MAGNOLIA HYBRIDS AND SELECTIONS

by

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Magnolia, one of the most ancient genera among flowering trees, now has one of the newest horticultural organizations sponsoring it. Several of the American Magnolia Society's members are hybridizing among at least a few of the approximately 90 known species. Some members, myself included, have been active in collecting Latin American species, and selecting among relatively recently introduced eastern Asiatic species in the United States. Breeding is also under way in Japan and England. Within each of the two large subgenera, most current interest is directed toward ornamental trees and shrubs. But several of the larger growing species have timber value. We foresee a possibility of getting some hybrids useful to forestry as a by-product of the ornamental breeding.

Magnolias at present are a smaller component of forest vegetation than the fossil records indicate they were in some earlier epochs, starting with the Cretaceous period. But they are still widely dispersed. Along with several related genera *(Talauma, Michelia, Liriodendron)* that are still included in the Magnoliaceae, both subgenera *(Magnolia* and *Pleurochasma)* are found in both America and Asia. *M. acuminata,* if we include *cordata* as a variety, is the sole American species of subgenus *Pleurochasma,* but it has one Chinese relative, M *liliflora,* in the same botanical section. In the subgenus *Magnolia,* there is section Rytidiospermum, with four species in the U.S., one in Mexico, one in the Himalayas and another two in Japan and China. Other sections are restricted to a single hemisphere, with more sections, as well as more species, being Asiatic.

Several factors complicate the hybridization possibilities. Though the subgenera may be inter-grafted, pollinations across the subgeneric division, up to now, have yielded only apomicts of the female parent. Inter-sectional pollinations have resulted in some apomicts and some true hybrids, part of which are more or less fertile. In both subgenera, there are both diploids and hexaploids. Both *acuminata* and *liliflora* are tetraploid. Known tetraploids in subgenus *Magnolia* include Oliver Freeman's hybrids known to be *virginiana* x *grandiflora,* plus the grandiflora-like and fertile `Charles Dickens' whose unknown ancestry may include *macro phylla.*

Among hybrid magnolias, synthetic pentaploids *(M.* x *Soulangiana)* and tetraploids (`Freeman') are partially fertile in some cases, but no fertility has been found in the triploids. Even several diploid level hybrids, such as intersectional crosses involving *M. virginiana* with other American and Asiatic diploids, and the Asiatic *Sieboldii* x *hypoleuca* hybrid, have been highly sterile to further breeding. In contrast, the intra-sectional *salicifolia* x *Kobus* hybrids appear quite fertile. Among the four United States species belonging to section Rytidiospermum and sympatric to various degrees, none is known to have crossed with any other American species within its section, though two have now been outcrossed on *virginiana,* and one *(M. tripetala)* shows suspected compatibility on two related Asiatic species. In some inter-specific (and inter-sectional) combinations, the cross has been successful in only one direction. There are species *(M. acuminata, M. denudata)* and varieties *(M. virginiana* var. *australis)* with very high clonal self-sterility, contrasted to high self-fertility in clones of related species or varieties.

In prehistoric times hybridization no doubt played its part in the evolution of magnolia species as we now know them. For hexaploids like *M. grandiflora* and the Asiatic Yulania section, the ancestry could have been very complex. Most of the ancestors of Theorhodon, the *grandiflora* section, were probably exterminated in the ice ages, or pushed far to the south, where we now have species of limited distribution in the warm-temperate highlands from southern Mexico to easternmost Venezuela. What later came northward included some species of wider adaptability, due in part, we can surmise, to mutations, and partly to recombinations of chromosomes previously found in separate species. Whatever their history and interrelationship, both *M. Schiedeana,* the most widespread Mexican magnolia, and our own *M. grandiflora,* distributed from Texas to North Carolina, now show a 114-chromosome count. *M. grandiflora* can still cross with the 38-chromosome *M. virginiana* and the 38-chromosome *M. guatemalensis,* as demonstrated respectively by Oliver M. Freeman and myself. There is evidence, presented further on, that *grandiflora* has received part of its great variability in relatively recent times through natural introgression by *M. virginiana australis* in the Georgia to Texas region of species overlap.

