THE AMERICAN Horticultural MAGAZINE

JOURNAL OF THE AMERICAN HORTICULTURAL SOCIETY, INC. October 1967

AMERICAN HORTICULTURAL SOCIETY

1600 BLADENSBURG ROAD, NORTHEAST / WASHINGTON, D. C. 20002

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Reprints will be furnished in accordance with the following schedule of prices, plus postage, and should be ordered at the time the galley proof is returned by the author: One hundred copies--2 pp $7.20; 4 pp $13.20; 8 pp $27.60; 12 pp $39.60; Covers $13.20.

Second class postage paid at Baltimore, Maryland and at additional mailing offices. *The American Horticultural Magazine* is included as a benefit of membership in The American Horticultural Society, Individual Membership dues being $6.00 a year.

OCTOBER • 1967

THE AMERICAN Horticultural MAGAZINE

FORMERLY THE NATIONAL HORTICULTURAL MAGAZINE VOLUME 46 • NUMBER 4

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OCTOBER COVER ILLUSTRATION

Grassula. Original drawing by R. Hays. Courtesy of Mrs. Charles Bittinger.

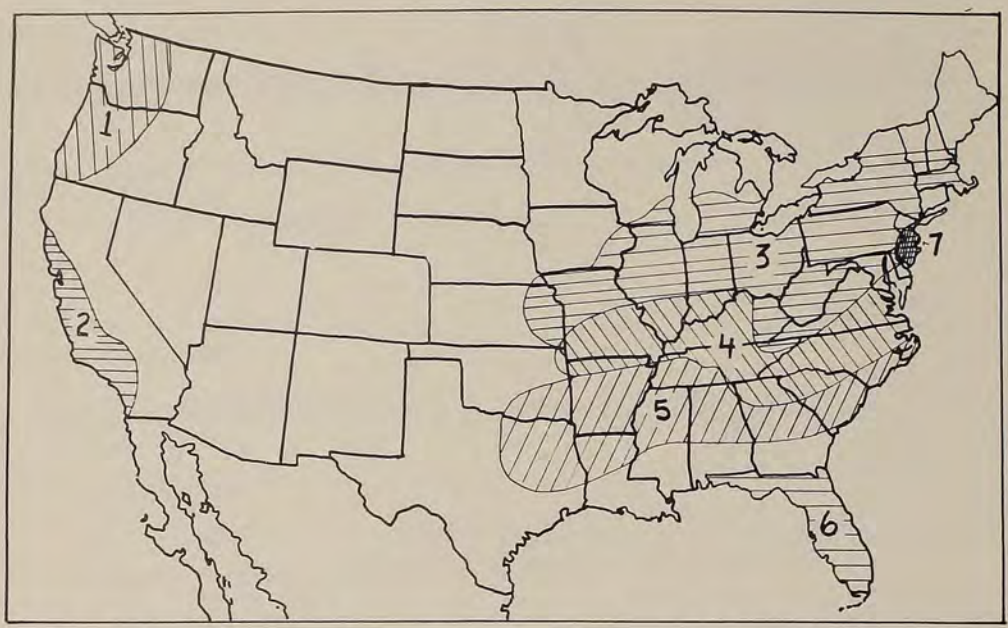

Fig. 1. Where some blackberry varieties are adapted. The blackberry is not so hardy as the red raspberry and is grown mostly farther south and not so far north. Many different species are in the ancestry of different varieties, hence their different adaption.

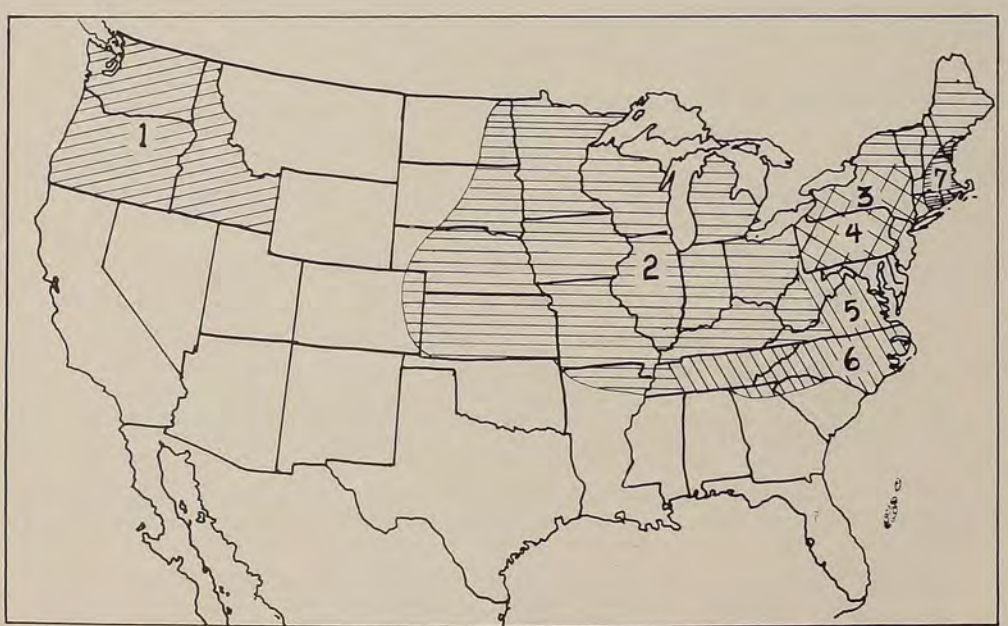

Fig. 2. Where some red raspberry varieties are adapted. The red raspberry is hardier and is raised farther north than the blackberries and is not well-adapted to the south. The largest acreage is in western Washington and northwestern Oregon.

The Cultivated Raspberry and Blackberry in North America—Breeding and Improvement

By George M. Darrow*

Raspberries and blackberries (*Rubus* spp.) have been important in the United States and Canada for about 100 years. The first raspberry varieties or cultivars were of European origin introduced before 1800. Native red raspberries harvested extensively in the wild helped to make it a popular fruit. The 'Brinkles Orange' raspberry of European parentage, raised by Dr. Brinkle of Philadelphia in 1845, of exceedingly high flavor, and 'Turner' of American parentage, raised about the same time in Illinois, made this fruit popular in gardens and for the local market. Later in the 1870's and 1880's, the 'Antwerp' (*R. idaeus*) and 'Cuthbert' (*R. idaeus* × *strigosus*) were good enough to make an important commercial industry. About 1870, black raspberries became important with the general distribution of 'Doolittle'. The purple raspberry, following the introduction of 'Columbian' in 1891, said to have been grown from seed of 'Cuthbert' (but probably not) became of some importance. The greatest acreage in cane fruits was from about 1890 to 1910. Blackberry varieties are not so hardy as raspberry varieties and are grown mostly south of the center of raspberry production. (See maps Figs. 1 and 2)

Through the past 60 years the acreage of these berries has steadily decreased: for blackberries and dewberries from 50,211 acres in 1899, to 49,004 acres in 1909, to 43,684 acres in 1959; and for raspberries from 60,916 acres in 1899, to 48,668 acres in 1909, to 24,215 acres in 1959. The decrease has been due largely to labor costs in harvesting but in part to disease and insect pests which have been difficult or costly to control with available methods.

New research on virus and other diseases, the production of virus-free stocks (Fig. 3), and the introduction of new cultivars, even thornless blackberries, offer gardeners and commercial growers

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About the Author

It has been over 50 years since the author first became interested in raspberry and blackberry improvement. The first farmers' bulletins by him on berries were published in 1915 (Blackberry Culture), 1916 (Dewberry Culture), 1917 (Raspberry Culture), and 1918 (Logan Blackberry Culture). A review of the world information on the improvement of these fruits was published 20 years later in 1937 in the Yearbook of the U. S. Department of Agriculture. When the author retired in 1957, even though important research had been done, there was doubt as to the future of the raspberry and blackberry as important fruits due to the increasing harvesting costs, the difficulty of disease and insect control, and the changing food habits of the public. Now with the mechanization of cultural operations, the actual beginning of mechanical harvesting, the great improvement in pest control, especially in the commercial production of virus free plants of some varieties and soon of many varieties, and the introduction of high-flavored, very productive, and thornless varieties, their future is much more promising.

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Fig. 3.* 'Latham', *the standard red raspberry of eastern U. S. since about 1920. It originated and was selected at the Minnesota Experiment Station so is very hardy. Now that virus-free stock is available it should be even more valuable. Though of only fair dessert quality, it has very good flavor when frozen or in jam.

a far better opportunity with these fruits than for many years past.

In the latitude of Maryland, the fall-fruiting red raspberries, 'September', 'Fallred', and others make it possible to have this fruit for more than three months instead of three weeks —'Fallred' for high flavor, and 'September' for both eating and freezing. By cutting all canes off in winter of the fall-fruiting red cultivars so as to have no fruit in June, a heavier crop is obtained on the new canes from August to the end of October. By growing the new 'Smoothstem' thornless blackberry which has pinkish flowers and nearly evergreen foliage, a heavy crop is harvested in August when, in the Maryland area at least, birds have quit eating the berries. The thorny erect-growing hardy 'Darrow' blackberry of high quality ripens in July in Maryland, but in some years in garden patches the birds may take all the fruit; at most they leave only half the crop. When birds are not a problem this variety is a most worthwhile addition for gardeners and commercial growers. The year 1967 should see the first extensive use of a harvesting machine for the 'Raven' blackberry in Arkansas.

Many raspberries and blackberries have been freed of virus diseases in the U. S. Department of Agriculture and cooperating states research programs and 20 raspberry and 13 blackberry cultivars have been released to nurseries for propagation as free of known virus. Stock of some of these may now be purchased from nurseries. The increase in yield of the virus-free over the ordinary stocks varies greatly, both with the cultivar and with the virus, but in some cases it has been four-fold. (Fig. 4)

The present commercial American raspberries are from three species, *Rubus strigosus* (red) and *R. occidentalis* (black), both American, and the

Fig. 4. A. Each basket of berries is the yield for one picking of a 15-foot row of mosaic-virus infected plants of the Newburgh red raspberry.
B. Each two baskets is the yield of a 15-foot row, virus-free plants of the Newburgh red raspberry.

European *R. idaeus* (red). Most, if not all of the widely grown red raspberry cultivars of today have both red-berried species in their parentage—*strigosus* provides genes for resistance to low winter temperatures and *idaeus*, genes for large firm fruit. The purple raspberries (hybrids of the red × black) have all three species in their ancestry.

Blackberries, including the trailing ones often called dewberries, became important about 1870. The early cultivars were selected from the wild. Today's cultivars are derived from at least ten species, probably as listed below.

Wild Relatives of Raspberries and Blackberries

Raspberry species and cultivars of North America are diploid (2n = 14) with two sets of chromosomes. No triploids (with three chromosome sets) or tetraploids (with four chromosome sets) have succeeded, though some are grown occasionally in Europe. The wild black raspberries do not show a great range of variability and black raspberry cultivars are relatively uniform. The only native American red raspberry species, *R. strigosus*, is much more variable than the black raspberry, and most red-fruited raspberry cultivars now grown are highly variable genetically.

Blackberry (*Rubus*) species north of Mexico are numerous (conservatively about 35) and form a genetically variable series from diploid to 12-ploid. Bailey (1941-45) recognized over 350 species, most now considered to be merely natural hybrids. The blackberry group as a whole is highly variable. Some species, such as Himalaya blackberry (*R. procerus*) and evergreen blackberry (*R. laciniatus*), may reach 20 feet in height, others barely two inches. Some are evergreen and subtropical (*R. trivialis*), others are deciduous and range far north in Canada (*R. hispidus* and *R. chamaemorus*); some produce few, others many stems from the crown, and they vary greatly in drought, heat, cold, disease, and insect resistance, in productiveness, in fruit size and color, and in flower and seed size. The homoploid blackberry species (those with the same chromosome number) are mostly interfertile. Even some of the heteroploid blackberry species (those with different chromosome numbers) are somewhat interfertile. Self-sterility is very widespread in wild blackberry species which differ in chromosome number and are cross-pollinated by bees. Now immense numbers of hybrids, hundreds of thousands of them, some fertile, many not, are to be found throughout eastern

Blackberry Cultivars

Erect growing cultivars:	
Early Harvest	*R. argutus*
Eldorado	*R. alleghanensis* × *argutus*
Lawton	*R. alleghanensis* × *frondosus*
Darrow	*R. alleghanensis* × *argutus* × (unknown)
Trailing, eastern type:	
Lucretia	*R. baileyanus* × *argutus*
Rogers	*R. trivialis*
Semi-trailing, western type:	
Logan	*R. ursinus* × *idaeus*
Boysen	*R.* (*ursinus* × *idaeus*) × (*baileyanus* × *argutus*)
Olallie	*R. ursinus* [(*ursinus* × *idaeus*) × (*baileyanus* × *argutus*)]
Chehalem	*R. macropetalus* × *procerus*
Cascade	*R. macropetalus* × (*ursinus* × *idaeus*)
Semi-erect:	
Himalaya	*R. procerus* (introduced)
Evergreen (and Thornless Evergreen)	*R. laciniatus* (introduced)

North America. Einset (1951) examined some of these and found all that he tested produced a high proportion of apomictic (non-sexual) seedlings. He even found many haploid plants with only one set of chromosomes. In one population of 681 seedlings of a wild tetraploid raspberry having four sets of chromosomes, 43 haploids were found. The original cultivars selected from the wild were self-fertile, often tetraploid variants or hybrids of largely self-fertile diploid populations. A great many fine fruiting wild blackberries have been tested under cultivation only to fail because they required cross-pollination. Virus, causing sterility, is also present in wild blackberry plants in some areas. Fungi and insects in the flowers may be a factor in the sterility of native plants as well as of cultivated blackberries.

Many desirable characters are present in the various native and naturalized blackberry species—some listed by Darrow in 1937 are:

cold hardiness	firm fruit	crown gall resistance
thornlessness	large fruit	leaf spot resistance
vigor	excellent flavor	anthracnose resistance
drought resistance	small seed	verticillium resistance
immense flower clusters	early to late ripening	root knot resistance
orange rust resistance		double blossom resistance

Three Methods of Raspberry and Blackberry Breeding

Obviously the problem of breeding must be approached with a recognition of the great range of available characters. Three methods are available: (1) characters in present cultivars may be recombined to originate greatly superior ones as has been done in breeding 'Latham', 'Taylor', and 'Willamette' red raspberries and the 'Cascade', 'Olallie', and 'Darrow' blackberries; (2) besides the hitherto relatively limited use of American species there are hundreds of foreign wild species and many cultivars from which new breeding stock (germ plasm) may be introduced, as has been done in obtaining the 'Van Fleet' and 'Mandarin' raspberries and the 'Smoothstem' blackberry; and (3) new combinations of characters in wild species may be made looking toward entirely new kinds of berries.

Recombining Germ Plasm of Present Cultivars

Greatly improved new cultivars could be obtained quickly if all the best characters in present or old cultivars were combined. Cultivars introduced by public agencies since 1936 have resulted mostly from recombinations listed in Table I.

Raspberry Breeding

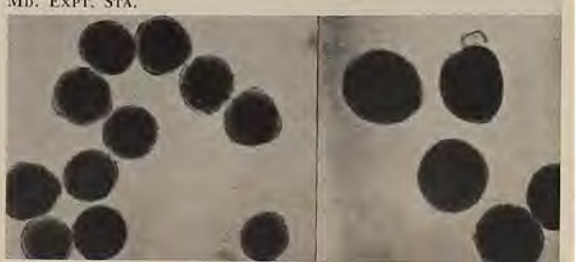
Black raspberries are relatively uniform (homozygous) although named cultivars are quite superior to wild forms, for example 'Older' is hardier, 'Bristol', larger-fruited, and 'Cumberland' somewhat freer from mildew and leaf spot. Most of the black raspberry breeding has been done at the New York Experiment Station, with less emphasis at the North Carolina, Oregon, Missouri, Iowa, and Maryland stations. Breeding in Maryland and North Carolina aimed for cultivars better adapted for the South, in Iowa for hardy varieties, and in New York for larger size and greater production by straight black raspberry breeding and through backcrosses with purples. At the Maryland

MD. EXPT. STA.

Fig. 5. Comparative size of stomates of a normal diploid, (2x) on left and of a tetraploid (4x), on right, black raspberry seedling. 500x.

Fig. 6. Comparative size of pollen of normal (2x) diploid, left, and a tetraploid (4x) black raspberry. 960x.

MD. EXPT. STA.



