, began a golden age for maize genetics and cytogenetics at Cornell (Rhoades 1984).

At the Ithaca Congress in August 1932, Emerson could confidently present a genetic map with linkage groups correlated with numbered chromosomes, thus setting the stage for further cooperative and significant contributions to maize cytogenetics (Rhoades and McClintock 1935). Rhoades also organized a “living chromosome map” in which mutant plants were arranged according to their chromosomal positions (Crow 1992).

**FOUNDING THE MAIZE GENETICS COOPERATION NEWS LETTER**

By February 1934, Emerson had applied to the RF for a grant-in-aid for support of work in collecting and disseminating maize stocks and information (CU). Emerson submitted a separate portfolio of exhibits (RF exhibits A–J, Rockefeller Foundation Archives, Sleepy Hollow, NY) to document his application dated February 6, 1934. Emerson’s “Historical summary of cooperation among maize geneticists” (RF exhibit A) described how the maize cooperation began ~15 years previously in a small way among his former students. Soon other investigators were asked to be included. He documented interactions among these researchers with a “mimeographed summary of linkage in maize, 1929 [sic]” (RF exhibit D); this exhibit was actually Emerson’s “second folder of mimeographed information issued sometime
after the first one” (mentioned in Emerson 1940). His “mimeographed summary” (RF exhibit D) included all of the linkage data compiled and sent to maize geneticists on April 17, 1930, and July 26, 1930 (Emerson 1930a,b). Emerson’s first (our emphasis) mimeographed letter, Emerson’s list of cooperators, we have no documentation that she attended the meeting and it would not dated April 12, 1929 (Emerson 1929), “considered News Letter 1” by Emerson himself (see Emerson 1940), was distributed to maize geneticists shortly after the “corn-fab” held in Emerson’s hotel room at the time of the AAAS Christmas meetings in New York City in 1928. It included a long folder of linkage information and the names of researchers assigned each linkage group (see Table 1 based on the original). Emerson (April 12, 1929) carefully explained, “To those not at the New York Meeting . . . this assignment [of linkage groups] was . . . made in accordance with the expressed interests of those assuming the responsibilities entailed. It was far from our purpose to preempt groups for ourselves and thereby warn off other workers. Our purpose rather was to make sure that each known group would be given immediate and adequate attention to the end that the not very exciting job of chromosome mapping may go forward with some dispatch, thereby making possible an attack on certain important genetic problems now awaiting just such tools as accurate linkage maps afford” (Emerson 1929, p. 117).

Although Barbara McClintock’s name appears amid Emerson’s list of cooperators, we have no documentation that she attended the meeting and it would not have been appropriate in that era for a single woman to attend a gathering in a man’s hotel room. The cooperators who did attend, however, were most familiar with McClintock’s work (see Kass 2003) and would have attended the AAAS Christmas meetings in New York City in 1928. It included a long folder of linkage information and the names of researchers assigned each linkage group (see Table 1 based on the original). Emerson (April 12, 1929) carefully explained, “To those not at the New York Meeting . . . this assignment [of linkage groups] was . . . made in accordance with the expressed interests of those assuming the responsibilities entailed. It was far from our purpose to preempt groups for ourselves and thereby warn off other workers. Our purpose rather was to make sure that each known group would be given immediate and adequate attention to the end that the not very exciting job of chromosome mapping may go forward with some dispatch, thereby making possible an attack on certain important genetic problems now awaiting just such tools as accurate linkage maps afford” (Emerson 1929, p. 117).

Although Barbara McClintock’s name appears amid Emerson’s list of cooperators, we have no documentation that she attended the meeting and it would not have been appropriate in that era for a single woman to attend a gathering in a man’s hotel room. The cooperators who did attend, however, were most familiar with McClintock’s work (see Kass 2003) and would have recommended her for this endeavor. Following the New York meeting (December 1928), George Beadle acted as secretary of the group (Beadle 1929a,b, 1930; Emerson 1931). Beadle requested from maize cooperators the summaries of linkage data, which Emerson, in cooperation with Beadle and Fraser, would send to cooperators (Emerson 1931), until Marcus Rhoades subsequently succeeded him as secretary (Rhoades 1932a).

In his review of “The Early Years of Maize Genetics,”
Rhoades (1984) recalled the New York City “cornfab,” which was his first with the maize cooperators. Rhoades had arrived at Cornell in the fall of 1928 from the University of Michigan, where he had studied with Emerson’s former student E. G. Anderson. Anderson was soon recruited by Morgan for his newly established Biology Division at Caltech. Rhoades then spent the 1929–1930 academic year there with Anderson (CU) (Anderson and Rhoades 1931; Birchler et al. 2003), where he resumed cooperating with Beadle and Burnham. They returned to Cornell to attend the ICG in the summer of 1932, where Emerson (1932) recognized their contributions to maize cytogenetics.

Following the Congress, Rhoades’ first letter to maize cooperators made clear that “anyone may begin or continue to work with any group whether or not it has been assigned to him.” It was expected that when “two or more are interested in the same group, they will work in close cooperation!” Rhoades then distributed a call for stocks, wants, and news items, on December 12, October 5, 1932 (RF exhibit C; Rhoades 1932a), which was retroactively numbered “Vol. 2,” in the Cornell Plant Breeding Department’s bound volumes of the MNL [MNL, Vols. 2–14, 1932–1940, and MNL, Vols. 15–21, 1941–1947; Plant Breeding Department Archives (PB), Cornell University, Ithaca, NY]. Therein, Rhoades summarized the resolutions discussed and favorably acted upon by a committee of maize-genetics workers at the Ithaca meeting held on August 26, 1932, in connection with the International Genetics Congress. In addition to discussing the numbering and naming of gene symbols, linkage groups, and chromosomes, the group agreed that Cornell should be the “clearing house” where the records would be kept and that a repository should be formed for storing and disseminating the new information. Emerson, chair of the committee to oversee their resolutions, along with R. Alexander Brink, Donald F. Jones, Paul C. Mangelsdorf, and Lewis J. Stadler, had chosen Rhoades (1) to act as custodian of the seed stocks, (2) to furnish a list of stocks received, and (3) to distribute stocks to workers. They also reallocated the 10 maize linkage groups to individuals who would assume primary responsibility for the group assigned (Table 2) (see also Coe 2001).