As I write, I am awaiting the first flower opening on one of a few hybrids combining Asiatic and American ancestry *(M. denudata, M. liliflora* and *M. acuminata).* My more extensive work, especially in the past decade, has dealt with field studies, selection and breeding among American species and hybrids in subgenus *Magnolia,* including *M. grandiflora, M. virginiana* and a few others. Particularly rapid progress now is underway with forms and intervarietal hybrids of Sweet Bay Magnolia, *M. virginiana* var. *virginiana* L. and *M. v.* var. *australis* Sarg., and I shall discuss these more fully.

I was selecting in *Magnolia grandiflora* in Alabama more than 30 years ago, and have continued with it in Illinois since 1950. *M. grandiflora,* the evergreen North American species best known around the world, has been called the most extensively cultivated of all American flowering trees in other countries. Compared to our *Cercis canadensis* and *Cornus florida,* it proved better adapted in the climates of the warmer parts of Europe. One current cultivar, 'Victoria', was selected in Canada. It was on Vancouver Island, Canada's mildest zone. The species is cultivated in Japan, being hardier than any of the evergreen Asiatic magnolias, and it has even been taken into the tropics of both hemispheres. Actually, in all probability, *M. grandiflora* has not become as truly 'naturalized in Europe and Asia as our *Robinia pseudoacacia,* but it is more often planted for strictly ornamental purposes, while the black locust is grown more for other reasons, or tolerated where it springs up.

M. grandiflora now can be grown from cuttings. Some clonal forms have been layered since the 1700's in Europe. There have been three different bases of selection from these times: (1) hardiness, still important, particularly as one gets north of USDA Plant Hardiness Zone 7; (2) tree and foliage characteristics, which show wide variation; and (3) flower size, quality and abundance, also showing wide variation. Color of flower varies little, but form and size are unpredictable in unpedigreed seedlings. Generally, there are nine tepals, but 12 are seen fairly frequently on some trees' flowers, and about twice that number (counting staminodes) in those of the "doublest" clone I have seen, the `Santa Cruz', named at that California town only this September.

In some coastal areas the flowering season frequently is extended to fall, but in Tennessee and northern Alabama and up to southern Illinois, that is seldom true. My father and I selected 'Alabama Everblooming' in the early 1930's at Cullman, Alabama, where it usually continued flowering into September and sometimes later. It has particularly fragrant flowers. 'Madison' is another "everbloomer," of neater growth habit, selected in the early 1950's from Madison, Alabama, and now in commercial propagation near Mobile. 'Cairo' from the southernmost Illinois town, was registered less than 3 years ago and is not yet commercially available. In addition to having the "everblooming" habit, it has distinctively shaped, highly glossy leaves, and makes a handsome broad-columnar tree. I have employed the 'Cairo' in cross-breeding both with other grandifloras at Carbondale and Urbana, and with both varieties of the Sweet Bay Magnolia. I am still looking for cultivars, everblooming or not, that will be reliably hardy and 'evergreen in the climate of Urbana. Most of the named *grandiflora* selections, including mine, have not been fully evaluated outdoors in central Illinois. Selection and breeding will be continuing in *M. grandiflora* and its hybrids, to get clones with still better combinations of hardiness, shapely trees and distinctive flowers.

What I now believe to be natural hybrids have existed among clones cultivated as "grandiflora" for around two centuries. William Aiton in Hortus Kewensis (1789) published his *M. grandiflora lanceolata.* Known also under its synonym *M. g. exoniensis,* the 'Exmouth' cultivar of var. *lanceolata* (first flowered by the 1730's in the Devon town of that name), has been horticulturally distinctive enough to persist into current propagation, and has been used in recent breeding with which I was associated. (Harvey and Jewel Templeton of Winchester, Tennessee, gave me reciprocal hybrids between *lanceolata* and 'Charles Dickens'.) Like some of my recent selections and others now in clonal propagation that may have it as an ancestor, *lanceolata* shows enough similarity to some controlled hybrids between *M. virginiana* and *M. grandiflora* to suggest the likelihood that it, too, is of hybrid derivation, probably an F2 or later generation from a chance cross of *M. virginiana australis* x *M. grandiflora.* Besides the varietal differences (lanceolate leaves and less widely opening flowers) described by Aiton, *lanceolata* (like known hybrids) has stipular scars on some of its leaf petioles. This criterion for such hybrids has been suggested in correspondence by the British Museum's taxonomist, Mr. J. E. Dandy. *M. grandiflora* and the numerous Latin American species in its section Theorhodon all are supposed to have their petioles attached to the stem free of the stipules. In *M. virginiana* and all other North American species outside Theorhodon, stipules are adnate to the petioles, leaving scars where they detach.