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and U. S. Experiment Stations, the chromosome number has been doubled and the tetraploids used in breeding. (Figs. 5 and 6) The 'Mysore' raspberry, selected at the South Florida station, is a seedling of *Rubus albescens*, a subtropical black raspberry species of southern Asia. Drain (1956) has used the latter species in Tennessee and also *R. crataegifolius*, another Asiatic species, in extensive crosses with black raspberry varieties. Williams in North Carolina and Waldo in Oregon have used Asiatic species, *R. coreanus, biflorus, kuntzeanus* (Figs. 7 and 8), and others but no commercial varieties have yet resulted. Slate in New York and others have used the wineberry, a black raspberry type. (Fig. 9)

Purple raspberries are first generation hybrids of black × red raspberries, although 'Success', a sweet cultivar that suckers sparingly, may possibly have some genes from *R. chamaemorus*, as its red parent was a sister of 'New Hampshire' (see Table I). Purple raspberries have not yet been successfully backcrossed to obtain the desired combination of characters derived from the parent black and red cultivars. A few purple

Fig. 7 (top). **Rubus biflorus,** ***an extremely vigorous and very large raspberry of the black type. The fruit may be yellow, orange, or dark red and each berry is densely covered with a mat of hairs. The berries are borne in small clusters and are up to one and a half inches across. Though quite flavorful when eaten, a mat of hairs remains in the mouth.***

Fig. 8 (center). **Rubus kuntzeanus,** ***a raspberry from China. It has enormous flower and fruit clusters, wine-colored berries like a small black raspberry, and is a very vigorous plant. The cultivar*** **'Van Fleet'** ***resulted from a cross of the species with*** **'Cuthbert'** ***red raspberry.***

Fig. 9 (bottom). The wineberry, **Rubus phoenicolasius,** ***an Asiatic black raspberry type widely naturalized, especially east of the Appalachians from New England to Georgia. It has glossy, wine-colored, rather tasteless berries with densely glandular, red hairy calyx and stems. It is sometimes found in the markets.***

TABLE I

Raspberry and Blackberry Cultivars Originated by Public Agencies, Introduced 1937-1966

Raspberries

Black	Cultivar	Cross	Introduction: Place	Introduction: Year
1	Allen	Bristol × Cumberland	Geneva, N. Y.	1957
2	Black Hawk	Quillan × Black Pearl	Ames, Iowa	1955
3	Huron	Rachel × Dundee	Geneva, N. Y.	1965
4	Manteo	Cumberland × self	Raleigh, N. C.	1951
5	Mysore	*R. albescens*	Homewood, Fla.	1948
6	Somo	unknown	Mt. Grove, Mo.	1956
Purple				
7	Clyde	Bristol × NY 17861	Geneva, N. Y.	1961
8	Purple Autumn	Bristol × Indian Summer	Urbana, Ill.	1953
9	Success	Morrison × N. H. 100	Durham, N. H.	1956
Yellow				
10	Amber	Taylor × Cuthbert	Geneva, N. Y.	1950
11	Goldenwest	Cuthbert × Lloyd George	Puyallup, Wash.	1953
Hybrid reds				
12	Dixie	*R. biflorus* × Latham	Raleigh, N. C.	1938
13	Mandarin	(*R. parvifolius* × Taylor) × Newburgh	Raleigh, N. C.	1951
14	New Hampshire	F_2 (Taylor × *R. chamaemorus*) × Newburgh	Durham, N. H.	1955
15	Tennessee Luscious	Lloyd George × Tenn. 169 (Van Fleet × Viking)	Knoxville, Tenn.	1944
16	Tennessee Prolific	Lloyd George × Tenn. 169	Knoxville, Tenn.	1948
17	Vandyke	Adams 87 × Viking	Vineland, Ont.	1947
Red				
18	Antietam	Marcy × Sunrise	College Park, Md.	1953
19	Boyne	Chief × Indian Summer	Morden, Man.	1960
20	Canby	Viking × Lloyd George	Corvallis, Ore.	1953
21	Carnival	Ottawa × Rideau	Ottawa, Ont.	1955
22	Citidel	Complex Hybrid	College Park, Md.	1967
23	Comet	Ottawa × Modawaski	Ottawa, Ont.	1955
24	Crimson Cone	Latham × Milton	Urbana, Ill.	1955
25	Durham (Presumed apomictic from mother plant)	Taylor × Boysen	Durham, N. H.	1947
26	Early Red	Lloyd George × Cuthbert	S. Haven, Mich.	1952
27	Fairview	US-Oreg. 782 × Washington	Corvallis, Ore.	1961
28	Fallred	N. H. 7 × N. Y. 287	Durham, N. H.	1964
29	Fraser	Chief × Viking	Saskatoon, Sask.	1960
30	Gatineau	Lloyd George × Newman 23	Ottawa, Ont.	1950
31	Hilton	Newburgh × St. Walfreed	Geneva, N. Y.	1965
32	Ithasca	------ ------ ------ ------ ------	St. Paul, Minn.	1956
33	Killarney	Chief × Indian Summer	Morden, Man.	1961
34	Madawaska	Lloyd George × Newman 23	Ottawa, Ont.	1943
35	Meeker	Willamette × Cuthbert	Puyallup, Wash.	1967
36	Milton	Lloyd George × Newburgh	Geneva, N. Y.	1942
37	Muskoka	Newman 23 × Herbert	Ottawa, Ont.	1950
38	Ottawa (Presumed apomictic from mother plant)	Viking × (Logan × Ranere)	Ottawa, Ont.	1943

crosses have been introduced but have not been successful. 'Vandyke', derived in part from 'Adams 87' (with purple ancestry) and a true red in appearance, may be the first successful purple hybrid. No hybrid from *R. coreanus, R. albescens* or other black raspberry species has yet been named, although these species have been used as parents at several stations as possible sources of resistance to leaf, cane, and virus diseases and adaptation to southern regions.

Red raspberry breeding has been relatively successful in the production of successful new cultivars which have replaced older ones. The commercial

TABLE I (con't.)

Raspberries

39	Puyallup	Washington × Taylor	Puyallup, Wash.	1953
40	Reveille	Complex Hybrid	College Park, Md.	.....
41	Rideau	Lloyd George × Newman 23	Ottawa, Ont.	1943
42	Scepter	Complex Hybrid	College Park, Md.	1967
43	Sentinel	Complex Hybrid	College Park, Md.	1967
44	Sentry	Complex Hybrid	College Park, Md.	1967
45	September	Marcy × Ranere	Geneva, N. Y.	1947
46	Summer	Washington × Tahoma	Puyallup, Wash.	1956
47	Sunrise	Latham × Ranere	Glenn Dale, Md.	1939
48	Tahoma	Latham × Lloyd George	Puyallup, Wash.	1938
49	Tennessee Autumn	Tenn 181 × Lloyd George	Knoxville, Tenn.	1948
50	Thames	Lloyd George × Newman 23	Ottawa, Ont.	1952
51	Trent	Newman 23 × Lloyd George	Ottawa, Ont.	1943
52	Tweed	Newman 23 × Lloyd George	Ottawa, Ont.	1946
53	Washington	Cuthbert × Lloyd George	Puyallup, Ont.	1943
54	Willamette	Newburgh × Lloyd George	Corvallis, Ore.	1942

Blackberries

Trailing to Semi-erect				
1	Big-Ness	F_3 (*R. rubrisetus* [= *trivialis*] × Nessberry)	College Sta., Tex.	1946
2	Cameron	Young × Lucretia	Raleigh, N. C.	1938
3	Carolina	Austin Thornless × Lucretia	Raleigh, N. C.	1951
4	Earli-Ness	F_3 (*R. rubrisetus* × Nessberry)	College Sta., Tex.	1946
5	Flordagrand	F_2 (Regal-Ness × *R. trivialis*)	Gainesville, Fla.	1958
6	Oklawaha	F_2 (Regal-Ness × *R. trivialis*)	Gainesville, Fla.	1964
7	Ranger	Dewblack × Eldorado	College Park, Md.	1966
8	Raven	Dewblack × Eldorado	College Park, Md.	1961
9	Regal-Ness	F_3 (*R. rubrisetus* × Nessberry)	College Sta., Tex.	1946
10	Aurora	U. S.-Oreg. 616 × U. S.-Oreg. 73	Corvallis, Ore.	1961
11	Cascade	Zelienski × Logan	Corvallis, Ore.	1940
12	Chehalem	Santiam × Himalaya	Corvallis, Ore.	1948
13	Marion	Chehalem × Olallie	Corvallis, Ore.	1956
14	Olallie	Black Logan × Young	Corvallis, Ore.	1950
15	Pacific	Zelienski × Logan	Corvallis, Ore.	1940
16	Early June	Oreg-US 266 × NC-US 36	Experiment, Ga.	1959
17	Flint	Brainerd × Eldorado	Experiment, Ga.	1957
18	Jersey Black	Evergreen × Eldorado	New Brunswick, N. J.	1953
19	Williams	Himalaya × Taylor	Raleigh, N. C.	1961
Erect				
20	Bailey	Unknown	Geneva, N. Y.	1950
21	Brazos	F_2 (Lawton × Nessberry)	College Sta., Tex.	1959
22	Darrow	(Eldorado × Brewer) × Hedrick	Geneva, N. Y.	1958
23	Hedrick	(Eldorado × Brewer)	Geneva, N. Y.	1950
Trailing Thornless				
24	Smoothstem	US 1482 (Merton Thornless × US 1411) × open	Beltsville, Md.	1966
25	Thornfree	US 1410 (Brainerd × Merton Thornless) × US 1414 (Merton Thornless) × Eldorado	Beltsville, Md.	1966

canning, freezing, and preserving industry for red raspberries is centered largely in western Oregon and Washington and the most important cultivar 'Willamette', is much larger, firmer, hardier, and more productive than the older 'Cuthbert'. 'Canby', a relatively new cultivar, seems to be succeeding there also. The 'Latham' is still important in Eastern North America because of its low-temperature resistance and virus tolerance, but 'Sunrise', 'Taylor', 'Durham', and 'September' are also important. Virus-free stocks of 'Latham' are much more productive than older stocks. 'Sunrise' has been useful as a very

early, very hardy reliable cultivar of medium size and flavor, and 'Taylor' as a later, large, high-flavored cultivar for northeastern states. 'Sunrise' has also been useful as a parent for its leaves which persist well in summer. The late-summer and fall-fruiting habit on the current season's canes makes 'Indian Summer', 'Durham', and 'September' especially important for home use. They are all cold hardy.

Fischer *et al* (1943) treated 2,500 raspberry seedlings with the drug colchicine and obtained 17 partially or completely tetraploid plants. Larger and thicker leaves and calyx were the most obvious induced changes due to polyploidy. Pratt *et al* (1958) grew seedlings of a triploid *R. idaeus* in various crosses and obtained 38 diploid, 385 triploid, 93 tetraploid, three pentaploid, and 13 aneuploid (those not having multiples of the basic chromosome number) seedlings. When so many triploid seedlings come from a triploid, it seemed to be the beginning of a triploid apomictic population of red raspberries. Pollen and seed were much larger in the tetraploids and could be used in identifying the 4× or tetraploid progeny.

Hull and Britton (1958) raised 1,200 tetraploid black raspberry seedlings from some 40 partially or almost fully fruitful colchiploid seedlings (a tetraploid produced by treating with colchicine) that had flowered. They also crossed the colchiploids with various blackberries of mixed ploidy and with tetraploid red raspberries. The one tetraploid red raspberry seedling bore purple fruit and gave a good fruit set.

Yellow cultivars of the red raspberry type, 'Amber' and 'Goldenwest', are of high quality and of value for home gardens where adapted to soil, climate, or other factors.

Hybrid red raspberries have not yet become important although 'New Hampshire' (showing only red raspberry genes) seems promising in New England and 'Ottawa' (showing no 'Logan' genes) in parts of Canada. 'Dixie' and 'Mandarin' show disease resistance and may yet prove important in breeding.

Blackberry Breeding

In general, blackberry breeding research is further advanced than raspberry breeding. Waldo and Darrow (1948) reported on their crosses of octoploid western blackberries with a tetraploid raspberry and with a tetraploid blackberry. None of the blackberry × raspberry hybrids were equal in fruit characters to 'Logan', of similar parentage, but the octoploid × tetraploid blackberries gave many seedlings superior to 'Mammoth'.

The review of blackberry breeding at the Oregon Station at Corvallis by Waldo (1950) and his introduction of a series of new cultivars, several of which are now of commercial importance, has been especially rewarding. Selections of promise were obtained from many crosses involving parents with different but high, chromosome numbers. (Table II)

Though many seedlings resulting from Waldo's breeding work were partially or completely sterile, several crosses between cultivars with different chromosome numbers gave 40 to 75 per cent fertile perfect-flowered seedlings. Crosses between widely different cultivars, such as 'Santiam' (='Ideal'), a selection from the wild western trailing blackberry (8x) × Himalaya (4x) with 47 per cent of the seedlings fully fertile, resulted in productive named cultivars. The cultivar

TABLE II

BLACKBERRY SELECTIONS—OREGON, 1951

Cross	*Number of selections*
Oreg. 743 (9x × 6x) × Oreg. 73 (6x × 8x)	5
Oreg. 743 (9x × 6x) × Oreg. 877 (8x × 4x)	17
Oreg. 743 (9x × 6x) × Oreg. 878 (8x × 4x)	2
Oreg. 743 (9x × 6x) × Oreg. 880 (8x × 4x)	16
Oreg. 743 (9x × 6x) × Boysen (6x)	1
Oreg. 743 (9x × 6x) × Chehalem (6x)	3
Oreg. 743 (9x × 6x) × Himalaya (4x)	2
Oreg. 743 (9x × 6x) × Olallie (6x)	2
Oreg. 876 (8x × 4x) × Oreg. 73 (6x × 8x)	1
Oreg. 880 (8x × 4x) × Boysen (6x)	1
Oreg. 884 (8x × 4x) × Oreg. 743 (9x × 6x)	4

In this list of 54 very fruitful selections from various crosses only one, Oreg. 880 × 'Boysen', was between parents of like chromosome number. Even that cross may not have been between like chromosome number parents, for later stocks of 'Boysen' in the trade were seven-ploid.

'Cascade', with the finest flavor yet known in blackberries and adapted to western Oregon and Washington, resulted from a cross of 'Zielinski', a native selection (12x) × 'Logan' (6x). New forms of blackberries are still being introduced from this work. 'Aurora', introduced in 1961, was selection Number 616 [Zielinski (12x) × Logan (6x)] × Number 73 [Logan (6x) × Austin Thornless (8x)] having cultivars with three different chromosome numbers in its ancestry.

Verticillium wilt has been a major trouble in blackberries on the Pacific Coast. The standard cultivars 'Boysen', 'Young', and 'Eldorado' are susceptible and 'Logan', 'Evergreen', and 'Himalaya' are resistant. The 'Cascade', 'Chehalem', 'Marion', 'Olallie', and 'Pacific', all from the U. S.-Oregon breeding work, are also resistant.

Hull and Britton (1956, 1958), in Maryland, induced polyploidy in many types of *Rubus*. They obtained an octoploid of the erect-growing 'Eldorado' blackberry (4x) and tetraploids of the diploid black (Figs. 5 and 6) and red raspberries. Thornless seedlings were also obtained from 'Eldorado' parentage and from 'Thornless Logan'. They state, "many colchiploid (4n) blackberries, black raspberries, and red raspberries showed promise for developing breeding lines in their own right besides serving as parents in wide crosses. The colchiploid Rubi were almost invariably chimeral in nature." Propagation by leaf-bud cuttings or tip plants assured their perpetuation. "Fruit size varied directly with the ploidy (chromosome level) of the third histogenic layer (L-3) if the plants were otherwise comparable. Unstable plants were found among both colchiploids and natural polyploids."

Instability was associated with polyploidy and when breeding near or above the 6x level of ploidy, the breeder must take this instability into account. A seedling apparently worthy of introduction may become altered in character and become worthless. Some of the unstable seedlings produced two or more different plants with different chromosome numbers from the same root, as different as widely different species. (Fig. 11) A fertile, synthetic, erect-growing 'Logan' was vigorous and hardy (Figs. 12a and 12b). Britton and Hall (1959) have also reported a fertile tetraploid black raspberry-blackberry hybrid. Both Darrow (1955) and Einset and Pratt (1954) have reported similar raspberry-blackberry hybrids. (Fig. 13) In a study of thornlessness in 'Austin Thornless' the latter authors obtained 91 entirely thornless out of over 1,000 F_1 seedlings. There was a range of expression of thornlessness from completely thornless to very thorny, and thornlessness was transferred in the F_1 generation to many different types at different levels of chromosome number. Hull (1961) used 'Austin Thornless' in crosses to obtain thornless plants of widely different types.

"Unreduced" fertilized eggs were of frequent enough occurrence in *Rubus* to warrant the making of crosses to take advantage of this character (Britton and Hull, 1956). Mitotically unstable seed lings at about and above the 6-ploid

MD. EXPT. STA

Fig. 10. Effect of chromosome number on leaf appearance. To left a leaf of the tetraploid (4x)* 'Eldorado' *blackberry cultivar; to the right a leaf of the octoploid (8x) of the* 'Eldorado' *and, above, a haploid (2x) seedling of the* 'Eldorado' *(after Hull and Britton).

FIG. 11 MD. EXPT. STA.

Fig. 11. Very different canes from roots of a single seedling blackberry of the cross **'Austin Thornless'** *(8x)* × **'Eldorado'** *(4x). Cane to left is pentaploid (5x), center cane is decaploid (10x), and cane to right is aneuploid (8x + about 4). Such unstable plants can affect a breeder's work with* **Rubus** *and a selection, apparently worthy of introduction, may become altered in character (after Hull and Bitton).*

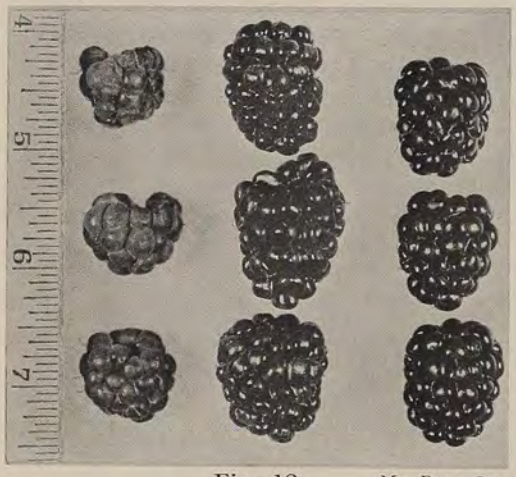


Fig. 12a MD. EXPT. STA.

Fig. 12a. Fruits of the (left) **'Hailsham'** *(4x) red raspberry, (right)* **'Austin Thornless'** *(8x) blackberry, and (center) the* F_1 *hybrid (6x). This hybrid pulls off the receptacle like a raspberry (after Hull and Britton).*

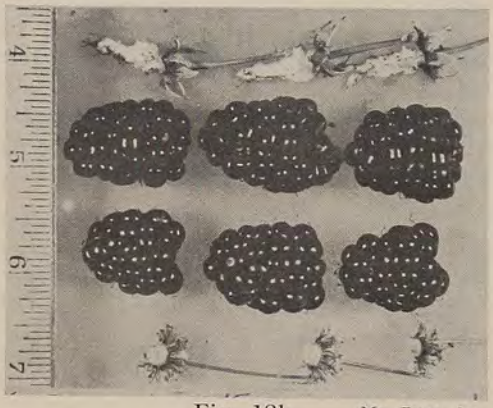


Fig. 12b MD. EXPT. STA.

Fig. 12b. Fruit of two seedlings of the cross of **'Hailsham'** *(4x) red raspberry* × **'Austin Thornless'** *(8x) blackberry. Above, raspberry-like separation with the core remaining with the pedicel; bottom, blackberry-like separation with core remaining in the fruit (after Hull and Britton).*

level were found among both colchiploids and natural polyploids. Such plants were of widely different types with different and lower chromosome numbers than the mother plants.

Kerr (1954) in Ontario studied seed development in three apomitic cultivars of blackberries and in five normally developing cultivars (three blackberries and two native raspberries). Many chromosome irregularities were common in the apomitic species and about one-third of the seeds that started development contained no embryo. Einset (1951) obtained 41 triploid, one tetraploid, and 14 pentaploid seedlings from open pollinated *R. canadensis* (3x) but no seed from 156 emasculated bagged flowers. He concluded that this thornless species was largely pseudogamic (parthenogenetic).

