SOME UNUSUAL OPPORTUNITIES IN PLANT BREEDING

GEORGE M. DARROW, Senior Pomologist, GUY E. YERKES, Horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry

OPPORTUNITIES for the development of new and improved plants by breeding are by no means limited to those now grown in home or commercial gardens. All our present cultivated plants, it must be remembered, have been derived from wild plants. Those that were most outstandingly useful or most readily adaptable to cultivation, man took from forest and field and grew in his own doorway. Others he left in their wild state, for one reason or another, though he continued to use their products. One of the plants left wild until very recently was the blueberry. The work of the late Frederick V. Coville, described elsewhere in this Yearbook, shows how modern knowledge and modern technique, applied to suitable wild material, can change and improve it enormously for human uses. Not all neglected wild plants, undoubtedly, would produce such splendid results as the blueberry under Coville’s handling, but the achievement suggests that there is a wealth of material not yet touched, awaiting merely the right imagination and the right opportunity for the breeder to transform it in greater or less degree.

Some of the native wild plants and introductions from foreign countries need only careful selection of superior strains to increase their usefulness. In other cases a planned program of breeding is necessary, including crosses with types already in cultivation. It must be recognized that hybrids between distinct species are made with considerable difficulty in most cases, and only rarely are they directly valuable in a horticultural way. However, occasionally valuable things do come from such distant crosses, and the only way to find them is to make the attempt.

PLANTS THAT AWAIT THE BREEDER’S ATTENTION

Some of this material may be mentioned at random here. In the Northeastern States some people use milkweed like asparagus and also make soup of it. If varieties with many short internodes on their underground stems could be located and improved by breeding, they might be a welcome addition to the perennial vegetable garden. Different colored varieties of the butterfly milkweed might be selected and bred as ornamentals. Strains of the hard or sugar maple that came true to various autumn leaf colors would be desirable additions to our list of shade trees, and others might be found with unusually high sugar content in the sap, to be used in the sugar bush.
might reveal strains of longleaf pine trees having high turpentine yield. Trees of upright narrow form have special value in landscape use, especially for screens, high hedges, and narrow streets. Lombardy poplar, quite widely used for this purpose, usually proves short-lived. If more varieties of long-lived trees of this form could be developed, they would be valuable additions to our nursery products. Such forms have been propagated from American elm, several species of maple, English oak, oriental cherry, and others, but they have never been as extensively planted as this form warrants. Chinese elm apparently has received little attention from the standpoint of developing varieties of columnar or pyramidal or low-growing dense form, though such varieties would be useful, especially in sections subject to drought and other conditions adverse to some of the other trees.

Native hardy rhododendrons and azaleas are a fascinating group for breeding, with the object of developing varieties that would endure the summer heat encountered from Philadelphia southward better than present varieties, and also of increasing the winter-hardiness of some Asiatic forms, especially Rhododendron obustum Planch. and allied species. Although this group of plants is rather limited in its adaptability because of soil and climatic requirements, its use is increasing very rapidly wherever any of its diverse forms can be grown well. R. calendulaceum Torr., the flame azalea of the southern Appalachians, owing to its hardiness and splendid range of colors, offers a good subject not only for crossing with other species but also for selecting the best specimens in the wild and propagating them as varieties.

There are many unusual or unimproved native and introduced fruits awaiting the attention of the breeder. Some of these have been studied more or less casually, but many are worthy of systematic continued study. For the Northern States there are the barberries (Berberis spp.); buffaloberries (Shepherdia spp.); cornelian-cherry (Cornus mas L.); elderberries (Sambucus spp.); hawthorns (Crataegus spp.); honeysuckles (Lonicera spp.); juneberries, known also as shadberrys, shadblow, or sarvisberries (Amelanchier spp.); mulberries (Morus spp.); mountain ash (Sorbus spp.); wintergreen and salalberries (Gaultheria spp.); and for the more southern States, elderberries, juneberries, the mayhaw (Crataegus aestivalis Torr. and Gray), the species of Eugenia, feijoa (Feijoa sellowiana Berg.), the pawpaw (Asimina triloba L.), and the persimmon (Diospyros virginiana L.). The writers have been especially interested in the actinidias, the American cranberrybush, several species of Elaeagnus, the oriental quinces, and the Chinese bush cherries. Brief discussions of these as material for the plant breeder are given in the following pages. Some of the other fruits previously listed are just as promising, but they have not been so readily available to the writers.