M. virginiana was one parent of the next hybrid to come to attention, and that hybrid was long thought to be merely a variant of Sweet Bay. It originated as a chance seedling in Mr. Thompson's nursery at London in 1808. Its publication as a hybrid, *M. x Thompsoniana* C. de Vos, with *M. tripetala* the other parent, came late in the nineteenth century. I have found this hybridization relatively easy to repeat in recent years, but only where *M.* v. var. *virginiana* is the seed parent, as it obviously was with Thompson. The reciprocal, and crosses of *M. v. australis* with *tripetala* either have failed to set seeds, or else such seeds as matured gave only non-hybrid, apparently apomictic progeny of the seed parent. Now being multiplied for introduction is one of my new *M. x Thompsoniana* clones. Several of these have the good flower quality of the original clone from England, but seem as hardy as *tripetala* and the deciduous *virginiana* in Urbana where the crossing was done. Cultivation of the original *Thompsoniana* had been limited by the fact that it frequently died back in climates like that of Philadelphia, and its Midwest use stopped at about Cincinnati. Unfortunately for further breeding, it now appears that all diploid level interspecific hybrids having *M. virginiana* as one parent have proved almost if not totally sterile. This has been the case with several hybrids that William F. Kosar produced at the U.S. National Arboretum, of *M. hypoleuca (M. obovata)* x *M. virginiana* var. *virginiana.* His hybrids of *M guatemalensis* x *M. v.* var. *virginiana,* and mine of *M.* v. var. *virginiana* x *M. macrophylla* have not yet flowered.

Up to now, the hybrid Magnolias that have been most widely recognized and used come from the subgenus *Pleurochasma.* Except for *M acuminata* (with the varieties *cordata, acuminata* and *ozarkensis),* this subgenus is Asiatic. Two species from China, the hexaploid *M. denudata* and

the tetraploid *M. liliflora* proved crossable (in either direction) to give the hybrid *M.* x *Soulangiana* (still commonly misspelled with an "e"). Soon after its first clone was introduced at Paris in the 1820's, it became the magnolia that really put hybrids into popular cultivation. It was a fortunate cross. Although no more beautiful than either parent, it was hardier than the commonly grown clones of *liliflora,* and was more reliable in its flower display and easier to multiply by vegetative propagation than *denudata.* These qualities led to its rapid distribution.

Although it was pentaploid, *M.* x *Soulangiana* was not fully sterile. Besides some clones from newer crosses, it now includes clones whose exact pedigrees are unknown; some are probably backcrosses to one or the other of its original parents. One derivative cultivar, *M.* x *S.* `Lennei' and others (`Rustica', 'Grace McDade' and 'Lombardy Rose') that may be most probably selfed seedlings of `Lennei' are highly fertile, apparently at the hexaploid level. Probably a tetraploid of hybrid derivation is the clone known as `Darkest Purple', according to Kosar's observation. On the other hand, we can get *Soulangiana* forms or derivations that are more completely sterile; they can be either triploid or aneuploid. Not fertile, in my experience, is the attractive clone introduced by an Alabama nursery as "Lennei Hybrid", a confusing and probably improper name, since Termer was already itself a hybrid. Californians speak glowingly of `Lennei alba', believed to be one of several good clones from `Lennei' x M *denudata.* It is fertile.

Later introduced to western gardens are other Asiatic hexaploids belonging to the same Yulania section as *M. denudata.* The most magnificent of all deciduous species in flower, but so tender in new early growth that it is practically limited to a strip along our Pacific Coast, is the Himalayan *M Campbelli.* The curve of hardiness among Asiatic hexaploids probably ascends from *Campbelli* (Indian type) to its China-Burma var. *Mollicomata,* to *M. Sargentiana* (including var. *robusta),* to *M. Dawsoniana,* to *M. Spregeri,* whose var. *diva* may be at least as hardy as *denudata.* Except possibly for *Dawsoniana,* which seems to set few seeds in this country, all these hexaploids now have been crossed with one or more of the other related species, and some promising cultivars have emerged, particularly in England. It was there that *M.* x *Veitchii* was produced by crossing *M denudata* x *M Campbelli* in 1908. *Veitchii,* which succeeds better than *Campbelli* in our Southeastern states, has been used for further crossing, with *liliflora* with `Lennei alba', and more recently with *M. Sprengeri* var. *diva.* Now being introduced as the finest Asiatic hybrid produced at Caerhays Castle in Cornwall is a cross between *M Sargentiana* var. *robusta* and *M. Sprengeri* var. *diva.* Var. diva has been crossed reciprocally with *denudata,* and both Kosar and I are growing some young hybrids of this parentage.

