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Introductions of the Twentieth Century

DAVID G. FAIRCHILD took charge of the Office of Foreign Seed and Plant Introduction in 1897, and held that post, except for tours of exploration, for twenty-seven years. Under his leadership the Office set up an efficient system for disseminating plants, and experts in different parts of the country were employed to locate new plant materials. In 1902 Fairchild's division came under the jurisdiction of the new Bureau of Plant Industry. Three other divisions—the Arlington experimental fram, Congressional seed distributions, and tea investigations—were established at the same time.

When the Bureau of Plant Industry was organized in 1900, is was the first official agricultural organization of its kind devoted exclusively to plant introduction. In addition to the four branches listed above, there were divisions concerned with physiology and pathology, botany, grass and forage plants, pomology, and the experimental gardens and grounds. Under Beverly T. Galloway, the Department's leading plant pathologist, more than two hundred employees were engaged in plant work. The Bureau had several gardens and farms at its disposal, and experiment and field stations were established as they were needed for plant experiments. The Arlington Farms and Potomac Flats were located in Washington, D. C., and an eighty-acre garden at Chico, California. The South Texas Garden, established at Brownsville in 1907, contributed much to the development of the Winter Garden district in the Rio Grande Valley of South Texas.

THE SEARCH FOR NEW CROPS

At the turn of the century, the Department of Agriculture accelerated its search for new and better crop varieties. Secretary

Wilson encouraged the importation of date palms, Egyptian cotton, and superior varieties of barley for commercial purposes. He also was interested in macaroni wheats, and the culture of hops and prunes. The Department conducted experiments in 1903 with new varieties of cassava for feeding stock and for starch production. Mexican peaches and apricots were investigated as potential crops for the South, and the Department became interested in the problems of irrigation and crops for dry farming areas.

Growers asked for cover crops for fruit orchards and tobacco fields, and florists were searching for healthy varieties of Easter lilies. A soil improver was sought, along with disease-resistant cottons, and grains able to resist drouth, rust, and alkali. Fruit growers in Florida wanted some new, fancy varieties for the market. The northern states called for trees that could be used for shade and for windbreaks.

A Laboratory of Plant Life History was set up by W. T. Swingle in 1904 to study the soil, climatic, and cultural requirements of various plants. Previous work by Swingle on the Smyrna fig and the date palm had demonstrated the value of studying the life histories of plants before attempting to introduce them. Extensive research was done on the clovers and the alfalfas by the Laboratory.

The Office of Dry-Land Agriculture was established in 1906 to cope with the problem of utilizing the arid lands of the West for agriculture, and within three years experimental work was in progress at nine stations. Farmers became interested in the possibilities of dry farming after seeing the results of experiments with durum wheats.

New experimental gardens—By 1907 a new date palm garden had been established at Laredo, Texas, and *Peruvian alfalfa,* hardy citrus fruits, sorghum varieties, Egyptian cotton, and durum wheats were being given further study.

P. H. Dorsett, who was placed in charge of the plant introduction gardens in 1910, was instrumental in increasing the size and number of the gardens used for plant testing. Bamboos and dasheens were grown experimentally at Brooksville, Florida, and mangoes were tested at Miami. Two new gardens were located at Chico, California, and Rockville, Maryland. The station in southern Texas tested tropical and citrus fruits, and the *Chinese elm* and wild peaches were raised at Ames, Iowa.

Experiment stations set up in Puerto Rico, Hawaii, and the Philippines tested tropical plants before their introduction into the United States.

INTRODUCTIONS BY MEYER

One of America's outstanding plant explorers, Frank N. Meyer, made four trips to Asia over a period of twelve years, and sent back more than twenty-five hundred introductions. He was first sent to Asia in 1905 by the Office of Seed and Plant Introduction with instructions to secure plants of unusual vigor and hardiness. Meyer's first shipment contained varieties of the English walnut, the Chinese pistache, wild and cultivated apricots, wild peaches, hardy apples, Chinese grapes, and edible-fruited hawthorn, ornamental and shade trees, millets, field beans, and lawn sedge.

Two years later, Meyer sent more than a thousand seed and plant specimens from China, Siberia, and Manchuria.[1] In 1908, he shipped seedless Chinese persimmons, new spruces, elms, and pines. He returned to the United States with a wealth of information on dry-land farming, Chinese agriculture, forestry, and market gardening.

Meyer began his second tour of Asia in 1909 through the semidesert areas in the Crimea, the Caucasus, Bokhara, and the Chinese Turkestan. He sent varieties of the *Chinese lychee* to the United States about the same time that other varieties of this fruit were being secured from Java and the Philippines. By 1910, he had made promising discoveries of wild almonds, "Afghasian" apples, varieties of pears, *Erivan alfalfa,* cold-resistant Crimean olives, a good collection of table grapes, a drouth-resistant apple, a collection of edible, sweet-kernelled apricots, a collection of winter wheats from southern Russia, and many soil binding plants.