Craig (1960) found all the native American thornless *R. canadensis* studied by him to be triploid apomicts but pollen of *canadensis* used on commercial blackberries formed fertile hybrids. Its pollen on tetraploid varieties produced 2x, 3x, 4x, and 5x seedlings as well as some cytologically unstable. As a female parent, *R. canadensis* also produced some sexual pentaploid seedlings. It was concluded that *R. canadensis* could be used successfully in broadening parental material for breeding thornless hardy plants. (Fig. 14 and 15)

Use of Diverse Rubus Species

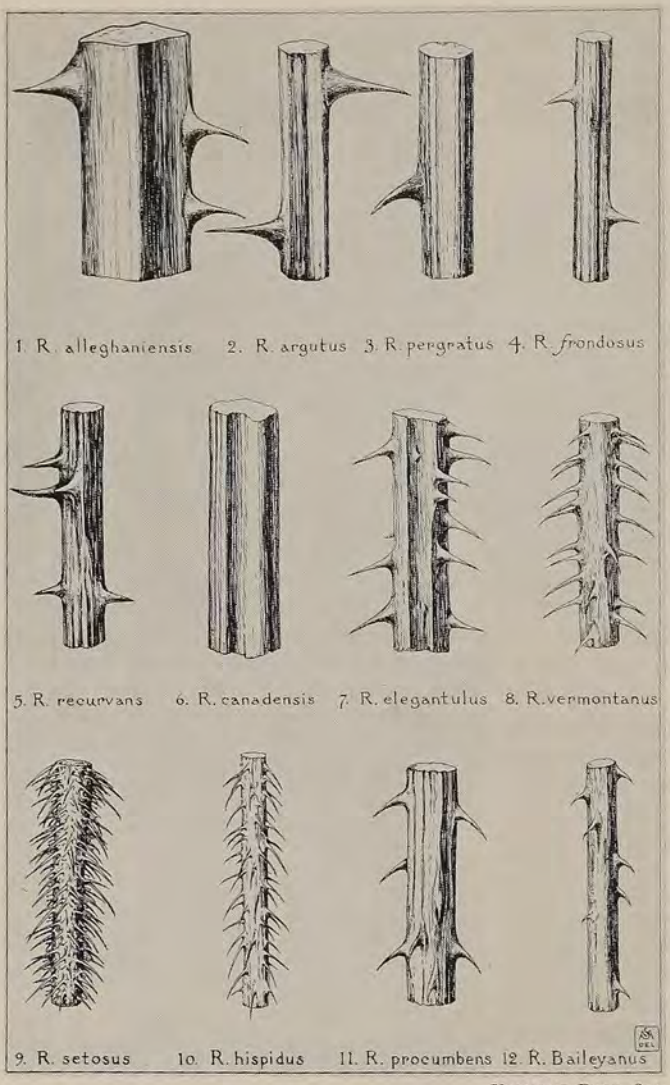
Besides the species already referred to, Yeager and Meader at the New Hampshire station have crossed the raspberry and blackberry and in breeding have used *R. canadensis* (for thornlessness), *R. odoratus* (for hardiness and disease resistance), *R. arcticus* and *R. chamaemorus* (for flavor), and *R. pungens* 'Oldhami' and *R. morifolius* (for earliness). In cooperative work in North Carolina, C. F. Williams used *R. parvifolius* (for large size, productiveness, disease, and heat resistance), *R. glaucus* (for large size, disease resistance, and adaptation to the South), *R. biflorus, R. coreanus, R. ellipticus* (Fig. 16), and *R. kuntzeanus* (for adaptation to the South and for disease resistance). Williams found it was desirable to combine the desired characteristics of two or more species into a single selection and use it to cross with the best cultivars. Darrow and others have attempted to use the giant-fruited *Rubus* of northern South America, but true crosses have not yet been obtained. (Figs. 17 and 18)

U.S.D.A.

Fig. 13. The raspberry and blackberry have often been crossed and a few hybrids named. None have succeeded commercially except raspberry crosses in the Pacific Coast species,* R. ursinus (Logan Phenomenal). *The seedling on the left is sterile. The berries on the seedling on the right do not pick as a blackberry nor fall off as a raspberry, but mash in the hand.

Summary

Much background information is now available that should stimulate further breeding of raspberries and blackberries. Many cultivars resulting from the breeding have been, and others recently introduced undoubtedly will be successful. These have resulted from breeding to pyramid desirable qualities within the raspberry and blackberry groups; the use of introduced and native wild species, and new combinations looking toward new kinds of berries. Research within the raspberry and blackberry



VERMONT EXPT. STA.

Fig. 14. Canes of some of the best known species of blackberries of Eastern North America. The canes of different clones of* Rubus canadensis *range from entirely thornless to those with scattered prickles. It is a high mountain species of the Appalachians from Georgia northward. It is a triploid and, therefore, an ancient polyploid.

U.S.D.A.

Fig. 15. Typical appearance of a plant of the native American thornless blackberry,* Rubus canadensis *as grown in the Arnold Arboretum, Boston, Massachusetts. This plant was about five feet high and ten feet across. It is a triploid, often fruitful in the wild and though seedlings of it may have variable chromosome numbers those that succeed seem always to be triploid.

U.S.D.A.

Fig. 16. Base of plant of the semitropical golden evergreen, Rubus ellipticus, *at Watsonville, California showing a foot ruler. Some of the densely red hairy canes shown are three inches in diamter and 15 feet high. This species is from southern Asia. The author has seen it naturalized at Cartago, Costa Rica at the foot of Mt. Irazu. It bears blackcap-like berries of a golden yellow color of only fair flavor.*

U.S.D.A.

Fig. 17. Fruit of Rubus macrocarpus, *the giant blackberry or raspberry at El Peñon near Bogata, Colombia. This berry pulls off like a raspberry but the plant is more like a blackberry.*

U.S.D.A.

Fig. 18. A fruit cluster of Rubus roseus. *This species grows at 9,000 to 13,000 feet near Baños, Ecuador and is allied to the giant blackberry or raspberry of Colombia.* × ½.

U.S.D.A.

Fig. 19. The leading fungus disease of raspberries in most of the U. S. is anthracnose. Infected plants have light spots on the canes. The disease is readily controlled with Fermate. Many Asiatic species are resistant to this disease and may be useful in breeding.

group seems especially favorable in helping to solve many genetic problems: production of haploids and various polyploids can be planned and obtained with relative ease in *Rubus*; the production of apomitic cultivars offers a method of freeing propagating stock of virus; interspecific crosses can be made for new forms and for obtaining unstable plants that can result in the production of new species. The genus *Rubus* is a large one with a wide distribution in North America. Many problems have been solved and many remain.

Results of recent research make blackberry and raspberry growing much more interesting for the home gardener than in years past. There are some new varieties for most parts of the United States and in all regions far higher yielding, virus-free stocks are becoming available. Weedicides and mulching make weed control easier. There are new sprays for fungus diseases and insects, and new bird control devices are available. (Fig. 19)

Cultivars for the Home Gardener

The maps in Figures 1 and 2 show the approximate regions of the U. S. where today's blackberry and raspberry cultivars are adapted. Notably, there is 'Thornless Logan' for California (Fig. 20), and the 'Thornless Evergreen' (Fig. 21) for western Washington and Oregon and for central and southern New Jersey. Then there is the new 'Smoothstem' thornless blackberry for the region from Maryland to Missouri and Arkansas. 'Smoothstem' also lends itself to use on arbors and in the landscape for it has large pinkish flowers in immense clusters and its deep green foliage is resistant to troubles and stays green in Maryland until midwinter. The large berries (with large seeds) ripen in August after other varieties are past. In Florida the new 'Flordagrand' and 'Oklawaha' are extremely productive and have very large fruit of very good quality. The 'Cascade' of western Washington and Oregon is considered to be the highest flavored blackberry in the world. It is, however, more difficult to grow than some. The 'Darrow' blackberry seems to have all the good qualities of 'Eldorado', is a little hardier, and, so far, has not shown susceptibility to diseases of other blackberries.

The new varieties of red raspberries do not differ as greatly as the newer blackberries. However, the fall-fruiting 'Fallred', besides producing well, has excellent flavor. The fall-fruiting 'September' does not have as good flavor fresh but has excellent flavor in preserves and after freezing. In Maryland, by cutting all canes to the ground in late winter, the new canes bear more heavily in August, September, and October. A crop is obtained for three months in late summer and in the fall rather than for three to four weeks in early summer.

Blackberry Culture

The trailing blackberries 'Flordagrand', 'Oklawaha', 'Thornless Logan',

U.S.D.A.

Fig. 20. Training the* 'Logan' *blackberry to a two-wire horizontal trellis. Ten canes are left for fruiting. A thornless chimaeral sport of this cultivar is just as productive and has entirely replaced the thorny one in California. Like the* 'Thornless Evergreen', *it must be propagated by tip layering, for root-cutting plants are always thorny.

'Boysen', 'Olallie', 'Chehalem', and 'Cascade' are planted about six feet apart in the row; the more vigorous semi-trailing 'Thornless Evergreen' and 'Smoothstem' eight to ten feet apart; the semi-erect 'Early Wonder' about six feet apart and the erect 'Eldorado' and 'Darrow' about four feet; all with rows eight to ten feet apart. About ten canes of the trailing and semi-trailing and four canes of the erect-growing should be left to fruit. When the new young shoots of the erect varieties reach twenty-four inches the cane tips should be pinched off to make them branch. In the dormant season canes of the erect-growing cultivars are pruned to a convenient height, about five feet, and the lateral branches back to twelve to eighteen inches.

The plants may be mulched with hay, straw, wood chips, leaves, etc. to keep down weeds and to conserve moisture. Blackberries and raspberries need ample soil moisture, especially in the two to three weeks before ripening and, if rains do not occur, irrigation would be beneficial. To help keep down weeds, spray with Diuron or Simazine before growth starts in the spring according to directions on the containers.

The early history of raspberries and blackberries in America is given by Hedrick and associates in "The Small Fruits of New York" (1925). Gruber, Knight, and Keep in the "Handbook of Plant Breeding" (German) in 1961 abstracted the North American literature and provided an extensive bibliography. No attempt to repeat all this has been made here.

U.S.D.A.

Fig. 21. Training the* 'Evergreen' *blackberry to a two-wire horizontal trellis. Here 13 canes were trained. The* 'Evergreen' *is tetraploid, trailing, and extremely productive. Now a thornless chimaeral sport of it has entirely replaced the thorny variety but must be propagated by tip layering to be thornless, for root cuttings grow from interior tissue and are always thorny.

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Ferns for an Indoor Limestone Boulder Habitat

By W. H. Wagner, Jr. and Robert C. Woodside*

Some of the most striking species of native American plants grow mostly or exclusively upon limestone cliffs or boulders. However, very few of them are actively used for indoor gardens or demonstrations. Outstanding among our limestone plants are various species of ferns, whose culture is confined mainly to outdoor situations or terraria by a small number of fern enthusiasts. Nevertheless, it seemed to us that the appreciation of these plants could be expanded to a wider audience, and the following account describes an artificial limestone habitat created in the greenhouses of the University of Michigan Botanical Gardens for demonstration and instruction purposes.

The Michigan Gardens are devoted primarily to staff research and the teaching of university students. Unfortunately, the Ann Arbor area lacks rock outcroppings in the immediate vicinity, so that the demonstration and study of rock inhabiting plants is in general very difficult without taking trips of 150 or more miles. It seemed desirable to have available an artificially constructed limestone boulder upon which various lime-loving plants could be cultivated, so that students could be made aware of the nature of this habitat and the kinds of plants which prefer it or are limited to it entirely.

The idea of how this might be accomplished was given us by C. E. Delchamps of the University of Miami, whose private collection of living Florida limestone ferns is grown upon piles of limestone rock in his greenhouse. We therefore set out to find an appropriate place in our large conservatory-greenhouse where we might set up an artificial limestone habitat, and we obtained enough limestone from a nearby quarry to carry out the following steps.

An open place was selected, at the south end of the conservatory. The "limestone boulder" was built against a north-facing brick wall five feet high. Shade was provided not only by the wall, which protects from the sun's rays to the south, but also by two large bougainvillea vines above and on either side.

The original plan was to form a solid box-like arrangement of the limestone rocks, the sides more or less vertical and the top horizontal. Instead, we made a rounded mass of limestone, roughly three and a half feet tall and fifteen feet long. Not only did the idea of producing a rounded mass accord more with the shape of a typical limestone boulder, but the arrangement of the rocks proved to be more stable and less likely to be washed out.

A mound of leafmold was tightly built up against the brick wall and shaped roughly to resemble a natural boulder. Rocks of limestone mostly 6-12 in. x 3-6 in. x 4-6 in. were built up by laying them one upon the other and digging away leafmold as necessary. The mound at the base is vertical for the first one to two feet, the rocks laid almost directly above one another, then gradually rocks were laid in a curved pattern.

The shape of the mound permits observers to look down on the plants at all levels, those growing along the top and those growing nearly at the base.

The maintenance of the artificial limestone habitat has been fairly easy. The planting of delicate specimens is

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**We are indebted to Edward L. McWilliams for suggestions and to Richard Tetley for the photographs.

PHOTOS BY RICHARD TETLEY

Fig. 1. View of the indoor limestone habitat.

done with forceps, placing them deep in the crevices. Naturally, various greenhouse weeds have introduced themselves, especially ferns. The small sorrel, *Oxalis repens,* has to be removed from time to time. Fern spores from ladderbrake (*Pteris vittata*), holly fern (*Cyrtomium falcatum*), and species of *Thelypteris* are blown into the crevices where they find ideal moist conditions for germination, so the sporelings of these pests must be removed with forceps. The only serious animal pests are slugs, which are removed by hand or deterred by using a dusting powder (Makon's "Arbortox").

Watering is accomplished by spraying with a fine mist. It was originally thought that we could water simply by pouring water into the back of the limestone along the brick wall, but this tended to cause some washouts. Fertilizing is done once a month with a spray ("Plant Marvel," 1 teaspoon per gallon of water).

In regard to most of the fern species on display, it is extremely interesting to note that no winterizing is required to keep them growing normally. In fact, the majority of them continue to produce fronds throughout the year, without any interruption at all. This seems to be in contrast to the situation in various terrestrial ferns, which evidently require a winter cold period to foster normal growth. Indeed, in our studies of species of *Dryopteris* and *Polystichum* from temperate North America, we have discovered that in the fairly constant conditions of the greenhouse many plants will form the next year's rosette of young crosiers (fern fronds) and then stop growing entirely, ultimately dying. The cultural requirements of fern species is much in need of careful study. The limestone ferns, however, seem not to be badly influenced by year-round culture in the greenhouse, and actually flourish under artificial conditions, growing in some cases to a larger size than is customary in their native habitats.

We are indebted to a number of people who have contributed materials for this demonstration. C. E. Delchamps and Ernest M. Ford have sent living plants from Florida; Dean Whittier, from Tennessee; and Mr. and Mrs. Dale J. Hagenah, from northern Michigan. It is surprising to see limestone plants growing together from widely separated latitudes as for example the Canadian Zone Upper Peninsula of Michigan and the subtropical southern tip of peninsular Florida. Under the conditions of our artificial limestone habitat, nevertheless, the species from such climatically different areas grow equally well.

We did not intend to grow a large

***Fig. 2. Spleenworts,* Asplenium trichomanes *and* A. resiliens *and Purple cliff-brake (upper right)* Pellaea atropurpurea.**

number of species, and have chosen approximately two dozen to illustrate either unusual adaptations or great rarity. Of the limestone ferns, those which possess an ability to reproduce by special vegetative means (propagules or gemmae) are perhaps the most interesting. The walking-fern, (*Camptosorus rhizophyllus*) is a textbook example, in which the long, tail-like leaf tip grows across the dry, exposed rock surface and inserts a young plant in another crevice. Walking fern, though not entirely limited to limestone, flourishes best on calcareous rocks. The creeping star-hair fern (*Goniopteris reptans*) is a striking fern of Florida and the Carribean which produces more than one proliferation, along the attenuate tip of a single leaf. The bulblet bladderfern (*Cystopteris bulbifera*) produces round bulb-like bodies (bulblets) 2-4 mm. in diameter along the upper midrib of the leaf; these bulblets fall off and roll into crevices to produce new plants. A particularly interesting plant in our demonstration is the hybrid bulblet fern *Cystopteris* × *tennesseensis* (*C. bulbifera* × *C. protrusa*). One of the parents (*C. protrusa*) lacks any device for propagation other than rhizome growth and spores. The hybrid is remarkable in that the bulblets are deformed, highly irregular objects in the same positions as they occur in *C. bulbifera* (Wagner and Hagenah, 1956). It is doubtful whether hybrid bulblets in the hybrid play any role in natural propagation.

Three calciphilous ferns, blackstem spleenwort (*Asplenium resiliens*), purple cliffbrake (*Pellaea atropurpurea*), and smooth cliffbrake (*P. glabella*) notable for their peculiar asexual reproduction

***Fig. 3. Walking-fern,* Camptosorus rhizophyllus.**

***Fig. 4. Hart's-tongue,* Phyllitis scolopendrium *var.* americanum.**

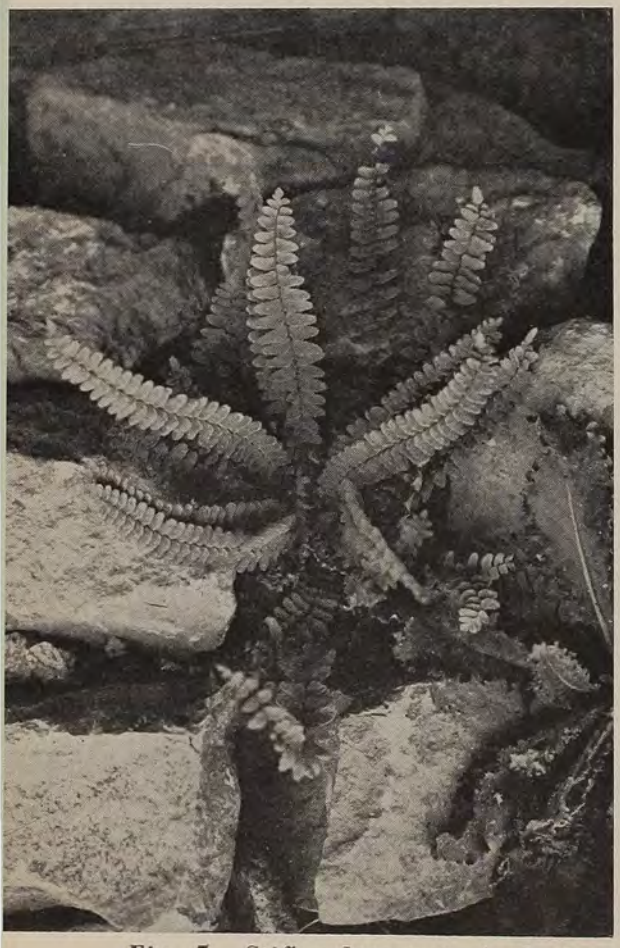

***Fig. 5. Stiff spleenwort,* Asplenium resiliens.**

by spores (Wagner and Wagner, 1955), are included in the collection. Among the very rare species demonstrated is the American hartstongue fern (*Phyllitis scolopendrium* var. *americanum*), known only from the Niagara limestone where it occurs sporadically in New York and northern Michigan. This unusual plant attracts much attention for its curious leaf shape, and it grows well in our artificial habitat. Among the Florida spleenworts we have included the excessively rare hybrids *Asplenium* × *A. curtissii* and *A.* × *plenum,* along with their parents so that observers can see the interesting morphological combination of characters of the parents in the crosses. The odd least-halberd fern, *Tectaria minima,* a miniature species from Florida and Cuba, thrives successfully in our indoor habitat, growing much larger than it does in many of its natural haunts in the limestone sinks of Florida.