Occupying a section to themselves (Tulipastrum) are the two natural tetraploids, *M acuminata* and *M liliflora.* The Brooklyn Botanic Garden breeders and I have each produced two hybrids of *M. acuminata* x *M. liliflora.* Mine, which have not yet flowered, appear to have inherited the shrubby habit of the male parent, but one of the two vigorous trees from the Brooklyn work, which Doris M. Stone says is fertile, was patented this year and will soon be introduced as a cultivar.

Because *M. acuminata* is our hardiest American magnolia species (ranging northward into Ontario), besides being the latest of the whole subgenus *Pleurochasma* to open its flowers in spring, its fertile hybrid or hybrids should be extremely interesting for further breeding. We may hope for a series of showy flowered cultivars for planting in large areas of our continent where even the most wood-hardy of the Asiatic species and hybrids frequently are frosted after their flower buds start expanding. Perhaps some newer hybrids may even be useful timber magnolias. Frank B. Galyon, M.D., has an interesting seedling, evidently an *acuminata* hybrid, which resulted from crossing *M. Sprengeri diva* pistils with a mixture of tetraploid pollens. It has been fully hardy and remarkably fast growing in the 4 years it has stood at Knoxville, Tennessee.

Among Asiatic diploids in section Buergeria, the most shrubby is the one usually called *M stellata.* Benjamin Blackburn recently has reduced *stellata* to varietal status under *M. Kobus,* along with var. *borealis,* while regarding *"Loebneri"* as to be "accepted under typical *Kobus."* (Personal communication, extending his 1957 treatment in Baileya 5:3-13.) My own opinion is that the intermediate *M.* x *Loebneri* Kache is an intervarietal hybrid with *stellata* as one parent. Both var. *Kobus* and var. *borealis* grow into large tree size, and have flowers with mostly six to nine tepals. *Stellata* is many-tepaled (frequently 20-30), and the flowers as well as the plant size of *Loebneri* are intermediate. Whether we regard *stellata* as a separate species or a *Kobus* variety, it is one of the hardiest and most horticulturally useful magnolias. Some of its fairly recently introduced cultivar selections (`Waterlily', 'Royal Star') open their flowers a little later than the older forms, so may be expected to put on a good display more reliably in much of this country. The generally available *Loebneri* cultivar is an Arnold Arboretum selection originally registered under the name 'Merrill', but the first nursery to advertise it added a "Dr." to its name. A newer cultivar, selected from seedlings in the President's garden at the University of Illinois, has long been observed to be slightly later flowering and more cold-resistant in bud than other *Loebneri* clones, including `Merrill'; it is named 'Spring Snow' both for its drifts of fragrant white flowers and for, the usual occurrence of the latest snowfall at Urbana during its April flowering season. Apparently the 'Spring Snow' tree will be shorter at maturity (about 30 feet) than the 'Merrill', which shows more inclination to grow toward the higher stature of typical *Kobus.* A number of 'Spring Snow' seedlings from the abundant open pollinated seeds now have flowered. These seedlings are not uniform, and usually have fewer tepals.*

Two other species of the Buergeria section are in cultivation, although not yet as generally available as the

*(Author's later note.) In 1969, a cultivar selection among 'Spring Snow' seedlings, with as many as 31 showy tepals, was named `Ballerina'.

Kobus varieties and cultivars. One is the gracefully slender tree, *M. salicifolia,* a native of Japan like the *Kobus* alliance. Still scarcer is *M cylindrica* from western China, a fine tree named as recently as the 1920's and introduced to both England and the United States as seeds imported in the 1930's.