By this time McClintock had left Cornell but her pioneering contributions to maize cytogenetics had been both recognized and rewarded. She was awarded a National Research Council Fellowship (1931–1933) and, after spending time with L. J. Stadler at the University of Missouri, had joined Anderson’s group at Caltech, where she resumed cooperating with Beadle and Burnham. They returned to Cornell to attend the ICG in the summer of 1932, where Emerson (1932) recognized their contributions to maize cytogenetics.

Following the Congress, Rhoades’ first letter to maize cooperators made clear that “anyone may begin or continue to work with any group whether or not it has been assigned to him.” It was expected that when “two or more are interested in the same group, they will work in close cooperation!” Rhoades then distributed a call for stocks, wants, and news items, on December 12, 1932 (Rhoades 1932b), and the third Corn News Letter followed on January 23, 1933 (Rhoades 1933; RF exhibit C in part). These two letters are bound together at Cornell (MNL, Vols. 2–14, 1932–1940, PB) and the latter is numbered “Vol. 3.”

Funding the Maize Genetics Cooperation: Emerson’s “historical summary” (RF exhibit A) additionally revealed that his committee was also responsible for devising a way to “carry out the work which the Cornell maize geneticists were asked to continue and to enlarge.” His committee did not find a way to provide funds, but it led to an alternative opportunity. The committee on agronomy appointed by the Division of Biology and Agriculture of the NRC, a unit of the National Academy of Sciences, unanimously recommended a grant-in-aid of $1000/year for 5 years for an information and supply service for maize work to be headed by R. A. Emerson of the Plant Breeding Department of Cornell University, for the purpose of maintaining the service for “one of the most important crops and . . . for extending our knowledge in the field of genetics and cytogenetics.”

---

**TABLE 1**

To whom linkage groups were parceled out at New York, at the “Cornfab” held in R. A. Emerson’s hotel room in December 1928

<table>
<thead>
<tr>
<th>Linkage group</th>
<th>Recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Wx</td>
<td>Eyster (Bucknell University); Beadle (Cornell University)</td>
</tr>
<tr>
<td>R-G</td>
<td>Lindstrom, Jenkins, Wentz (Iowa State University)</td>
</tr>
<tr>
<td>Su-Tu</td>
<td>Emerson (Cornell University)</td>
</tr>
<tr>
<td>B-Lg</td>
<td>Stadler (University of Missouri); McClintock (Cornell University)</td>
</tr>
<tr>
<td>Y-Pl</td>
<td>Hill (Cornell University)</td>
</tr>
<tr>
<td>P-Br</td>
<td>Emerson (Cornell University)</td>
</tr>
<tr>
<td>Ra-G1</td>
<td>Brewbaker (University of Minnesota); Jorgenson (Ohio University); Li (Cornell University)</td>
</tr>
<tr>
<td>D1-Pg2</td>
<td>Not assigned</td>
</tr>
<tr>
<td>A-Ts4</td>
<td>Brink (University of Wisconsin); Li (Cornell University)</td>
</tr>
</tbody>
</table>

Based on Emerson (1929).
We have described here, and also explained that in the "standardizing nomenclature and symbolization for requested a separate grant-in-aid to hire her as his re-

Kass upon returning from the Boston AAAS meetings, where but worried about finding a job (careful study of the application they had decided against By April 1934, McClintock returned to Cornell where

D. melanogaster about the same relative position among plants that the without reservations, fostered by Emerson's cooperative

laid" general linkage summary to be published from (see also Rhoades 1932b), and exhibit V, by Roman numerals: exhibit IV, Rhoades' letter dated Agriculture at Cornell University for the "support of

On March 16, 1934, the Rockefeller Foundation appropriated $5000 for the New York State College of Agriculture at Cornell University for the “support of collecting and disseminating maize stocks and information relating thereto” directed by Professor R. A. Emerson. Within the week, Emerson (1934) asked cooperators if they were willing to use his unpublished linkage data in “the much heralded and too long delayed” general linkage summary to be published from Cornell (NARA). Students of maize genetics responded without reservations, fostered by Emerson’s cooperative and enthusiastic, yet trustworthy, nature. Emerson soon after announced the Rockefeller award in a letter to cooperators on September 13, 1934 (MNL Vol. 7, 1934, PB). At that time, 60 genetics researchers were receiving the News Letter.

On December 26, 1933, the secretary of the NRC committee on grants-in-aid notified Emerson that after careful study of the application they had decided against making the grant of funds. Emerson received their letter upon returning from the Boston AAAS meetings, where both maize and Drosophila geneticists had suggested “standardizing nomenclature and symbolization for maize” (RF exhibit H). While there, Emerson had discussed with Frank Blair Hanson (Assistant Director, Natural Sciences, Rockefeller Foundation) an alternative plan for applying for funds to the Rockefeller Foundation should the NRC grant not be approved (Hanson’s diary, RF). Four months previously (September 1933) RF officers Warren Weaver (Director, Natural Sciences) and Hanson, while visiting Cornell on other matters, had been apprised of Emerson’s “information and supply service to corn geneticists” and his need for funds; but at that time Emerson was confident that the NRC would support the work (Weaver’s diary, RF; Emerson to Stadler, November 8, 1933, CU).

Within a month of learning that the NRC recommendation had been denied, Emerson applied to the Rockefeller Foundation for funding and submitted Rhoades’ most recent “mimeographed letter to maize geneticists,” dated January 25, 1934 (RF exhibit J; MNL Vol. 4, PB). By this time, among the 53 maize geneticists engaged in cooperative work on genetic mapping, it appears that not fewer than 30 were Emerson’s collaborators at Cornell, had been graduate students there, or had done some postdoctoral work in his department. Emerson identified 24 cooperators as “most actively engaged in genetic studies”; 16 had been graduate students and 2 had been postdoctoral fellows at Cornell (RF exhibit E). He submitted the exhibits (RF exhibits A–J), which we have described here, and also explained that in the spring of 1933, parts of a manuscript of “A Summary of Linkage in Maize” then in the course of preparation by Fraser, Beadle, and himself (RF exhibit F) "together with work sheets had been sent to those to whom particular linkage groups had been assigned." The draft manuscript was, of course, the notable “A Summary of Linkage Studies in Maize” that would be published by Emerson, Beadle, and Fraser in 1935.