Meyer secured many different varieties of the *Chinese jujube* and citrus fruits. In 1913, he found chestnut trees which were resistant to the bark disease then attacking chestnut trees in the United States. Other trees Meyer obtained were the *Chinese early cherry* which came to be grown commercially in California;

[1] Of these, the Department was particularly interested in the northern Manchurian apples, blackberries and currants from Korea, twenty-four named pears of North China, bush cherries, plums and peaches from northern Siberia, drouth-resistant alfalfas, dry-land rices, and many ornamentals.

a Chinese poplar, and the *Chinese elm* which is now widely planted in the Great Plains and New England Areas.

The spinach industry of Virginia was saved from extinction by a disease-resistant variety brought back by Meyer, from which the *Virginia Savoy* was developed. Chinese cabbage (celery cabbage) and several kinds of bamboos also were considered as significant introductions.

On his last trip to China in 1918, Meyer disappeared from the deck of a steamer plying the Yangtze River. There is some indication that he may have committed suicide, for his letters reveal that the mental and physical hardships of his lonely existence may have broken his will to live. His last important "introduction," found in his luggage after his death, came to be one of the best-known lawn grasses in Florida—the *Centipede Grass.* In a will made before leaving Washington, Meyer had provided a thousand dollars for the staff of the Office of Plant Introduction, but the money was dedicated in honor of his memory for what became the Meyer Medal for meritorious work in plant introduction.

WORK OF BURBANK

Luther Burbank did much to awaken interest in the commercial possibilities of new plant forms through his many valuable plant "creations." The wide publicity his work received may be accounted for by the fact that his attitude towards plant breeding was as much commercial as scientific. He not only tested plants introduced by the Department of Agriculture, but also imported many varieties himself. However, he often failed to keep adequate scientific records of the elements that entered into his selections. In at least one instance, he claimed to have created a plant, the spineless cactus, which actually had been sent in by David Fairchild years before in introductions from South America and the Mediterranean region. He did add, however, an amazing number of new, superior varieties of stone fruits and other economic and ornamental plants to American agriculture.

INTRODUCTION BECOMES LESS IMPORTANT

When William A. Taylor succeeded Galloway in 1913, the Bureau's emphasis on plant introduction was superseded by work

on hybridization and selection. Disease control and cultivation methods became the main concerns of the Bureau. An appropriation of $100,000 was given the Bureau in 1915 for an annual broadcast of new field seeds. This work was distinct from the Congressional seed distributions, and did not include seeds of new foreign plants.

During the 1920's, the shift in interest from introduction to breeding as a means of improving crops became more pronounced. Plant introduction was no longer the most important service rendered by the Department of Agriculture as new breeding materials—genes—for barley, alfalfa, sugar cane, and Irish potatoes were sought. The Department looked for new, noncompetitive crops, and varieties resistant to disease, insects, and climatic conditions. Plant explorers searched for grasses and browse plants for range control as well as insecticide plants to replace the lead and arsenic compounds which were becoming less effective.

A further departure in the original objectives of the Department of Agriculture occurred in 1934 when the Bureau of Plant Industry became interested in ornamentals as such. In the past, introductions of ornamentals had been made in conjunction with some recognized economic function of the plant. The Department entered a new field of research in 1937 when a Vegetable Breeding Laboratory was established near Charleston, South Carolina.

DISTRIBUTION METHODS

Plant introduction gardens and field stations followed the practice of distributing materials in areas where they were likely to succeed. For example, the introduction garden at Brownsville assisted the citrus industry in that region. In 1909 the Chico gardens distributed more than five thousand plants—among which were the wild Chinese peach, the dry-land elm, a new Chinese poplar, edible hawthorns, and a Chinese jujube—all sent there by the plant explorer, Meyer. The Office of Seed and Plant Introduction was responsible for the distribution of over forty thousand "special rare foreign plants" in 1912. An appropriation in 1913 promoted the wider dissemination of alfalfa, clover, cowpeas, grasses, lespedeza, millet, soybeans, velvet beans, and cotton. Large appropriations for this work continued up to 1928.

Frank N. Meyer, agricultural explorer, brought more than twenty-five hundred plant varieties to America from China. (From *The World Was My Garden* by David Fairchild, Chas. Scribner's Sons).

In 1927, an unusually active year, approximately 370,000 plants, seeds, cuttings, roots, and bulbs were distributed to domestic experimenters, and about 7,000 were sent to foreign collaborators and others.