M. salicifolia has early opening white flowers, overlapping the season of the *Kobus* alliance, with which it appears to give frequent hybrids when *salicifolia* seeds from arboreta or other mixed magnolia groupings are sown. The hybrid, *M.* x *Proctoriana,* was first described from a Massachusetts garden. One clone of *M.* x *Proctoriana,* growing near the administration building of the Morton Arboretum, Lisle, Illinois . has given excellent performance there, and was the basis of the Arboretum's recommendation of *M. salicifolia* for northern Illinois, before the plant was redetermined as a hybrid. Both Blackburn and I believe that the superior 'Wada's Memory' is *proctoriana,* not *Kobus. M. Salicifolia,* 'Else Frye', registered by the University of Washington Arboretum a few years ago, remains to be tested in our region. Some *salicifolia* seedlings have shown evidence of adaptability at Carbondale and Benton, Illinois, but it cannot yet be said whether they are as well adapted as *Kobus.* In any event, the controlled hybridization of *salicifolia* with selected forms of other species is yet to be fully explored.

M cylindrica also should be a worthy new parent for future hybridization. Though it was named for its fruit shape, before the flowers were seen, the *M. cylindrica* bud opens into a beautiful, rather cylindric flower, with tepals having more substance than other diploids of its section. Besides Seattle and England (where it won an award from the Royal Horticultural Society), the species is hardy in southern Michigan.

The diploid intrasectional hybrids, as well as intervarietal crosses among the Kobus alliance all appear to be normally fertile. But crosses of *stellata* with tetraploid or pentaploid Magnolias so far evidence complete sterility. One such hybrid is 'George Henry Kern', which the late Carl Kern, Sr., produced in Cincinnati from *stellata* seed. Its other parent probably was some *Soulangiana* form. Just published this year are a group of eight new hybrids from crosses made at the U. S. National Arboretum by Francis de Vos and W. F. Kosar. They crossed two *M. liliflora* forms with *stellata* pollens. These shrubby hybrids, which were selected for flowering later than *stellata* (up to mid-May at Washington, D.C. for 'Pinkie') are apparently all sterile triploids. Dr. Santamour can tell you more about their behavior.

Another line of breeding in subgenus *Pleurochasma* appears feasible—diploids x hexaploids. This year a squirrel beat me to the several plump fruits developed on a bush of *stellata* 'Royal Star' that I had pollinated by *denudata.***

* *I obtained one true hybrid in a cross of *stellata* `Waterlily' x *M. denudata.* Further along are Dr. Galyon's *denudata* x *stellata* hybrids. At Seattle, Joseph Witt has obtained hybrids of *Kobus* x *Sargentiana robusta,* but slugs consumed his first lot in the seed flats. He is repeating the cross in 1969.

Rodent and bird predators of the maturing (or planted) seeds are things the Magnolia workers share with breeders of conifers and nut trees. Seed-eating birds go for seeds of all the American magnolias. Grackles are particularly attentive to fruits on *M. acuminate* long before they mature, and can strip a tree. They also damage *M. tripetala* fruits, but are less persistent in attacking them. Weather is another hazard for the breeder of early-flowering magnolias in this part of the country. It is frequently chilly and windy or wet at their flowering time. Southward at Washington, and even at Mobile, a later freeze can destroy the result of crossing on early flowers. We can envy such breeders as D. Todd Gresham, whose climate at Santa Cruz, California, permits him to make crosses even with the more tender early flowering species with a high expectation that the fruits, once they are set, will persist to maturity.

I have been luckier in making crosses and gathering seeds in good quantities on the mid-May to July flowering *Magnolia virginiana.* There are other conveniences with this species. Its times of flower receptivity and of pollen shedding are better marked than with the *Pleurochasma* subgenus. Its pollen is more abundant, thus easier to collect and use. With successful crosses, there is a shorter interval of 60 to 90 days before the seeds of *virginiana* mature in August and September. Starting with clones already in private cultivation around Champaign-Urbana, I later began to collect variant forms in the wild, and had other growers and collectors send them to me as seed or scions. *M virginiana,* for a study in depth of its varieties and forms, had a distinct advantage over the foreign species: I could get to its native stands without going much east of Boston, south of Miami, or west of Houston. No one else seemed to be doing much Sweet Bay Magnolia breeding, and the possibilities with clonally propagated selections in it had been mostly ignored, although it had been admired in this country since Colonial times and was introduced to Europe in the 1600's. Soon after concentrating on selection and intraspecific breeding, as well as interspecific breeding with *M. virginiana,* I found that its botanical distinction into varieties was still somewhat confused, although it is the type species of the genus.