Thus far we have emphasized the ferns, largely because so many interesting and highly characteristic species of this group of plants are confined to limestone in their natural occurrences. For references to the ideal species of ferns for this demonstration we have found the two field guides by Edgar T. Wherry (1961, 1964) to be especially useful. Although his books give helpful

***Fig. 6. Bulblet fern (center)*, Cystopteris bulbifera.**

tips on cultivation of the plants we are growing, his emphasis is on outdoor rock gardens. Further, for some of the species we are growing his comment is "not cultivated." We do not think it is commonly realized how readily the plants described here will grow under greenhouse conditions, given the proper light, humidity and substrate.

Of the few flowering plants, we have included two stonecrops (*Sedum ternatum* and *S. nevii*) and the little-rock saxifrage (*Saxifraga virginiensis*). We have also introduced species of mosses from the limestones in the vicinity of Nashville, Tennessee.

An artificial indoor limestone boulder habitat has much to recommend it. For the little labor involved in its upkeep, yield in display of interesting and unusual plants, and the educational value of illustrating the edaphic factor in plant habitat selection makes it a useful and worthwhile demonstration.

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Callaway Gardens

By Patricia LeGrande*

Callaway Gardens is a haven for thousands seeking beauty and enjoyment. Located at Pine Mountain, Georgia, approximately eighty-five miles south of Atlanta and thirty miles northeast of Columbus, the Gardens are fifteen years old this year.

The story of Callaway Gardens begins with a man, Cason J. Callaway, Sr., Georgia industrialist. It was here, in the Pine Mountain area where one finds an abundance of Southern Appalachian vegetation that, during the late thirties, Mr. Callaway came to seek solitude from the hectic life of a textile magnate. Farming and lumbering had left their ugly marks in much of the area. The unmarred woodland where wildflowers and shrubs abounded was restricted to the isolated ravines. Mr. Callaway's aim was to preserve these native plants and to revitalize the area.

The Gardens were initially conceived as an exclusive area for Mr. Callaway's friends and associates to relax and enjoy the natural beauty. The plan was altered by his desire to share its loveliness with all people and, in 1952, the area was opened to the public as a living and growing memorial to his mother, Ida Cason Callaway. The original undertaking comprised eleven lakes, a nine-hole golf course, a 17th-century sytle club house and restaurant, boating, fishing, and picnicking facilities, and many walking trails and scenic drives featuring native flora, as well as specialized horticultural areas.

Some of the many recreational facilities now included in the 25,000 acre predominately wooded area are the sparkling, spring-fed lakes, an excellent manmade sand beach, fishing on the 175-acre Mountain Creek Lake, golfing on one of the three golf courses, picnicking, horseback riding, tennis and Club House dining. Continuous expansion and planning has made the Gardens what it is today and what it will be in future generations. It is truly unique, for it is rare that one finds so many horticultural and recreational facilities so well integrated yet each vitally significant in itself.

Callaway Gardens is owned by the Ida Cason Callaway Foundation. Its purpose is charitable, educational, recreational, and inspirational. It is operated in its entirety, either by the Foundation or by the Gardens Services, Inc. (which is wholly owned by the Foundation). All revenue derived from the Gardens is used solely for maintenance and improvements toward furthering its purpose.

Callaway Gardens is educational in many of its endeavors. Much of the area is actually used as an outdoor laboratory where plants are well labeled. The Meadowlark area and the Greenhouse area are prime examples. On the Laurel Springs Trail, one may take a self-guiding booklet to become better acquainted with the area. School groups from kindergarten to college, as well as garden club members, avail themselves of the educational resources here and request tours through specific areas.

Nature walks are conducted each spring and fall by the horticultural staff. Held twice weekly, the flower and foliage succession determines the location of these walks. Also, in the spring and fall, 'Nature Quests' are conducted for Girl Scout Leaders. These are one-day nature study programs. After attending a 'Nature Quest,' leaders are entitled to bring their troops into the Gardens for a free educational tour.

The Horticultural Department has a student work program each summer. By this means, students of the plant sciences

*Callaway Gardens, Pine Mountain, Georgia.

acquire practical experience and broaden their knowledge of horticultural procedures. Essentially, it is a program of learning by doing.

The Gardens also provide workshops twice a year. The workshops generally consist of a lecture by some noted authority on gardening, or a related subject, and conducted tours of the Gardens. These workshops are open to the public and are entirely free of charge.

Several thousand kinds of native, naturalized, and exotic plants are arranged in a naturalistic manner throughout the Gardens. As one enters the Main Gate, long-blooming floribunda roses and beautiful crape myrtle flank the highway. After entering the "Twentieth Century Garden of Eden," during the flowering season, visitors are confronted with a multiplicity of color and beauty. Near the entrance, the Azalea Trail winds through wooded areas, grassy openings, hillsides, and lake shores. This trail includes extensive collections of ornamental azaleas, among them being kurumes, indicas, Glenn Dales, and Beltsville hybrids, as well as the later blooming Satsuki and Back Acre cultivars. Mountain-laurel, dogwood, redbud, whitebud and fringe-tree also add color to this area. Many small perennials, such as *Bellis, Digitalis,* and *Astilbe,* as well as native phlox, wild-ginger, foam flowers, *Trillium,* wild orchids, and saxifrage enhance the beauty of the trail and extend its colorful season. Still on the Azalea Trail, on the sloping hillside of Mountain Creek Lake, near the Club House and Overlook Pavilion, a great variety of flowering crabapples are planted. Native roses are also plentiful in this area.

As one drives along the Scenic Drive—there are 18 miles of paved roads in the Gardens—the native wildflowers, trees, and shrubs take precedence. From early spring until fall, there is a succession of

Greenhouse displays are changed seasonally, but some of the tropical plants remain permanently.

PHOTOS BY CALLAWAY GARDENS

***Spring on the wildflower trail brings rain-lilies* (Zephyranthes atamsco), *Dogwood* (Cornus florida), *the piedmont azalea* (Rhododendron canescens), *and Florida azalea* (R. austrinum).**

colorful native azaleas. Late March and early April bring the fragrant, yellow flowers of the Florida azalea, *Rhododendron austrinum,* and the sweet-scented piedmont azalea, *Rhododendron canescens,* with its pink to white flowers. Later in April, the brilliant red-orange colors of the oconee azalea, *Rhododendron speciosum,* beckon the visitor to the woodland followed by white Alabama azalea, *Rhododendron alabamense,* with flowers with a yellow blotch and a lemony fragrance. May and June bring the white swamp azalea, *Rhododendron viscosum,* and the brilliant flame azalea, *Rhododendron calendulaceum.*

The white-sweet azalea, *Rhododendron arborescens,* and the bright red plumleaf azalea, *Rhododendron prunifolium,* are the last to bloom. Some plumleaf azaleas have been known to bloom sporadically as late as August and September. The plumleaf is a relatively rare azalea, found in a restricted area of west-central Georgia and eastern Alabama. Mr. Callaway first found this plant near Blue Springs and set out to preserve it. In 1946, the Garden Club of America awarded Mr. Callaway the 'Frances K. Hutchinson Medal' for his efforts toward the conservation, preservation and perpetuation of this species.

Other azaleas blooming in the spring and summer seasons at the Callaway Gardens include pinxterbloom, *Rhododendron nudiflorum;* pinkshell azalea, *Rhododendron vaseyi;* coastal azalea, *Rhododendron atlanticum;* baker azalea, *Rhododendron bakeri;* and the hammock-sweet azalea, *Rhododendron serrulatum.*

All of these azaleas blend naturally in the woodland landscape. The various species are usually found in separate mass plantings, so that delicate color differ-

ences may be observed. Blended with the azaleas along the drive are many other native plants. In addition to the many herbaceous species, serviceberry, silverbell, sourwood, pinckneya, oak-leaf hydrangea, dogwood, redbud, sparkleberry, rose-bay rhododendron, red buckeye, sweetshrub, fringe tree, wild plum, hawthorn, wax-myrtle, mountain-laurel, and numerous hollies are integral parts of the landscape. The clear waters of the many lakes artistically reflect their surrounding beauty.

Laurel Springs Drive, just off the Scenic Drive, is quite different ecologically from other areas of the Gardens. Because much of the Laurel Springs area is on the rocky slopes of Pine Mountain, it has been spared many of the blows of civilization. Here dogwood, red maple, chestnut oak, sourwood, tulip-poplar, witch-hazel, mountain-laurel, and blueberries abound and autumnal coloration reaches its peak. From the small, crystal clear spring emerges a stream along which large mountain-laurel, red-bay, sweet-bay and a multitude of ferns grow to lush proportions.

Other attractions located off the Scenic Drive are the chapel and the greenhouses. They are a delight at all times of the year. The greenhouses are separated into specific temperature, work, and display areas. It is here, also, that the lath house and the nursery area are located. Seasonal displays in the greenhouses include poinsettias, Easter lilies, chrysanthemums, cyclamen, fuchsias, tuberous begonias, and other exotic plants. The succulent and tropical greenhouses remain somewhat more permanent in their floral displays.

At the present time, the Gardens test All-American Rose cultivars and the All-America Selections of annual seed varieties. In both instances, new varieties and strains are grown in test areas prior to introduction and release. These plants, listed by number, are evaluated and later introduced to the trade, if they have sufficient merit.

Early spring brings pansies, various willows, English daisies and many flowering bulbs to the outdoor display area. As the season progresses, iris, daylilies, roses and the many annuals take precedence. Fall brings an exquisite show of hardy chrysanthemums which blanket the area with color.

Somewhat apart from worldly things, nestled in a wooded area, near a natural waterfall and overlooking Rocky Falls

In midsummer, plum-leaf azalea* (Rhododendron prunifolium) *offers bright red blossoms against dark green foliage.

Lake, the Ida Cason Callaway Memorial Chapel is always open for personal meditation. The stained glass windows in the little chapel seem to reflect the true spirit of the Gardens. The natural stone and rustic exposed beams enhance the beautiful windows which depict the Gardens in its ever changing seasons. Not only are the flowers and trees artistically captured, but the subtle, yet bold, colors of the seasons themselves, convey the beauty of the surroundings.

Farther along the drive is the Meadowlark Area, where one has a choice of more than two miles of walking trails. Plants in this area are permanently labeled for quick identification and inspection.

The Azalea-Wildflower Trail offers the native azaleas, plus a multitude of native trees, shrubs, and herbaceous species. Some of the most outstanding wild flowers on this trail are the dwarf crested iris, *Iris cristata;* birdfoot violet, *Viola pedata;* trilliums; liverleaf, *Hepatica americana;* bloodroot, *Sanguinaria canadensis;* butterfly-weed, *Asclepias tuberosa;* firepink, *Silene virginica;* pink-root, *Spigelia marilandica;* and wildginger, *Asarum arifolium.*

The English, Oriental, and American Holly Trails in the Meadowlark Area are comprised of over 400 species and cultivars of holly. The yellow-fruited Chinese holly, *Ilex cornuta* 'D' Or'; and the yellow-fruited *I. vomitoria* 'Otis Miley' have been grown and introduced here. The Oriental Holly Trail contains many cultivars of *Camellia sasanqua,* providing an exquisite show of color in the fall. *Lycoris* species are also planted on these trails for late summer color. The American Holly Trail is transformed into a fairyland of bright colorful daffodils in the early spring; over a hundred varieties are planted in graceful patterns along the Trail.

The magnolia and flowering quince collections, as well as the Rhododendron Trail and the Bird Study Trail, are located in the Upper Meadowlark Area. The flowering quince collection is one of the largest in the south and brings some of the earliest spring color. Oriental magnolia varieties are also along the adjacent Rhododendron Trail. The hybrids on the Rhododendron Trail are at their peak of color from mid-April through May. Many large plants offer exquisite blossoms.

Leading off from the Rhododendron Trail is the Bird Study Trail. Many *Viburnum* cultivars are planted near its entrance to attract birds. One walks through a mixed pine and hardwood forest on this secluded trail, which winds around Hummingbird Lake. Feeding stations, fruiting shrubs, and observation benches are strategically located along the trails. The Gardens have been declared a bird sanctuary.

Another striking feature of Callaway Gardens is a 7½ acre, demonstration fruit and vegetable garden. 'Mr. Cason's Garden' contains over 400 kinds of fruits, vegetables, and herbs. Vegetables are sold to the Club House, Holiday Inn, and to guests. The garden contains both usual and unusual crops, most of which are suitable for our climate. Some crops, such as the globe artichoke, are not particularly suited for this climate, and are strictly for display purposes.

'Mr. Cason's Garden' is laid out in terraces. As you enter the garden, the first terrace contains the fruit trees, apples, pears, peaches, figs, and muscadines; the second terrace contains annual crops; the third is used for perennials. Apple and pear trees are espaliered along the natural stone wall of the semicircular garden. Most of the annual vegetables produce two crops per year—spring and fall. Some long season warm weather crops, however, produce only one crop. A most interesting portion of the vegetable garden is the herb section, which contains medicinal as well as culinary herbs. All varieties are labeled and there are additional information and descriptive signs throughout the area.

Colorful summer bloom is emphasized in the plantings at Robin Lake Beach, where much of the summer activity is centered. Colorful crape myrtle varieties are used attractively. Other plantings include hibiscus, daylilies, floribunda

roses, hydrangeas, chaste tree (*Vitex*), and many colorful annuals.

Callaway Gardens has required careful planning and work on the part of many people vitally involved in its growth and development. Mrs. Cason Callaway, President of the Callaway Foundation, and a dedicated staff of trained horticulturists, directed by Fred C. Galle, are fulfilling Mr. Cason's dream to "build the finest garden—until Gabriel blows his horn."

Organ concerts are held on Sunday afternoons in the Ida Cason Callaway Memorial Chapel.

Magnolia virginiana var. *australis* 'Henry Hicks', a new evergreen magnolia

By Joseph C. McDaniel*

'Henry Hicks' is the first registered cultivar of *Magnolia virginiana* var. *australis* Sarg., and probably the best tested clone for persistent green foliage through subzero Zone 5 winters. Now under propagation, plants may be commercially available by December 26, 1970. That will be the centenary of the birth of Henry Hicks. It was he who grew the seedling from which this superior clone has been developed.

In the Coastal Plain and adjacent parts of Georgia, Florida, Alabama, Mississippi, Louisiana, southern Arkansas and eastern Texas, the tree-sized southern variety of the sweet-bay or laurel-leaved *Magnolia virginiana* var. *australis* is clearly the commonest magnolia of the area. Yet it is is very seldom planted on home grounds or public areas of southern towns. In Tampa, Florida, for instance, where both species occur in nearby moist woods, you can see thousands of trees of *Magnolia grandiflora* in cultivation. On a recent visit there, I saw *M. virginiana* var. *australis,* with flowers smaller but equally white and often more fragrant, included in only one landscape planting.

Several factors may explain the general neglect of the southern sweet-bay in and near its native areas, for the following reasons:

1. *M. grandiflora,* known as THE Southern Magnolia, has dominated the market, and is the one species recognized as "magnolia" by nearly every southerner. It is widely available in nurseries, though usually only in seedling form.

2. Since the southern sweet-bay reproduces in swampier sites then *M. grandiflora,* the mistaken supposition has become established that the sweet-bay will not thrive in a non-swampy site. Another of its common names is "swamp magnolia." As with *Taxodium* in much of its native range, few people have learned that the sweet-bay does not require an excessive amount of watering when grown in a reasonably fertile upland site.

3. Partly because its seeds are rather difficult to collect in quantity from the wild, trees of the southern sweet-bay are scarce in southern nurseries. Even some large wholesale propagators in the southern states have confined their sweet-bay propagation to the generally smaller growing, more completely deciduous, and less fragrant northern variety, *M. virginiana* var. *virginiana,* whose seeds are considerably easier to obtain.

North of Tennessee, the southern variety has seldom been tried. For botanical reasons, the northern and southern varieties have been poorly understood and ill-defined in texts as to their distribution in nature. For this reason many nurserymen have not heard of the southern sweet-bay, or if they have read of it, they may have read an erroneous hardiness rating. This discouraged the effort needed to bring the plant north. The late Mr. Hicks did obtain from an unknown source, one clone of the southern sweet-bay that has thrived in Zone 5 of the U. S. Department of Agriculture plant hardiness map. Unselected clones of the southern sweet-bay are not invariably as hardy-

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Original tree of* Magnolia virginiana *var.* australis 'Henry Hicks' *at Swarthmore, Pennsylvania, March, 1965.

JOHN M. FOGG

nor so evergreen and dense growing as 'Henry Hicks' has proved to be.

Previously, I published some observations (4, 5) on the wide variations seen in *Magnolia virginiana* L. Further studies through mid-1967 strongly support my earlier opinion that there are at least two major botanical varieties within this species, each with geographic races and a considerable number of different forms, several of which offer promise as clonal cultivars.

