Ornamental Plant Introduction— Building On the Past

It is a particular pleasure to participate in the Centennial Celebration of the Arnold Arboretum, not only because of the esteem with which we all hold "The Arnold", but also because of the fact that I have been assigned a subject to which I have devoted the major portion of my career — plant introduction and exploration.

As many of you know, plant introduction is a foundation stone on which a successful arboretum, botanic garden, or like institution, must build. Any one of the special activities that is encompassed by the broad term "plant introduction" can be an exciting program, whether simply exchange of plants and seed, the undertaking of actual field explorations, or the subsequent evaluation of introduced plants. The Arnold Arboretum has been deeply involved in all these pursuits and, because of its role in the introduction of new trees and shrubs and the explorations of E. H. Wilson in Asia, has often been called "America's Greatest Garden".

During the course of the past 100 years, the Arnold Arboretum has introduced more than 2,000 new plants, of which 60–70 are common in American gardens. The Arnold Arboretum is, of course, not alone in such activities, although during the early part of the 20th Century it was the Arnold Arboretum and the U.S. Department of Agriculture that were responsible for the majority of introductions through exploration. Today, many arboretums and botanic gardens are engaged in plant introduction, and there is no longer a single "greatest garden" but, rather, many great gardens share in the efforts to introduce new plants to the American public.

Although the USDA has been engaged in plant explorations since 1897 and has undertaken over 150 explorations, these have been mostly for economic crop plants. Early USDA explorers did not ignore ornamental plants when encountered, but only the Arnold Arboretum sent out collectors whose main objective was to collect ornamental plants. It is fairly safe to say that these two organizations have pre-empted plant ex-

Reginald Farrer

Frank N. Meyer

George Forrest

Photo: P. Popper

ploration for the United States, while English collectors have been in the same position in Europe. In 1956, however, the USDA, as a result of the cooperative Longwood-ARS program, assumed the leading role in ornamental plant exploration which I will discuss later.

The history of plant exploration since about 1900 is replete with incidents of high adventure, encounters with adversity and tragedy, often in the loss of valuable plants enroute, failures after plants had arrived, and, sadly, in the death of plant collectors in the field — Frank Meyer (1918), Reginald Farrer (1920), and George Forrest (1932) — all of whom met their fate in the China or Burma region. While it is the professional explorer who must receive the plaudits for his contributions to horticulture due to his authoritative role and, in part, to the better documentation of his collections, mention must be made of the missionaries, doctors, foreign service officers, and occasional travelers who accounted for many of our plant introductions. A medical missionary, Ralph Mills, collected the handful of seed of Korean Lespedeza (*Lespedeza stipulacea*) in 1919 that was the basis of this multi-million dollar crop. A missionary, A. S. Cooper, introduced the lot of seed of *Ilex cornuta*, P.I. 65860, from which the widely-used clone 'Rotunda' was selected. The USDA inventory states that he collected the seed near Ichang, China, in 1923. Those of you who are familiar with the travels of our Chinese explorers will appreciate that this was the principal starting point on the Yangtse River for journeys into western China. This lot of seed was sent to the McIlhenny Estate, Avery Island, Louisiana, where it was sown and the seedlings planted into a long hedgerow. From this highly variable introduction, nine named selections have been made. Another scarcely-known collector was the departmental pathologist, R. Kent Beattie, who traveled in Japan and Korea from 1927 to 1931 while studying chestnuts, particularly *Castanea mollissima* and *C. crenata*, for sources of resistance to chestnut blight. In addition to large shipments of chestnuts, he sent back a number of ornamental plants. But, chiefly, he should be remembered for the collection of some 80 evergreen azaleas that were used by B. Y. Morrison as parents in the development of the Glenn Dale azaleas. When I traveled to Japan in 1955, Beattie's notes on Japanese nurseries and the lists of rare plants he encountered there were most valuable since the nurseries still maintained many of the plants described by Beattie. Today, because of very strict international quarantines, limitations of where most people can travel in foreign countries,

and fewer opportunities to encounter unique plants, the role of the casual collector has all but disappeared.