Northern and southern Sweet Bays show consistently great enough differences to have justified C. S. Sargent's publication on *M. virginiana* var. *australis* for the more southerly (and westerly) ranging variety in 1919. (W. W. Ashe in 1931 even proposed *M. australis* as a separate species.) Unfortunately, Sargent's variety description included some characters, pubescence and leaf persistence, in which populations and individual clones of the two varieties overlap. This led to his inclusion of the eastern Carolinas in the *australis* range, which I believe is erroneous. What I have found commonly around Wilmington, North Carolina, is a pubescent form of the northern var. *virginiana,* which form also is widely distributed in cultivation northward to Massachusetts and Iowa. The true southern *variety,australis,* occurs from western North Carolina and Tennessee to Arkansas, Texas, and Florida, and in eastern Georgia overlaps the var. *virginiana.* It is not always, in its more northern and western range, any more evergreen than some

clones of var. *virginiana*. Var. *australis*, throughout its range, I find readily distinguishable when in flower, by its stronger, more lemon-like fragrance, and its paler, nearly white pollen. Mostly, it grows into a larger tree, with a more dominant central leader, but shrubby clones are known. Another consistent difference I find is self-infertility in nearly all clones of var. *australis*, where var. *virginiana* is fully self-fertile.

Despite their apparent lack of interbreeding where their ranges overlap in Georgia, I find the varieties both fertile to reciprocal intercrossing.

The numerous Ft intervarietal hybrids that now have flowered for me also show high fertility when intercrossed, or backcrossed to either parent variety. This is in contrast to the sterility that characterizes interspecific diploid hybrids of var. *virginiana* with both *M. tripetala* and *M. hypoleuca*.

Add to this fertility the precocious attainment of flowering (sometimes at less than 2 years) in certain populations of intervarietal hybrids, and the morphologically and physiologically varied array of clones now becoming available for backcrossing, and the breeding possibilities in *M. virginiana* appear promising, indeed. Some of my Ft clones already would be candidates for cultivar introduction, except for the likelihood of getting better resynthesis of the varietal and clonal characteristics in the F2 or in backcrosses a few years hence.

Clonal differences are so wide, both in varieties and in the Ft, that several cultivars of varying stature and habit probably will be selected. First priority might be assigned to those recombinations approaching the most evergreen habit of the best forms of var. *australis*, accompanied by what I consider its superior fragrance, and the generally more shrubby, multistemmed habit found in select forms of var. *virginiana*. There will be places for tall tree forms, but the more shrubby Sweet Bays, like the shrubby var. *stellata* in *M. Kobus*, will find wider usefulness in home landscapes. Deciduous segregates may enable the fragrance of var. *australis* to be enjoyed farther north than it can be grown at present.

One evergreen clone, the registered cultivar *M. v. australis* 'Henry Hicks', has proven outstandingly hardy, up to Brookville, Pa., where David G. Leach first rooted cuttings from the original tree at Swarthmore, Pa. Several expert propagators have since failed to root cuttings of it, but it can be budded on *virginiana* seedling stocks. I find that crosses of 'Henry Hicks' with both varieties are readily rooted from cuttings, and this will be one criterion in selection of future cultivars for introduction, along with hardiness. I have crossed 'Henry Hicks' with several other clones in its own variety, including some from Polk County in east Tennessee that have the most glossy leaves I have seen in the species. Glossiness is at least partially dominant. Another cross combines 'Henry Hicks' with a larger flowered *australis* from near Mobile that ripens fruit with very red carpels. 'Henry Hicks' has been crossed with shrubby clones in both varieties, one cross on var. *virginiana* giving 10 unusually precocious seedlings that flowered before they were 3 years old. Inter-crossing is planned between some of these lines, with the hope of eventually getting an easily rooted, precocious, hardy, shrubby cultivar as evergreen and fragrant as 'Henry Hicks' but with added interest from glossy leaves, larger flowers, and red colored fruits.

Crosses are being explored with seedlings of *australis* from the Florida Everglades, which are initially faster growing than those from other sources. They also approach tropical adaptation, growing, in some cases, throughout the short winter days in the greenhouse. One clone and one younger seedling of the broad leafed Texas race also show this winter growing habit.