Maize linkage groups 1–10 were reassigned to individuals by the committee of maize researchers convened at the ICG on August 26, 1932 (after Rhoades 1932a). Researchers listed are from Rhoades’ letter of October 5, 1932.

(The RFC exhibit B). The NRC committee supported their recommendation with six exhibits (cited as exhibits I–VI), which Emerson had submitted to document his accomplishments to date. These exhibits were not in the files at RF but we did locate two exhibits identified by Roman numerals: exhibit IV, Rhoades’ letter dated December 12, 1932 (Rhoades 1932b), and exhibit V, dated January 23, 1933 (Rhoades 1933); we found these numbered exhibits in archived files of the Maize Coop (see also Emerson 1940, where maize communications are identified by roman numerals). The committee, composed of M. Francis Morgan, Ralph J. Garber, and Richard Bradfield (chairperson), emphasized that “maize occupies about the same relative position among plants that the fruit fly D. melanogaster does among insects” (RF exhibit B). Surprisingly, their recommendation was not accepted by the Council.

On December 26, 1933, the secretary of the NRC committee on grants-in-aid notified Emerson that after careful study of the application they had decided against making the grant of funds. Emerson received their letter upon returning from the Boston AAAS meetings, where both maize and Drosophila geneticists had suggested “standardizing nomenclature and symbolization for maize” (RF exhibit H). While there, Emerson had discussed with Frank Blair Hanson (Assistant Director, Natural Sciences, Rockefeller Foundation) an alternative plan for applying for funds to the Rockefeller Foundation should the NRC grant not be approved (Hanson’s diary, RF). Four months previously (September 1933) RF officers Warren Weaver (Director, Natural Sciences) and Hanson, while visiting Cornell on other matters, had been apprised of Emerson’s “information and supply service to corn geneticists” and his need for funds; but at that time Emerson was confident that the NRC would support the work (Weaver’s diary, RF; Emerson to Stadler, November 8, 1933, CU).

Within a month of learning that the NRC grant appli-
that other methods (i.e., reciprocal translocations) gave a definite check on previous trisomic determinations for linkage groups 1, 4 (su-Tu), and 9 (c-wx). The early MNLS (1929–1932, reprinted in MNL, Vols. 52–57, 71, and 72) demonstrate McClintock’s and other cooperators’ contributions to their maize linkage studies.

Continued cooperation throughout the country and the world: The work of maize cooperators stimulated interests in cytogenetics. By 1935 translocations were used to construct many tester lines that contained both phenotypic characters and a translocation. About one-third of the three-point and four-point tests reported in the linkage monograph (Emerson et al. 1935) involved a translocation as a marker. Such translocation-associated three-point tests were extremely valuable, since they allowed confirmation of gene associations with specific chromosomes and gave the order of genes and of cytological locations with translocation breakage points (McClintock 1931; Rhoades 1931). In addition, Creighton (1934) used pachytene stage chromosomes to continue deletion mapping studies.

Early on, Emerson fostered cooperation among researchers throughout the world. He encouraged both domestic and foreign students to join his research team at Cornell (Figures 3 and 4) and published their findings in the Cooperation’s News Letter. Soon, this news circular, which united the maize genetics group, was not limited to offers and demands for strains but also disseminated unpublished results among the researchers. The rule was that any data appearing there could not be cited in publications without the direct consent of the contributor. Maize researchers from around the world—Austria, USSR, Yugoslavia, China, South Africa, Brazil, and Mexico—were honored to share their unpublished results, as we found in MNL reports through 1934.

The first numbered Maize Genetics Cooperation News Letters: The first set of bound News Letters, which we located in the Department of Plant Breeding at Cornell (MNL, Vols. 2–14, 1932–1940), was numbered by hand in pencil, beginning with Rhoades’ letter of October 5, 1932, labeled “Vol. 2.” This led us to believe that Rhoades’ letter was not Maize News Letter 1. These News Letters appear to have been bound and numbered retroactively under the guidance of Emerson, who was the secretary for MNL, Vol. 14, 1940. The “Historical Notes on Maize Cooperation,” listed on p. 56, of MNL, Vol. 14, although unsigned, were probably prepared by Emerson, who was secretary for that News Letter. Those notes clearly state that the mimeographed letter of April 12, 1929, is “considered News Letter 1.” Coe (1976, 1978) used the “Historical Notes” as a guide to compile an archival list of materials of the MNL and related cooperation. While conducting research on the history of maize linkage studies, Kass and Bonneuil (2004) recently found some of the missing (starred) items on Coe’s list. This new information permitted us to recon-
CHANGES AND TRANSITIONS IN MAIZE GENETICS COOPERATION

Emerson officially retired in 1941, and thereafter the MNL was edited by his colleagues, students, and occasionally by Emerson himself. He remained active in research until his death on December 8, 1947 (Russell et al. 1948). Emerson’s colleagues, former students, and friends contributed to a memorial fund in his name (MNL, Vol. 27, 1953). The funds were applied toward the purchase of a lighted exhibit case placed in the hall of the Plant Breeding Department at Cornell (MNL, Vol. 29, 1955). Part of the exhibit case was used to display continuously some of Emerson’s own work. This case was on the first floor of the Plant Science Building at Cornell until the department moved to Emerson Hall, named for R. A. Emerson, in 1968 (Williams 1968). One of the authors (L. B. Kass) recalls assiduously exploring this case in the lobby of Emerson Hall when she was a graduate student at Cornell in the 1970s. The case is no longer maintained and its contents and whereabouts are not known at this time.