I should now like to return to the professional plant collectors and comment on some of their journeys. The grand period of ornamental plant exploration began just prior to 1900 and continued up to about 1930. In 1899, E. H. Wilson set off for China on behalf of the English firm, Veitch and Sons. Before starting his field work, Wilson spent some time with the famous British medical officer, Dr. Augustine Henry. Henry was one of the most learned botanical collectors of the 19th Century, with years of experience in China, and was stationed at Ichang from 1882 to 1889. Wilson's two trips for the Veitch nursery in 1899 and 1903 netted a number of important ornamentals of western China, but chiefly his early trips are remembered for the introduction of *Davidia involucrata* and *Meconopsis integrifolia*. On Wilson's return to England, his reputation as a plant collector was established. Here begins one of the more intriguing developments in plant exploration of the early 20th Century.

David Fairchild, champion of plant exploration in the Department of Agriculture, was responsible for many of the Japanese economic and ornamental plants introduced into the United States. He arrived in Japan on April 26, 1902, but, according to his notes, too late to see the flowering cherries he had set out to collect. However, he traveled the length of Japan, sampling the curious edibles with enthusiasm. The margins of his field map are annotated with notes on interesting plant localities. During his journey, he noted the extensive use of *Zoysia japonica* as a lawn grass and sent the first introductions of *Zoysia* (P.I. 9299–300) to the United States, along with a collection of 18 bamboos and 30 varieties of flowering cherries. To David Fairchild we owe recognition not only for his own collections, but also for his sustained encouragement of the Department's plant exploration program in China, resulting in vast numbers of plant introductions that have contributed to American agriculture.

Charles S. Sargent, who had already been to Japan in the fall of 1892, was also determined to develop a leadership role for the Arnold Arboretum in plant exploration in the Orient. While Sargent spent only 10 weeks in Japan, his journey to Mt. Hakkoda was most rewarding. Not only must it have encouraged him to give primary attention to woody plant introductions from the Orient, but he introduced *Rhododendron kaempferi, Acer nikoense* in large quantity, and several mag-

nolias into the United States. It was here that he may have been encouraged by James Veitch to emphasize collecting in China. Japan for many years after was not intensively explored for ornamental plants.

Fairchild employed Frank Meyer, a Dutch immigrant, in 1905 to undertake extensive explorations in China. Meanwhile, Sargent was negotiating for the employment of E. H. Wilson, who finally accepted to collect in China for two years and hoped to return to become a member of the Arboretum staff. Meyer arrived in China in 1905 and concentrated on economic plants near Peking during the first winter, then moved down to the Yangtse River in the spring of 1906 and slowly journeyed northward during the summer as far as Manchuria and western Korea, collecting small grain cereals, forage crops, and soybeans. His shipments from northeast China included, as well, fruits with unusual hardiness and a number of shrubs and shade trees.

Wilson arrived in China in 1907 and met with Meyer in Shanghai on an arrangement between Sargent and Fairchild. Meyer explored the Lau-shan mountains and agreed to collect in the Wu-tai mountains, a rather desolate and disappointing region. Nevertheless, Meyer collected more than a thousand seed and plant specimens from North China and returned with a wealth of information on dry-land farming methods and other facts on Chinese agriculture. Wilson, meanwhile, traveled his familiar route up the Yangtse from Ichang and spent the next two years collecting in western Hupeh and Szechuan, from Cheng-tu across the mountains to Tatsien-lu, and covered the triangle formed by the mountains Wa-wu-shan, Wu-shan, and Omei-shan. Keep in mind that, although this was only a journey of less than 100 miles, the terrain was of such a dangerous nature it was indeed a remarkable trip and yielded more than 2,000 packets of seed and 1,400 living plants. Both explorers returned to the United States; Meyer in 1908 and Wilson in 1909. And both soon were back in the field; Meyer in central Asia in 1909 and Wilson again in China in 1910. The accounts of their further journeys are so familiar that I need not go into them here.