As I have observed it in the wild and on collected clones, the sometimes disputed (2) southern sweet-bay (var. *australis*) occurs near the coast as far north as Savannah, Georgia. Its southern limit is south of Miami, Florida. Westward, it gets to Montgomery County in Texas. While it is most abundant on "bay heads" and other wet lands near the coast, there are irregular extensions along spring-fed streams several hundred miles inland, as in Hot Spring County, Arkansas, Cullman, and Etowah Counties, Alabama, and Cherokee County, Georgia. It grows the length of Mississippi (though uncommon in the Delta) and into the headwaters of the Hatchie River in McNairy County, western Tennessee. There is one small outpost at 1600 feet elevation near Turtletown, Polk County, in eastern Tennessee, and another near the South Carolina border south of Columbus, Polk County, North Carolina. The Columbus stand is the farthest north I know, and I have not seen wild trees of the true southern variety elsewhere in either of the Carolinas. A tree cultivated at Duke University was collected in southern Georgia.

The southern variety, in nature, agrees only roughly with the original 1919 description of *M. virginiana* var. *australis* Sarg. (6). Sargent's description was incomplete, and his range for the variety was probably in error in including trees near Wilmington, North Carolina. I find that the Wilmington area trees are indeed pubescent, but they have otherwise the habit and flower characteristics of typical northern *M. virginiana* var. *virginiana*. Likewise, Fernald's (3) 1950 extension of var. *australis* sparingly into southeastern Virginia was probably based on herbarium specimens of the pubescent form of the northern variety. It appears to me that

Graft of* 'Henry Hicks' *(left) compared with a clone of* M. virginiana *var.* virginiana *native in Essex County, Massachusetts.

PHOTOS BY J. C. MCDANIEL

Virginia has only var. *virginiana*. Trees of a deciduous pubescent form are widespread in cultivation in the Northeastern and Midwestern states, and appear to be as hardy as the glabrous trees. They still in most instances are not *australis,* if that name is to have true biological significance.

An overlap occurs in the varietal ranges, at least in eastern Georgia, where I have seen trees of var. *australis* side by side with var. *virginiana* in Chatham County. Plants in the Florida Everglades area are apt to be confusing, in having juvenile leaves and stems fully as glabrous as in northern var. *virginiana,* but with flowering branches with pubescent peduncles and pedicels, and flowers with a lemon-like odor and very pale pollen color of var. *australis*. In western Louisiana and eastern Texas is another population of trees (occasionally shrubs) with broader, heavily pubescent leaves, showing prominent green veins beneath, and tending to be largely deciduous by January. Their flowers, again, have the characteristics that will put this trans-Mississippi race in var. *australis*.

W. W. Ashe in 1931 proposed *M. australis* (1) as a separate species after observing its Georgia overlap with the northern sweet-bay. He reported that the two appeared never to intergrade in the wild. I have, however recently produced numerous controlled intervarietal hybrids (or interspecific, if we follow Ashe.) The three that have flowered, and which are combinations between six different parents, all show hybrid characteristics, and have both pollen color and fragrance intermediate between those of their parental varieties. A few trees seen in cultivation in Illinois and Missouri are suspected of being natural hybrids, from seed of isolated var. *australis* specimens pollinated by var. *virginiana*. The cultivar 'Henry Hicks', which fits not only Sargent's description but my criteria for pure *M. virginiana* var. *australis,* has better flower fragrance than the other variety or any known hybrid of it. Besides being evergreen, even northward, it should grow somewhat taller than var. *virginiana* and make a more symmetrical tree.

The late Henry Hicks, member of an old Long Island family for whom Hicksville was named, operated a prominent landscape nursery on that island, and was, until his death in 1954, one of America's most respected plantsmen. According to the present head of Hicks Nurseries, Mr. Hicks was very enthusiastic about the sweet-bay, whose northern var. *virginiana* still occurs on Staten

Island in New York, and extends northward to Magnolia, Massachusetts, where Cotton Mather is said to have found it in Colonial times.**

Mr. Hicks grew hundreds of Long Island seedling sweet-bay. Keen plantsman that he was, he probably also investigated some southern sources following Sargent's 1919 description of var. *australis* as being evergreen which it is, in part. The provenance of his seedling which became the 'Henry Hicks' could have been in the foothills of the mountains in Tennessee, where var. *australis* grows in Polk County, or in Polk County, N. Carolina. Oliver M. Freeman later collected and transplanted var. *australis* from Polk County, N. Carolina while residing, until 1966, near Tryon. The Gardens of the Blue Ridge, Inc., at Ashford, McDowell County, N. Carolina have also upon occasion sold sweet-bay (hardy in Illinois) which proved to be the var. *australis*. I have not checked on the possibility of a native stand of var. *australis* in mountainous McDowell County, but the one in Polk County, Tenn., at 1,600 feet, and the one in Polk County, N. Carolina both consist of hardy evergreen trees.

**I have not seen a native stand reported to occur at Fitzwilliam, New Hampshire.

Whatever their source, John C. Wister's records at the Arthur Hoyt Scott Horticultural Foundation, Swarthmore, Pennsylvania, show the accession of seven small sweet-bay plants as a gift by Mr. Hicks in 1934. Now present in the magnolia planting at Swarthmore is one typically tall shrub of var. *virginiana* which was down to its last green leaf when I saw it in early December. Near it grows a decidedly different small evergreen tree sweet-bay, first brought to my attention by David G. Leach, whose rooted cuttings from the evergreen plant have been as evergreen as any of his rhododendrons at Brookville, Pennsylvania, where –32° F. has been recorded in recent years killing var. *virginiana* seedlings. Dr. Wister, who approved registration of the 'Henry Hicks' magnolia, later supplied me with additional cuttings, for distribution to three wholesale nurseries. In praise of 'Henry Hicks' magnolia, Mr. Leach writes: "I think this clone is also remarkable for its handsome habit of growth. At seven feet, my trees formed nearly perfect pyramids densely clothed with leaves to the ground. They were much superior to any other *M. virginiana* var. *australis* that I have seen.

Southwestern and northern extreme geographic forms of* M. virginiana *var.* australis, *with* 'Henry Hicks' *(at right). The taller clone (left) is from Montgomery County, Texas, and center plant is a seedling from the outpost in Polk County, Tennessee.

Lower leaf surfaces show some of the variation within* M. virginiana *var.* australis. *Left: Seedling from the southern extreme of the species and variety, in Dade County, Florida. Center: A clone from Montgomery County, Texas, characteristic of trees from west of the Mississippi River (Texas, Arkansas and western Louisiana) in having comparatively large leaves, obtuse at apex, with green veins prominent on the otherwise glaucous undersurface. The western trees tend to have larger flowers and fuits than those from east of the Mississippi, but frequently shed most of their foliage by January. Right: The* 'Henry Hicks' *cultivar, grafted from the original tree.

"The old tree at Swarthmore, as I recall, had lost its lower limbs or they had been removed, but the head of the tree there was also exceptionally dense and attractive. Since this is an evergreen tree, the foliage density to my mind is as important as it would be for *Ilex opaca*, for example. I believe this to be a conspicuous ornamental feature of the clone."

Description of *Magnolia virginiana* var. *australis* Sarg. 'Henry Hicks' n. cv.

The leaves of 'Henry Hicks' have elliptic to ovate-lanceolate blades as substantial as any I have seen on var. *australis* trees in the Southeast. The dark green upper leaf surface diverges at a slight angle from the yellow-green midrib, with occasionally a slight undulation, but without the rolling under at margins seen in some other clones of var. *australis* and var. *virginiana*. The leaf apex deflects downward, forming a "drip point." The lower leaf surfaces are glaucous throughout, giving a silvery reflection when stirred by the wind. Pubescence on lower leaf surfaces, petioles, pedicels, peduncles and young branchlets is dense, but shorter than on many *australis* clones. Trees retain their leaves well through cold winters, usually some remaining green until flowering is well under way. Leaves of 'Henry Hicks' are more consistently evergreen than many native trees of var. *australis* in the South, including most of the Texas-western Louisiana population.

Flowers of 'Henry Hicks' open in

June and July, sometimes starting as early as May at Swarthmore and continuing into August at Brookville, Pennsylvania. They are average in size and typically white as in var. *australis,* predominantly with eight petaloid and three sepaloid tepals, and a spicy, lemon-like fragrance. Unopened anthers and pollen when shed are pale nearly white. The flower buds, consistently with those of other var. *australis* clones, open relatively late in the day (around 7 p. m., daylight time), perfuming the surrounding air most strongly in the early evening. Newly opened flowers close their petaloid tepals around 10 p.m., daylight time, opening and closing both later than in typical var. *virginiana,* and slightly later than with known inter-varietal F_1 hybrids. Flowers open again and pollen is shed late the next day (or on the third day if the second day is rainy and overcast in the afternoon), then usually re-close before a final opening on the third day, when they begin to fade. Occasionally, in cool, rainy weather, a flower omits its normal first opening, in which case it misses the receptive stage for pollination, and will be shedding its own pollen when the retarded opening occurs. As with all members of the subgenus *Magnolia* that I have observed, var. *australis* clones set seeds quite freely if pollinated with viable, compatible pollen very near the time the flowers are first open. Pollination on the next morning is likely not to effect fertilization before the stamens absciss.

The original 'Henry Hicks' magnolia at Swarthmore, Penna. in 32 years has attained about 20 feet in height, with a single upright central trunk of about ten inches d. b. h. It shows sprouts around the base, which have been suppressed by occasional pruning or mowing. The pubescent branchlets now expand the tree's crown only a few inches each year. It grew faster when younger, and Mr. David G. Leach at Brookville, Penna. reports his trees of this clone to be vigorous.

Unlike most var. *virginiana* plants, but like numerous other var. *australis* clones tested or observed outside their native areas, 'Henry Hicks' is seldom if ever receptive to its own pollen. The original Swarthmore tree produces few seeds, which may be the result of crossing either with var. *virginiana* or with *M. grandiflora,* and no seedlings have been grown from it there or at Brookville. At Urbana, 'Henry Hicks' produced seeds this year (1967) when pollinated by two other *australis* selections. Previously, its pollen had proven cross-fertile with clones of both var. *australis* and var. *virginiana.* One cross with a shrubby var. *virginiana* clone has given some fertile and remarkably precocious seedlings among the F_1, flowering during their second year from seeds. If the intense flower fragrance of var. *australis* can be recovered in another generation, a later article may tell of a shrubby evergreen sweet-bay magnolia.

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Squills and Bluebells

By J. F. Ch. Dix*

The hardy spring-flowering scillas are easily grown inexpensive bulbs, producing attractive and charming displays in groups of a couple of dozen or more. Those that are lower growing and bloom in March or early April are popularly known as squills. The taller ones, blooming in early May, are commonly called bluebells. Blooming dates will, of course, be earlier in warmer climates.

Flowers of squills and bluebells are bell-shaped and frequently nodding or star-shaped and open-faced. They are blue, pink, or white. Some of the blues found in *Scilla* flowers are brilliant and intense and inescapable to the eye. The pinks are rarely as clear in color. The flowers in racemes are borne on leafless stems (scapes) from four to 18 or so inches tall. The scapes are accompanied by two to 12 narrow, strap-like leaves arising from the base of the plant. The leaves of most species die down by June, about the same time as daffodil leaves.

Cultivation

The bulbs are round or pear-shaped up to an inch or two in diameter, a few larger, and in some instances with a brown or purple tunic or membrane covering the bulb. The bulbs are best planted in early autumn while they are still dormant and should be set about three to four inches deep (to the base of the bulb) and about the same distance apart. Unlike tulips and hyacinths in many gardens in the United States, scillas come back year after year without replacement, and once established are rarely attacked by diseases.

Scillas increase naturally from seed and bulb offsets. Most spread readily from seed distributed by wind, rain, and birds. The bulbs may be divided and reset as often as every three years if they appear too crowded. The flowers are better the second season after planting and usually do better if the bulbs are left undisturbed.

Scillas are easy to cultivate and grow well in semi-shade or sun. A woodland area with high shade is fine. Any reasonably good, well-drained soil will do for them.

The small early scillas or squills bloom before most daffodils and tulips; the larger, later bluebells about the same time as the late tulips. The early ones are suitable for nooks and crannies and may be tucked away in odd corners or in the rock garden. Both the squills and the bluebells are suitable for growing around shrubs and trees, in rose beds, or in naturalistic plantings in woods.

Scillas belong to the lily family (Liliaceae). There are over 60 species in cultivation. A few of the more common hardy spring blooming species are considered here.

Some scillas have been known as far back as the 16th century and by the early writers were named *Hyacinthus*. Linnaeus in 1753 gave the generic name *Scilla* to eight species. The intervening two centuries have given the taxonomists plenty of time to classify and reclassify, name and rename. The results are mildly devastating to the amateur gardener. The Siberian Squill from southern Russia and southern Siberia, the Caucasus and Asia Minor, has remained fairly stable nomenclaturally. Once *Scilla amoena sibirica* or *S. amoenula*, it became, and still is, *S. sibirica*. It is best known through its cultivar 'Atrocoeruleá', sold as 'Spring Beauty'. This cultivar, of course, is not to be confused with the common wildflowers (*Claytonia caroliniana* and *C. virginica*) also known as spring beauty.

The Spanish bluebell from Spain and Portugal was formerly *S. hispanicus* or *S. campanulata*; the English Bluebell, from Western Europe and Britain, was formerly *S. festalis, S. nonscripta,* or *S. nutans*. Both bluebells were recently

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placed in a genus separate from *Scilla*, i.e. *Endymion*, and are now known botanically as *Endymion hispanicus* and *E. nonscriptus*, respectively. It is a pity that the name *Scilla*, used for centuries, should be changed to the stranger and more formidable *Endymion*. As a group, all are herein referred to as scillas.

Kinds of Early Squills

First to bloom is the excellent and relatively new squill (*S. tubergeniana*) introduced from northwest Persia in 1931 by the van Tubergen firm of Holland. Its pale grayish blue flowers open in early March. A detailed description and illustration of *S. tubergeniana* appeared in the January, 1967 issue of this Magazine. The named cultivar 'Zwanenburg' has very pale petals on the outside with a distinct blue midrif.

The two-leaf squill (*S. bifolia*), from central Europe, also blooms early in March. The flower scapes are four to eight inches tall, and the flowers starry, six to ten to a stalk, and usually bright blue (sometimes pinkish) with a contrasting center of whitish filaments tipped by green anthers with yellow pollen. The species is quite variable in flower color, and time of flowering: 'Alba', white; 'Praecox', very early and stronger; 'Roseo', purplish pink; and 'Taurica', violet-blue.

The Siberian squill (*S. sibirica*) blooms in late March or early April. It is the best known of all the scillas. The flowers are a brilliant gentian blue on scapes up to eight inches, with two to three nodding, bell-shaped flowers on each scape. The lance-shaped channeled leaves are four to six inches long. The Siberian squill spreads freely. There is a fine white variety, 'Alba', and a cultivar 'Atrocoerulea' ('Spring Beauty'), perhaps a little earlier, sturdier, and deeper blue. 'Taurica' is paler, with deeper colored tips to the tetals. The Siberian squill is in many regions the most indispensable of the early spring bulbs.

PHOTOS BY GENE EISENBEISS

Endymion hispanicus, ***deep blue, large-flowered cultivar of the Spanish bluebell.***

Endymion hispanicus, ***close-up of the inflorescence.***

Kinds of Bluebells

The later spring blooming scillas (now *Endymion*) are much taller and resemble in some respects the common hyacinth, but are less dense and chunky and much more slender, delicate, and graceful, as well as taller, up to 18 inches in height.

Endymion:

E. hispanicus, the Spanish bluebell or wood hyacinth, has bell-shaped flowers that vary from deep to pale blue, pale pink, and white on scapes up to 15 or 18 inches, 8 to 12 flowers to a stem. There are about 50 named varieties. The following are among the best:

Alba, white
Alba Maxima, white
Blue Giant, deep blue, erect stems, large flowers
Blue Queen, light blue
Dainty Maid, deep purple-pink
La Grandesse, white, large flowers
Peach Blossom, pink
Queen of Pinks, campanula-violet
Rose Queen, bright pink
Sky Blue, deep sky blue, late
White Excelsior, white
White Triumphator, white, tall

E. nonscriptus, the English bluebell or harebell, is similar to the Spanish bluebell. In England some regard it as too weedy and invasive, which indicates its vigor, yet in appearance it is less robust than the Spanish bluebell. It is particularly suited to woodlands. The flower scape reaches a height of around 12 inches or more. The flowers are blue, white, or pinkish, and narrower than in the Spanish bluebell. There are a few cultivars: 'Alba', white; 'Alba Major', larger white; 'Carnea', pink; and 'Italicus', blue.

Summer Bloomers

The spring blooming scillas are followed by the summer-flowering species blooming in late May or June to August. Of these the most familiar is the Cuban lily (*S. peruviana*), having nothing to do with either Cuba or Peru, but coming from the Mediterranean region. It has handsome lilac or blue starry flowers borne in dense conical clusters six inches across, but is rather tender. *S. peruviana* 'Alba' is a pure white form. There are a number of African species with striped foliage and inconspicuous flowers. But these are quite tender. Neither the summer flowering species nor the African species are dealt with here.

Squill Relatives

The early squills are closely related to, and sometimes confused by the lay gardener with glory-of-the-snow (*Chionodoxa*), another fine early spring flowering bulb. However, the six perianth segments (tepals) of the nodding flowers of *Scilla* are usually completely separated to the base while the tetals of the starry, outward facing *Chionodoxa* flowers are joined at the base and part way up. There are hybrids of *Chionodoxa luciliae* and *Scilla bifolia* (× *Chionoscilla*) of which the most common is × *C. allenii,* with handsome dark blue flowers.

Also, *Puschkinia scilloides* (syn. *P. libanotica*), the striped squill, looks very much like *S. tubergeniana,* save that the flowers of puschkinia have inside the petals a small corona or central tubular nectary of six lobes around the greenish yellow stamens. *P. scilloides* may be treated by the gardener as a scilla. It blooms in early April, about a month after *S. tubergeniana.* The very pale blue flowers are about ¾ inch wide and have a blue stripe down the middle of the tepals. There may be 15 or more flowers to the scape. The plant is four to eight inches tall.

Uncommon Scillas

Bulbs of the scillas mentioned here are usually obtainable from bulb distributors in the United States who import them from Dutch sources.

There are a few, hardy scillas not easily available, if at all. *S. amoena,* the Byzantine squill or star hyacinth is six inches tall, has starry, violet-blue flowers, and blooms in April. While known in gardens since the 16th century, it is ineffective as a flower and little used. *S. autumnalis,* the autumn squill, is inconspicuous, with rose flowers, blooming in August before the leaves appear. *S. chinensis,* the Chinese squill, also blooms in August or September, sometimes earlier, with pinkish flowers on a six-inch scape. There is some question as to whether it is really hardy in the colder climates, but many have had success with it. *S. italica,* the Italian squill, is another very old species. It has starry six to 30 gray-blue flowers in a conical raceme on a six to ten inch scape. Again there is a question as to hardiness in the north. *S. pratensis,* the meadow squill, is quite hardy and blooms in May. The flowers are bluish purple borne in a dense raceme up to eight inches tall with 12 to 30 blooms. *S. verna,* the vernal squill, is dwarfer than most hardy scillas, blooms in April, has bright blue flowers, and is difficult to grow.