The Rockefeller Foundation supported the MNL and Stock Center at Cornell through 1953, when funding was withdrawn (MNL, Vol. 27, 1953). Rhoades recognized and confirmed that by the early 1950s scientists at Cornell were ready to forego the Stock Center and News Letter functions when RF withdrew funding, and he arranged to move them to Illinois (see MNL, Vol. 27, pp. 1–2, 1953; Table 3). In 1953, responsibility for the MGC-Stock Center collection moved from Cornell to Illinois, where it was again undertaken by Marcus Rhoades, joined by Earl Patterson (MNL, Vol. 28, pp. 2–10, 1954). Support was provided by the National Science Foundation (NSF) until 1981, following which the U.S. Department of Agriculture supported the program. The Stock Center is now a permanent USDA-Agricultural Research Service program under the direction of Marty Sachs. Its history, catalogs, and ordering procedures are at http://www.aces.uiuc.edu/maize-coop/.

After the Rockefeller Foundation withdrew support of the maize cooperation, Cornell funded the MNL from 1953 to 1955, with subsidies from seed companies like DeKalb Agricultural Association; Green Giant; Northrup, King; and Pioneer Hi-Bred Corn (MNL 28: 1, 1954). In 1955, oversight of the MNL moved from Cornell to Illinois under Marcus Rhoades as secretary (MNL, Vol. 30, pp. 1–3, 1956) and it accompanied him to Indiana in 1958 (Table 3). At Illinois funding for the MNL was obtained from seed companies and a grant from NSF. The MNL continued to be edited by Rhoades, aided by Ellen Dempsey (his research associate and former student), as previously, and prepared and distributed at Indiana through 1974. That year the MNL transferred to the University of Missouri, under Edward Coe as secretary, until 2000, when Mary Polacco and Jim Birchler became co-secretaries. The News Letter (now “Newsletter”) continues to be compiled, edited, printed, and distributed at Missouri and is available online at http://www.maizegdb.org/mnl.php for previously printed issues or at http://www.agron.missouri.edu/mnl/ for issues that are in process. Support for its distribution is from an endowment fund established from individual and corporate contributions.

Annual Maize Genetics Conferences were initiated in 1959, following a proposal from John R. Laughnan at the University of Illinois. The conferences are organized and run by a Steering Committee. The 2004 meeting was held in Mexico City. Information about past and future conferences is provided at http://www.maizegdb.org/cooperators.php.

The Maize Genome Database (MaizeGDB) was begun in 1991 as an extended medium for communication and for access to data, established by the U.S. Department of Agriculture-Agricultural Research Service at Missouri (USDA-ARS) under the direction of Ed Coe, joined by Mary Polacco. Content of the database, including gene lists, maps, bibliography, and cooperator’s addresses, initially was drawn directly from the files and compilations of the MNL, supplemented by entries of new data. In 2005, the MaizeGDB became a joint endeavor, supported by USDA-ARS, between Missouri (Mary Polacco) and Iowa State University (Volker Brendel, Trent Seigfried, Darwin Campbell, and Carolyn Lawrence). Curation of data content is conducted at the two locations.

<table>
<thead>
<tr>
<th>Years</th>
<th>News Letter</th>
<th>Stocks</th>
<th>Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>1929–1953</td>
<td>Cornell</td>
<td>Cornell</td>
<td>NA</td>
</tr>
<tr>
<td>1953–1955</td>
<td>Cornell</td>
<td>Illinois</td>
<td>NA</td>
</tr>
<tr>
<td>1956–1957</td>
<td>Illinois</td>
<td>Illinois</td>
<td>NA</td>
</tr>
<tr>
<td>1958–1974</td>
<td>Indiana</td>
<td>Illinois</td>
<td>NA</td>
</tr>
<tr>
<td>1975–1991</td>
<td>Missouri</td>
<td>Illinois</td>
<td>NA</td>
</tr>
<tr>
<td>1991–2002</td>
<td>Missouri</td>
<td>Illinois</td>
<td>Missouri</td>
</tr>
<tr>
<td>2003–</td>
<td>Missouri</td>
<td>Illinois</td>
<td>Iowa State and Missouri</td>
</tr>
</tbody>
</table>
and the database is served from Iowa State at http://www.maizegdb.org/.

In 2000, a Maize Genetics Executive Committee was elected whose mission is "to identify both the needs and the opportunities for maize genetics, and to communicate this information to the broadest possible life science community. This community includes scientists, funding sources for scientists, and the end users for the accomplishments of maize genetics, from farmers to consumers." Information about the Committee is given at http://www.maizegdb.org/mgec.php.

This perspective was developed from a presentation given at the workshop, "The Mapping Cultures of 20th Century Genetics," at The Max Planck Institute for the History of Science, Berlin, Germany, in March 2001. We thank R. MacIntyre for sharing bound and numbered copies of *Drosophila Information Service*, Vols. 1–8, 1934–1937; M. E. Smith for sharing bound and hand-numbered copies of MNL, Vols. 2–14, 1932–1940, and Vols. 15–21, 1941–1947; William Provine for sharing Lester Sharp’s unbound and unnumbered copies of MNL, 1933–1938, and for extensive use of his reprint collections; R. P. Murphy for significant insights and encouragement for this project and for sharing his unpublished manuscript on the history of Cornell’s Plant Breeding Department; archivists at the Rockefeller Archives Center, Sleepy Hollow, New York, with special thanks going to T. Rosenberg; U.S. National Archives and Records Administration, College Park, Maryland, with special thanks going to J. Schwarcz; Division of Rare and Manuscript Collections, Carl A. Kroch Library, Cornell University, with special thanks going to E. Engst; librarians at the Mann Library, especially Tom Clausen; and The L. H. Bailey Hortorium Library, especially P. Fraissinet for bringing many valuable references to our attention. We are grateful to R. P. Murphy, W. B. Provine, and R. H. Whalen for reading early drafts of this article. L.B.K. acknowledges the following for support of archival research: National Science Foundation (grants SBR0511866 and SBR0710488); American Philosophical Society Library, Mellon Resident Research Fellowship; and the Departments of Plant Biology and Plant Breeding and Genetics, Cornell University, Ithaca, New York, for logistical support.

LITERATURE CITED


Emerson, R. A., 1934 To cooperators who have contributed unpublished data for a summary of linkage in maize, March 22, 1934. U.S. National Archives and Records Administration, College Park, MD.