The general distribution of free seed by Congress, which included many imported seeds and bulbs, was discontinued in 1923. Seed distribution for serious experimental purposes was continued, however, under the control of the Department. This work spread many cotton, tobacco, and forage crop varieties into suitable, local regions. Congress doubled the appropriation of $20,000 for plant introduction work in 1905, and the allotment grew in succeeding years until it reached $182,300 in 1928.

SIGNIFICANT INTRODUCTIONS, 1901–13

The work of the Division of Plant Exploration and Introduction has encompassed a study of thousands of plants of possible economic value. Some individuals, unduly impressed by the special qualities of certain plants, have promoted them against the tide of popular taste. However, their efforts can be defended on the grounds that profitable and practical new crops may be developed by such experimentation.

WHEATS

The spectacular success of Carleton's wheat introductions from Russia proclaimed the value of searching for new varieties of wheat. Although many wheat introductions were made, no new wheats proved as highly successful as the *Kubanka* and *Kharkov* varieties. By 1903 the value of the durum wheats had been recognized, but further introductions of macaroni wheats were made, including two special lots—one a rust-resistant variety from Bombay, and the other the *Saragolla* from Italy. A drouth-resistant wild wheat found in Palestine aroused so much interest that an explorer was commissioned to procure seed for breeding. A hardy wild wheat found by Aaron Aaronsohn on the dry mountain slopes of Palestine created a flurry of excitement from 1910 to 1914 but did not prove as valuable as expected.

The famous *Marquis* was rapidly adopted in 1913 and 1914 from seed imported from Canada. This hard red spring wheat descended from a cross made by A. P. and William Saunders was the most extensively grown spring wheat from 1919 to 1935.

Three important varieties of Australian wheat adapted to the United States were brought in between 1914 and 1916. The *Florence,* obtained in 1914, and distributed to experiment stations in the western states, was grown on 150,000 acres in 1939, but its greatest contribution was as a parent of several new varieties. (1) The *Federation,* a spring wheat produced by the famous Australian wheat breeder, William Farrer, and brought to the United States in 1914, showed promise as early as 1916 at the Sherman Branch Experiment Station in Oregon. By 1944, 694,000 acres of Federation were grown in the West. The *White Federation* from Victoria in 1916 was first grown at the Sherman Branch Experiment Station. Because of its high yields, seed were grown in 1918 at Chico for distribution. By 1944, 244,000 acres of the White Federation were being grown, and several lesser varieties imported at the same time are still cultivated.

BARLEY

About 1900 the Department of Agriculture began a search for pure strains of barleys suited to the exact and elusive requirements of the brewing industry. American barleys were badly mixed and too nitrogenous and were not starchy enough for brewing. Two-rowed barleys were secured from Europe in 1901, as well as the *European Chevalier barley* and the *Beldi* from Algeria. *Club Mariot* from Egypt and the *Hancheen* from Sweden were brought in two years later. These last four varieties were planted to a combined 500,000 acres in 1927. Two thousand pounds of the *Hanna barley,* a famous pedigreed variety from Moravia, were obtained in 1904.

In 1905 the *Trebi barley* from Trebizond, Turkey, came to the Bureau of Entomology in a bulk lot of seed ordered through the Office of Seed and Plant Introduction. Trebi was widely grown in 1945 in the Northwest from a selection made by Harlan in 1909 in cooperative breeding work with the Minnesota Agricultural Experiment Station. On an exploring trip in 1923, Harlan secured thirty lots of barley in India, nineteen in Spain, Tunis, and Algeria, thirty-two in Egypt, and thirty-three in Abyssinia.

RICE

Other rices were obtained after Knapp's successful importations of the Japanese Kiushu. Forty-one varieties, mostly from

China and Japan, were tested in Florida in 1903. They produced thirty thousand pounds of seed for distribution. Wild rice from the Sudan, the 100-day rices from Japan, and eleven varieties from India—a total of forty-six new varieties—were introduced for other tests in 1907. *Patna* types of rice for soup making, brought from British India and Burma for tests in 1931, proved too slow maturing for the United States. The plants were killed by frost while in bloom.

SORGHUMS

When growers became convinced that they could not successfully refine sugar from the sorghums, they began experimenting with the plants for use as grain and forage crops for the West. *Feterita, hegari,* and *Sudan grass,* all from Africa, became valuable additions to the other grain and grass sorghums. After the first seed of feterita received in 1901 failed to secure any results, a second introduction was made for the Office of Forage Crops in November, 1906, from V. F. Naggiar, a merchant of Alexandria, Egypt. Seed from this lot, grown in 1907 at the Chillicothe (Texas) Experiment Station, spread the crop throughout the Southwest. Ten years later the annual value of the crop was estimated at $16 million.