Award Winners of the Society for 1967

The following awards were made to distinguished horticulturists at the 22nd American Horticultural Congress of the American Horticultural Society held September 20-23, 1967 in Cleveland, Ohio.

The Liberty Hyde Bailey Medal Awarded to Dr. Harold B. Tukey, Sr.

Scientist, Author, Administrator, and World-ambassador of Horticulture.

Resident of Woodland, Michigan. Graduate of the University of Illinois with a Doctorate from the University of Chicago. Associated with the New York State Agricultural Experiment Station for 25 years as Chief of Horticulture Research and Professor of Pomology. In 1945, became Head of the Department of Horticulture at Michigan State University, and, since 1962, retired as Professor Emeritus.

Teacher, scientist, administrator, and leader in the field of horticulture, his career spans more than 40 years. His research interests have involved plant breeding, plant propagation, fruit culture, rootstock studies, dwarfed fruit trees, the development of herbicides, the absorption of nutrients through leaves and roots, studies of fallout products from nuclear detonations, the loss of nutrients from leaves and fruits by leaching, the use of radioisotope techniques in the study of the internal mechanisms of plants, the use of plant materials as test agents in cancer research, the development of a rapid germination test for seeds of woody plants, studies in developmental morphology of fruits, and plant embryo culture techniques. His scientific work has been published in the leading journals here and abroad. His books include "The Pear and Its Culture", "Plant Regulators in Agriculture", and "Dwarfed Fruit Trees".

Member of many horticultural societies and organizations, he was President of the XVII International Horticultural Congress held at College Park, Maryland in 1966.

He has traveled widely always trying to broaden the image of horticulture in education, in physical and mental therapy, in art and for leisure. He has long been in touch with practical horticulture and gardening. He often refers to horticulture as a great green carpet that covers the earth as a safety valve for society. A love of plants imposes no bounds among people in all walks of life—scientist, businessman, tradesman, housewife, artist, musician, physician. His students may be found carrying on his philosophy in every corner of the world.

Citation in Amateur Horticulture to Hubert A. Fischer

For Leadership and Service in Local, National, and International Gardening and Plant Organizations and for the Origination of Improved Cultivars of Several Kinds of Plants.

Resident of Hinsdale, Illinois. Ideal amateur gardener with broad interests in growing a wide range of plants hardy in his area, especially oriental poppies, peonies, daffodils, and lilacs. His specialities are iris and daylilies, and his hybridizing work on these plants is well known here and abroad. He has been the recipient of numerous awards for his iris and daylily originations in international competitions in Germany, Austria, and England, and served on a team

of international judges at Florence, Italy and Hamburg, Germany.

He is now President of the American Iris Society and past-president and charter member of the American Hemerocallis Society. He is past-president of the Chicago Men's Garden Club, the Hinsdale Men's Garden Club, and the Chicago Daylily Society.

Citation in Science to Dr. Neil W. Stuart

For Contributions to the knowledge of the Nutrition and Effects of Environment on Ornamental Plants and Their Practical Application in the Production of Florist and Nursery Crops.

He graduated from Michigan State University and received his Doctorate from the University of Maryland. Since 1936 he has been Plant Physiologist with the U. S. Department of Agriculture in Ornamentals Investigations, Beltsville, Maryland.

Research has contributed greatly to knowledge of plant growth, specifically changes induced by growth regulating substances, evaluating cold hardiness of root stocks, control of flowering in Easter lilies, chrysanthemums and hydrangeas, biochemical and structural changes during dormancy of several florist crops, specific responses to light, temperature and nutrients and the interactions of these factors, the development of high-speed propagation of bulb crops, and studies on the use of chemicals for controlling height, bud formation, dormancy, and other plant responses.

He is currently President of the American Society for Horticultural Science.

Citation in Plant Development and Production to Anthony M. Shammarello

For Development, Production and Distribution of Rhododendron and Azalea Varieties Improved in Flowering Characteristics, Habit of Growth, and Hardiness.

Resident of South Euclid, Ohio. In 1918 he began to work under his father who was a landscape contractor. Widely known for his work with rhododendrons and azaleas, especially cold-hardy selections. With plants salvaged from the severe freeze of 1935-36, he started serious work on rhododendrons to refine the habit of growth, increase the flowering, produce clearer colors, extend the period of flowering, and obtain races of rhododendrons and azaleas that would be better adapted to landscape use in colder regions, especially northeastern United States.

Over the past 30 years, he has grown more than 100,000 rhododendron seedlings and introduced 29 named selections of rhododendrons and eight named selections of azaleas and several named Japanese holly selections. He has also made available high grade nursery plants in a wide range of improved forms.

Citation in Teaching and Professional Horticulture to Professor F. L. Steve O'Rourke

For Outstanding Ability and Success as a Stimulating and Respected Teacher and for Contributions to the Science and Practices of Horticulture.

Raised on a Delaware fruit farm, he graduated from the University of Delaware and took a Master's degree in Horticulture at the University of Maryland. For 22 years he served the U. S. Department of Agriculture in the Bureau of Entomology, the Soil Conservation Service, and the Office of Foreign Agricultural Relations.

In 1945, he joined the faculty of Michigan State University as a teacher to conduct research in landscape horticulture and nursery management, and for several years he was in charge of the University Arboretum. For six years he was involved in technical horticultural aid to Ecuador and Thailand. Since 1964 he served as a consultant in South America, taught for two years at Iowa State University, and is now teaching at Colorado State University.

He has gained wide admiration among countless numbers of his students here and abroad as a stimulating and brilliant teacher of horticulture. His far-reaching influence on the horticultural industry, research, and teaching of hor-

ticulture extends to all areas of this country and to many foreign countries through his students who were trained under him.

He has published numerous research reports in technical journals and has contributed a large number of articles in trade journals. He has traveled widely in Europe, Asia, and in North and South America.

Citation for Horticultural Journalism to Isabel Zucker

For Dedicated Service in the Dissemination of Gardening and Plant Information to Home Gardeners, Seedmen and Nurserymen, and for Encouraging, Stimulating, and Practicing the Highest Standards of Horticultural Journalism.

Resident of Bloomfield Hills, Michigan. Exhibited an active interest in gardening from childhood, winning her first blue ribbon on sweet peas at age six. Graduate of Cornell University in Floriculture and Ornamental Horticulture; took graduate work in landscape architecture at several institutions. She operated two florist shops until marriage. Presently she is Director of the National Garden Bureau.

She continues her work in landscape design and maintains an extensive experimental garden. She has visited botanic gardens, arboretums, private gardens, nurseries, and seedmen in many parts of the world, largely to increase her attainment as a garden writer.

She regularly contributes to the leading garden magazines in this country. Almost 2,000 articles were published under her by-line during 20 years as Garden Editor of *The Detroit Times,* and over 2,600 publications have used her writings in the National Garden Bureau releases. Her profusely illustrated book "Flowering Shrubs," published in 1966, is an outstanding contribution for gardeners living in hardiness zones one through six (U. S. D. A. Plant Hardiness Zone Map).

The Gardeners' Pocketbook

Nymphaea × 'Antares', A New Hybrid Waterlily

One of the primary aims of the *Nymphaea* breeding program at Longwood Gardens is to raise new varieties of garden merit, both in color and adaptability, for garden pools.

During the summer of 1962 it was decided to commence a series of pollinations using members of the tropical subgenus *Lotus*. Members of this group are commonly known as the night-bloomers; the flowers open at dusk and stay open until 10-11 the following morning. Garden lighting has opened a new field for these showy nocturnal aquatics, considerably enhancing the display qualities. Most of the cultivars in the trade are derived from crosses between an African species, *Nymphaea lotus,* its variety *dentata,* and *N. rubra* which is a crimson species from India.

Wherever possible, reciprocal pollinations were made, using parent types that appeared promising. The breeder is somewhat limited as he is confined to species or hybrids contained in the subgenus *Lotus*.

The seed was collected from the fertile pods and sown as soon as ripe. Under normal conditions, approximately one year must elapse between sowing and flowering, but this can be reduced by growing the seedlings under supplementary fluorescent lights during the winter months.

The progeny from one particular cross, 'H. C. Haarstick' as seed parent, a large crimson, rather shy bloomer, and 'Emily Grant Hutching's' as pollen, parent, a medium red, free-flowering variety, showed excellent habit. The flowers were a good deep red and it possessed interesting foliage color and pattern. The most desirable of these seedlings were selected and grown for one additional year. One single clone that possessed all the desired qualities, being distinct in color, extremely florifierous and medium in size, was finally chosen. A well grown plant of this clone supported four to five flowers at one time, each flower lasting three to four nights. This new hybrid has been grown under display conditions and has stood up well for two seasons at Longwood Gardens and for one season at the Missouri Botanical Garden, St. Louis, Mo.

Because of the glowing fluorescent qualities of this hybrid, the name 'Antares' was selected as appropriate and finally chosen. Antares is the red heart and largest star of the constellation Scorpius; it is a brilliant first magnitude star classified as a red or M class star because of its temperature.

To be acceptable a variety must be capable of producing tubers for further vegetative propagation. 'Antares' has proved to be a good "propagator." Stocks of this hybrid are being increased.

PATRICK A. NUTT
Longwood Gardens
Kennett Square, Pennsylvania

Description of *Nymphaea* × 'Antares' n. cv.

Night blooming with 7-8 inch, bowl-shaped flowers; tepals RHS Tyrian Pur-

LONGWOOD GARDENS

***Nymphaea* × 'Antares' at Longwood Gardens, Kennett Square, Pennsylvania.**

ple 727/2 somewhat suffused with Dahlia Purple 931/3, making the color changeable and giving it a glowing quality which is striking under artificial light; outer tepals 4¼ inches long by 1½-2 inches in diameter; inner tepals smaller; leaves floating, green, suffused dark purple, about 16 inches in diameter, irregularly dentate with teeth to ¼ inches long and with 1-4 teeth to the inch.

Most similar to *Nymphaea* × 'Red Flare' from which it differs in the iridescent quality of the flowers and in the shape of the flowers which open flat on 'Red Flare' and are bowl-shaped in the new hybrid.

Donald G. Huttleston
Longwood Gardens
Kennett Square, Pennsylvania

The Variegated Bitter Ginger—*Zingiber zerumbet* 'Darceyi'

Several hundred different kinds of ginger are known to science, virtually all tropical plants. The majority of them are indigens of the hot lands of Asia and its surrounding island areas, though various genera occur in Africa and in the American tropics from Cuba and Mexico southward.*

In addition to furnishing us with several important spices—the culinary ginger, tumeric, and cardamom, among others—the members of the Ginger family, Zingiberaceae, are increasingly popular with collectors of showy and exotic plants. These are most often seen in the warmest parts of the United States in protected gardens, or under glass elsewhere.

A majority of the gingers are rhizomatous with thick, aromatic, underground "stems," and, on occasion, grow twenty feet tall. The majority of the gingers cultivated in this country produce their most impressive growth during the late spring and summer months. One of my personal favorites is the variegated form of the bitter ginger, *Zingiber zerumbet* 'Darceyi, (*zin*-ji-ber ze-*rum*-bet *dar*-see-eye). It is a native of India. The plant is sometimes encountered as *Zingiber darceyi*. It is not difficult to obtain, and it grows with a minimum of attention, yet it is very seldom seen.

If bruised, the bitter ginger exudes an odor similar to the true ginger of commerce, *Zingiber officinale* (oh-fis-i-*nah*-lee), particularly when the parts are dried. The stems, arising from a fleshy, knotty, subterranean system of rhizomes, sometimes attain a height of four feet, though two to three feet is more usual. Each of the dull red-flushed stems support from a dozen to twenty alternate, broad, wavy-margined, somewhat leathery leaves to a foot long and three inches or more broad. The leaves vary considerably in color (depending upon the soil and amount of shade) and are usually bright shiny green with a creamy-white margin and stripes of that hue in the center. Sometimes the green is rather subdued, and the markings have a distinct pinkish cast.

In the fall months the inflorescences or flowerheads are thrust out of the ground near the base of the leafy stems. These gradually grow a foot or more tall, the apical part of which becomes enlarged and develops into a large, oblong, bright red cone or flower-head. The flower-heads consist of many overlapping, lustrous, dark red, rounded bracts. From between each of these bracts in the upper portion of the inflorescence a blossom will eventually protrude. The stem supporting this red cone is also heavily sheathed by showy red bracts.

The flowers of the bitter ginger are of a very unusual pale whitish color, in age becoming semi-transparent, particularly on the margins of the segments. They are extremely fragile and short-lived, seldom persisting more than a single day. Measuring about an inch across, the flowers superficially resemble a small orchid—a family vaguely allied to the Zingiberaceae.

If one of the cone-like or, in many instances, ball-like inflorescences is gently squeezed, a clear syrupy fluid exudes. This has a very spicy taste, much like ginger-flavored water. In my younger days in Orlando and other parts of Flor-

*The tropical gingers should not be confused with wild ginger (*Asarum* spp.) found in north temperate regions. (Ed.)

ida, this was great fun with my juvenile colleagues—though too much of this "ginger juice" promptly made us all sick to our stomach.

The plant delights in a rich mucky location, with an abundance of water during active growth. In fact, rich and moist, yet reasonably well-drained soil is a requisite of almost all of the cultivated gingers, and this one is certainly no exception. Best color development of the lovely foliage and showy cones is obtained when the plants are kept in a semi-shaded spot, yet not without some good diffused light during at least part of each day. When the stems have died down in winter (November and December), the rhizomes can either be left in the ground, in sufficiently warm climates, or dug and stored in a dry place until re-planting time in March or April. Since this ginger is a very heavy feeder, plants should be fertilized with animal manure or commercial sludge every year for optimum results.

Zingiber zerumbet 'Darceyi' spreads rapidly in suitable locations, forming dense clumps, with a large number of stems and flowering cones. It is fairly tender, though I have in the past grown it outdoors in Orlando, without any special protection where winter temperatures in the mid-20's may occur. It also makes an exciting pot-plant, one which can be brought indoors for two weeks or so at a time. When kept in pots, it must be carefully watered and completely renovated annually with compost.

Alex D. Hawkes
P. O. Box 435
Coconut Grove, Florida 33133

Ornamental Mountain-laurel and a New Cultivar: *Kalmia latifolia* 'Bettina'

The native evergreen mountain-laurel, *Kalmia latifolia,* provides massive splashes of glorious color in late May and June, from Quebec and New Brunswick, south to Florida and west to Tennessee and Ohio. The extensive cultivation of mountain-laurel, also called big-leaved ivy, laurel-leaves, broad-leaved laurel, calico-bush and spoon-wood, is attributed to its widely appreciated beauty. In the native populations throughout the distribution range, considerable variation exists in the color of the flowers, from almost pure white to rosy-red and deep purplish pink. Several forms with consistently atypical and unusual flower color and morphology, or foliage characteristics have been recognized and named. Although a large number of the most interesting and handsome selections may be found in botanic gardens and arboreta, few are commercially available in this country, mainly because of propagation problems.

Cultivar 'Alba', in cultivation since 1801, has almost pure white flowers with very faint pink or purple markings. Cultivar 'Rubra', with deep pink to purplish pink flowers and somewhat thicker and darker green leaves has been cultivated since the early 1800's. Like 'Alba', 'Rubra' is connected to the typical light pink flowering type by intermediate color forms. Another clone which has rose-red flowers has been called 'Rosea', but apparently is not available in the United States.

In 1903, Alfred Rehder described a plant from Canaan Four Corners, New York, as var. *fuscata* (= 'Fuscata') Fig. 1. This entity is characterized by a

T. R. Dudley

Fig. 1. Close-up of *Kalmia latifolia* 'Fuscata', cultivated at the Arnold Arboretum.

broad, dark, purplish to chocolate brown band inside of the corolla which fades into dots at the base of the corolla. The upper margins of the corolla are bordered by a narrow pink band, and the outside is white, almost translucent, thereby allowing the dark internal band to be conspicuous. This plant catches the eye immediately, and is one of the most striking and handsome of all kalmias. It was introduced into cultivation in 1925, but is apparently extant only at the Arnold Arboretum and the New York Botanical Garden.

In 1870, Professor Stone of the Department of Botany, University of Massachusetts at Amherst, called attention to an unusual plant of mountain-laurel discovered by Miss M. Bryant near South Deerfield, Massachusetts. It was introduced into cultivation in 1885, and was given the name var. *polypetala* (= 'Polypetala') (Fig. 2), in 1896 by George Nicholson of Kew Gardens. The aberrant corollas of this plant are divided almost to the base of the flower into five flattened, narrow and club-shaped segments. When in flower, the divided corollas, together with varying degress of staminody, give the plant an attractive and unusual feathery appearance.

A seedling selection named 'Clementine Churchill' was introduced in 1952 by Mr. J. H. Setford, and was given a Royal Horticultural Society Award of Merit in the same year. This was the result of a 40 year breeding program at Sheffield Park, Uckfield, Sussex, England, which utilized stock from the Knap Hill Nursery and the Arnold Arboretum. This plant is distinguished by its large, deeply colored flowers measuring ¾-1 inch across. The outside of the corolla is Tyrian Rose, and the inside dark rose red (Rose-Madder). Another selection from the same source was named 'Sheffiield Park'. Its flowers are described as being very large and having the darkest deep rose color of any selection.

A dwarf, compact, slow-growing selection called 'Myrtifolia', cultivated since 1840, is an excellent subject for gardens with limited space. It will attain a height of 2-4 feet and its dark green leaves measure from 1-2 inches long, and a half an inch wide. Another *Kalmia latifolia* cultivar, distinguished by unusual foliage characteristics, is 'Obtusata'. Like 'Myrtifolia', it is slow-growing and forms a compact, rounded shrub. The almost sessile leaves, however, are oval to oblong, about 2 inches long, and rounded at both ends. 'Obtusata' was discovered by Mr. J. Bowditch near Pomfret, Connecticut, and has been cultivated since 1886. The 'Ovata' available from European sources probably is a synonym.