From the various letters and comments in books by and about Fairchild and Sargent, there was to continue an obvious amount of professional suspicion throughout their relationship. It is somewhat reflected in the attitude of Wilson and other collectors toward the rather morose Meyer. But I can find no similar attitude of his colleagues in the letters written by Meyer to Fair-

child. Indeed, Meyer's methods of collecting, with little attention to herbarium specimens and other supporting materials, his patient resolve to remain in the field in winter, and his attitude toward the Chinese customs, seem to have annoyed other collectors in China (see Farrer, R. *On The Eaves Of The World*, Vol. II:276–282. 1917). Herein Farrer describes, with his vivid flair for over-emphasis, his encounter with Meyer in the village of Siku, Kansu Province in 1914. It is one of the enjoyable insights into the highly complex attitudes that prevailed among these individualistic collectors. It must also be remembered that Purdom, who had followed Meyer on an equally unfruitful journey to Wu-Tai for the Arnold Arboretum in 1909, was now the traveling companion of Farrer during the 1914 expedition to Kansu and may also have influenced Farrer's opinions.

Despite their keen competition, these two very strong leaders (Fairchild and Sargent) did not permit their feelings to interfere with the sharing of introduced materials between the Arnold Arboretum and the USDA. This cooperation has continued through the century to the general benefit of American horticulture.

The fervor of plant collecting in western China peaked just prior to the First World War. No fewer than six well-known British and American collectors — Farrer, Forrest, Kingdon Ward, Meyer, Purdom, and Wilson — could be found attacking the great snow ranges of western China, up from Burma as seemed to be the route for Forrest and Kingdon Ward, or along the Yangtse River with Ichang as the starting point for Wilson, and the North China route for Meyer, Purdom and Farrer. Following the First World War Joseph Rock began collecting, first for the USDA in 1920 and later for the Arnold Arboretum and the National Geographic Society, until 1934. But now, Meyer and Farrer were both dead and Wilson had left off field work, leaving Forrest and Kingdon Ward to continue collecting. Kingdon Ward was the only one of this group who carried on into contemporary times. His field work exceeded 40 years and the amazing record of 23 expeditions. Few, if any, more recent collectors of note of ornamental plants can be added to this list. Fairchild did, however, continue his travels in the 1920's and 1930's to Europe, Africa, and South America, expounding on the importance of plant exploration and encouraging others to collect. The USDA continued in its collecting of economic plants and sent 38 exploration teams into the field between 1930 and World War II, and many of these collectors sent home ornamental species.

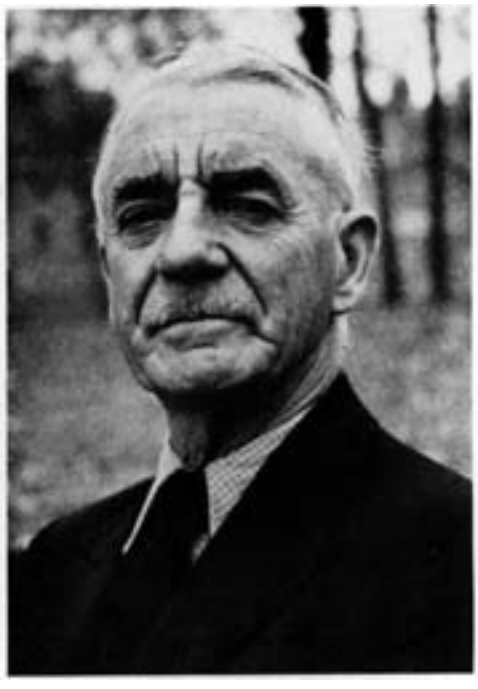
Time does not allow for a discussion of the many introductions of plants obtained during the first 40 years of the 20th Century that survived the rigors of climate, war and depression, and horticultural acceptance to become important nursery plants. These are well documented in horticultural literature. As for plant exploration, an era was at end. No longer would explorers roam remote places on trips of several years' duration and the methods of collecting and shipment would be sharply changed by the advent of plastic films and the airplane. As for China, it was thought that the cream of the species had been collected already and there was little reason to continue interest in that country. But it should be noted that this same opinion was voiced prior to the explorations that began the 20th Century.