Hegari, another important grain sorghum from the Sudan, was received from Khartoum in March, 1908, and planted that spring at Chillicothe. From these seed A. B. Connor of the Texas Agricultural Experiment Station made a selection in 1910 which was the forerunner of practically all the hegari grown in the United States. In the spring of 1916 the Bureau of Plant Industry distributed 17,000 pounds of seed.

Sudan grass arrived in the spring of 1909 from R. Hewison, Director of Agriculture and Land, for the Anglo-Egyptian Government at Khartoum. It came to the United States as the result of a search instituted through the Office of Seed and Plant Introduction by C. V. Piper, agrostologist. Seeds of many related forms intermediate between Johnson grass and sorghum were received, but only two—Sudan and Tunis grasses—proved of value. Sudan grass gained recognition immediately as a dryland hay crop for the South and Southwest. Within six years enough of it was being grown to meet all demands for seed. Sudan grass is now a familiar hay and grazing crop worth millons of dollars annually and is grown over almost the entire nation.

Tunis grass, received in 1909 from Dr. L. Trabut of Algiers, aroused some attention in the Department of Agriculture. Hundreds of sorghum introductions were made during the first two decades of the twentieth century. They came from Africa, India, China, and Australia for testing, breeding, and selection at a time when the vast ranch lands were giving way to farms and more intensive livestock raising in the Great Plains. The sorghums were indispensable in this transformation of the West.

NEW FORAGE PLANTS

An intensive search for varieties of alfalfa began with the organization of the Section of Seed and Plant Introduction and continued for over a decade. Hundreds of alfalfas were tried, and several unusual and distinctly valuable varieties such as the *Peruvian alfalfa* were discovered. Alfalfa exploration in Turkestan in 1901 discovered types with great resistance to cold and drouth.

Ernest A. Bessey explored in the Turkestan and adjacent regions in 1903 to find alfalfas, cereals, and fruits for the Northwest. He shipped the Department 5,000 pounds of four types of alfalfa adapted to extremes of cold, heat, and alkali. Contracts were made with growers to harvest seed for the Department. In 1903 two other explorers searched Algeria and Egypt for alkali-resistant plants, especially alfalfas.

Niels Ebbesen Hansen, commissioned by the Department in 1906 to explore in Russia, found the yellow-flowered *Siberian alfalfa.* That same year, a new, distinctive *Arabian alfalfa*—not hardy, but suited for the irrigated lands of the Southwest—was brought to public attention. Hansen returned to Siberia in 1908 and secured more seed and different types of the yellow-flowered alfalfa and other forage plants. Of more than six hundred varieties of alfalfa tested in 1927, the Peruvian proved the most valuable.

The *berseem clover,* now grown to some extent in the Southeast, was brought from Egypt by Lathrop and Fairchild for use as a soil reclaimer and enricher. On a visit in 1903 to the estate of Cecil Rhodes near Capetown, Lathrop and Fairchild also obtained seed of *Rhodes grass,* a valuable hay crop. Fifteen distinct varieties of velvet beans, most of them from Asia, had been planted in Florida by 1909. One of these, the *Lyon bean,*

very productive of seed pods, already was being grown throughout Florida.

Korean lespedeza, introduced in 1919 and again in 1921, proved useful in the South and Northeast because it was able to withstand unfavorable growing conditions. Its planting had been extended to 5 million acres by 1935. H. L. Westover explored through southwest Asia in 1929. Again the following year, with K. A. Ryerson, he searched North Africa and Spain for varieties of alfalfa resistant to bacterial wilt. This disease had appeared in the Midwest about 1926 and crop losses in many cases reached 25 per cent. In 1934, Westover also toured Russian Turkestan, Persia, and Afghanistan with C. R. Enlow, searching for plants that would prevent soil-erosion in the Great Plains. They returned with eighteen hundred lots of seeds from drouth-resistant plants, some of which, it was hoped, would yield suitable plant covers for wind-blown topsoil.

The expedition to Central Asia secured grasses and legumes from areas bordering the Gobi desert in 1935. More than a thousand grasses and forage items for soil control were collected by the Division of Foreign Plant Introduction in 1936, and the following year a similar collection was made.

COTTON

Various lots of seed of Egyptian cotton were secured prior to 1900, but selections from seed of the *Mit Afifi* procured by Fairchild about 1901 were the basis of successful Egyptian cotton production in Arizona. Alkali-resistant cottons and other types were secured at the same time in Egypt and Algeria to promote long-staple production in the United States. The Department hoped to extend cotton cultivation into alkali lands and produce the long-staple cotton which was being imported to the extent of $15 million annually. For several years growers were disappointed with Egyptian cotton due to its rank growth and other undesirable changes caused by the transfer from its original home. However, efforts at adaptation by selection brought a yield of two bales per acre in Arizona in 1908. Three superior varieties discovered were the *Egyptian, Durango,* and *Acala.* By 1913, 3,500 acres were being grown, and the value of the crop in 1920 was $20 million.