A plant discovered in Cape May County, New Jersey, described in 1945 by A. Rehder as forma *angustata* (= 'Angustata'), is cultivated at the Arnold Arboretum. The unusual characteristic of the plant is its short and very narrow (1½-3 inches long, ¼-½ inch wide), oblanceolate to linear leaves. A single bud sport having foliage similar to 'Angustata' was found near Lanham, Maryland, in 1926. All other branches of this plant had typical leaves and flowers. The single branch with narrow leaves bore flowers with five flattened segments. The petaloid segments, however, were not club-shaped as they are in 'Polypetala', but were broad, obovate-spathulate

T. K. Dudley

Fig. 2. *Kalmia latifolia* 'Polypetala', cultivated at the Arnold Arboretum.

with long conspicuous claws. Regrettably, no attempt was made to propagate the sport, and the entire branch apparently was made into herbarium specimens. The flowers of this Maryland sport depict an intermediate floral stage between 'Polypetala' and the cultivar described below.

Numerous natural and undeveloped areas of the U.S. National Arboretum in Washington, D. C., abound with native populations of *Kalmia latifolia*. Individual plants within these large populations exhibit the general range of morphological variability expected for the species, especially with regard to flower color. Two plants, assumed to be spontaneous near the dogwood planting overlook above the Anacostia River, deviate so extremely from the typical expression of the species that they were designated by Mr. Sylvester March, Propagator at the U. S. National Arboretum, as selection No. 6, and given the accession number of N.A. 25589. The unusual campanulate-urceolate flowers with deep purplish pink corollas are contrasted with the long exserted white filaments and deeply colored or white styles. These features contribute towards making this selection of interest to the exponents of unusual plants.

This "sport" is extremely interesting biologically, as it represents a transitional stage of floral morphology from the typical sympetalous saucer-shaped corollas of typical *Kalmia latifolia* to the deeply divided ones of 'Polypetala', which appears to have free petals. The corollas of N.A. accession 25589 are divided approximately one-half the length of the tube, and the lobe sinuses coincide with five anther pouches. The normal corolla of *Kalmia* has 10 anther pouches; however, they number only five in N.A. accession 25589, and are very poorly developed. Even in flower buds 6-8 mm long, the anthers are not located in pouches as would be expected, and the stamens are coiled and reflexed. The flower is often asymmetrical, a feature caused by the long exserted styles being curved and off-center. At anthesis, five of the variable number of stamens are spreading and exserted through the corolla-lobe sinuses. Apparently due to adverse climatic conditions during the summer and fall of 1966, and the spring of 1967, the flowers produced for the flowering season of 1967 were atypical with regard to color. Rather than a deep purplish pink, they were pale pink, fading to white.

Description of *Kalmia latifolia* 'Bettina' n. cv.

Flowers campanulate-urceolate, deep purplish pink (7.5 RP 6/12),[1] 8-15 mm long; corolla tube 5-10 mm long and 3-4 mm in diameter at base and lobes 3-5 mm long, with blunt and rounded apices that are reflexed at anthesis. The flower never opens widely and the mouth measures 5-7 mm in diameter, while the area slightly above the middle at the anther pouches and corolla lobe sinuses is somewhat dilated and measures 7-8 mm in diameter; anther pouches 5 and poorly developed. Filaments 5-10, white, 12-20 mm long, erect to patent, exceeding the corolla lobes at anthesis by 2.5-7 mm and are short pilose at the base. Anthers strong yellowish brown (7.5 YR 5/7). Styles 9-20 mm long, exserted beyond corolla lobes at anthesis by 4-10 mm,

[1]All color readings are designated from the Munsel Hue Nickerson Color Fan, distributed by the American Horticultural Society.

U.S. National Arboretum

Fig. 3. Close-up of *Kalmia latifolia* 'Bettina', cultivated at the U.S. National Arboretum.

glabrous, white or paler than the corolla (7.5 RP 7/10 strong purplish pink); stigmatic surfaces deeper colored (7.5 RP 4/11 strong purplish red). Inflorescences dense, bearing up to 100 flowers each. Pedicels generally strong purplish red (7.5 RP 5/12). Calyx lobes spreading at anthesis, with blunt or rounded apices; color, especially along margins, deep pink (2.5 R 6/11).

Kalmia latifolia, N.A. accession 25589, is named 'Bettina' after the author's wife in appreciation of her assistance and encouragement. To insure perpetuity of this clone, it will be propagated and distributed to appropriate cooperators. In accordance with the *International Code of Nomenclature for Cultivated Plants* (1961), the cultivar name has been registered with the Arnold Arboretum, the registration authority. Documentary voucher herbarium specimens (F. G. Meyer and T. R. Dudley No. 1383, 6 June 1966) and photographs have been deposited in the Herbarium, U.S. National Arboretum, Washington, D.C.

T. R. Dudley
U.S. National Arboretum
Washington, D. C.

The Carpathian Walnut

The Carpathian walnut is a cold-hardy race of the Persian (English) walnut (*Juglans regia*) that withstands the climate of midwestern America. It is a relative newcomer to this Continent. It was not until the mid-1930's that the Reverend Paul C. Crath, a Canadian Missionary, brought seed nuts to Ontario from the rugged Carpathian Mountains on a visit to his native Poland.

The Wisconsin Horticultural Society, through its secretary, Henry J. Rahmlow, purchased a shipment of seed walnuts from the Reverend Crath and in the spring of 1936 distributed 370 pounds of nuts to 1,030 persons, mainly in the Midwest. The usual distribution was nine walnuts per person.

Trees grown from these seed walnuts are now in early maturity and full bearing in many Midwestern areas. The various state nut growers associations and the agricultural colleges in these regions, notably those in Iowa, Michigan, Ohio, and Pennsylvania, have sought out and evaluated the walnuts of the various seedling trees in order to select noteworthy superior clones as named cultivars for grafting.

Not all of those cold-hardy cultivars originated from the seed nuts gathered in the Carpathian Mountains. Some were brought over as seed from Germany by the "Pennsylvania Dutch" in the early 1700's. Later Czech, German, Russian, and Slavic emigrants carried seed nuts with their personal effects and planted these near their new homes in America. Thus to-day we have a diversity of cold-hardy Persian walnuts from various regions in Northeastern Europe which are termed "Carpathians," mainly to distinguish them from the tender French and Spanish cultivars now grown in California.

Carpathian growers claim their walnuts have a better flavor than those from California. They pridefully point to consistent annual yields of 4 to 6 bushels (120 to 180 pounds) from trees 25 to 30 years of age. Carpathian walnuts generally fall free of their husks so there is no hulling problem.

The named cultivars have ordinarily been selected on the basis of thin shells, easy cracking, good flavor, and a high per cent of kernel. Other qualities are resistance to winter cold, late blooming to escape spring frosts, and the ability to produce well-filled kernels in a climate with a relatively cool and short summer.

A nationwide survey made in 1966 indicated that the following ten cultivars (clones), listed below with the average per cent kernel, are currently preferred by growers:

1—Hansen	60%
2—Metcalfe	52%
3—Fickes	51%
4—Somers	48%
5—Broadview	47%
6—Lake	50%
7—McKinster	48%
8—Colby	53%
9—Merkel	53%
10—Burtner	47%

Other clones favored by growers are 'Alleman', 'Caesar', 'Clinton', 'Gratiot', 'Greenhaven', 'Helmle', 'Jacobs', 'McDermid', 'Neyer', 'Orth', and 'Schafer'. Many new and superior clones are discovered each year. The future holds promise for even better ones.

Several Carpathian cultivars are self-pollinating, but a better crop is usually secured when three or more clones are planted near each other. Trees from seed start to produce nuts in their fifth to sixth year, while grafted trees usually bear within two years. The Carpathian walnut may be grafted or budded on the native black walnut with which it forms a strong and compatible union. Many growers do their own grafting as they find it an enjoyable and fascinating art, requiring only a little time and patience.

In Iowa plantings of Carpathian walnuts preferably should be located south of U.S. Route 30. In the northern part of the state occasional winter cold spells may severely freeze back the top and outlying branches. In all areas it is advisable to plant walnuts on a slight slope where adequate drainage may carry away cold air masses both during the winter and on frosty spring nights.

Pruning is seldom necessary but walnuts do respond to an annual application of a balanced fertilizer. Mulching with straw or hay will conserve soil moisture and improve yield and quality.

Spraying has not been practiced in the past but with more and larger plantings the walnut husk maggot may become a problem. It is controlled by two sprays in late summer.

Harvesting is easy as the walnuts fall free of the shucks and can be picked from the ground. They should be air-dried for two or three weeks and then stored until used in a cool dry place.

The landscape value of the Carpathian walnut should not be neglected. Its rounded canopy of green shade in summer will grace any lawn and the whitish bark and spreading silhouette is pleasing in the winter months. On a medium to wide street it may be used as a street tree with 60 foot spacings. It produces a fairly dense shade but not so much as to affect the growth of grass beneath. On the whole, this rather recent tree emigrant may prove both valuable and attractive on the American scene.

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A Book or Two

(Books available ***for loan*** *to the membership are designated: (Library). Those not so designated are in private collections and are not available for loan. Books available* ***for sale*** *to the Membership are designated with the special reduced price and are subject to the usual change of price without notice. Orders must be sent through the American Horticultural Society accompanied by the proper payment. Please allow two to three weeks for delivery. Those not designated for sale to the Membership at reduced prices can be purchased through the Society, however, at the retail prices given. In these instances the full profit is received by the Society to be used for increased services and benefits of the Membership.)*

Mushroom Growing Today

Fred C. Atkins. Macmillan Co. 866 Third Ave., New York, New York 10022. 1966. 188 pages. Illustrated. $5.95. (Library). Members price $5.05.

Mr. Atkins is an internationally respected authority on mushroom growing with the rare ability to express in layman's language the scientific aspects of producing one of the most sensitive food crops. His book is a well-organized presentation of the procedures (and problems) involved in commercial mushroom production from building a mushroom house to packaging and marketing the product.

In his discussion of commercial production in Britain, he includes the valuable contributions of research scientists on the continent and in the United States as well as those of Britain.

Constantly reminding the reader that, with all the variants of composts, soils and climate, few definite rules can be given for handling a crop; he details the fundamental requirements necessary to produce satisfactory results under a variety of conditions.

His discussion of disease and animal pests of cultivated mushrooms is well presented. The American reader has only to keep in mind our federal restrictions on the use of chemicals on food crops.

While stressing the need for experience and adequate financing for commercial production, Mr. Atkins includes a chapter for the amateur grower and one on converting cellars, unused stables, and other structures for growing mushrooms, primarily for home use.

His chapter on the food value of mushrooms will be of interest to readers who may not be concerned with production.

VIOLET K. THOMAS

New Trends in Flower Arrangement

Rae L. Goldson. Hearthside Press Inc., 381 Park Avenue South, New York, New York 10016. 1966. 122 pages, 99 black and white photographs. Price $4.95. (Library).

"New Trends in Flower Arrangement" will be a welcome addition to the advanced arranger's library; in fact, I consider it a must. The chapter on *New Rules for the Advanced Arranger* will be helpful even to the most experienced arranger who will find the illustrations in most instances are just as appropriate for use in the home as for winning blue ribbons in the flower show. Mrs. Rae L. Goldson has the ability to explain modern flower arrangements in simple, understandable terms, and to illustrate her points with magnificent arrangements, as is demonstrated in this new book. Her approach in presenting the modern and contemporary arrangements is stimulating, practical, and down to earth. The author stresses the use of natural materials and lets the weathered branch, snarled root, mushrooms, naturally dried leaves, and what-have-you dictate the design which tends to get away from the sterotyped and bizarre arrangements often associated with the new trend.

The book consists of 20 chapters, 99 black and white photographs, and a comprehensive Index which is most helpful. The following list gives a few of the interesting Chapter headings which are typical of the coverage:

"Changing Arrangements in a Changing World," "Form Follows Function," "Futurism—Contemparary Emptions," "A New Way of Thinking about Art," "Fantastic Art," "Abstraction—Design Rather than Subject Becomes Primary," "Flower Arrangement as a Creative Art Expression."

Borrow it from AHS library and chances are that you will want a personal copy for frequent reference in your own library. Other books by the same author are: *Contemporary Flower Arrangement* and *Workbook on Containers, Stands, and Mechanics.*

CLEO V. MOOSBERGER

Birds in Our Lives

Alfred Stefferud (Editor). Published by U. S. Department of the Interior, U. S. Government Printing Office, Washington, D. C. 1966. $9.00. (Library).

In his Foreward, Secretary Stewart L. Udall states the purpose of this book quite succinctly: To consider birds as a part of the Web of Life.

No aspect of the influence of birds upon man, or of man upon birds, goes unexplored in this monumental work. An imposing array of contributing writers, all experts in their fields, gives authority to the material contained in the text. Birds in the Bible, birds as treated by the old masters, birds on coins and on stamps, all come into the discussion, with, of course, especial emphasis on the eagle as our Nation's symbol. The role of the bird as an aid to the scientific study of the influence of environment is well documented, as is the use of bird embryos in the production of life saving vaccines.

In the section of the book devoted to the sports and recreation aspects of bird-lore, your reviewer became so engrossed in the chapter on the ancient sport of falconry it was tempting to digress briefly to track down more detailed information.

Each section leads the reader on to a better understanding of the role of the bird in Nature's scheme of things, to a fuller grasp of man's dependence on the continuance of this scheme for his survival, and his obligation to fulfill his part in maintaining this order. The necessity for sane conservation practices is set forth clearly, and ways of implementing this program are suggested.

Definitely not a book to be lightly skimmed and laid aside, *Birds in Our Lives* deserves an honored place on the bookshelf of every home, to be read, and re-read, until its message has become a part of our way of life.

M. L. FISHER

Daffodils Are Dangerous

(The Poisonous Plants in Your Garden) Hubert Creekmore. Illustrations by Helen Spence. Walker and Company, New York, New York. 1966. $4.95. (Library).

Daffodils *are* dangerous; but so are sharp knives, and matches, and crossing a downtown street in rush hour. This book makes its point adequately without resorting to the "scare" tactics which have recently become so popular with authors of non-fiction. The author advocates, rather, that the amateur gardener develop an acute awareness of what is in his garden, either deliberately planted by him, or as an invader brought by the wind, or the rain, or the birds. This knowledge can be priceless protection against possible tragedy.

Divided into sections covering The Garden, Intruders, The Indoor Garden, and Miscellany, the text covers a vast amount of material. As one reads, he is led into fascinating by-ways of plant lore to be found in literature from earliest times. Medieval herbals are freely quoted, as are the Greek and Latin classics through which we struggled before we became aware of the incidental information to which we were being exposed. Some interesting hypotheses are offered concerning the true identity of some of the materials discussed. Was Homer's *Nepenthe,* perhaps opium?

The horticultural merits of the genera discussed are weighed against their potential for harm, and usually the balance favors their continued use as ornamentals. Only a few are unreservedly condemned.

The excellent illustrations by Helen Spence do much to help identify unfamiliar materials; an extensive bibliography, most of which deals with readily available references, encourages further reading on this subject.

M. L. FISHER

Your Future in the Nursery Industry

John J. Pinney. Richard Rosen Press, Inc., New York, New York, 10010. 1967. 160 pages. $4.00. (Library).

An informative book on the nursery business and the career opportunities that it offers. It describes the nursery industry and its many variations of operation, and the possible jobs that are available. The nursery industry is presented in all of its aspects, opportunities, and satisfactions to be had, as well as the disadvantages which are involved. Suggestions are given for training and education that is needed, as well as sources of information. The author has had a successful career as a nurseryman and writes with this well-informed background of authority.

CONRAD B. LINK

The Picture Book of Annuals

Arno and Irene Nehrling. Hearthside Press, Inc., New York, New York. 1966. 288 pages. $6.95. (Library). Members' Price $5.90.

This is more than a picture book on annuals. Not only does it illustrate all of the annuals commonly and some less commonly found in gardens, but it tells something about each. Each annual is identified by the family to which it belongs plus its scientific name. Cultural information is provided for each plant and often comments on special forms or varieties or uses suitable for that kind. Special chapters describe propagation of annuals outdoors and indoors, including the use of fluorescent lights, garden practices, growing in containers and for use as house plants. A chapter is included on landscaping with annuals in the design. This is a most useful book to those maintaining or selling annual flowers.

CONRAD B. LINK

Patterns of Life: The Unseen World of Plants

W. M. Harlow, Harper and Row, 49 E. 33rd St., New York, New York 10016. 1966. 128 pages. Illustrated. $6.95. (Library).

This book opens with a beautifully written

prologue by the botanist Paul B. Sears, followed by some descriptive notes on plant characteristics. The body of the book consists of about 100 photographs which illustrate details of winter twigs and buds, inconspicuous flowers, fruits, bark, roots, and wood cross-sections. Each is accompanied by a brief description and comments. The plants chosen are all relatively common, both woody and herbaceous. Such illustrations are always interesting, whether considered as studies in design or as expressions of the functional life of the plant. All photographs were taken by the author who is professor of forestry at Syracuse University. He has also written the useful *Fruit and Twig Keys* which utilize similar illustrations and is co-author of *Textbook of Dendrology*.

R. L. BAKER

Blueberry Culture

Paul Eck and Norman F. Childers, Editors. Rutgers University Press, New Brunswick, New Jersey 08903. 1966. 378 pages. Illustrated. $15.00. (Library).

The title of this interesting and timely book is somewhat misleading. The subjects covered include not only culture but history, taxonomy, morphology, breeding and marketing, as well. A serious effort has been made to cover all aspects of the blueberry industry by enlisting the aid of many research workers in writing the book. However, the greatest value of this book will be as a reference source, since it is unlikely that it will have a wide appeal. A great deal of time is spent in reporting and discussing research results rather than synthesizing the results into a straightforward statement on how to grow blueberries. A passing thought has been given to blueberries in the home garden but by the time one gets to this final chapter it strikes you as an afterthought. This small concession is hardly sufficient to recommend this book to the person interested in growing a few blueberries, but for the serious grower or student it can be highly recommended.

E. G. CORBETT

Tune In To Nature, A Pictorial Essay

Ruth H. Smiley. Lake Mahonk Mountain House, New Paltz, New York. 1966. $1.00. (Library).

This little booklet, only twenty pages in length, manages to convey an incredible amount of nature lore within its covers. It succeeds admirably in achieving its avowed purpose, to bring to its readers an "awareness of nature." The text is embellished with a number of color photographs of surprising excellence. The publishers have produced a work which may well stand as a standard of achievement for others contemplating the preparation of similar material.

M. L. FISHER

Some Ancient Gentlemen

Tyler Whittle. Taplinger Publishing, New York, New York. 1966. 244 pages. Illustrated. $5.95. (Library).