While *australis* flowers typically open nearly pure white, many *virginiana* clones have a creamy tint. I now have a clone of each with some pink coloration. In *australis*, one of the seedlings from the Everglades has light pink markings on its tepals. It was crossed this summer with a clone of *virginiana* long cultivated in Mt. Pulaski, Illinois, that bears large creamy multi-tepalled flowers with a pinkish tinge near the center inside. The Mt. Pulaski clone already had given seedlings that inherited some of its "doubleness" (up to 20 tepals) and had a similar flower color. Its flowers are the largest I have yet seen in the species, though some on the *australis* race in east Texas may grow as large.

M v. australis in and near Texas has frequently larger leaves than *australis* from east of the Mississippi River. Predominantly, but not invariably, the Texas plants shed most of the leaves by Christmas. Other characteristics of most *australis* in that area, including western Louisiana and Arkansas sources, are persistent pubescence on the upper as well as the lower leaf surfaces, and veins which stand out green on the otherwise glaucous undersides. Seedlings from that area produce long taproots the first year, perhaps indicating drought tolerance.

The only three western-source *australis* clones I have so far flowered were of the winter-deciduous type. They were intercrossed, and also outcrossed to an Alabama red-fruited *australis* and to a shrubby var. *virginiana*. In the crossed seedlings resulting, the leaves in the first year are mainly intermediate in shape, thickness and pubescence, and the lower leaf veins and the taproots are more like the Texas parent.

Var. *australis* generally flowers later in the season than var. *virginiana* in the same location. However, in the Everglades, the local *australis* trees were seen flowering in mid-February. The local race in. western Tennessee (McNairy County) and some trees cultivated in Jackson, Tenn., which have shed most of their seeds by late August (when most seeds were unripe as far south as El Dorado, Ark.) appear to be atypically early flowering for the southern variety. I have used two of the Jackson trees for crossing, and also one cultivated at Webster Groves, Mo., that has been observed to flower from the first week of May into September. The latter tree has good qualities, and would be a desirable one to propagate in spite of relatively unpersistent foliage, but it, like 'Henry Hicks', seems resistant to rooting of cuttings.

Some var. *virginiana* clones of the pubescent form are thriving in western Iowa, as far north as Woodbine. I now

have a number of seedlings from a heavy flowering specimen in a Shenandoah, Iowa yard. Also available for future breeding are two clones from the northeasternmost native stand (Essex County, Mass.) for which the town of Magnolia, Massachusetts, was named.

One successful cross has been made by W. F. Kosar at the National Arboretum, with northern *virginiana* pollen on a clone of *M. guatemalensis* that I sent back in 1964 from the type locality, the swamp at Tactic, Guatemala. Dr. Santamour, while still at Morris Arboretum, had used a seedling from my seed collection near there, to determine that *guatemalensis* is a diploid. We'll have to wait a little longer to tell whether the *guatemalensis x virginiana* hybrids are as sterile as crosses of *virginiana* with other diploids. While still in Guatemala, I was able to cross a *grandiflora* (probably var. *lanceolate)* with pollen of *M. guatemalensis.* The few resulting seedlings, which have not flowered, look much like some F1 hybrids between *virginiana* and *grandiflora.*

M. guatemalensis apparently will make a tree as big as *M. grandiflora* where the climate is favorable, judging from the large specimens I saw at Coban , Guatemala, some apparently native. But Coban people, like others where native magnolias are available in the Latin American highlands, prefer to plant the larger flowered *grandiflora. M. guatemalensis* flowers are less fragrant and smaller than *grandiflora,* but its tree is of densely conical growth when young, has interesting red coloration of its stipules and juvenile foliage, and is nearly completely glabrous. Its seedlings, from a distribution made in 1966, have stood the winters outside in San Francisco, Tampa, and Lafayette, Louisiana.

Also growing in the National Arboretum's greenhouse is a graft from another unnamed glabrous species in section Theorhodon, that my wife and I found in the cloud forest zone of Chiapas State, Mexico. Thomas MacDougall of New York told me he had previously collected herbarium specimens from the same small stand on the road between San Cristobal las Casas and the Yerba Buena mission. The quite different (pubescent) *M. Sharpei* Miranda came from near there. We were looking for it, but did not find it on a cloudy day. (There are some *Sharpei* seedlings growing on the California coast now.)

