

The Golden Age of Corn Genetics at Cornell
as seen through the eyes of M. M. Rhoades

Maize Genetics at Cornell began in 1914 when R. A. Emerson came from Nebraska to head the Department of Plant Breeding. Emphasis in those early days was on such basic genetic problems as the location of numerous unplaced genes, factor interaction, establishment of linkage groups, linkage maps, pericarp variegation, the inheritance of gametophytic characters, the genetic basis of semi-sterility, etc. Emerson's masterful analysis of the inheritance of plant colors did more than any other single paper to place maize genetics on a firm basis. Much was learned at Cornell about the composition and architecture of the maize genome by Emerson, Hutchinson, Demerec, E. G. Anderson, Lindstrom, Lyster, Sprague, Phipps, Li, Brunson, Bregger, Fraser, among others. The importance of these early investigations cannot be over-emphasized. They set the stage for the remarkable advances in cytogenetics which followed. The cytogeneticists stood on the shoulders of their predecessors.

Prior to the mid 1920's, little cytological work was done with maize, which was not regarded as favorable cytological material. This was an erroneous conclusion. McClintock, using the carmine smear technique invented by Belling, found that the pachytene chromosomes could be accurately identified by length, arm ratios, and heterochromatic knobs in specific locations. Maize was an excellent organism for both cytological and genetical studies and the combination of the two disciplines (cytogenetics) quickly led to a large number of significant studies. Maize cytogenetics may be said to have begun in 1929 when McClintock's paper on triploid maize appeared in Genetics. That progress was explosive in the next few years is evident from the following account of the advances made in the subsequent six years.

The status of maize cytogenetics by the mid 1930's was summarized in the paper by Rhoades and McClintock published in The Botanical Review in 1935. The accomplishments described below were largely taken from that paper although a few research findings, more genetical than cytogenetical in nature, are included. The names of the investigators responsible for each advance are indicated in parentheses. Capital letters designate those individuals who were trained or were postdoctoral fellows at Cornell.

The Status of Maize Genetics in 1935.

1. The establishment of ten linkage groups corresponding to the 10 chromosomes of the haploid complement. (Cooperative studies by many, mostly American, geneticists).
2. The association of each linkage group with a particular, morphologically identifiable member of the chromosome complement. (McCLINTOCK, Brink, and BURNHAM).
3. The placement of specific genes at definite positions within the physical chromosome. (McCLINTOCK and others).
4. The cytological proof of genetic crossing over (CREIGHTON and McCLINTOCK).
5. Cytological and genetic proof of chromatid crossing over (McCLINTOCK, RHOADES).
6. Cytological determination of the physical location within the chromosomes of reciprocal translocations, inversions and deficiencies. (McCLINTOCK, BURNHAM, Brink, CREIGHTON, RHOADES, V. H. RHOADES).
7. The genic control of chromosome behavior. (BEADLE, McCLINTOCK).
8. Proof that chiasmata are points of genetic crossing over. (BEADLE).
9. Nonhomologous pairing and its genetic consequences. (McCLINTOCK, Stadler).
10. Instability of ring-shaped chromosomes leading to variegation. (McCLINTOCK).
11. Divisibility of centric regions. (McCLINTOCK).

12. Correlation of heteropycnosis with genetic inertness. (RANDOLPH).
13. Artificial production of polyploidy. (RANDOLPH).
14. Mutagenic effects of X-irradiation. (Stadler).
15. Cytological and genetical analysis of Zea-Euchlaena hybrids (EMERSON, BEADLE, Mangelsdorf and Reeves).
16. Cytological studies with Zea-Tripsacum hybrids. (Mangelsdorf, Reeves).
17. Cytoplasmic male sterility. (RHOADES).

The above compilation indicates the prominent role that Cornellians played in the development of maize cytogenetics. The period from 1929-1935 was truly the Golden Age of Maize Genetics at Cornell. The achievements of the Cornell group in the 1920's and 1930's was unrivaled by any other constellation of plant geneticists and was second only to the famous Drosophila school under Morgan at Columbia.

Adding to Cornell's reputation was the establishment at Ithaca of the Maize Genetics Stock Center for the maintenance and distribution of genetic stocks and the founding of the Maize Genetics Cooperation News Letter, in which appeared unpublished data unselfishly contributed by geneticists at many institutions. This unique cooperative effort was so successful that it became widely copied.