American Horticulturist

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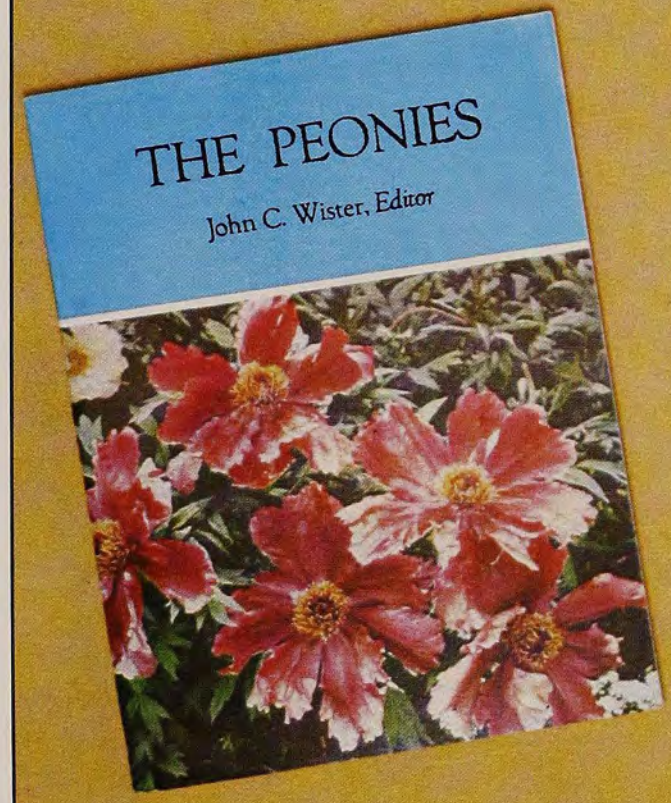

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an editorial . . . .

Horticulture for Everybody

Webster's Third New International Dictionary, Unabridged, defines horticulture as the science and art of growing fruits, vegetables, flowers, and ornamental plants. Horticulture deals with the cultivation of plants, then; with gardens and gardening. People who grow plants are horticulturalists (today, that word is losing a syllable to become "horticulturists"). The orchard owner is a horticulturist and so is the apartment dweller who tends a house plant in the window.

Horticulture and agriculture feed people. It is true that agriculture does the bulk of this work by providing wheat, rice, millet and other grains as well as all the meats, poultry and dairy products, vegetable oils and similar produce. But horticulture makes the meal savory with vegetables, spices, fruits and nuts. And horticulture feeds the soul when it supplies flowers for the table. In fact, horticulture often supplies balm for the human spirit just as a great symphony, a fine painting or divine piece of sculpture, or a breath-taking ballet does. After a day in the market place, what a pleasure it is to relax in the concert hall, the art gallery or the theater—or in a beautiful garden. "Music calms the savage breast" and so does the atmosphere created by skilled horticulturists.

Today's people need horticulture. Americans are on several "kicks" just now; organically grown foods are very popular, and everybody is talking about planting more trees to help produce oxygen for smothered cities. We gardeners do not need to be told how succulent the zucchinis picked fresh from the volunteer plant on the compost pile will be or about the air freshening quality of trees when we are gardening under a linden in full flower. We know even more. We know the soothing sensation of working with our hands in crumbly damp soil with the sun hot on our backs. We know the thrill of planting seeds that produce seedlings after a breathless period of suspense. We have come home late and walked in our gardens at twilight to discover a newly unfurled rose pouring its fragrance on the evening air and we have visited the garden at dawn to find it diamond encrusted with dewdrops sparkling in the horizontal rays of the sunlight. These are passive pleasures; perhaps our greatest pleasure is in knowing that by practicing the techniques and arts of horticulture, we have brought these pleasures into being.

Shall we share horticulture with our fellow men? It is easy to say that it is there for the asking—anybody can get a pot of soil and a packet of seeds and have at it. But it is not that simple; people have to be led to esthetic pleasures. Public and private schools teach art appreciation, music and music appreciation, literature, drama and more; in America few schools introduce students to horticulture, either as a science or as an art. That leaves it up to us; to each one of us who gardens and who wishes to share his pleasure in gardening. We can work more efficiently through an association such as The American Horticulture Society. We need to lobby for horticulture for everybody.