In 1905, Peruvian and East Indian varieties were being tried

to find cotton that could resist the boll-weevil attacks. The weevil was seriously reducing yields and destroying some crops completely as it spread from Mexico into the cotton South. Growers soon found that the weevil-resistant varieties from Mexico and Central America possessed other valuable characteristics such as long-staple lint and large bolls. From these varieties growers developed the Durango which extended the northern limits of cotton production in both Virginia and Texas. In California it was planted to 30,000 acres in 1914. The Acala, an upland cotton brought from Southern Mexico in 1906, also had shown many points of superiority by 1914. It entered into commercial production in 1916, and by 1924 had become widely acclaimed for its earliness, large bolls, and strong fiber. This had become the predominant crop in the irrigated valleys of the Southwest and the Imperial Valley in California by 1928, and its annual value exceeded $50 mllion.

TROPICAL PLANTS

Dates—Large collections of dates continued to be made in the search for varieties to extend the crop into other parts of the Southwest. In 1901 the best Egyptian varieties were procured. Lathrop sent in a large shipment of young date plants in 1902, and the Department of Agriculture had an eleven-acre cooperative orchard established in Arizona and planted to 580 imported trees. The first successful crop of the *Deglet Noor,* a widely marketed sort, was produced in 1904 in this cooperative garden with the help of the California Agricultural Experiment Station.

Thomas H. Kearney procured many valuable varieties in Tunis in 1905. At the same time, he spent several months investigating olives and discovered the *Barouni,* now a successful olive in California. In the same year, H. A. Rankin, an Englishman in Egypt, was commissioned to secure superior date varieties from Fayum, Egypt. The Rev. S. M. Zwemer, a writer on Arabia, made a journey into the oases of that country for other varieties.

The date garden at Tempe, Arizona, established in 1900, had 143 varieties in 1912, and other experiments were being conducted in cooperation with private growers in California, Arizona, and Texas. Further date importations from Egypt were made in 1912 in the form of offshoots. The policy established in 1921 stressed the importation of proven Old World dates to extend the industry and replace poor varieties. Galloway esti-

mated the value of the expanding date industry in 1928 at $500,000. From these studies, more scientific information on the date accumulated in the Southwest than in all the date growing regions of the Old World combined.

The acquisition by the United States of tropical island colonies after the Spanish-American War provided climates suited to the production of crops that had been suggested for Florida. Experiment stations were set up in the colonies to determine what varieties of coffee, cacao, bananas, avocadoes, fiber plants, and rubber plants were most desirable, before introducing these plants into the United States.

Mangoes—After a tree of the East Indian mulgoba mango survived a severe freeze in Florida in 1895, the Bureau of Plant Industry sought other mangoes with resistance to frost. Fifty of the best varieties from India also were procured in 1903 to satisfy a mango enthusiasm among growers in the South. The Department had the largest mango collection in the western hemisphere in 1905 with more than a hundred varieties. Collections were sent to Florida, Puerto Rico, and Hawaii for fruiting trials. Fiberless East Indian mangoes had fruited in Florida by 1909. Mangoes were looked upon as a coming crop in the South and there was a great demand for grafted varieties. Florida mangoes are now marketed to a limited extent at high prices.

Avocadoes—Hundreds of introductions of avocadoes were made in early efforts to establish them in California and Florida. After Guatemalan varieties introduced in 1914 had been propagated for distribution, the plant's value became recognized. The most important contribution to this crop was the collection of twenty-three varieties sent from Guatemala by Wilson Popenoe in 1916. After distribution of these, many avocadoes came into commercial production. A search for cold-resistant varieties brought more valuable plants from Ecuador and Mexico in 1922.

The *mangosteen,* a tropical fruit promoted by Fairchild after he had been attracted by it in the East Indies, failed to prosper for lack of a good root system. To increase its chances of success, a related plant was found in 1909 for use as a rootstock. Pineapple plants were secured in 1903 from Natal, South Africa, to improve this established crop.

Cassavas and *dasheens* were considered desirable for their fleshy, edible rootstocks. P. H. Rolfs, an agent of the Depart-

ment sent to Jamaica in 1903, purchased a collection of cassavas there including many varieties high in starch content. These were tested and grown for use as stock feed. Many new tropical yams and dasheens were introduced in 1920. The Department made 1,600 distributions of dasheens in the South that same year. They were considered as a possible cheap substitute for potatoes, and with promotion by the Department are still grown to some extent in the southern states.