Fraser, A. C., 1924 Heritable characters of maize. XVII. Intensified red and purple aleurone color. J. Hered. 15:119–125.


Hutchinson, C. B., 1922 The linkage of certain aleurone and endosperm factors in maize and their relation to other linkage groups. Cornell Univ. Agric. Exp. Station Mem. 60:1421–1473.


McClelland, C. K., 1930 The genetics, breeding and improvement of corn. A bibliography covering more than forty years work (1889–1929) in the breeding improvement and study of inheritance in corn. Published by the author, Fayetteville, AR.


APPENDIX II


Reproduced in this Appendix is the MNL report for the expanded chronological list of archival materials related to the *Maize Genetics Cooperation News Letters* and related cooperation. Based on Emerson’s Historical Notes on Maize Genetics Cooperation (*MNL* 14:56), an original list was compiled by Ed Coe, former editor of the *Maize Genetics Cooperation News Letter*, and published in 1976 and 1978. Coe’s original list had some items missing from the historical record and, as recorded in this report, Kass and colleagues found some of the missing items. Using many of the archived materials listed in this updated report, Kass et al. (2005, see Appendix I) were able to present an historical perspective of the origin and founding of the *Maize Genetics Cooperation News Letter*. The *Maize Genetics Cooperation News Letter* early volumes reprinted in this two-volume 90th Anniversary book provide documentation for the story told in their historical perspective and in the list provided in the following document.
Table 1.

<table>
<thead>
<tr>
<th>File</th>
<th>PB No.</th>
<th>Vols.</th>
<th>MNL No.</th>
<th>MMR No.</th>
<th>LS Dated</th>
<th>Pp.</th>
<th>Subject</th>
<th>Reprinted in</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/7/23</td>
<td>6</td>
<td>Emerson</td>
<td>Factor Notation.</td>
<td>52:147–149</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>L.</td>
<td>4/12/29</td>
<td>30</td>
<td>Emerson</td>
<td>Two-page letter, &quot;You who attended the &quot;cornlab&quot; in my hotel room at the time of the winter science meetings in New York… linkage group commitments, and a folder of shared linkage information with references. &quot;, [ref. MNL 14:56, and in papers of E. G. Anderson].</td>
<td>53:117–130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1c</td>
<td></td>
<td>12/19/29</td>
<td>1</td>
<td>Beadle</td>
<td>Summarization of Linkage — Request for Data.</td>
<td>54:136</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1d</td>
<td></td>
<td>2/5/30</td>
<td>1</td>
<td>Beadle</td>
<td>Summarization of Linkage — Request for Data.</td>
<td>54:136</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a.1</td>
<td>II.</td>
<td>4/17/30</td>
<td>17</td>
<td>Emerson</td>
<td>Revisited maps [&quot;second folder of mineiro&quot;] Exhibit D found at RAC, and in papers of E. G. Anderson.</td>
<td>54:136–139</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a.2</td>
<td>II.</td>
<td>7/26/30</td>
<td>23</td>
<td>Emerson</td>
<td>Linkage Data [&quot;second folder of mineiro&quot;] Exhibit D found at RAC, and in papers of E. G. Anderson.</td>
<td>54:140–145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/18/31</td>
<td>1</td>
<td>Emerson</td>
<td>Call for Linkage Data [PB Records, Cornell Archives]; &quot;Records should be sent to Dr. G. W. Beadle&quot; at Caltech.</td>
<td>71:119</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td>II.</td>
<td>8/26/32</td>
<td>Emerson?</td>
<td>Cooperation planned at VI Cong (ref. MNL 14:56): [&quot;Coordination of maize geneticists planned at … congress&quot;] Genetic Congress held at Ithaca in August 1932 — Historical Notes in MNL 14:56; this apparently does not refer to a written item, but a report/summary of meeting held on 26 August 1932 is included as part of Rhoades’ letter of 10/3/1932 [Exhibit C RAC].</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Call for stocks contributions and wants, and for news items &quot;so that we may list your contributions and wants in the corn-letter which will come out in the near future&quot;, request for data to include in the linkage summary; Exhibit IV cited in 1933 NRC grant, see below.</td>
<td>57:192</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Vol. 3</td>
<td>III.</td>
<td>2</td>
<td>1/23/33</td>
<td>2</td>
<td>Rhodes, RAC, Exhibits C in part</td>
<td>Warn, Symbols, Stocks, Gene list [&quot;Third Corn News Letter …long list of known genes of maize,&quot;] — MNL 14:56] [&quot;MNL 3&quot;] [&quot;Exhibit V&quot; cited in 1933 NRC grant — see below — and included in Exhibit C, RF grant 1934].</td>
<td>57:192-200</td>
</tr>
<tr>
<td>3b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Grant Support [ref MNL 14:56]. Emerson submitted the NRC grant in January of 1933, see MNL 14:56, correspondence about possible grant of money for Maize Cooperation, Jan. 1933. Exhibit V = Rhodes 1/23/1933, cited in NRC grant, 1933 and included with Exhibit C, RF grant 1934].</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RAC, Exhibits B, C, D, E.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3d</td>
<td>[4]</td>
<td>III.</td>
<td>3</td>
<td>11/33/33</td>
<td>2</td>
<td>Rhodes</td>
<td>&quot;This letter is a call for information to be used in succeeding corn letters. We thought it would be appropriate if the first letter in the fall of each year presented new and pertinent information of value to all maize investigators, such as new linkages, …&quot; Deadline January 15.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Vol. 4</td>
<td>IV.</td>
<td>4</td>
<td>12/18/33</td>
<td>3</td>
<td>Rhodes</td>
<td>News [&quot;Many news items contributed by cooperators.&quot;] — MNL 14:56; Letter of 12 pages (sic)]. [RAC application denied (Exhibit A, RAC).]</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Vol. 5</td>
<td>V.</td>
<td>5</td>
<td>1/25/34</td>
<td>1</td>
<td>Rhodes</td>
<td>Nomenclature, Stocklist [&quot;Big Inventory of corn&quot;] — MNL 14:56].</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Vol. 6</td>
<td>VI.</td>
<td>6</td>
<td>2/21/34</td>
<td>4</td>
<td>Rhodes</td>
<td>Nomenclature [&quot;Discussion of nomenclature;&quot;] — MNL 14:56].</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RAC = Rockefeller Grant-in-aid for pure research and a clearing house for corn genetics (RAC).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Vol. 7</td>
<td>VII.</td>
<td>7</td>
<td>9/13/34</td>
<td>11</td>
<td>Rhodes</td>
<td>Nomenclature, Stocklist [&quot;Big Inventory of corn;&quot;] — MNL 14:56].</td>
<td></td>
</tr>
<tr>
<td>9c</td>
<td>[9]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Emerson</td>
<td>Emerson to about 15 &quot;cooperators who have contributed unpublished data for a summary of linkage in maize: … I desire to know whether you are now willing to allow publication from Cornell of your as yet unpublished data which are included in the [mimeographed linkage] summary.&quot; [NARA].</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Vol. 9</td>
<td>IX.</td>
<td>9</td>
<td>3/6/35</td>
<td>22</td>
<td>Rhodes</td>
<td>Call, News, Gene list, Mailing list of 39 maize geneticists plus 21 others who asked to receive the news letter; announcement of RF grant for 5 years, no date identified when grant began.</td>
<td></td>
</tr>
<tr>
<td>10b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Emerson</td>
<td>Disease resistance test cooperation requested [half-sheet; not in PB volume].</td>
<td></td>
</tr>
<tr>
<td>10c</td>
<td>[9]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Emerson</td>
<td>Call for news items; summary of linkage in maize off the press; cooperative disease resistance tests; collective short publications on linkage proposed [Emerson signs as secretary &quot;pro tem.&quot;] Exhibit &quot;B&quot; at top of page in green ink (and crossed out) in Emerson’s handwriting (no department number); used to document Emerson's RF grant report — in pencil is &quot;Put after vol 9 before Vol 10&quot;; Sharp’s copy has</td>
<td></td>
</tr>
</tbody>
</table>