**ACTINIDIA**

The actinidias (known also as Chinese or Japanese gooseberries and sheep peaches) are climbing shrubs, chiefly of eastern Asia, ranging from the northern part of Japan south to the tropical islands.
Some seven species are in cultivation chiefly as ornamentals, for their beautiful foliage is remarkably free from insects and fungi. Two species, at least, are worth cultivating for their fruit, *Actinidia arguta* Miq., which is hardy in New England (fig. 1), and *A. chinensis* Planch., which is hardy north to Washington, D. C., though the growing season does not seem to be long enough at Washington to mature the fruit. In southern California very fine crops of *A. chinensis* are sometimes produced. The fruit of *A. arguta* is about an inch long, that of *A. chinensis* up to 2 inches, or about the size and shape of a medium to small hen's egg. The fruit is tart until fully ripe, when it is sweet, with a texture somewhat like that of a fresh ripe fig. It is used fresh, for jelly, and for sauce. The leaves of *A. chinensis* are relished by cats, like catnip. Michurin, the Russian plant breeder, has intro-

*Figure 1.—One of the actinidias (Actinidia arguta) on a trellis at the Arnold Arboretum, Boston, Mass. The actinidias are potentially important food plants of the United States, just awaiting the study of a plant breeder. This species bears fruit about an inch long; but another kind, *A. chinensis*, bears fruit up to 2 inches long.*

duced five varieties, Ananasia Michurin, Clara Zetkin, Pozdniaia (late), Raniaia (early), and Urezhainaia (high-yielding). The beauty of the vines, their wide climatic adaptation, their vigor, and the pleasing flavor of the fruit make them promising for the United States. They are readily propagated by softwood and hardwood cuttings and by layering. The one need is the origination of varieties regularly productive, for the seedlings now grown only rarely produce heavy crops. A single vine may produce several bushels of fruit one year and only a few fruits most years. Hybrids between *A. arguta* and *A. chinensis* were raised by David Fairchild, but the hybrids never fruited.
Figure 2.—The American cranberrybush in flower. The large white marginal flowers around each cluster are sterile. Only the small inner flowers set fruit.

AMERICAN CRANBERRYBUSH

The fruit of the native American cranberrybush, highbush cranberry, or pembina (*Viburnum trilobum* Marsh.),¹ is used for jelly making in sections of the northern United States and Canada.² From the fruit is produced a jelly rich in color and in pectin but of relatively strong flavor and odor. The fruit resembles that of the cranberry in color and size, but

¹ Formerly known as *Viburnum americanum* Mill.

---

---
the plants are not related. The fruit of the American cranberrybush is borne on a high bush in clusters, like the elderberry, while the cranberry is borne on a low vine. The American cranberrybush is a close relative of the elderberry and grows to about the same height and in similar clumps with similar flowers (fig. 2). It is sufficiently hardy to grow in the colder parts of the United States. It is often confused with the European Viburnum opulus L., which is widely used in the United States as an ornamental, but is readily distinguished from the latter by its clear, acid fruit. The fruit of V. opulus is so intensely bitter as to be inedible.

In the spring of 1921 the Bureau of Plant Industry took over for 10 years a plantation of the American cranberrybush established by A. E. Morgan, formerly president of Antioch College, now chairman of the Tennessee Valley Authority, at East Lee, Mass. The plants were the best obtainable selections following a personal survey by Morgan of this fruit in the wild in New

Figure 3.—Three varieties of the American cranberrybush introduced by the United States Department of Agriculture through cooperating nurseries: A, Wentworth; B, Hahs; C, Andrews. The fruit is used for making jelly, which is as rich, red, and firm as that made from the currant and the cranberry.
York and New England and even in Manitoba and Saskatchewan. Fruit was obtained through correspondence from Alaska to Newfoundland.