Bamboo—The many uses of bamboos in the Far East suggested to the explorers, especially Fairchild, that these might be grown in the southern and western United States. An agent in Japan in 1908 returned several thousand plants, including types grown for edible shoots. Of 3,000 bamboo plants of hardy timber kinds imported in 1909, a large number were planted at the Chico Introduction Garden in California. Successful growths in 1916 showed that United States growers could produce canes comparable to those grown in the Far East. In these tests a ten-acre planting of bamboos was made at Brooksville, Florida, and a smaller planting made at Avery Island, Louisiana. In 1919 two more edible types were secured for experiment.

Investigations in the production of rubber in the United States have been concentrated on the use of native wild plants, but in 1927 two kinds of African rubber-producing trees and two ornamental rubber-producing vines from Madagascar were planted in Florida for trial.

MISCELLANEOUS INTRODUCTIONS

Thousands of fruit introductions suitable to temperate and northerly climates have been made by the Office of Seed and Plant Introduction. Only a few specific collections can be named, but many of the items brought in for use by breeders and experimenters contributed desirable qualities to the familiar fruits. The prune industry in the Pacific Northwest is indebted to an agent sent to France whose studies of the prune industry there led to the importation of several worthy varieties. Peaches, apricots, and cherries were secured from Mexico in 1903 by Onderdonk.

Over a hundred varieties of French phylloxera-resistant grapevines were secured in 1904 for trial in the infected vineyards of California, and a number of resistant South African grapevines were sent in by Lathrop. In 1904 two hundred hardy *Vladimir*

Sib pollination of a squash flower. One of the methods used at the Regional Primary Introduction Stations to prevent cross-fertilization of the various species. Taken at the Ames, Iowa, station.

cherry trees were brought from Russia for the Northwest, and an entirely new fruit-producing vine, the *yang-taw* from central China, was presented to the Department by Consul Wilcox of Hankow. About two hundred peach varieties with unusual cold resistance were received from the Caucasus in 1944.

The *Jordan Almond* was successfully introduced in 1903 in California. Although almond crops of several million pounds were then being produced in California, the quality was so inferior to the Jordan of Spain that large quantities of nuts were imported annually. In 1906, 6,000 trees of the *pistache,* a green-fleshed nut used in coloring and flavoring confections, were sent to experimenters, and new varieties from the Turkestan and North China were introduced. Hardy wild stocks were being secured and studied for use as rootstocks at the same time, and Kearney secured the best almonds from Italy. Later Meyer was to find many types in Asia, but progress has been slow for this crop in America.

Potatoes—L. R. Jones, an explorer commissioned to go to Europe in 1905, collected ninety potato varieties on the Continent. In the same year, four varieties from the higher altitudes of Ecuador were sent to the United States by the Minister of Commerce and Agriculture of Ecuador, and an Uruguayan variety also was brought in. The Department received seventy-two varieties from Chile in 1909 to be used in breeding blight-resistance and potatoes for dry-land farming. Explorations in the Andes of Peru and Bolivia in 1913 secured over 250 sorts of wild and cultivated potatoes and proved this region to be the native home of the Irish potato. Four explorers, Donald Reddick, C. O. Erlanson, Paul Russell, and M. J. Souviron, searching for wild and cultivated potatoes in 1930 in Mexico, made collections for breeding resistance to blight and cold. Corn from Central America secured for acclimitization in 1906 behaved very erratically in the new, northerly environment.

Matting—Agriculturists were concerned at the turn of the century with the fact that $4 million worth of matting materials had to be imported yearly because there was no competitive native crop. Growers in South Carolina wanted a substitute crop for their rice fields which could no longer compete with the rice fields in Texas and Louisiana. The Department of Agriculture sent John H. Tull to Japan in 1906 to study the industry and secure plants. Attempts to introduce rushes two years earlier

had not been successful. Tull encountered opposition from the Japanese matting industry similar to that experienced by other explorers—the communities feared they might be deprived of a market for their commodity if they permitted plants to leave the country.

However, the final abandonment of the matting industry in America was not due to the difficulty in securing plants, but the economic aspects of its cultivation. Upon Tull's return, the Japanese rushes were distributed and a machine invented for mat-weaving. Many other varieties of rushes and reeds also were collected in Asia. Agriculturists hoped these crops might utilize abandoned rice fields, cheap swampy lands, and parts of the Mississippi delta. Although large collections of the plants had been established by 1908, the problem of securing enough cheap labor brought the work to a standstill, and attempts to promote a matting industry were abandoned the following year.

Experiments in the use of reeds for lathing in building construction were abandoned due to the cost of preparation and other findings of the experiments. The mitsumata paper plant, from which a very superior quality of paper was manufactured in Japan, was used in experiments, but failed to win notice after a few years.