The present era of plant introduction opened with a resounding discovery. *Metasequoia glyptostroboides*, previously known only from paleobotanic records, was discovered in China as a living species in 1945. Following this lead, the Arnold Arboretum promptly supported an expedition to the locality on the Szechuan-Hupeh border. As a result, a limited stand of about 1,000 trees was discovered in the Shui-sa-pa valley in Hupeh. Seed from this find was widely distributed by the Arnold Arboretum in 1948 and seedlings became established in almost every suitable locality around the world. I first reported on the rooting of *Metasequoia* from juvenile cuttings in 1948 and the National Arboretum selected and released a clone, 'National', in 1963 from P.I. 16188. This came from seedlings growing at the National Arboretum as the result of a shipment of seed sent from the National Central University, Nanking, to the USDA in 1948. I believe no species received as wide and as rapid a distribution around the world as was the case of *Metasequoia.*

The finding of *Metasequoia* in a locality not far from where many early explorers had worked rejected the concept that the enormously rich flora of China had been sampled to the point of diminished returns. The opportunities to find new forms and more useful variants of ornamental plants in China was as promising as at any earlier time.

During the first several years after World War II, arboretums that received scant support prior to World War II, such as the National Arboretum, began to progress markedly. Their interests turned to the evaluation of the many early introductions now reaching maturity in our arboretums, botanic gardens, and other test localities. A broader interest in horticulture resulting from the development of suburbia caused horticulturists

B. Y. Morrison



F. Kingdon Ward

Photo: J. E. Downward

to look for better and different types of trees and shrubs. Dr. Donald Wyman provided outstanding leadership in this research evaluating hundreds of species and varieties trying to develop lists of those with the best qualities. Others followed this same approach. For example, when Frank Meyer collected seeds of *Pyrus calleryana* in China, his main purpose was a source of fire-blight resistance. The ornamental possibilities of this species were not even considered. In 1952 I selected a tree from the few specimens of *P. calleryana* remaining at the U.S. Plant Introduction Station, Glenn Dale, Maryland, grafted it onto *P. calleryana* seedlings, and established the trees in a nearby subdivision for a street tree study. Over the ensuing years, this selection has become more and more popular and the USDA named it 'Bradford'. Today, the 'Bradford' pear is regarded among the top ten trees for street planting in eastern United States. But it is limited in its cold-hardiness. Perhaps a search of its native Chinese homeland will locate additional germ plasm for evaluation. This species, it is important to note, was first introduced into the United States in 1908 by E. H. Wilson.

Ornamental exploration had yet to fully recover from the War years. Kingdon Ward was back in the field and conducted six explorations in the Assam-Burma area between 1946 and 1957. The Royal Horticultural Society and the Japanese sent teams of explorers to Nepal in the early 1950's. In the United States a new concept of plant collecting resulted from the 1946 Research and Marketing Act. It gave support to foreign and domestic exploration on a sustained basis. Previously there were few Federal funds for explorations, and no mechanism to provide for inputs by States and others in determining priorities for exploration. Under the new Federal/State cooperative program plant explorations became mission-oriented with emphasis on collecting to fill the gaps in our germ plasm base of specific crops. General collecting became a thing of the past. In addition to introduction activities, this program provided for four regional introduction stations — Geneva, New York; Ames, Iowa; Experiment, Georgia; and Pullman, Washington. Later a special inter-regional potato station was established at Sturgeon Bay, Wisconsin, and in 1958 a National Seed Storage Laboratory was established at Fort Collins, Col. to house our genetic resources under optimum conditions for long term storage.