COLUMBIA, MISSOURI
University of Missouri

ITHACA, NEW YORK
Cornell University

Maize Genetics Cooperation News Letter Files: Expanded chronological list of materials and related cooperation
— Coe, EH, Kass, LB


We present here an expanded, current list of archival materials and cooperation and welcome your contributions towards completing the collections.

— Coe, EH, Kass, LB

PB=Plant Breeding bound volumes, Cornell. MMR=Marcus M Rhoades. LS = Lester Sharp File. RAC = Rockefeller Archives Center. NARA = National Archives and Records Administration.
News, Stocks, Symbol Index for 1/23/33-3/6/38; Maps by Langham, hand-drawn (A “showing the loci of those genes whose position can be determined with reasonable certainty”; B “showing the approximate loci of many genes.” Working map. More 3-point tests needed …) (at end of PB volume and in Anderson copy; Sharp’s copy, p. 3 is last page — chromosome linkage maps are missing; Sharp’s last un-numbered copy is dated March 6, 1938).

News, Stocks, Bibliography. Mailing list of 77 persons, 20 outside of the US. Mann Library numbered copies begin with no. 13 (April 15, 1939); the first bound Plant Breeding volume ends with volume 14, March 5, 1940; the second bound Plant Breeding volume ends with volume 21, March 1, 1947 (“MNL, Vols. 2–14, 1932–1940.”) “MNL Vols. 15–21, 1941–1947” (PB). There are no covers included in the PB bound volumes, only blue pieces of paper separating volumes. — LBK checked the bound volumes at Mann Library; manila folder cover hand written title and number 13 on cover. Anderson copies through this date are unnumbered.

News, Editorial Policy of GENETICS (Rhoades), Stocks, chromosome assignments, Bibliography [Mann Library copy, Anderson copy, and Stadler copy have “an appreciation” of 2 pgs. preceding pg. 1 within the manila cover and affixed with brass round-headed paper fasteners; see above, vol. 14].

News, Bibliography (by Lebedeff), Historical Notes on Maize Genetics Cooperation I–XIV on page 56 likely by Emerson (last 3 pages in PB volume 14 are letter of 2/5/41 and “An Appreciation” of Emerson, see below) [Mann Library Copy, L.J. Stadler copy, and E.G. Anderson copy have only the 56 pgs.].

Professionally printed, numbered covers begin with vol. 14. 

Letter, Emerson’s retirement and reunion of maize genetics workers: “As you may know Dr. Emerson reaches retirement age this coming June … this coming summer is an appropriate time to hold a reunion of his former students and coworkers in corn genetics. Preliminary arrangements are now being made for such a reunion to be held at Ithaca in late August or early September, either just before or just after the summer meeting of the Genetics Society at Cold Spring Harbor.” List of 30 names to whom this invitation is sent appended below and those (11) who have already indicated they would attend are starred.

Professional printed, numbered covers begin with vol. 14.

Call for 1940 MNL; deadline January 15.

News, Editorial Policy of GENETICS (Rhoades), Stocks, chromosome assignments, Bibliography [Mann Library copy, Anderson copy, and Stadler copy have “an appreciation” of 2 pgs. preceding pg. 1 within the manila cover and affixed with brass round-headed paper fasteners; see above, vol. 14].

News, Editorial Policy of GENETICS (Rhoades), Stocks, chromosome assignments, Bibliography [Mann Library copy, Anderson copy, and Stadler copy have “an appreciation” of 2 pgs. preceding pg. 1 within the manila cover and affixed with brass round-headed paper fasteners; see above, vol. 14].

Reports, Stocks, Bibliography [plus 1 pg. 11/22/43 Emerson to 11 cooperators-see below] Only the year is listed on PB copy, Vol. number not hand written in this or subsequent bound PB volumes.

Reports, Stocks, Bibliography (by Smith) [pg 2 has an announcement by Emerson, “Arrangements have been made to continue the Maize Genetics Cooperation at Cornell University for a period of not less than three years. Professor R. L. Cushing, who has been responsible for the work done during the past few years, will help initiate Prof. H. H. Smith who will have charge of the work in the immediate future… R. A. Emerson.”] [disclaimer is emphasized by addition of a box border].