Despite ecological awareness, today horticulture is on the defensive. A recent government survey reports "that people are not afraid to go into public parks, it is just that there is nothing there to do." Truer words were never spoken. American park systems always have confused playgrounds and parks. To grant that playgrounds are essential and that more are needed is not to agree that park lands should be converted to ball diamonds any more than they should be given over to super highways. Today we need public gardens that are not Victorian relics; we need exciting, beautiful, public gardens that are immediately accessible to crowds of people; gardens that are properly developed and maintained so people will want to visit them. Even more, we need private gardens. America was a country of home owners; today it is becoming a country of city dwellers who live in multiple dwellings. We gardeners need to push for extensive public gardens for these people (and let's not settle for a "garden" that is largely pavement and waterworks). We need to show apartment dwellers how to grow plants in pots and in hanging baskets. We gardeners need to overcome our reticence; we need to share our knowledge of gardening, and we need to promote gardening as a possible cure for many of the world's ailments today.

Horticulture is for everybody; we have no exclusive rights to its pleasures. There is no such thing as too much horticulture—too much gardening. The practice of horticulture is healthy, creative recreation and work. The product is a beautiful flower, a salad, or a bowl of fruit. We gardeners have an obligation to share this bounty with everybody. We should actively push for horticulture in our schools, and for horticulture in public parks.—**J.P.B.**

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JOHN PHILIP BAUMGARDT, *Editor*

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O. KEISTER EVANS, *Executive Director*

For United Horticulture . . . the particular objects and business of The American Horticultural Society are to promote and encourage national interest in scientific research and education in horticulture in all of its branches.

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IN THIS ISSUE

OUR COVER PHOTO—Apples are nature's gift during late summer and through the fall months. Fresh fruit is possible from every home garden. A fruit tree shades the terrace, welcoming spring with fragrant blossoms. Blueberries make suitable border shrubs producing fruit and fall color. Raspberries, blackberries, currants, gooseberries, strawberries and grapes border the kitchen garden or utility area. Photo by I. G. A., Vaduz, Liechtenstein.

Paeonia japonica. *A plant flowering at Nikko with three compound cauline leaves.*

TWO ATTRACTIVE JAPANESE

Paeonia japonica. *Detail of a flower.*

An American tramping the temperate mountain woodlands of Japan in spring, as I have done in recent years, would recognize many herbaceous wildflowers reminding him of home. For the Japanese archipelago shares many genera with our country and especially eastern North America. The family of the buttercups (Ranunculaceae) is a good example with a number of familiar plant faces such as clematis, anemone, buttercups, columbine, baneberry, goldthread, snakeroot, and marsh marigold. On the other hand there are also unfamiliar wildflowers like the two buttercup relatives described below. Either one would make an attractive addition for spring flowering in a woodsy shaded garden.

Paeonia japonica

To gardeners who think of the herbaceous peony in terms of the large-flowered, heavily-scented cultivars of sunny gardens, it may come as a surprise that small-flowered woodland species also exist. The native peony of Japan is such a plant and one of several similar species found in eastern Asia. This mountain wildflower of shaded thickets and open woodlands is found on the three major southern islands of Japan—Honshu, Shikoku and Kyushu. It also occurs on the mainland of Asia in neighboring Korea and Manchuria. To the Japanese, *Paeonia japonica* is known as *yama-shakuyaku* ("Mt. Shakuyaku") and they consider it one of their choicest woodland wildflowers. The stance of a slender Japanese beauty was often compared to that of this plant, for the saying is that such a girl "stands like *shakuyaku,* sits like a *botan* (tree peony) and walks like *kiku* (chrysanthemum).

The wild peony of Japan is prized there as an unusual garden subject but un-

Photos by author

Glaucidium palmatum. *Wild plants in flower in early June on Mt. Hakkoda in northern Honshu.*

WILDFLOWERS

*W. H. Hodge**

like the popular tree peony *(botan)* is seldom seen by the visitor. It is usually grown in shady spots with such other wildflower subjects as ferns, asarums, and the like. The delicate stem may stand up to two feet in height and produces in spring (April to June) a solitary white flower. The five to seven petals form an attractive simple cup, about two inches across, revealing within whorls of yellow stamens surrounding the several, maroon-tipped, stubby greenish carpels. In mid-August, at maturity, the latter yield the gardener a double dividend for the follicular fruit splits open to reveal a half dozen or more jet-black seeds which are set off in the midst of attractive crimson pulp. Seeds of this species have been supplied to the U.S. National Arboretum, Washington, D.C. for trial. It should thrive in our hardiness zones 5 and 6.

