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THE BUSSEY INSTITUTION

THE Bussey Institution has played an important part in the development of the Arnold Arboretum. When the Arnold Arboretum was established in 1872 the Bussey Institution provided most of the land for the new organization. The two institutions worked in harmony for many years and when the Bussey Institution was closed in 1936 part of the funds were used to support the work of the Arboretum. Under the reorganization of botanical activities at Harvard these two institutions will continue to cooperate.

In 1835 Benjamin Bussey provided in his will for both the land and an endowment for a school of agriculture and horticulture, thus anticipating by more than 25 years the Morrill Act of Congress establishing the State Agricultural Colleges. The obligations of the Bussey Trust were not liquidated until 1862, and the organization of the Bussey Institution was effected in 1871. The curriculum covered a three-year course for undergraduates who had done a year's work at the Lawrence Scientific School. Inadequate funds, competition from State Colleges, and the transfer to the Arnold Arboretum of most of the Bussey land led to the termination of Harvard's undergraduate school of agriculture in 1906.

In 1907 the Bussey Institution was reorganized as a graduate school "for advanced instruction and research in scientific problems that relate and contribute to practical agriculture and horticulture." Under the administration of W. M. Wheeler, with the cooperation of East, Castle, Brues, Bailey and Ames, the Bussey Institution soon became a center of graduate instruction and research in genetics, entomology, plant anatomy, and economic botany. It attracted graduate students from both the United States and foreign countries who have subsequently become leaders in agricultural institutions and other fields of applied biology. In the field of genetics alone 40 men obtained the Sc.D. degree before the Bussey Institution was closed in 1936.

The research contributions from the Bussey Institution have been equally im-

pressive. Perhaps the greatest single contribution to agriculture of this century was made by two biologists of "Ivy" colleges—Shull of Princeton and East of Harvard—when they developed the method of crossing inbred lines of corn to produce the vigorous and productive hybrid corn which now dominates American agriculture. It is estimated that the development and utilization of hybrid corn was worth more than half a billion dollars to the farmers of this country last year.

In 1930 the Bussey faculty was merged with the faculty of Arts and Sciences, and in 1936 the Bussey staff was transferred to the Biological Laboratories in Cambridge. The Bussey Institution continued as a holding agency, and the funds were used largely to support the work of the Arnold Arboretum. Under the recent reorganization of botanical activities at Harvard, the Bussey Institution will be included in the newly created Institute for Research in Experimental and Applied Botany, whose objective is that of coordinating the activities of the Botanic Garden, the Bussey Institution, the Harvard Forest, the Atkins Garden and Research Laboratory in Cuba, and the living collections of the Arnold Arboretum.

During the war years the Bussey Building was renovated by the Medical Corps of the U.S. Army, who occupied it until the summer of 1946. Most of the building is now occupied by the Massachusetts Department of Public Health, which will be responsible for all maintenance and repairs. We have retained a large laboratory for use as summer quarters for staff members and students in horticultural and botanical work, and have ample quarters for the Arnold Arboretum maintenance staff in the basement. The grounds and greenhouses will continue to be used for experimental work in botany, plant breeding, horticulture and agriculture by staff members and students. The grounds also contain the greenhouses and nursery plots of the Arboretum, although much of the nursery work has now been transferred to the Case estates in Weston.

When the Bussey Institution gave up undergraduate instruction in agriculture and horticulture, and became organized for graduate work in applied biology, the original functions of the institution were not forgotten. Many of the graduate students came from agricultural colleges, and of those who specialized in plant genetics most have returned to agricultural work in State or Federal service. Since agriculture is based upon the fundamental biological sciences a curriculum in pure science can provide the essential training for research in agriculture. The Bussey Institution fulfilled this need in the past and now as part of the Institute for Research in Experimental and Applied Botany can again contribute to the instruction of graduate students interested in agricultural research. In addition, provision has been made for work in tropical agriculture, the field work to be done at the Atkins Botanic Garden in Cuba.

During recent years experimental work in agriculture and horticulture has been conducted at the Bussey Institution by Professors Karl Sax and Paul C. Mangelsdorf. Problems related to the origin of corn are being studied by crossing standard varieties with forms from Central and South America and with related genera.

By means of genetic and cytological analysis it is possible to determine relationships and possible origins of our modern corn varieties.