After a study of the selections at East Lee, and of plants in the wild in various regions, three were named, propagated, and introduced—Wentworth, Ilahs, and Andrews (fig. 3). Analyses for acid and pectin and jelly tests by C. A. Magoon, of the Bureau of Plant Industry, indicated that these three were superior to the other selections. They also covered a long season, Wentworth being early, Ilahs midseason, and Andrews latest. Through cooperating nurseries these three varieties are now available in the trade. They are propagated by softwood and hardwood cuttings and by layering (fig. 4).

Many northern State experiment stations have cooperated with Morgan and the United States Department of Agriculture in testing this fruit, and several are continuing their interest in it. These stations include those in Maine, New Hampshire, Massachusetts, New York, Wisconsin, Minnesota, North Dakota, Montana, and Idaho.

Besides being of value for its fruit, the American cranberrybush is a widely used ornamental, beautiful in flower and fruit, with a rich green summer foliage which becomes highly colored in fall (fig. 5).

Rehder states that there are in all about 120 species of Viburnum, nearly all natives of the cooler sections of the Northern Hemisphere. Many are bitter-fruited, many others are sweet-fruited, and some bear clear, acid fruit.

It would seem that the viburnums have great promise for the breeder because of their value as ornamentals as well as for fruit production. Species such as V. carlesii Hemsl. and V. fragrans Bunge are delightfully fragrant, while sterile forms of V. opulus L. and V. tomentosum Thunb. are the snowballs of commerce. Valuable hybrids would probably result from crossing the Andrews, Ilahs, and Wentworth with V. carlesii, V. fragrans, the evergreen V. rhytidophyllum Hemsl., selections of V. lantana L. and related sweet-fruited species, the clear acid-fruited V. wrightii Miq., and V. dilatatum Thunb.
GOUMI OR ELAEAGNUS

Goumi is the name applied in Japan to several species of Elaeagnus grown chiefly for their ornamental value. One species, the cherry elaeagnus (Elaeagnus multiflora Thunb., fig. 6, C), is also of value for its tart fruit. Another subtropical species, *E. philippensis* Perr., called the lingaro, has produced well in southern Florida. It has edible fruit prized for use in sherbet. Still other species, such as *E. ovata* Serv. (fig. 6, A) and *E. umbellata* Thunb. (fig. 6, B), bear immense quantities of small fruit.

Figure 5.—The American cranberrybush is ornamental in flower (A) as well as in fruit (B). Both the white flowers and the brilliant red fruit contrast well with the foliage. It is one of the highly prized and widely used ornamentals of the northern part of the United States.
Figure 6.—Elaeagnus or goumi: A, Flowers of *Elaeagnus ovata*; B, fruit of *E. umbellata*; C, fruit of *E. multiflora*, the largest-fruited one. These hardy, drought-resistant, fruiting shrubs are valuable as ornamentals and as food for wildlife. *E. multiflora* is a valuable food plant of parts of Asia.
Though the cherry elaeagnus was introduced into this country many years ago, it has not become an important fruit even in the garden. The explanation seems to be that it has been almost entirely grown from seed. The seedlings are extremely variable, some producing very little fruit and that small and astringent, others producing abundant fruit as large as cherries and having a pleasant flavor.

Elaeagnus seems worth the attention of the breeder because the fruit is of considerable importance in parts of central Asia, the plants are very hardy and drought-resistant, the seedlings are quite variable, and there are a great many species. A breeding program might include selections of the best fruiting forms from large numbers of seedlings, and hybridizing between species such as *Elaeagnus multijflora*, *E. ovata*, *E. umbellata*, and *E. pungens* Thunb. In the Southern States the fragrant October-flowering species *E. pungens* may be of some value for its fruit and for hybridizing.