Glaucidium palmatum

Unlike *Paeonia,* a number of species of which are native in both hemispheres, this perennial herbaceous genus has only a single species, limited to the high mountain woods of central and northern Japan (Honshu and Hokkaido). *Shirane-aoi,* as this species is known to the Japanese, should be an excellent subject for the woodland or rock garden in our hardiness zones 5 and 6. Wild plants observed near Mt. Hakkoda in the Tohoku district of northern Honshu formed large clumps producing up to a dozen flowers. The solitary terminal blossoms, up to three inches across, are very showy with four spreading, petal-like sepals; the latter are pale rose-purple in color reminding me of the purple-flowering raspberry *(Rubus odoratus)* of northeastern North America. ◈

**Walter H. Hodge, Program Director, Office of Ecology, National Science Foundation, Washington, D. C.*

REPORT ON SHADE TREES

*Leon C. Snyder**

In 1969 your Research Committee undertook a survey to determine the adaptability of shade trees to various parts of the country. The information in this report is based on reports from nineteen cooperators located at the leading arboreta and botanical gardens across the country. The number of stations reporting and information on soil type, soil moisture, acidity, light preferences and hardiness zones for each species and cultivar is given.

It should be admitted that information in this survey is far from complete. The soil preference represents the soil conditions in which the trees were growing and does not necessarily indicate the best soil conditions for each tree. It does indicate the range of soil conditions that each tree will tolerate. For seed propagated trees the range of hardiness represents the total range for the species but not the range for a given seed source. For example the red maple, *Acer rubrum*, is hardy from Florida to Ontario. This does not mean that seeds collected in any one location will survive over the entire range. For cultivars the range is more meaningful.

The value to gardeners of a listing of plants tested in various parts of the country, under varying environmental conditions, is obvious; one can judge if a particular species or cultivar may grow locally. This preliminary report is not definitive; and yet, if no specimen of a particular tree is found in your town, and this table indicates that it is supposed to be hardy in your zone, and at a soil type, soil moisture, and soil pH similar to your local conditions, you would be encouraged to try a planting of that tree. Herein lies the benefit of this committee's work to members of the American Horticultural Society; every member can read through this list and check species that *ought* to grow locally but that are not grown locally. Your local botanical garden or arboretum can refer you to a source of these species, and when you move them into your garden or into a public planting American horticulture is enriched by that much. As fall is a good time to plant many kinds of trees, your task is to get right at your analysis of this report.

**Chairman, Research Committee of* The American Horticultural Society *and Director of the Landscape Arboretum, University of Minnesota, Box 132-1, RR. 1, Chaska, Minnesota 55318.*