Other work with corn includes the production of new sweet varieties adapted to New England. Seven years ago the white "Midget," an early corn of very high quality, was crossed with "Golden Bantam." The hybrid was backcrossed on "Midget" and the yellow segregates backcrossed on "Midget" a second time. The next year the plants were selfed to obtain pure yellow types. These were selected for uniformity of growth habit and foliage color, and were then intercrossed. As a result we have a new variety which has the earliness and high quality of "Midget" but one which is more productive and has more vitamin A. We have named the new variety "Seven-eighths Midget" since approximately seven-eighths of its germplasm is derived from "Midget." We now have seed for distribution to those who wish to cooperate in making field tests for productivity and eating tests for quality.

Although the "Seven-eighths Midget" is a corn of very high quality, the yields are relatively low. Yields have been increased by crossing "Seven-eighths Midget" with an early dwarf strain of "Golden Bantam" and utilizing the vigor of the first generation hybrids. This hybrid corn retains most of the quality of the "Midget" and is, in our opinion, of higher quality than any of the many hybrid sweet corn varieties now on the market. Seed of this hybrid is being produced this year so that it can be distributed for testing in the New England area next year.

The artificial induction of polyploidy to increase the size of flowers, fruits and seeds has been of considerable value with certain ornamental plants. Doubling the chromosome number of species of crop plants has not been very satisfactory. Such polyploids are partially sterile and seed production is reduced. We have produced tetraploid sweet corn, broccoli, turnips, rye, wheat and barley, but none of these polyploids have been of economic value. Chromosome doubling in sterile generic or species hybrids, however, restores fertility and results in new species or genera. At the Bussey Institution we have produced a new genus by doubling the chromosome number of a wheat-rye hybrid, and a new species of wheat has been resynthesized. Hundreds of new species have been produced throughout the world during the past decade by the artificial induction of polyploidy in sterile species hybrids. Some of these will be of economic value. Many of our economic crop plants have originated by natural doubling of the chromosomes of species hybrids in nature, but nature required thousands or perhaps millions of years.

Investigators at the Bussey Institution were among the first in this country to utilize embryo culture as an aid in plant breeding. Crosses between distinct species often produce no viable seed, but in some cases this sterility can be overcome by culturing the young embryos in nutrient solution and permitting them to mature independently of the mother plant.

Clonal lines of apple root stocks are becoming more generally used since it has

been found that tree growth can be controlled if certain types of root stocks are used. Of special interest are the "Malling" dwarfing root stocks originated in England. The disadvantage of clonal root stocks is the cost of propagation by layering. In our breeding of ornamental species of apples we have found half a dozen Asiatic species which breed true from seed due to apomixis. We are now testing these species—*Malus toringoides*, *M. hupehensis*, *M sikkimensis*, and other species —as root stocks for "McIntosh" and other commercial varieties with the hope that some may have a dwarfing effect. These Asiatic species are also resistant or immune to crown gall—a factor of some importance in commercial propagation.

In the genus *Prunus* we have found that *P. tomentosa* has a dwarfing effect on the commercial varieties of peaches and promotes early fruiting, but more time is required to determine its practical value. For lilac propagation the tree lilac is giving very promising results as a root stock for standard *Syringa vulgaris* varieties. In the Pomoideae a more or less systematic survey is being made of the grafting compatibility of the different genera.

The work of the Bussey Institution is closely coordinated with that of the Arnold Arboretum and the Harvard Forest. Under the auspices of the Cabot Foundation, a forest tree breeding project was started ten years ago. Numerous hybrids have been made between the species of poplars growing in the Arnold Arboretum. We now have about fifty selected clonal lines of hybrid poplars which make a much more rapid growth than do the parental species. These are to be tested under field conditions at the Harvard Forest for growth rate and disease resistance in order to select desirable types which can be used for reforestation for special purposes. Species hybrids of pines also show hybrid vigor and a number of our hybrids have been planted in the Arnold Arboretum for further tests and seed production. Eventually these, too, will be tested at the Harvard Forest.

The Bussey Institution, as part of the Institute for Research in Experimental and Applied Botany, will continue to conduct work in pure and applied science. With the facilities of the Arnold Arboretum, the Biological Laboratories, the Harvard Forest, and the Atkins Garden, Harvard is in a better position than it has ever been before to contribute to the basic sciences of agriculture and horticulture.

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