Tyler Whittle, an urbane and witty English TV personality, claims scribbling as a trade. The fourteen essays on gardening, however, belie such flippancy for they rank with Sacheverell Sitwell's damask-satin prose and Richardson Wright's salty epigrams. Whittle revels in the polished and pungent phrase, the obscure word and literature's characters.

Some Ancient Gentlemen is a misleading title for one would assume from the title page quote from Hamlet, "There is no ancient gentlemen but gardeners, ditchers and grave makers," that the book dealt with dirt gardeners whom Whittle dismisses unsympathetically as "that dodo-like functionary." Instead, the book opens with a compressed but amusingly informative outline of garden-makers of the Orient, Middle-East, the Mediterranean, and Northern Europe and in more serious vein praise for the Scandinavian "disciplined free form" of design and on the "formalization of informalization" of this country's and Latin America's school of landscaping.

The second essay on English gardens is possibly best summarized by "The English have two fundamental characteristics: they are accustomed to snail-pace developments, and they have a next-to-pantheistic adoration of the land. And besides this, the founders of the English Landscape School Lived in a quaint time . . . the Age of Reason."

In the chapter "Botanical Collectors," Tyler Whittle disclaims what he calls the public image of the botanist "as a pimply, knobbly-kneed and witless nincompoop who trips about the meadows with satchel, notebook and japanned black box." Instead, he gives an accurate description of their exploring ordeals and why they often suffer great indignities and take large risks of life and capital, to collect and probe for plants in the wilderness. In the chapter "Gardeners" he states: "Gardens can have a civilizing, tranquilizing influence; they can also brutalize, and drive the mildest and most amiable of men distracted because of frustration and disappointment." He questions "whence came the first influence" which makes them "moonstruck and mildly lunatic by plants." Later there's a nostalgic recounting of old potting sheds and tools. The author positively dotes upon his favorite tool, a hoe with a horseshoe-shaped handle "with the splendid local name of crocky dyle."

Perhaps the most illuminating writing deals with vegetables, and groves of trees known in England as boscage. Here is a whole new field for experiment in the exotic, tempered only by the imagination and sense of style of the gardener and gourmet. In fact, the gourmet will probably be titillated beyond reason like a feline rolling in catnip. To Tyler Whittle, the radish is the "king of root salading," and its varied uses are described in ways with which only an epicure would be familiar. There, too, is a brief

paean to gourds and their many historic and practical uses and later the remark, "one of the most charming of human eccentricities is to be quite dotty about herbs."

The comments on "Fruits" are worth remembering. A gardener is cautioned not to become "fruit-besotted" . . . as "the trees will then become chains about his neck." And who has heard of pollinating fruit against a high brick wall "by wandering from tree to tree sweeping the blossoms with a rabbit-scut lashed to the end of a bamboo pole?" Leaving his chores behind, one day the author went down the Severn to the meadows and orchards of Gloucestershire. He reminisces: "It was a majestic voyage . . . in a row boat." "The orchards of Shallow's country . . . are a wonder of England."

In the chapter "Boscage," Whittle's imagination really runs to the unique. He pictures "an exotic grove . . . well contrived and faultlessly designed," with visions of the dove tree, Kentucky coffee, cider gums, bird and rum cherries and Elisha's tears, amur cork, and the epaulette, as well as the *Maclura*, the ebony wood and other exotics. Trees, he states are a "personal and living shrine . . . and like an Oriental with a favorite speckled carp, [man] invests his tree with a personality and introduces it by name." The tree of his devotion for many years was the Empress tree (*Paulownia tomentosa*)—one which the reviewer rejects.

In the last essay, "Ornament," an appreciation of the art of topiary has finally scored. When a strange little man "resembling a decorated Easter egg" can convert a hedge carving from Field-Marshal Montgomery to a thoroughly wattled turky because of his skilled draughtsmanship and vision, the craft merits genuine attention.

One criticism is the lack of credits on the 16 plates, particularly Plate 15b which shows an amusing troupe of begging bears in a topiary nursery. And who is the sculptor of the gross naked Bacchus at the Boboli Gardens shown on Plate 14b, to whom the author likens himself? This monolithic fountain belongs in a museum—an exhibit of man's corruptibility, not in a tranquil garden. For the author to bring his delightful book to a close with such a disagreeable allergorical comparison to himself is like pulling the cork of a vintage wine after considerable expectancy and finding it has turned to vinegar. But Tyler Whittle evidently delights in creating naughty situations. Hopefully, he is more the likeable Puck, that he also fancies himself to be, than Falstaff.

MILLICENT M. SPICER

Hortulus

Walahfrid Strabo. Hunt Botanical Library, Pittsburgh, Pennsylvania. 1966. 92 pages. Illustrated. (Library).

This very handsome volume is the second of the Hunt Facsimile Series and should be a delight to the horticulturist as well as the connoisseur of fine books. The binding, paper, printing, and design all reflect the high standards set by the Hunt Library for their publications.

Hortulus (The Little Garden), one of the classics of gardening literature, was written by the Benedictine monk Walahfrid Strabo about 840 A.D. The principal manuscript of this poem was written shortly after the poet's death and lay undiscovered for nearly 600 years before it was recopied and first set in type. It is this manuscript, now in the Vatican library, that is reproduced in facsimile, without reduction in size. There follows a transcription in classical Latin form and an English translation in free verse by Raef Payne, with beautiful illustrations from linoleum cuts by Henry Evans. Wilfrid Blunt has written an account of what is known about the poet and the book concludes with a description of the published editions and a list of the plants mentioned in the text.

The flavor of the poem itself may be sampled in the description of Sage:

"There in the very front glows sage, sweetly scented.
It deserves to grow green forever, enjoying a perpetual youth;
For it is rich in virtue and good to mix in a potion,
Of proven use for many a human ailment.
But within itself is the germ of civil war;
For unless the new growth is cut away, it turns
Savagely on its parent and chokes to death
The older stems in bitter jealousy."

R. L. BAKER

BOOK LIST

How We Got Our Flowers

A. W. Anderson. Dover Publications, New York, New York 1966. 283 pages. Illustrated. $1.75 (Library).

A History of Garden Design (Revised Edition)

Derek Clifford. Frederick A. Praeger, Publishers, New York, New York. Revised 1966. 252 pages. Illustrated. $16.00. (Library).

Aphrodisiacs In Your Garden

Charles Connell. Taplinger Publishing Co., New York, New York. 1965. 145 pages. Illustrated. $3.50. (Library).

The Viruses

Helena Curtis. Doubleday and Company, Inc., New York, New York. 1965. 228 pages. Illustrated. $4.95. (Library). Members price $4.20.

Readers Digest Complete Book of the Garden

T. H. Everett. Little, Brown and Company, Boston, Massachusetts. 1966. 896 pages. Illustrated. $9.95. (Library).

The Principles of Pollination Ecology

K. Faegri and L. Van Der Pijl. Pergamon Press, Inc., Long Island City, New York. 1966. 248 pages. Illustrated. $9.50. (Library).

Travels In North America—Volume I and II

Peter Kalm. Dover Publications, New York, New York. Dover Edition 1966. 401 pages. Illustrated. $2.50 per volume. (Library).

Soil Organic Matter

M. M. Kononova. Pergamon Press, Inc., Long Island City, New York. 1966. 544 pages. Illustrated. $15.00. (Library).

The Vegetation of Poland

Wadyaaw. Pergamon Press, Inc, Long Island City, New York. 1966, English Translation. 738 pages. Illustrated. $18.50. (Library).

Anyone Can Grow Roses

Cynthia Westcott. Collier Books, New York, New York. 1965. 220 pages (paperback). Line drawings. $1.95. (Library).

American Rose Annual 1967

O. Keister Evans, Jr., Editor, Bernita G. Bosley, Editorial Assistant. Published by American Rose Society, 4048 Roselea Place, Columbus, Ohio 43214. 246 pages. Illustrated black and white and color. Membership in Society. (Library).

American Tomato Yearbook 1967

John W. Carncross, Editor. Editorial Office 114 Elmer St., Westfield, New Jersey 07090. 44 pages (paperback). $2.00. (Library).

The American Camellia Yearbook 1967

Joseph H. Pyron, Editor. Published by American Camellia Society, Tifton, Georgia. 1966. 314 pages. Illustrated black and white and color. $6.00 includes membership in Society. (Library).

The Yearbook of Agriculture 1966—Protecting Our Food

Jack Hayes, Editor. The United States Government Printing Office. For sale by the Superintendent of Documents, Washington, D. C. 20402. 386 pages. Illustrated. $2.50. (Library).

Forest Trees of the Pacific Slope

George B. Sudworth. Reissued by Dover Publications, Inc., 180 Varick St., New York, New York 10014. 455 pages (paperback). 207 line drawings. $3.00. (Library). Members price $2.55.

Tropical Gardening

T. M. Greensill. Frederick G. Praeger, Publishers, 111 Fourth Avenue, New York, New York. 272 pages. Illustrated. $8.95. (Library).

Wings in the Meadow

Jo Brewer. Houghton Mifflin Co., 2 Park St., Boston, Mass. 02107. 187 pages. Illustrated. $4.95. (Library).

Citrus Fruits

H. Harold Hume. Macmillan Co., 866 Third Ave., New York, New York 10022. Revised edition 1957, second printing 1966. Illustrated. $11.95. (Library). Members price $10.15.

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Illustration references are set in italics

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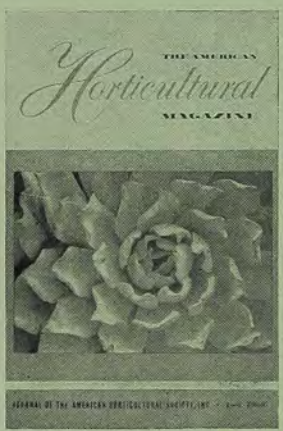

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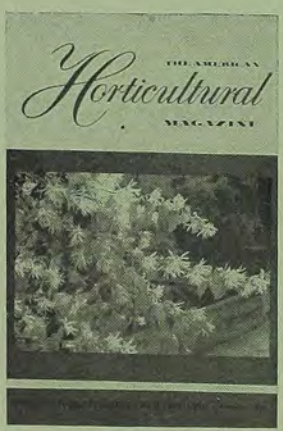

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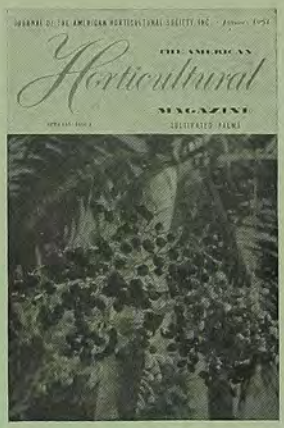

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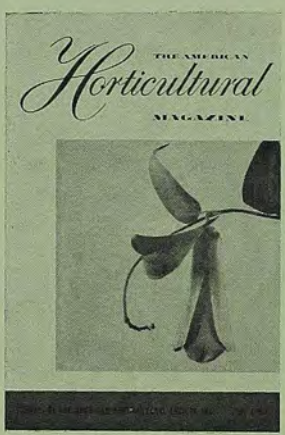

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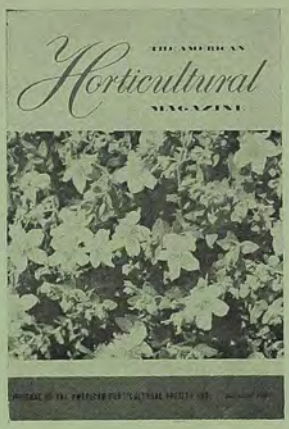

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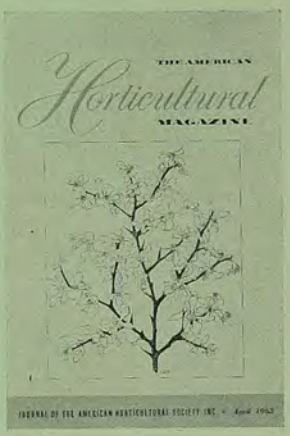

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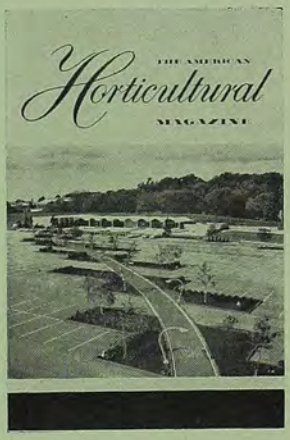

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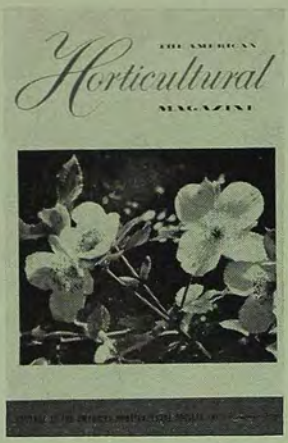

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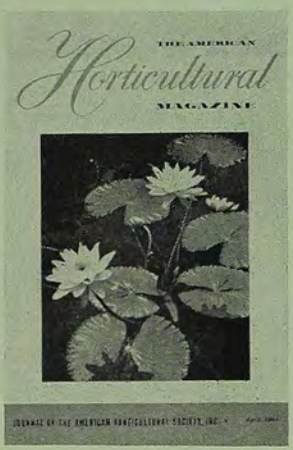

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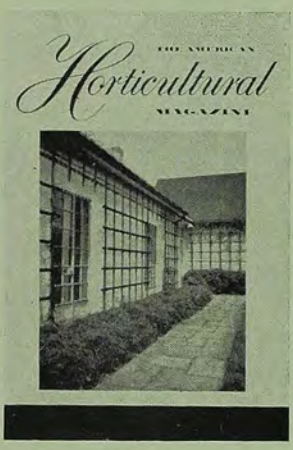

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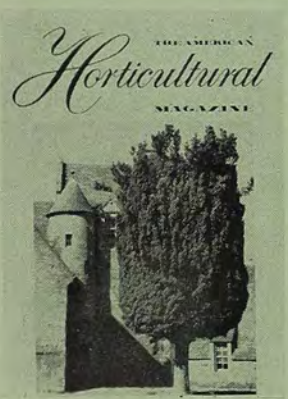

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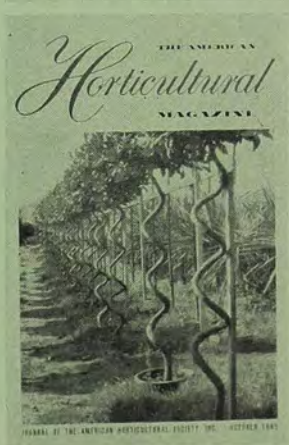

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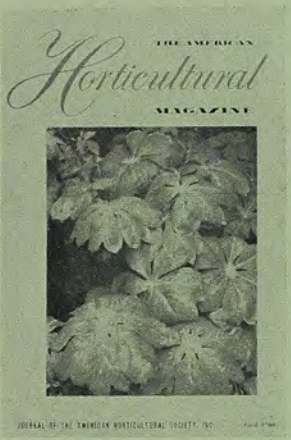

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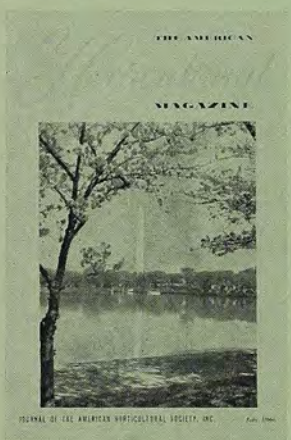

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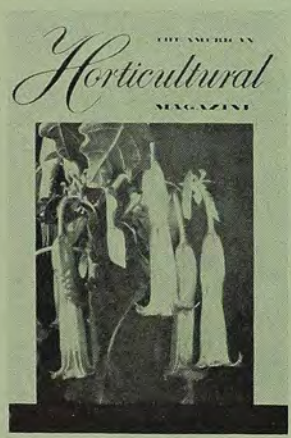

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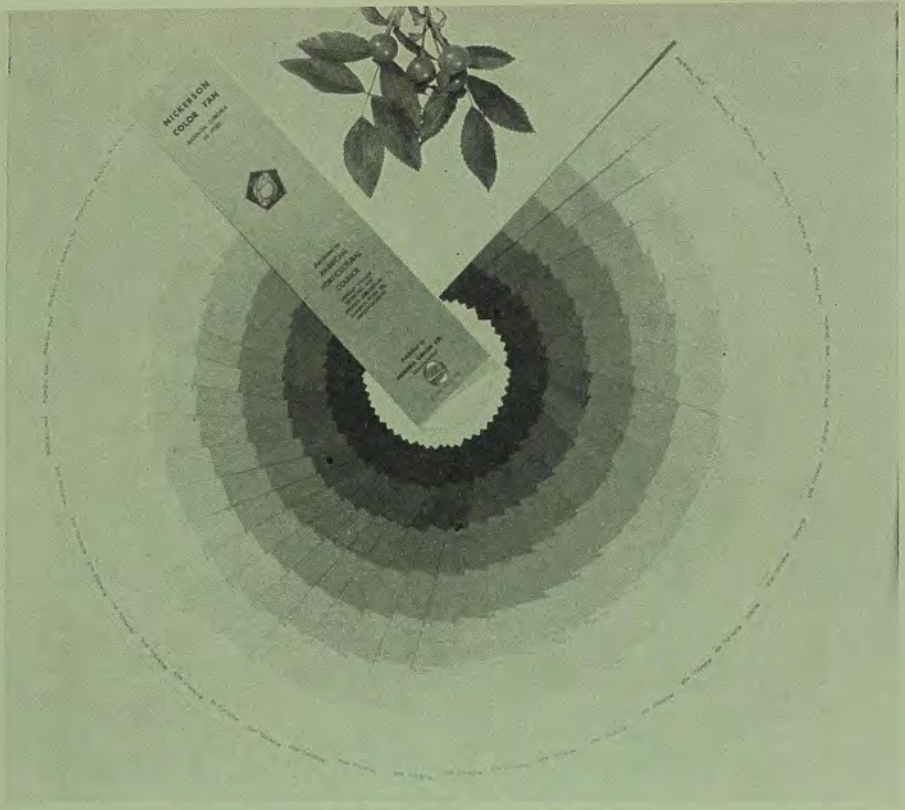

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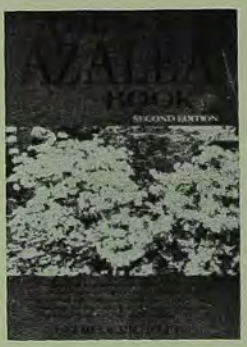

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