Tree	No. Reports	Soil Type [1]	Soil Moisture [2]	pH [3]	Light Requirement	Hardiness Zones [4]
Acer macrophyllum, Bigleaf Maple	4	silt-clay	moist-dry	acid	sun or shade	5a-10a
Acer nigrum, Black Maple	9	silt-clay	moist	neutral to acid	sun or shade	3a-7b
Acer platanoides, Norway Maple	17	silt-clay	moist-dry	neutral to acid	sun or shade	4a-10a
Acer platanoides 'Cleveland'	7	silt-clay	moist-dry	neutral to acid	sun or shade	4a-8a
Acer platanoides 'Columnare'	8	silt-clay	moist-dry	neutral to acid	sun or shade	4a-7b
Acer platanoides 'Crimson King'	15	silt-clay	moist-dry	neutral to acid	sun or shade	4a-8a
Acer platanoides 'Emerald Queen'	5	silt-clay	moist-dry	neutral to acid	sun or shade	4a-7a
Acer platanoides 'Fassen's Black'	9	silt-clay	moist-dry	neutral to acid	sun or shade	4b-10a
Acer platanoides 'Globosum'	5	silt-clay	moist-dry	neutral to acid	sun or shade	4a-7a
Acer platanoides 'Royal Red'	5	silt-sand	moist-dry	neutral to acid	sun or shade	4a-6b
Acer platanoides 'Summershade'	3	silt-clay	moist-dry	neutral to acid	sun	5b-7a
Acer pseudoplatanus, Sycamore Maple	11	silt-sand	moist-dry	high lime to acid	sun or shade	5b-7b
Acer pseudoplatanus,'Spaethii'	7	silt-clay	moist	neutral to acid	sun or shade	6b-10a
Acer rubrum, Red Maple	19	silt-sand	moist-wet	neutral to acid	sun or shade	3a-10b
Acer rubrum 'Armstrong'	6	silt-sand	moist	neutral to acid	sun or shade	4a-7b
Acer rubrum 'Columnare'	6	silt-sand	wet to moist	neutral to acid	sun or shade	4a-7b
Acer rubrum 'Autumn Flame'	5	silt-sand	wet to moist	neutral to acid	sun or shade	4a-7a
Acer rubrum 'Scanlon'	5	silt-sand	moist	neutral to acid	sun or shade	4a-8a
Acer rubrum 'Schlesingerii'	5	silt-sand	moist	neutral to acid	sun or shade	4a-7b
Acer rubrum 'Tilford'	4	silt-sand	moist	neutral to acid	sun or shade	4a-7b
Acer saccharum, Sugar Maple	19	silt-sand	moist to dry	neutral to acid	sun or shade	3a-10a
Acer saccharum 'Newton Sentry'	5	silt-sand	moist	neutral to acid	sun or shade	4a-7a
Acer saccharum 'Temple's Upright'	7	silt-sand	moist	neutral to acid	sun or shade	4a-7b
Aesculus X carnea, Red Horse-chestnut	12	silt-sand	wet-dry	neutral to acid	sun or shade	5b-10a
Aesculus X carnea 'Briotii'	9	silt-sand	wet-dry	neutral to acid	sun or shade	5b-10a
Aesculus hippocastanum, Horse-chestnut	16	silt-sand	moist-dry	neutral to acid	sun or shade	4b-10a
Aesculus hippocastanum 'Baumannii'	8	silt-sand	moist-dry	neutral to acid	sun to shade	5b-10a
Ailanthus altissima, Tree-of-heaven	15	silt-sand	moist-dry	neutral to acid	sun to shade	5a-10a
Alnus glutinosa, European Alder	15	silt-sand	moist-wet	neutral to acid	sun to shade	5a-10a
Alnus glutinosa 'Laciniata'	3	clay	moist	neutral to acid	sun to shade	6b-7a
Arbutus menziesii, Pacific Madrone	5	sand	moist to dry	acid	sun to shade	10a
Betula albo-sinensis, Chinese Paper Birch	6	clay	moist to dry	neutral to acid	sun to shade	3b-10a
Betula lenta, Sweet Birch	17	silt-sand	moist to dry	neutral to acid	sun to shade	3a-10a
Betula nigra, River Birch	16	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Betula papyrifera, Canoe Birch	16	silt-sand	moist to dry	neutral to acid	sun to shade	3a-10a
Betula pendula, European Birch	17	silt-sand	moist to dry	neutral to acid	sun to shade	3a-10a
Betula pendula 'Fastigiata'	7	clay-sand	moist	neutral to acid	sun to shade	4b-7a
Betula pendula 'Gracilis'	6	clay-sand	moist	neutral to acid	sun to shade	3b-7a
Betula pendula 'Purpurea'	7	clay-sand	moist	neutral to acid	sun to shade	4b-7a
Betula pendula 'Tristis'	5	clay-sand	moist	neutral to acid	sun to shade	3b-7a
Betula pendula 'Youngii'	7	clay-sand	moist	neutral to acid	sun to shade	3b-7a
Carya cordiformis, Bitternut Hickory	9	silt-sand	moist-dry	neutral to acid	sun to shade	3b-9a
Carya glabra, Pignut Hickory	9	silt-sand	moist-dry	neutral to acid	sun to shade	5b-9a
Carya illinoensis, Pecan	11	silt-sand	moist	neutral to acid	sun to shade	5a-10b
Carya laciniosa, Shellbark Hickory	7	silt-sand	moist-dry	neutral to acid	sun to shade	4a-9a
Carya ovata, Shagbark Hickory	15	silt-sand	moist-dry	neutral to acid	sun to shade	4a-10a
Carya tomentosa, Mockernut Hickory	8	silt-sand	moist to dry	neutral to acid	sun to shade	5b-9a

