Lecture 30
Origins of Horticultural Science

The origin of horticultural science derives from a confluence of 3 events: the formation of scientific societies in the 17th century, the creation of agricultural and horticultural societies in the 18th century, and the establishment of state-supported agricultural research in the 19th century. Two seminal horticultural societies were involved: **The Horticultural Society of London** (later the **Royal Horticulture Society**) founded in 1804 and the **Society for Horticultural Science** (later the **American Society for Horticultural Science**) founded in 1903. Three horticulturists can be considered as the Fathers of Horticultural Science: Thomas Andrew Knight, John Lindley, and Liberty Hyde Bailey.

Philip Miller (1691–1771)

Miller was Gardener to the Worshipful Company of Apothecaries at their Botanic Garden in Chelsea and is known as the most important garden writer of the 18th century. *The Gardener's and Florist's Dictionary* or a *Complete System of Horticulture* (1724) was followed by a greatly improved edition entitled, *The Gardener's Dictionary containing the Methods of Cultivating and Improving the Kitchen, Fruit and Flower Garden* (1731). This book was translated into Dutch, French, German and became a standard reference for a century in both England and America. In the 7th edition (1759), he adopted the Linnaean system of classification. The edition enlarged by Thomas Martyn (1735–1825), Professor of Botany at Cambridge University, has been considered the largest gardening manual to have ever existed. Miller is credited with introducing about 200 American plants. The 16th edition of one of his books, *The Gardeners Kalendar* (1775)—reprinted in facsimile edition in 1971 by the National Council of State Garden Clubs—gives directions for gardeners month by month and contains an introduction to the science of botany.

Thomas Andrew Knight (1759–1838)

The establishment of the Royal Society of London in 1660, devoted to "improving natural knowledge," received and published a number of papers on botany and in 1795 published a contribution by Knight on the grafting of trees in 1795. In 1804, Knight wrote to Sir Joseph Banks, the great naturalist who sailed with Captain Cook, as follows:

SoHo Square, March 29, 1894
My Dear Sir:
It having occurred to some of us here, that a Horticultural Society might be formed, upon a principle not very dissimilar from that of the numerous Agricultural Societies, which, if they have done no other service, have certainly wakened a taste for agriculture, and guided the judgements of those who wished to encourage it; two meetings have been held in order to commence the establishment, the proceedings of which I enclose to you. You will see that I have taken the liberty of naming you as an original member.

The Horticultural Society was formed in 1804 with Lord Dartmouth as president and John Wedgewood as secretary, with the first *Transactions* published in 1807. A Royal Charter was granted in 1809 and Knight assumed the presidency in 1811.


Thomas Andrew Knight

Thomas Andrew Knight president of the London Horticulture Society (later Royal Horticultural Society) from 1811–1838, can be considered the father of horticultural science. He was the first of the 18th century naturalists to devote himself to the emerging science of horticulture, having an interest both in basic issues in botany as well as applications in practical horticulture. He was both an observer/naturalist and an experimentalist. His interests were wide ranging and embraced the disciplines that we now call plant physiology, structural biology, and genetics. Knight investigated physiological problems such as the ascent and descent of sap, gravitational biology, tropisms, and the nature of the cambium. He was interested in relating morphology and anatomy to development and function. His studies on the effects of pollen in the garden pea on seed characters presaged the work Gregor Mendel carried out 40 years later. He describes dominance and segregation, although he fails to make the brilliant leap of Mendel in relating phenotypic characters to the factors we now know as genes. He reports observations on the genetics of animal behavior, a field not truly explored until the end of the 20th century.