Reports, Stocks (Cushing, Morris), Bibliography [disclaimer added to cover: “The data presented here are not to be used in publications without the consent of the authors”].

Reports, Stocks (Cushing, Morris), Bibliography [disclaimer added to cover: “The data presented here are not to be used in publications without the consent of the authors”].

Assumed Call for 1944, no copy found.

Assumed Call for 1944, no copy found.

Assumed Call for 1946, no copy found.

Assumed Call for 1946, no copy found.

Assumed Call for 1950, no copy found.

Assumed Call for 1951, no copy found.

Assumed Call for 1951, no copy found.

Assumed Call for 1951, no copy found.

Assumed Call for 1951, no copy found.

Assumed Call for 1951, no copy found.

Assumed Call for 1952, no copy found.

Assumed Call for 1952, no copy found.

Assumed Call for 1952, no copy found.

Assumed Call for 1953, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.

Assumed Call for 1954, no copy found.
LBK acknowledges the National Science Foundation (grants SBR9511866 and SBR9710488), for support of archival research; the Departments of Plant Biology and Plant Breeding at Cornell University for logistical support; with grateful thanks to Chris Bonneuil, Royse P. Murphy, William B. Provine, and Margaret Smith, for sharing notes and documents in the spirit of maize cooperation; to archivists Thomas Rosenbaum, RAC and Joseph Schwarz, NARA, for permission to use the collections and for supplying information and copies of letters, and to Mary L. Polacco for encouragement and aid in systematizing the information.
Contributor's Biographical Sketches

Dr. Lee B. Kass received her Ph.D. in botany and genetics from Cornell University (1975), and earned a B.S. in biology at The City College of New York (CUNY, 1969). She did postdoctoral research at The University of Cambridge (UK) and Vanderbilt University. She has served on the faculties of The University of Cambridge (UK), University of Tennessee (Nashville), Elmira College (New York), The College of the Bahamas (Nassau), Cornell University, and West Virginia University (Morgantown). Kass has authored, edited or co-edited ten books, and authored or co-authored more than 90 book chapters, proceedings papers, and articles in scientific journals. She is a member of the Botanical Society of America, The Bahamas National Trust, and a former member of many botanical organizations. Kass was chair of the Historical Section of the Botanical Society of America for many years. She established the Elmira College Herbarium in 1985, and currently serves on the Science Advisory Committee of the Bahamas National Trust. Among her awards is the Josef Stein Award, for excellence in teaching and scholarly achievement (1985) and a Fulbright Scholar Award (1996), during which time she and her spouse, Dr. Robert E. Hunt, established the National Herbarium of the Bahamas. She is Visiting Professor at Cornell University, and West Virginia University (Morgantown). Her research focuses on history of botany, and biodiversity and reproductive biology of Bahamian plants.

Dr. Edward H. Coe Jr. earned a Ph.D. (1954) in botany at the University of Illinois (with John Laughnan) and received his M.S. degree (1951) in plant genetics (with Charlie Burnham), and a B.S. degree (1949) in agronomy and plant genetics from the University of Minnesota. Following a postdoc with Ernest G. Anderson at Caltech (1954-1955), Coe joined the Plant Genetics Unit of the U.S. Department of Agriculture-Agricultural Research Service at the University of Missouri, where he is currently Professor Emeritus of Plant Sciences. His research has contributed to an understanding of anthocyanin biosynthesis, gametophyte functions, non-Mendelian inheritance, and extrachromosomal inheritance. He is author of or co-author of over 100 refereed journal articles, and author or co-editor of two books; most well-known is the co-edited Mutants of Maize. Coe is highly appreciated for his 26 years of continuous service as editor of the Maize Genetics Cooperation Newsletter (1974-2000). He played a central role in establishing the Maize Genome Database and in the early planning meetings leading to sequencing of the first plant genome, the maize genome. He is a member of various professional organizations, including the Genetics Society of America, the American Genetic Association, and the Crop Science Society of America. In recognition of his “lifetime contributions to the field of genetics,” Coe was awarded the prestigious Thomas Hunt Morgan Award by the Genetics Society of America in 1992. The award was presented to him in recognition of the importance of his basic research, his mentorship of students and postdocs, and his extensive and outstanding service to the maize genetics community. Dr. Coe was described as “the glue that holds the maize community together.” At the 2018, 60th Annual Maize Genetics Conference, held at Palais du Grand Large, Saint-Malo, France, Coe was honored with the newly established R.A. Emerson Award, which recognizes individuals for their extraordinary lifetime achievements in maize genetics. Recipients of this award are leaders in the maize community, who have made seminal contributions to our understanding of maize genetics. Coe's Emerson Award was presented at the March 2019 Maize Genetics Conference in Saint Louis, along with a short overview of his life and work. In April 2019, the Academy of Science – St. Louis honored Coe with The Peter H. Raven Lifetime Achievement Award, which recognizes a distinguished career of service in science, engineering, or technology.

Michael N. Cook is a Librarian whose MLIS degree (1997) and MA degree in philosophy (1994) are from the University of South Carolina, with a B.A. degree in English (1990) from Western Carolina University. He is the Head of Collections at Cornell University's Albert R. Mann Library. His areas of expertise include collection development, digital preservation, copyright, open access, digital repositories, special collections and rare books, and scholarly communication. Michael was the 2007 recipient of the State University of New York (SUNY) Chancellor's Award for Excellence in Librarianship and also received the 2017 Melanie Gardner Agriculture Network Information Collaborative (AgNIC) Distinguished Service Award.
Dr. Margaret E. Smith received her Ph.D. (1982) in Plant Breeding and Genetics from Cornell University. She subsequently worked as a plant breeder at the Tropical Agricultural Center for Research and Teaching (CATIE) in Costa Rica, and then ran a successful corn breeding program at the International Maize and Wheat Improvement Center (CIMMYT). Smith returned to Cornell in 1987 as an Assistant Professor of Plant Breeding & Genetics to head the corn breeding research project. She is now Professor and also the Associate Director of the Cornell University Agricultural Experiment Station. Her research goal is to enhance an understanding of corn adaptation to marginal environments and develop genetic materials that will improve corn productivity and sustainability in such environments. She assumed responsibility in 2004 as Extension Leader for Plant Breeding and Genetics, focusing on public education about plant breeding, variety testing, and seed issues. Smith is the Project Leader for the New York Seed Improvement Program of Plant Breeding and Genetics. She oversees the Corn Variety Testing program, which aims to evaluate hybrids over a range of environments in New York. She also teaches about genetically engineered crop plants (basic public issues education) and agriculture in the developing world. She has trained more than 20 Ph.D. students, and six Masters students. She was the recipient of the Outstanding Faculty Award (2015) from the College of Agriculture and Life Sciences Alumni Association and the College of Agriculture and Life Sciences (CALS) 2012 Outstanding Service to CALS award.