[1] *Based on simple categories such as clay, clay loam, loam, silt loam, silt, sandy loam, sand; generally reporting stations indicate a range of soils suitable for a given species, e.g., clay—sand.*

[2] *A general indication that a species will grow well on moist soil, on dry soil, or under varying conditions of soil moisture.*

[3] *pH is a measurement of acidity; for horticultural soils, pH 5.5 or lower is considered very acid, 5.5—6.0 acid, 6.0—6.5 slightly acid, 6.5—7.5 circumneutral, 7.5—8.0 alkaline. Very few plants grow well in soil more alkaline than pH 8.0.*

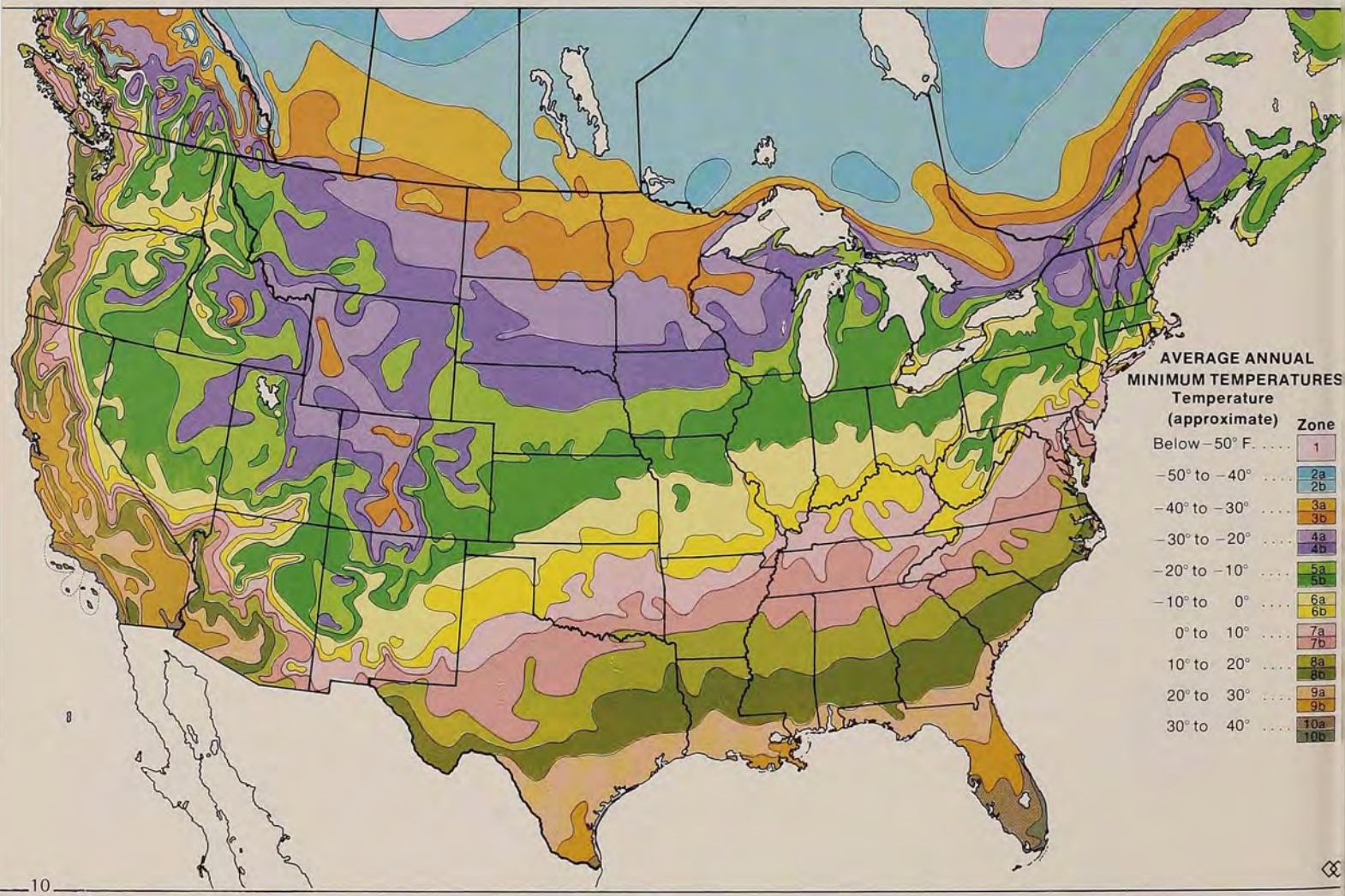
[4] *Plant Hardiness Zone Map, Miscellaneous Publication No. 814, United States Department of Agriculture. Revised 1965*