Knight's true love, however, was horticulture. In this field he investigated controlled environmental culture (greenhouse construction and vegetable forcing), plant nutrition and fertilization, culture of fruits and vegetables, pest control, and plant breeding. He was an early proponent of the development of plant improvement through cross breeding and selection, and he literally initiated the field of fruit breeding. He released a number of improved cultivars of both fruits (apple, cherry, strawberry, red currant, plum, nectarine, and pear) and vegetables (pea, cabbage, and potato). He was interested in developing improved cultural methods to enhance earliness and yield, the effect of rootstocks, the influence of girdling, plant hardiness, and the causes and control of disease. Clearly ahead of his time, he was the first to investigate the influence of electricity on plants. He contributed nearly a hundred scientific papers on a wide range of topics, with the bulk on horticultural science. Unfortunately, his notes are lost, so we know little of his methods of collecting data other than what is detailed in his papers. It is clear he appreciated the value of having appropriate controls, the value of replication, and the verification of data. He investigated such horticultural species as vegetables (bean, broadbean, cabbage, carrot, celery, melons, mint, mushrooms, onion, parsnip, pea, potato), fruits (avocado, apple, cherry, grape, lemon, mamey, mango, orange, nectarine, peach, pear, pineapple, plum, quince, strawberry, walnut) and ornamentals (amaryllis, camellia, fern, ivy, lily, palm, rose). His early experimental study of the effect of gravity on seedling growth in bean has become the cornerstone of modern gravitational biology. His 1806 paper entitled "On the direction of the radicle and germen during the vegetation of seeds," was selected for inclusion in the volume *Classic Papers in Horticultural Science* (1989). His study on the phototropism of tendrils has been incorporated in textbooks of plant physiology without attribution. A renaissance investigator, he is honored here for the breadth of his interests and his devotion to the science and the practical arts of horticulture. Devotees of the 19th century British author Anthony Trollope will recognize Knight as the quintessential 19th century country gentleman, landowner, hunter, and scientific dilettante, someone with the character of Plantagenet Palliser—moral, personally kind and gentle, but clearly a conservative of the old school. Second son of a clergyman, he inherited wealth, a castle, and a 10,000 acre estate at the age of 29 after the death of his renowned brother Payne Knight, author, art collector and member of parliament. This enabled him to intensively pursued his passion in plant physiology and experimental horticulture.

He was happily married for 46 years to Frances Felton. The life of his only son was cut short by a hunting accident; Frances, his eldest daughter, became a collaborator in his fruit breeding research. Knight was a vital part of the scientific establishment of his time and had extensive correspondence with Sir Joseph Banks and Humphries Davy, as well as a number of foreign naturalists.

Thomas Andrew Knight, a forerunner of the great American Horticulturist Liberty Hyde Bailey (1860–1954), is remembered today chiefly through the Knightian medal, still presented by the Royal Society, and by a genus of the Proteaceae that bears the name *Knightia* in his honor.

John Lindley (1799–1865)

John Lindley was one of the most remarkable horticultural scientists of the 19th century (Hershey

1989). It is mainly due to his efforts that this branch of knowledge (the science of horticulture) has risen from the condition of an empirical art to that of a developed science (1859, Proc. London Royal Soc. 9:40). His book *The Theory of Horticulture* (1840), with the 1855 2nd edition retitled, *The Theory and Practice of Horticulture*, is a classic and is still considered "one of the best books ever written on the physiological principles of horticulture" (1981, Encyclopedia Britannica).

John Lindley

Lindley's formal education lasted only through age 16 but his astounding ability for hard work enabled him to become one of the most productive plant scientists of his era. His capacity for sustained work was demonstrated early when he translated an entire French plant science book into English in one sitting, without intermission, of 3 days and 2 nights. The translation was published in 1819 as *Observations on the Structure of Seeds and Fruits.* Young Lindley's was truly dedicated; he slept on the floor while employed by Sir Joseph Banks to inure himself to the hardships of a planned plant exploration to the tropics.