**ORIENTAL QUINCES**

The oriental or flowering quinces include three species and many varieties, as well as certain hybrids. The best-known species, *Chaenomeles lagenaria* Koidz. (*Cydonia japonica* Pers.), is the so-called Japanese quince, which, however, is a native of central China. It is a spreading shrub with thorny interlacing branches, from 4 to 8 feet high. The dwarf Japanese quince, *Chaenomeles japonica* L., is a sprawling shrub with spiny branches and orange-scarlet blossoms. One hybrid between these two species, named *Chaenomeles superba* Rehd., has blood-red flowers. The flowers of these two species and their hybrids resemble apple blossoms and range from white to salmon and scarlet and even darker. One of the scarlet-flowered varieties most commonly propagated is so covered with flowers in early spring that it is sometimes called "fire bush."

Though ordinarily cultivated for the ornamental value of the bush in flower, the fruit (fig. 7, A) is of value for its acidity and pectin content. It has little flavor, but when used in making jelly and preserves with apples, cherries, plums, prunes, and the other cultivated quinces it helps to achieve the balance in the ratio between sugar and acid that is necessary for highest flavor. Tests have been made, in cooperation with the National Preservers Association, to select varieties for this purpose. The variety *grandiflora*, of *Chaenomeles lagenaria*, with fruit 3 to 4 inches in length and weighing one-fourth to one-third of a pound, was the largest and most productive at Glendale, Md., and contained the most malic acid, 5.75 percent. It has apple-pink to rose-pink flowers (fig. 7, B).

Because the flowering quinces are largely self-sterile, most people, having only a single bush or only one variety, have never seen the fruit. The varieties *C. lagenaria* var. *baltzii* (cerise-pink flowers), *C. lagenaria* var. *versicolor* (pink flowers), *C. superba* var. *atrosanguinea* (fiery scarlet flowers), *C. japonica* var. *candidissima*, and *C. japonica* var. *nivalis* (white flowers) all bear heavily, and though no tests have been made, some of them may be expected to pollinate the variety *grandiflora* of *C. lagenaria*. Colby, of Illinois, found that *C. lagenaria* var.
Figure 7.—The flowering quince (Chaenomeles lagenaria), a beautiful ornamental but also useful for its fruit (A), which is high in malic acid and pectin. B, Variety grandiflora, propagated originally for its apple-pink flowers but bearing very large fruit of very high acid and pectin content.
var. grandiflora was at least partly self-fertile, but no other variety that he tested was at all self-fertile. He has found the fruit of C. lagenaria var. versicolor fully as large as that of the variety grandiflora under his conditions.

The fruits of several varieties are fragrant and are used to perfume rooms. Colby lists the varieties baltsii and atrosanguinea as having much perfume. The Chinese cover the fruits with a coat of thin oil and keep them in the houses a long time.

Another species from China, Chaenomeles sinensis Koehne, is a small tree bearing its flowers singly and having fruit of enormous size, up to 6 inches or more in length. Though its fruit may also be used as a source of acid, it is coarser and has less acid and pectin than the other species. It has a strong flavor, and a small proportion will impart a pleasing suggestion of quince to jelly and preserves made from milder flavored fruits. It is very fragrant and is also used to perfume rooms. The foliage turns a brilliant scarlet in the fall, making it desirable for tall hedges and for ornamental plantings.

The two flowering species, Chaenomeles lagenaria and C. japonica, are hardy as far north as Massachusetts, New York, and Illinois, and may be raised southward to northern Georgia, or as far south as there is sufficient winter cold to break their rest period. The other species, C. sinensis, is hardy north to Philadelphia and may be raised in the South nearly to the Gulf of Mexico.

So far, improvement in the fruit characters of this group has been largely accidental. The high acidity and pectin content of the fruit of some varieties suggests that attempts to obtain still larger amounts would be desirable. Improvement might be made by developing larger sized and more handsomely colored fruit in varieties adapted to different regions, by securing more open growth so that the fruit can be picked more easily, by eliminating thorns on the bushes, and by developing self-fertile varieties. So far no hybrids with the European cultivated quince are known, but attempts should be made to produce them.