Tree	No. Reports	Soil Type	Soil Moisture	pH	Light Requirement	Hardiness Zones
						
Castanea mollissima, Chinese Chestnut	17	silt-sand	moist to dry	neutral to acid	sun to shade	5a-10b
Castanea dentata, American Chestnut	11	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Catalpa bignonioides, Southern Catalpa	15	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Catalpa speciosa, Northern Catalpa	12	silt-sand	moist-dry	neutral to acid	sun to shade	4a-10a
Cedrela sinensis, Chinese Toon	9	silt-sand	moist	neutral to acid	sun to shade	6b-10a
						
Celtis australis, European Hackberry	3	clay	moist	neutral to acid	sun to shade	6b-10a
Celtis bungeana	1	sand	moist	acid	sun	7b
Celtis jessoensis	1	clay	moist	acid	sun	6b
Celtis laevigata, Sugar Hackberry	8	silt-sand	wet-moist	neutral to acid	sun to shade	6b-10b
Celtis occidentalis, Common Hackberry	15	silt-sand	moist-dry	high lime to acid	sun to shade	3b-10a
Celtis sinensis, Chinese Hackberry	2		moist	neutral	shade	10a
Cercidiphyllum japonicum, Katsura-tree	18	silt-sand	moist-dry	neutral to acid	sun to shade	4b-10a
Diospyros virginiana, Common Persimmon	17	silt-sand	moist-dry	neutral to acid	sun to shade	5a-10a
						
Fagus grandifolia, American Beech	14	silt-sand	wet-dry	neutral to acid	sun to shade	5b-10b
Fagus sylvatica, European Beech	13	silt-sand	wet-dry	neutral to acid	sun to shade	5b-9a
Fagus sylvatica 'Asplenifolia'	9	silt-sand	wet-dry	neutral to acid	sun to shade	5b-7a
Fagus sylvatica 'Pendula'	10	silt-sand	moist-dry	neutral to acid	sun to shade	5b-8a
Fagus sylvatica 'Riversii'	7	silt-sand	moist-dry	neutral to acid	sun to shade	5b-7a
						
Fraxinus americana, White Ash	18	silt-sand	moist-dry	high lime to acid	sun to shade	4a-10a
Fraxinus excelsior, European Ash	12	silt-sand	moist-clay	high lime to acid	sun to shade	5b-10a
Fraxinus mandshurica	7	silt-sand	moist-dry	neutral to acid	sun	3a-8a
Fraxinus latifolia, Oregon Ash	1	clay	moist	acid	sun	6b
Fraxinus ornus, Flowering Ash	7	silt-sand	moist	high lime to acid	sun to shade	6b-10a
Fraxinus pennsylvanica lanceolata, Green Ash	13	silt-sand	moist-dry	neutral to acid	sun to shade	3a-10a
Fraxinus pennsylvanica 'Marshall's Seedless'	8	silt-sand	moist-dry	neutral to acid	sun	4a-7b
Fraxinus pennsylvanica 'Summit'	2	sand	dry	neutral to acid	sun	4a-4b
Fraxinus quadrangulata, Blue Ash	11	silt-sand	moist	neutral to acid	sun to shade	4a-10a
						
Ginkgo biloba, Ginkgo, Maidenhair Tree	18	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Ginkgo biloba 'Autumn Gold'	9	silt-sand	moist	neutral to acid	sun to shade	4a-10a
Ginkgo biloba 'Fastigiata'	4	silt-sand	moist to dry	high lime to acid	sun	5b-7a
Ginkgo biloba 'Pendula'	7	silt-sand	moist to dry	neutral to acid	sun	5b-8a
						