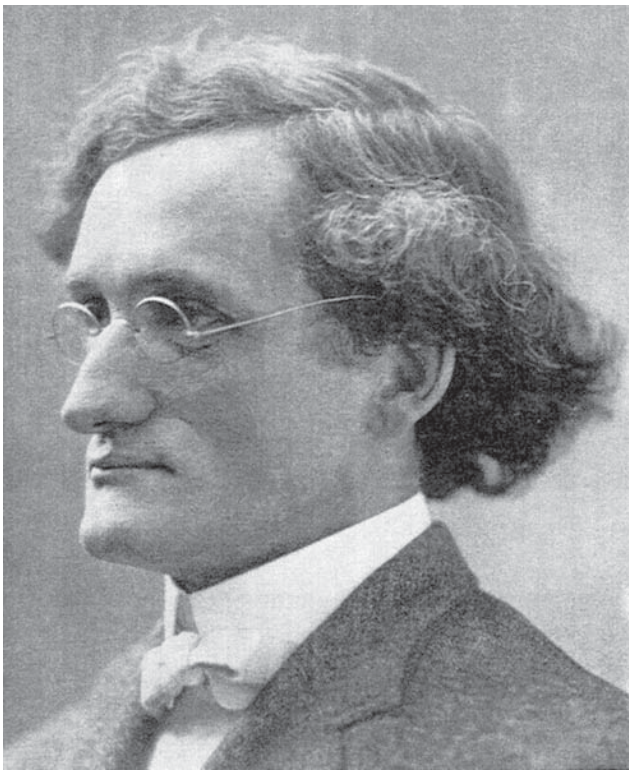
Lindley had several careers, most of them simultaneously. He was the "mainspring" of the London Horticultural Society for 40 years, Professor of Botany at the University of London for 33 years, editor of the *Botanical Register* for 18 years, editor of the *Gardener's Chronicle* for 25 years, and Professor of Botany and Director of the Physic Garden. In addition to his official duties, Lindley played a major role in saving Kew Gardens from being disbanded by the government as a budget-cutting measure. He was frequently consulted by the government on matters ranging from the Irish potato famine to the vegetation of Ascension Island, superintended the horticultural exhibits of the Great International Exhibition of 1862, and successfully crusaded to repeal the glass tax, enabling wider use of greenhouses.

Lindley excelled in several fields. His pioneering works on orchid taxonomy earned him the title of "Father of Modern Orchidology," and he authored books on medical uses of plants, general botany, popular horticulture, and fossil plants. His botanical texts helped establish the natural system of plant classification as the system of choice, he named innumerable new species brought back by plant explorers, and started the practice of ending plant family names in -aceae.

As the crusading editor for the *Gardener's Chronicle,* he worked to improve the state of horticultural science for 25 years. In 1831, Lindley wrote, "*No greater boon could be bestowed upon the gardening world than to reduce all horticultural operations to their first principles, and to lay bare the naked causes why in one case one mode of procedure is advisable, and another in another.*" Lindley's horticultural experiences working for his nurseryman father and the Royal Horticultural Society plus the scientific background gained working with the greatest plant scientists of his day made him the ideal person to bring science into horticulture. Lindley's *Theory of Horticulture* had a major impact on horticulture and was translated into German, Dutch, and Russian and published in an American edition (1841) with notes by A.J. Downing, prominent horticulturist and landscape gardener, and Asa Gray, prominent botanist. A second American edition was published in 1888. Although *Theory of Horticulture* was less popular in England, the much-expanded second edition in 1855, retitled *The Theory and Practice of Horticulture* was a success.

Lindley received recognition from the University of Munich, which awarded him an honorary Ph.D. in 1832; from the Royal Society, which awarded him their Royal Medal in 1857; from the Royal Horticultural Society, which named their Lindley Medal and Lindley Library in his honor, and from numerous taxonomists, who named 6 genera and numerous species in his honor.

Liberty Hyde Bailey (1858–1954)


Liberty Hyde Bailey

Liberty Hyde Bailey was a man of many interests and talents, a man of perception and foresight (Wilcox Lee). He was an extraordinarily successful scientist, teacher, administrator, poet, and philosopher, who profoundly influenced the direction of teaching, research, and extension in horticulture. Young Bailey devised a 3 phase plan for his life: 25 years for training in his chosen field of horticulture, 25 years for public service, and 25 years for retirement, during which he would be free to pursue his own interests. He predicted the first 50 years of his life quite accurately. However, his years in retirement numbered over 40, resulting in vast contributions to horticulture.