Provisions were also made for domestic explorations, taking advantage of the many experiment stations and their scientific staffs to conduct the field work. Since 1953, 39 such collecting trips have been made, of which 9 have been for native ornamental plants, including rhododendrons, junipers, mountain ash, and ground covers. While the principal objectives of the regional stations were preliminary evaluation, increase, and distribution of plant introductions, some ornamentals were tested on a regional basis and released as named varieties. 'Cheyenne' privet, P.I. 107630, collected by Edgar Anderson during an Arnold Arboretum exploration in Yugoslavia in 1934, was introduced into the trade because of its superior hardiness in the northern Great Plains. A sweet basil (*Ocimum basilicum*) collected in Turkey during a field crop expedition in 1949 was named 'Dark Opal' by the Connecticut Agricultural Experiment Station because of the purple coloring of foliage and flowers. It received the bronze medal in the 1960 All-America trials.

Despite the profound effort at organized introduction of economic crop germ plasm, ornamentals did not share in the support. Quarantine laws had been tightened and many of the ornamental trees and shrubs previously imported from Europe

were prohibited. This was unfortunate in that arboretums like the Arnold, Morton, National, and University of Washington were renewing their activity in assembling clonal material from European sources. In order that new material might reach the U.S., the Arnold Arboretum proposed a program to the USDA in 1953 whereby restricted plants already known to be in the U.S. would not be re-introduced. Rather the Arnold Arboretum would act as an "agent" for other gardens, and evidently "new" plants would be shipped from Europe to the Plant Introduction Station at Glenn Dale, Maryland, for quarantine. After the required 2-year quarantine, the plants were then released to the ordering institution and propagated for other gardens. Individual botanic gardens and arboretums also searched European nurseries for non-restricted plants and these have continued to be introduced in order to fully understand the variation in our ornamental species and to locate improvements over current cultivars.

Perhaps the most significant event in modern ornamental exploration was the initiation of the Longwood-ARS program in 1956. Recognizing that current Federal programs did not include ornamental collecting, Dr. Russell Seibert proposed that ARS enter into an agreement with Longwood Gardens to collect ornamentals on a sustained basis. For the first time public and private institutions were joining forces to meet the needs of the gardening public by collecting wild and cultivated plant materials in the fashion of the early explorers. In order not to conflict with other efforts, the Longwood-ARS program concentrated on regions of the world where exchange of plants and seeds could not be easily accomplished; it supported explorations to centers of origin of important ornamentals, and provided for a thorough survey of botanic gardens and nurseries of Europe for improved varieties otherwise not available to American horticulture.

Thirteen explorations have now been completed under this program. Of these, 9 collecting trips have been to Asia, virtually ringing mainland China. The two most recent were the New Guinea exploration by H. Winters and J. Higgins in 1970 and my own journeys to Siberia in 1971. Materials collected on all these explorations are shared with experiment stations, botanic gardens and arboretums, and the nursery trade as rapidly as possible. For example, a large group of *Impatiens* collected from the 1970 expedition to New Guinea has already been released to growers. These have created considerable excitement by their striking range of flower color and variation in form

and foliage. This material will be the basis of new cultivars for the commercial trade and, in addition, will provide a wealth of germ plasm for breeding programs.

With this rich history of plant collecting by various institutions and the success achieved in the evaluation of plant introductions, it is now time to look to the future. In relation to economic plants, there is a broad collaborative effort underway under sponsorship of a consortium of international agricultural institutions to develop a global network to collect, evaluate, and conserve genetic diversity around the world. There is evidence that our world's genetic resources of crop plants are being displaced, depleted, and, in the case of some collections, discarded. As a result, priorities for crops and geographical areas have been defined by experts in plant genetic resources for immediate action. Inventories are being developed of the total holdings of collections of crop germ plasm. Despite an inventory of over 2 million items reportedly held by various nations, an FAO survey showed that only 28% are under secure conditions to assure their survival. These are largely in the U.S., USSR, and a few other developed countries. There will be an attempt to place the bulk of our genetic resources into major regional storages before they are lost. The need for immediate action is readily understood.