Dennis E. Breedlove, a Stanford University botanist, more recently found another undescribed magnolia species growing near a Chiapas lake, within one kilometer of the Guatemalan border. There is probably a different one in another Guatemalan stand (mentioned but not collected by Standley and Steyermark, authors of The Flora of Guatemala). There is another species collected once in Honduras, one on a volcanic mountain in Costa Rica. Two or more are endemic to Panama highlands, and Steyermark has described two from extreme eastern Venezuela. In the islands, there are others in a different series of section Theorhodon, including two in different areas of Puerto Rico, one in Cuba, four in the Dominican Republic and two in Haiti. All appear to be of limited distribution, and practically unknown in cultivation.

M Hamori Howard, from the Dominican Republic, was examined by Dr. Richard A. Howard, and determined to be a diploid. The only Latin American species known as a hexaploid, and the only one of wide distribution, is *M. Schiedeana,* which grows in highland areas from Tamaulipas to Vera Cruz, Durango, Jalisco and Nayarit states. It is probably nearest to *grandiflora,* botanically as well as geographically. Part of its range is north of the Tropic of Cancer, and it is less tropical in habit than the most southern *M. virginiana australis* in Florida. The University of Washington Arboretum finds a clone of *Schiedeana* (seedling of Frederick G. Meyer's collection in northern Tamaulipas) about as hardy as *grandiflora* in Seattle, but winter killed at Knoxville, Tenn.

Two Asiatic evergreen species, *M Delavayi* and *M. nitida,* are not closely related to any American species. They have been grown to a very limited extent in Cornwall, England, but have not yet been hybridized.

The Asiatic section Oyama has deciduous species, bushes or small understory trees, of which *M. Sieboldii* is probably the hardiest and best known, though it is seldom seen in the Midwest. There are some hybrids or putative hybrids in this section, including *M x highdownensis (M. Wilsoni* x *M. sinensis)* and Todd Gresham's hybrid between *M. globosa* and *M. Wilsoni.* Intersectionally, the mainly sterile M x *Watsonii* is a cross between *M. Sieboldii* and *M. hypoleuca.*

A few attempts to cross *virginiana* with the Oyama section have yielded no hybrids so far.

I shall conclude with a few words on Section Rytidiospermum. This section includes over half of the native U.S. species, namely *Ashei, Fraseri, macrophylla, pyramidata* and *tripetala. M. dealbata,* the only Mexican deciduous species, exists in western Oaxaca, perhaps ranging into Vera Cruz, and, like *Ashei,* is closely related to *macrophylla.* Other large-leafed species in this section are *M. rostrata* from the Himalayas, *M. hypoleuca (obovata)* from Japan and Korea, and *M. officinalis* from western China. *M. hypoleuca* in the best known of these. Besides the hybrids previously mentioned (with *virginiana* and *Sieboldii)* it is suspected that it may cross naturally with *M. tripetala.* One seedling in Livonia, Mich., appears to be a hybrid between *M. officinalis* var. *biloba* and a nearby tree of *tripetala. M. Fraseri* was used by Mr. Kosar to produce a sterile, semi-deciduous three-species hybrid when it pollinated the `Freeman' *(virginiana x grandiflora). M. Ashei* and *M. pyramidata,* the two rarest and least cultivated U.S. species, are not known to have given any hybrids, and this is likewise true of M *rostrata.* In crosses with *macrophylla,* I have sometimes succeeded with its pollen on *virginiana* var. *virginiana,* but not on var. *australis.* A few reciprocal crosses between *macrophylla* and *tripetala* so far have given no seeds.

Species in the Rytidiospermum section heretofore have been propagated almost exclusively from seed, but several clonal selections are in the offing. There are flower color variants, white to yellow in *Fraseri,* and spotted (northern range) to unspotted white (Alabama to Louisiana) in *macrophylla.* At Fort Gaines, Georgia, there is a *pyramidata* with larger than usual flowers. Some *tripetala* clones in Michigan cultivation have up to 20 tepals. I have demonstrated that the hardy and readily available *tri-*

petals is a compatible stock for clones of *hypoleuca* and *officinalis biloba*. Selected clonal forms, therefore, can be available to future breeders with this generally neglected section, to cross among themselves, or to try for wider hybridization with such species as *grandiflora, Sieboldii* and *virginiana*. There are enough possibilities to keep many breeders employed for a long time to come. Perhaps we cannot achieve the hybrid of *Fraseri* x *officinalis biloba* which a colleague suggests "should have its leaves forked at both ends." But we can try that and many other recombinations in this very diverse genus.

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