Bailey was born in 1858 in South Haven, Michigan and was the youngest child of a hard-working family on a fruit farm. At an early age he became interested in collecting plants and animals, and in speculation on the relationship between one organism and another. Liberty Hyde Bailey Senior, although a conservative puritan, was nevertheless an open-minded man of independent thought and took pains to provide books as well as New York newspapers for his family. He allowed his precocious youngest son to read Darwin, whose ideas he considered incomprehensible, if not inflammatory, because Darwin seemed honest. The 2 books, 1 on evolution and the other on systematic botany, that were to create a lasting impression on the young Bailey were Darwin's *On the Origin of Species by Natural Selection* and Asa Gray's *Field, Forest and Garden Botany*.

In the United States one of the great influences on agricultural and horticultural research was the establishment of land-grant colleges created by the Morrill Act, signed by Abraham Lincoln in 1862. Each state was provided with grants of land for the establishment of a people's university emphasizing-but not restricted to-the agricultural and mechanical arts. The Hatch Act of 1879 institutionalized the federal and state experiment station systems. These initiatives of 19th century America were to have a profound effect on U.S. education and on agricultural research (Fig. 30-1, 2).

In 1877, at the age of 19, Bailey left South Haven and began his secondary education at the Michigan Agricultural College (now Michigan State University). While at Michigan, Bailey worked with William Beal, a botanist with whom he had become acquainted through participation in the Michigan State Pomological Society, and became interested in plant breeding. Young Bailey found time during his student years to organize and edit the student publication, *The College Speculum,* and to become involved in the Natural History Society and student government, and to publish his first articles on identification of local flora in *The Botanical Gazette*. He began his long-term involvement with classification of the genus *Rubus*. In short, the beginning of his academic career was the beginning of the type, diversity, and quantity of activity that was to characterize Bailey's entire life.

After leaving Michigan Agricultural College, Bailey went to Harvard to work for the botanist Asa Gray, where he was responsible for sorting and classifying plant specimens received from Kew Gardens. However, Gray's feelings about horticultural education were in distinct opposition to Beal's and those nascent in Bailey. Although Gray was enthusiastic about embracing new phases of botany-physiology and the use of horticultural species for scientific investigation, he held a very typical attitude of the period. Gray felt that research should be conducted in a laboratory or herbarium. Horticulture was considered an ornamental

art, while botany was considered the science. The 2 disciplines were generally not considered compatible in the 19th century. Consequently, Gray was disappointed when Bailey returned to Michigan in 1885 to assume a newly established chair of horticulture and landscape gardening. So strong was the dichotomy between botany and horticulture that it was predicted that if Bailey returned to horticulture, he would forfeit his growing reputation as a scientist and disappear into professional obscurity.

Fortunately for the world of horticulture, that prediction could not have been more inaccurate. Bailey spent several years at Michigan working to cross the "garden fence," his term for the wall of prejudice that existed between botany and horticulture, between science and the art of growing plants. This prejudice limited training horticulturists as well as botanists, educating farmers, and conducting research relevant to production agriculture, and most certainly precluded the development of teaching, research, and extension as we have come to know it. A wide array of other projects also received the force of his energy: the esthetics of the campus landscape, renovation of the campus orchards, continuation of his vegetable breeding work, and the publication of popular articles. Very importantly, he revised the agricultural curriculum, making horticulture come alive with student participation in laboratory courses. He also designed the first horticultural laboratory building in the country, which was subsequently approved and built by the college board of directors. As a professor at Michigan, Bailey also continued to publish his taxonomic works and, contrary to the predictions of those he left behind in Cambridge, established a reputation as a world authority on plant classification.

By 1888, the dynamic and prolific Bailey had a well-established reputation as a scientist and an innovator in the area of horticultural research and education. Consequently, he was recruited by Cornell to fill a new position: Professor of Practical and Experimental Horticulture. In this capacity, he continued his effort at establishing horticulture as a science by instituting research on practical problems and teaching science in horticulture, and publishing bulletins and books on a wide array of subjects. Extension activities were also becoming a large priority for Bailey at this time. He believed that not only the success of agriculture, but the quality and survival of life in rural communities, depended on extension education. He published many bulletins and books in order to extend information from the university to the people of the state. He also made countless trips around the state to give talks and establish a relationship of trust and credibility between the college and the rural population.