Judy L. Singer received her BA (1977) in Sociology/Anthropology, from Ithaca College. She began working at Cornell Plant Breeding for Professor and Department Extension Leader William D. Pardee in 1976, as a Secretary, then as an Extension Support Aide, and finally as an Extension Support Specialist. For 25 years she traveled the state of New York for the New York Hybrid Corn Performance Trials testing program participating in all aspects of field testing operations, collecting, compiling, analyzing data, and producing final reports. She later worked with Margaret Smith, and other Plant Breeding faculty members affiliated with the applied Plant Breeding programs. Judy helped Dr. Pardee to organize the 75th Synapsis Club Reunion (1982). She had organized, and saved, most of the files from that event, which later proved invaluable to the publication of the Department’s Centennial History. She co-versed as a production coordinator for the print version of the 2007 Centennial History book, and proof read the hard copy and later the e-book. She was also a member of the committee to organize former Plant Breeding Department Chair (1956-1979) R.P. Murphy’s 90th birthday celebration (May 2, 2004). For that event she organized family photographs, helped to coordinate events, and compiled the Memory Book of the event. She proofread for the McClintock Perspectives Companion Volume, edited by Kass. Judy retired from her permanent Cornell appointment in 2009 and was asked to return in a part time Temporary Service Professional position. On 29 November 2017, Judy received the first Chair’s Award for Excellence, for her 33 years of full time service to Plant Breeding & Genetics. She continues to work closely with the Plant Breeding & Genetics designated historian, Dr. Lee B. Kass, to save files of historical significance to the history of one of Cornell’s most notable Departments.

Foreword Contributor:

Dr. Edward S. Buckler received his Ph.D. (1997) in biological sciences from the University of Missouri-Columbia. He served as research geneticist, U.S. Department of Agriculture - Agricultural Research Service (USDA-ARS), and Adjunct Assistant Professor of Genetics at North Carolina State University, Raleigh, from 1998 to 2003, before starting at the USDA/ARS Robert W. Holley Center for Agriculture and Health, at Cornell’s Institute for Genomic Diversity in 2003. Buckler is a Research Geneticist with the Senior Scientific Research Service, USDA–ARS, and an Adjunct Professor of Plant Breeding & Genetics at Cornell. He is recognized as a leader in the integration of quantitative and statistical genetics with genomic approaches, whose work has deepened our understanding of the control of crop complex traits, and applying those superior genetic variations to crop improvement. Subsidized by the United States Department of Agriculture and National Science Foundation, he has led the largest maize research team in the US, achieving more than 200 periodical publications, including Science, Nature, Nature Genetics, PNAS, Plant Cell, Nature Review Genetics and Nature Communications. He has had the pleasure of mentoring over 50 postdocs and graduate students. In 2014, Buckler was elected to the U.S. National Academy of Sciences (NAS), Section of Plant, Soil, and Microbial Sciences. He was the recipient of the 2017, NAS Prize in Food and Agricultural Sciences, the first time this prize was awarded. This prize recognizes research by a mid-career scien-
Manuscript Reviewer:

Dr. Mark E. Sorrells received his Ph.D. (1977) in Plant Breeding and Plant Genetics from the University of Wisconsin – Madison. After a short post-doc he joined the faculty at Cornell University in the Department of Plant Breeding & Biometry. Since 1991 Dr. Sorrells has been Professor and served as Chair of the Department of Plant Breeding & Genetics at Cornell University (2006-2014). The primary focus of Dr. Sorrells’ research program is breeding methodology with application to oat, barley and wheat breeding for the Northeastern region of the United States. He has also been involved in several international projects in Africa, South America, and Europe. During his career Dr. Sorrells has actively developed and evaluated new breeding methods and currently he is integrating genomic selection into his breeding program to reduce pre-harvest sprouting, increase disease resistance and improve yield. Dr. Sorrells has published more than 288 papers in peer-reviewed journals. He has been active in teaching and advising students, serving as major advisor to 45 Ph.D. students, 12 M.S. graduate students and minor advisor to 25 students. He is advisor to Cornell’s Synapsis Club, the student-faculty organization founded by H.J. Webber when the Department began in 1907. Sorrells is a Fellow of the Atkinson Center for a Sustainable Future, a Fellow of the Cornell Institute for Food Systems, a Fellow of the Crop Science Society of America, and of the American Association for the Advancement of Science. He is the recipient of the faculty Award for Outstanding Career Accomplishments in Applied Research (2012), College of Agriculture and Life Sciences, Cornell University; the SUNY Chancellor’s Award for Excellence in Faculty Service (2015); and of the Outstanding Research Award (2016), of the Crop Science Society of America.
This 1945 Synapsis Club group photo is the last one we have that includes Professor R.A. Emerson (middle row, 3rd from left). Of the seven women in the photo, four on front row [from left, Florence N. Thomas (4), Fung Ting Fung (6), M. Rosalind Morris (7) Leona O. Schnell (8)] received their Ph.D.s with Plant Breeding faculty between 1946 and 1948. (Reprinted from Murphy & Kass 2011, p. 157; courtesy of Plant Breeding & Genetics and the publisher)
Maize Genetics Cooperation News Letter volumes 2-14 (1932-1940), and 15-21 (1941-1947), compiled by R.A. Emerson (background), and bound for the former College of Agriculture Library, Cornell University. (Courtesy of Margaret E. Smith, Plant Breeding & Genetics, Cornell University; photo image by Judy Singer)