Work over a period of many years by the Bureau of Plant Industry has resulted in a thriving bulb industry in the state of Washington. Introductions of quantities of bulbs for breeding from Bermuda, Japan, and other countries contributed to this success.

The Bureau also assisted tobacco cultivation by making introductions until varieties were found which would meet the exacting requirements of that industry. In 1901 Cuban and Sumatran varieties were introduced. Other varieties from Cuba were secured in 1904 for use as wrapper-leaf tobaccos, and in 1936, 655 tobacco items were imported for breeding purposes.

SOYBEANS

Soybeans from Asia are probably the most outstanding plant introductions since the Kharkov and durum wheats. Economic products of the soybean plant, now a major field crop, include hay, forage, food and feed products, and oil for many industrial uses. Recent introductions of the soybean have been merged

by breeding, into new, superior plants with little resemblance of the original.

Interest in the soybean as a commercial crop began with the introduction of three varieties from Japan in 1900. Nearly three hundred varieties were obtained in China, Japan, and India in 1909. The Department recommended soybeans as a crop that could be substituted for cotton in the South.

In 1910, twenty soybeans from a group of 350 under test were selected for wide distribution. Three hundred varieties received from Korea and northern Manchuria in 1914 were expected to extend soybean cultivation northward in America. An increased acreage was planted in 1916 for oil production and stock feed. Four years later there was a rapid expansion in the cultivation of eight selections made by the Department from over a thousand varieties collected up to that time.

Further selection progressed as soybean acreage was expanded. The distribution of soybeans was a prominent feature of field crop seed distribution after 1914. Estimated value of the crop of 2,500,000 acres in 1924 was $23,917,500. Because of its contributions to the new industry, the Bureau of Plant Industry claimed credit for half this value. Ryerson, in 1933, stated that all but three of the twenty varieties of soybeans then in cultivation were found by the Office of Plant Introduction.

When it became clear that the soybean would be a major crop, the Department decided to send two explorers to search the soybean areas of Japan, Sakhalin, Manchuria, Korea, and China to make sure our farmers would have the best varieties. After two years of work, P. H. Dorsett, of the Division of Plant Exploration and Introduction, and W. J. Morse, of the Division of Forage Crops and Diseases, returned with almost three thousand varieties.

The expedition also collected seeds of mung beans, lespedeza, alfalfas, barleys, wheats, grasses, and other agricultural plants. More soybean varieties were obtained, especially from Manchuria, in order to extend their cultivation to new areas. The acreage in soybeans continued to increase to meet the demands for the crop as food and feed, and for industry in the manufacture of paint, varnish, and glue.

Tung trees, identical with the varnish trees referred to by early plant explorers, were fruiting in 1910 from introductions

made by the Bureau of Plant Industry. Subsequently, small test plantings were made in the South. The crop was publicized widely as one that could be grown on poor lands. While the crop has not been grown on a large scale in this country because of the winter-killing, its production serves as a stimulus to the Chinese growers to export a good quality of unadulterated oil.

SUGAR CANE

The importance of a continuing supply of fresh sugar cane stocks has not diminished since Charles Mason first secured the assistance of the Navy in procuring East Indian varieties. Mosaic disease, a great enemy of Louisiana cane growers, has necessitated the breeding of new, resistant types. Javanese varieties restored the industry in Louisiana in the 1920's. But explorers in 1928 had to secure further cuttings for breeding stocks. Over a hundred varieties were found in New Guinea and Papua. In 1935 the Department claimed that the introduction of the mosaic-resistant varieties had maintained the sugar industry of Louisiana at an annual value of $20 million, and had saved investments of $100 million. New threats of mosaic among the resistant varieties developed in 1935, indicating that further work had to be done.

Beans were imported from Mexico in 1903 and again in 1945 from Chile, Columbia, Peru, and Mexico to supplement a breeding program. The spineless cacti of Tunis were brought to America in 1905 to test their utility as a feed crop. Thousands of plants of the Japanese blanched salad vegetable udo, similar to asparagus, were distributed about the same time. Hemp seed from Manchuria and China was tried in Kentucky, Nebraska, and California.

America began exchanging large numbers of plants with Latin American countries during the 1930's, and continued the practice during World War II when plant imports from other lands were shut off. As an example, cultivation of the *Derris elliptica*—the roots of which constitute a source of rotenone—has been extended by distribution of over 2 million cuttings to Latin American countries.

THE WAR YEARS

When the Japanese invasion spread over plantations of vital tropical crops in 1942, the Bureau adopted a new program of self-sufficiency in the Americas. From seed flown in from the

Philippines, several million young cinchona trees were raised at Glenn Dale, Maryland, and later flown to Latin America. Thus the cinchona returned to the western hemisphere. It had been discovered in 1852 in Peru by the Dutch botanist Hasskarl and sent to tropical Asia for cultivation.