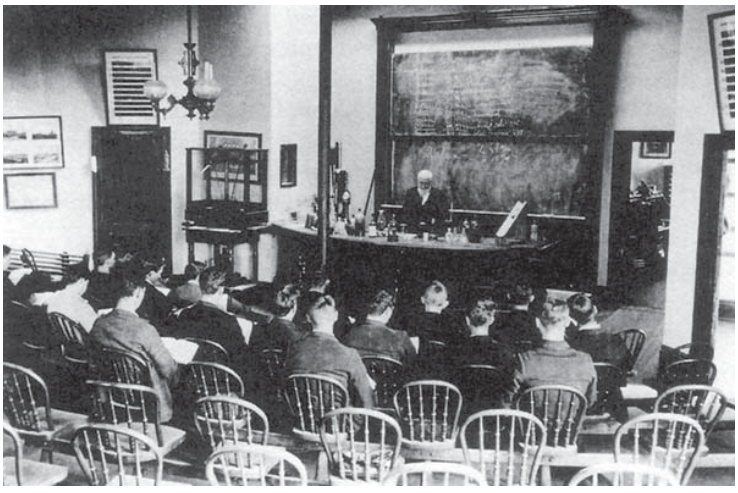


Fig. 30-1. A professor and students of agricultural chemistry in a laboratory lecture, Michigan State College (later Michigan State University) 1892. USDA photo.

Fig. 30-2. Harvey Wiley (in dark jacket), an eccentric Purdue University professor who became chief of the USDA Bureau of Chemistry, organized research in 1906 at Purdue Unversity that led to passage of the Meat Inspection Act and the Federal Food and Drugs Act. USDA photo.

In 1903, Bailey temporarily left research behind as he became dean of the College of Agriculture, which was established as a separate state-supported college within the university in 1904. During the 10 years that Bailey served as dean, the college grew rapidly. The faculty increased from 11 to over 100, and student enrollment grew proportionately, from 100 to 1400. Funding was acquired for buildings and for the functions of teaching, extension, and research. The departments of pomology, vegetable crops, and floriculture were established, as well as the foundations for what would later become rural sociology.

By 1913, the road was well paved for American colleges of agriculture to fulfill what Bailey felt should be their three proper functions: teaching, the discovery of truth through research, and extending their work to all the population. In 1903, Bailey was a cofounder and first president of the first professional society for horticulturists, the (American) Society for Horticultural Science, which gave a large boost to the establishment of horticulture as a legitimate science. Amid protests from his colleagues, Bailey chose to retire from public service to return to his early interests of plant exploration and identification. He was adhering closely to the schedule he had defined for himself, having been in public service for 28 years, three years over his self-imposed 25-year limit.

From the time he retired in 1913 to his death in 1954, Bailey remained active in horticulture, publishing prolifically and collecting and classifying plants from all over the world, including the first extensive classification of the palms. The establishment of the **Bailey Hortorium** at Cornell University also resulted from specimens collected by Bailey during his "retirement" years. Bailey died on Christmas Day in 1954, at the age of 96. His death ended nearly a century of horticultural achievements and in his pocket at the time of the injury ultimately responsible for his death were airplane tickets to Africa, the location for his next planned exploration and plant collection trip.

Bailey was a prolific writer and editor. His greatest contribution may be the *Cyclopedia of Horticulture*, a work in 5 volumes that first appeared in 1914 and which is still enormously useful. Other works include *Hortus* and *Hortus Second* written with his daughter Ethel Zoe Bailey. An update, *Hortus Third*, published by the staff of the Libery Hyde Bailey Hortorium in 1975 is a bible of horticultural taxonomy. Bailey's quote of Gregor Mendel's paper was influential in the discovery of this paper. During his early years at Cornell, Bailey did a great deal of applied horticultural research. In 1890 and 1891, he conducted a series of experiments to determine the feasibility of using electric lights in greenhouses and published a seminal bulletin. This paper on electro-horticulture is one relatively small work but is typical of Bailey's approach to horticulture.

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