These programs do not include ornamentals since it is assumed that the various associations devoted to ornamental horticulture will develop their own program. These could very well be along similar lines to those proposed for economic crops. Already the American Horticultural Society is moving forward with its Plant Record Center to document living collections in the U.S. The Longwood program is providing for a long-range plan for exploration and, as discussed earlier, a system has been developed by the Arnold Arboretum to introduce plants normally prohibited from entry. Perhaps our weakest link is lack of a nationally coordinated program for evaluation of new ornamentals and a system of regional testing of superior selections for adaptation. There are some instances of this, but not on a major scale. In the North Central States there is a cooperative regional testing program underway among States and Federal institutions. This began in 1954 and provides for performance trials of selected ornamentals with respect to established criteria: survival, growth, freedom from pests and diseases, pollution resistance, and characteristics of foliage, flowers, and fruit. The results of these trials, reported on a 5-year basis,

provide scientists, nurserymen, and home-owners with reliable information on potentially new ornamentals.

As for plant exploration, we are all aware that the future is on the Chinese mainland just as it was at the turn of the Century. The advent of air travel and access to areas previously unattainable because roads did not exist offer opportunities for collecting beyond what was accomplished by early explorers. In addition, new information gleaned from the ensuing years of evaluation, plant breeding, and taxonomic research provide us with useful priorities for future collecting trips.

The hollies of Eastern Asia, numbering some 120 species, illustrate this point. Although China is especially rich in species of *Ilex*, we know many of them imperfectly because of the few introductions. A similar situation had existed with the species native to Japan, but it is now somewhat improved. Since 1956 a broad base of variability of the major Japanese species, *Ilex crenata*, has been introduced under the Longwood program. Over 50 collections of *I. crenata* representing its total range of distribution in Japan have been introduced and distributed. Seed lots of 14 other species and natural hybrids were introduced for the first time during this period.

One of the very interesting research findings in relation to Chinese species of *Ilex* is the naming of a new species, *Ilex centrochinensis*, by Dr. S. Y. Hu of the Arnold Arboretum. Long confused with *I. ciliospinosa*, this new species was first introduced from China not far from the locality where *Metasequoia* was discovered. The importance of this species has been its usefulness in crosses with *I. cornuta*, from which some remarkably fine hybrids have been produced. Since there probably has not been a single wild collection of this particular species introduced under its own name during the last 50 years, it offers a challenge to the future collectors in China. Equally significant information could be developed for other Chinese holly species, i.e., *I. cornuta, I pernyi, I. rotunda*, and *I. yunnanensis*, and for many other plant genera. Just as for economic crop species, ornamentals are threatened with eradication and because of their lower status are usually the first to go when land is diverted to other use. Species diversity, and finally the species themselves, disappear as a result.

As far as future plans for collecting in China are concerned, we might develop various levels of exchange programs such as have been in effect between the U.S. and the USSR since 1959. This initial exchange of seeds and plants on a *quid pro quo* basis developed into a mutually satisfying arrangement,

leading to four explorations of the USSR since 1963. We know very little about current germ plasm activities in China. It has been estimated that there are over 200,000 accessions of some 50 crops in Chinese collections. This is about the extent of the collections held in the U.S. and in the USSR. Probably a considerable amount of attention has been paid to ornamentals judging from earlier exchanges that took place between Soviet and Chinese botanic gardens. With airports at Cheng-tu, Szechuan, Kun-ming, Yunan, and development of modern roads in Western China, a new and equally rewarding phase of plant collecting in China may become a reality with exchange and exploration initiated simultaneously.

JOHN L. CREECH
Chief, New Crops Research Branch, ARS
U.S. Department of Agriculture