The possible importance of this fruit in the preserving industry is indicated by the following quotation from Lathrop and Walde:⁵

Were a preserver to name the properties most needed in a new fruit by the preserving industry today, he would unwittingly be describing the Japanese quince * * * * * its bid for recognition and economic importance is not based upon its becoming a new, distinctive-flavored product. It serves a very different purpose:—to supply a non-flavored fruit, or fruit juice, very high in l-malic acid and pectin to those popular flavored fruits as the apple, cherry, European quince, and plum or prune when requiring additional l-malic acid. * * * * These familiar flavors of jellies and preserves when they reach the consumer in many instances do not show off to their best advantage. * * * * the marked effect and advantage of making small, definite additions of fruit acid in jellies and preserves was described in the case of some fruits to bring out more of the total fruit flavor actually present.

CHINESE AND OTHER BUSH CHERRIES

The Chinese bush, Manchu, or Nanking cherry, Prunus tomentosa Thunb. (called by the Chinese the mountain cherry),⁶ has been grown in the United States some 50 years as an ornamental shrub but now

---

is attracting attention for its fruit. It is one of the earliest of all shrubs to flower in the spring, its white to pink blossoms (fig. 8) opening just as the leaves start to unfold and its brilliant red fruit (fig. 9) ripening with the last of the strawberries. The fruit has a range in flavor and texture from the sweet to the sour cherry with a peculiarly attractive tang. It is as large as the wild cherries of

Figure 8.—Flowers of the Chinese bush cherry. It flowers on the previous season's growth.
Europe, from which the cultivated sweet and sour cherries have originated. The foliage is resistant to the common cherry leaf troubles. The tree is cultivated to some extent in China, and the fruit is also gathered in the wild and sold in the markets. The range of the Nanking cherry in Asia is from southern Manchuria to the Kashmir region of northern India, a region for the most part semiarid and in latitude and climate comparable to the territory from eastern New Mexico northward to North Dakota.

Figure 9.—The Chinese bush cherry in fruit. Its brilliant red fruits range in flavor from the sweet to the sour cherries. They are produced in great abundance provided they escape spring frosts and brown rot. Objectives in breeding this fruit should include late-flowering, brown rot-resistant seedlings.

When they escape spring frosts and severe attacks of brown rot, the bushes are loaded with fruit of the size of small sour cherries. The most needed improvements are the introduction or discovery of late-flowering and brown-rot-resistant seedlings (fig. 10). The brown rot fungus often kills back twigs and branches in humid sections.

Harlow Rockhill, strawberry breeder at Conrad, Iowa, has crossed the Nanking cherry with the western sand cherry, Prunus besseyi Bailey, and has grown several generations of hybrid seedlings. He feels that some are very promising for Iowa conditions, as they flower later and are less often injured by cold than the Nanking cherry. Importations are needed from different regions to make selections adapted for the coldest to the warmest, and the driest to the most humid regions of this country. Rockhill has crossed the Nanking cherry with the Napoleon (Royal Anne), Montmorency, and Zumbra cherries, and there is the possibility of obtaining hybrids with many other cherries. The Arnold Arboretum reported having a natural hybrid between P. tomentosa and P. triloba Lindl. in their plantings.
Slate,7 of the New York (State) Agricultural Experiment Station, has selected fine fruiting seedlings at Geneva and has started propagating them. By and large, it is a promising fruit for the plant breeder, and it may have commercial possibilities.

Figure 10.—Seedling plants of the Chinese bush cherry; in the middle an early flowering, at the right a later flowering, and at the left a much later flowering sort. These seedlings illustrate the possibility of obtaining much later flowering selections that may escape unseasonable frosts.

Prunus glandulosa Thunb. and P. japonica Thunb. are very hardy dwarf shrubs that are ornamental and have deep red to purple-black fruits useful for pies, jellies, and sauce. There are also many other species of bush cherries in Asia that may be worth using in breeding. Besides the bush cherries, P. triloba, classed as a flowering almond, is possibly a still more beautiful hardy flowering and fruiting shrub with flowers of pure pink.

---