The abaca, a banana-like Manila fiber plant, was planted in the Americas on a commercial scale for the first time during World War II. Corn strains came from Argentina, oat species from Uruguay, and a number of grasses, legumes, and varieties of opium poppy came from below the equator.

Dissemination of new plants was effected through field stations and by correspondence with individuals as well as by special agreements with experiment stations, superintendents of city parks, and private experimenters. Plant quarantines were tightened, and laboratory facilities increased to handle specimens.

Facilities for receiving introductions in 1944 consisted of the original stations at Glenn Dale, Maryland, the station at Savannah, Georgia, devoted to oriental crops including bamboos and chestnuts, and another at Coconut Grove, Florida. The Florida station has one of the largest permanent collections of living subtropical and tropical species and varieties in the western hemisphere. A fourth station at Chico, California, maintains collections of deciduous fruits, and such trees and shrubs as prefer the warm-arid climate of the west coast.

INVENTORY OF INTRODUCTIONS

In recent years, between three and four thousand items have been inventoried annually by the Office of Seed and Plant Introduction. Approximately 180,000 introductions have been recorded since the establishment of the Office. Table 8 shows an estimate made by Galloway in 1928 of the number of varieties of fruit crops inventoried by the Office.

The Department of Agriculture also maintains a large collection of important crop seeds to meet the demands for breeding materials. In 1945 this collection included 8,500 strains or varieties of wheat, 4,000 of barley, 1,000 rice, 400 flax, and sorghum and corn about 300 each.

The Research and Marketing Act of 1946 represented a significant development in plant work. It provided funds for a federal-state cooperative program of exploration, introduction, and test-

ing of plant materials for both crop and industrial uses, as well as the cataloging of present genetic stocks, and the preservation of basic germ-plasm for future breeding programs.

Regional activities have been centralized around four primary introduction stations at Pullman, Washington for the Western Region; Ames, Iowa, for the North-Central Region; Glenn Dale, Maryland, for the Northeastern Region; and Experiment, Georgia, for the Southern Region.

Foreign seeds received by the Division of Plant Exploration and Introduction are sent to these primary introduction stations for repropagation and distribution to state experiment stations. The growing plants are given a preliminary check for growth and disease factors at the primary stations, but detailed evalua-

TABLE 8

FRUIT CROP VARIETIES INTRODUCED BY OFFICE OF SEED AND PLANT INTRODUCTION

Crop	No. of Varieties Introduced
Apples	600
Avocadoes	353
Blackberries	100
Jujubes	225
Mangoes	498
Nectarines	50
Peaches	500
Pears	700
Oriental persimmons	600
Plums	450

Based upon an estimate made in 1928 by B. T. Galloway, Department pathologist.

tion of the plants and work on breeding programs is left to the experiment stations.

To insure the passing on of the "pure" strains as they are received, the primary introduction stations frequently resort to hand pollination of certain species that would otherwise cross freely by insects or windborne pollen. (See Fig. 3). In hand pollination it is necessary to keep both the male and female flowers covered to insure the desired parentage.

Where it is impractical either to isolate or hand pollinate large numbers of normally insect or wind-pollinated species, the plants are increased by vegetative cuttings. For growing areas

other than those directly served by the primary stations, secondary regional introduction stations have been planned. At these secondary stations, crops which have shown themselves adaptable to that area will be grown. This will relieve the primary stations of part of their repropagating burden and place the plants where they can thrive best.

Under the provisions of the Research and Marketing Act, five exploring expeditions were sent into the field between 1946 and 1948. Disease-resistant potatoes were secured from Mexico by D. S. Correll. Varieties of Mexican and Guatemalan cotton were found which have plant and fiber characteristics that may prove helpful in improving American upland cotton. Forage plants and wild and cultivated strains of peanuts came from South America. J. R. Harlan went to Turkey to find vegetables, forage plants, oil plants, and cereals for a domestic breeding program. In 1949, W. N. Kelz, was searching India for cereals for winter forage and plants with potential industrial uses. From these expeditions more than 4,500 introductions had been obtained and distributed to thirty-eight states by 1948.

LOOKING TO THE FUTURE

It seems certain that plant research and introductions of the future not only will contribute new food crops, but will aid as well the progress of mechanical and chemical technology. Often when experimenters develop disease-resistant plant varieties, the disease organisms in turn adjust themselves by developing new virulent strains. Redesigning plants with the desirable characteristics of many species fused into a single new variety offers a limitless challenge to plant workers. Like the introductions of Colonial days, the plants of tomorrow become America's crop heritage for future generations.