Gleditsia triacanthos, Common Honeylocust	18	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Gleditsia triacanthos 'Brownii'	2	silt-sand	moist to dry	neutral to acid	sun	4a-5a
Gleditsia triacanthos 'Imperial'	4	silt-sand	moist to dry	neutral to acid	sun	4b-6b
Gleditsia triacanthos 'Majestic'	5	silt-sand	moist to dry	neutral to acid	sun	4a-7b
Gleditsia triacanthos 'Moraine'	10	silt-sand	moist to dry	neutral to acid	sun	4b-7b
Gleditsia triacanthos 'Shade Master'	9	silt-sand	moist to dry	neutral to acid	sun	4a-9a
Gleditsia triacanthos 'Skyline'	6	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Gleditsia triacanthos 'Sunburst'	15	silt-sand	moist to dry	neutral to acid	sun to shade	4b-10a
Gymnocladus dioicus, Kentucky Coffee-tree	18	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
						
Juglans cordiformis, Heartnut Walnut	5	clay-sand	moist to dry	neutral to acid	sun to shade	6b-10a
Juglans nigra, Black Walnut	19	silt-sand	moist to dry	neutral to acid	sun to shade	3b-10a
Juglans regia, English (Persian) Walnut	13	silt-sand	moist to dry	neutral to acid	sun to shade	5b-10a
Kalopanax pictus, Castor-aralia	10	silt-sand	moist to dry	neutral to acid	sun to shade	5b-7b

Tree	No. Reports	Soil Type	Soil Moisture	pH	Light Requirement	Hardiness Zones
Liquidamber formosana, Formosa Sweet-gum	9	clay-sand	moist	neutral to acid	sun to shade	6b-10a
Liquidamber styraciflua, Sweet-gum	18	clay-sand	moist to dry	neutral to acid	sun to shade	5b-10a
Liriodendron tulipifera, Tulip-tree	19	clay-sand	moist to dry	neutral to acid	sun to shade	5b-10a
Liriodendron tulipifera 'Fastigiata'	2	clay	moist	neutral to acid	sun	6b-7a
Liriodendron tulipifera 'Tortuosum'	1	clay	moist	acid	sun	6b
Magnolia acuminata, Cucumber-tree	16	silt-sand	wet to moist	neutral to acid	sun to shade	4b-10a
Magnolia campbellii, Campbell's Magnolia	4	clay-sand	moist to dry	neutral to acid	sun to shade	6b-10a
Magnolia grandiflora, Southern Magnolia, Bull Bay	16	clay-sand	wet to moist	neutral to acid	sun to shade	6b-10b
Magnolia obovata, Whiteleaf Japanese Magnolia	6	clay-sand	moist	neutral to acid	sun to shade	6b-10a
Magnolia tripetala, Umbrella Magnolia	14	clay-sand	moist to wet	neutral to acid	sun to shade	4a-10a
Magnolia virginiana, Sweet Bay Magnolia	13	silt-sand	moist to wet	neutral to acid	sun to shade	5b-10a
Nyssa sylvatica, Black Gum, Black Tupelo	15	silt-sand	wet to dry	neutral to acid	sun to shade	5b-10a
Quercus alba, White Oak	18	silt-sand	moist to dry	neutral to acid	sun to shade	4a-10a
Quercus bicolor, Swamp White Oak	13	silt-sand	wet to dry	high lime to acid	sun to shade	4a-9a
Quercus coccinea, Scarlet Oak	16	silt-sand	moist to dry	high lime to acid	sun to shade	4a-7b
Quercus garryana, Oregon White Oak	5	clay-sand	moist to dry	neutral to acid	sun to shade	6b-10a
Quercus imbricaria, Shingle Oak	10	silt-sand	wet to moist	neutral to acid	sun to shade	5a-10a
Quercus nigra, Water Oak	9	clay-sand	moist to wet	neutral to acid	sun to shade	6b-10a
Quercus palustris, Pin Oak	18	clay-sand	wet to dry	neutral to acid	sun to shade	4a-10a
Quercus prinus, Chestnut Oak	12	silt-sand	moist to dry	neutral to acid	sun to shade	5b-9a
Quercus robur, English Oak	16	silt-sand	moist to dry	neutral to acid	sun to shade	4b-10a
Quercus robur 'Asplenifolia'	2	silt-clay	moist	acid	sun	6b-7a
Quercus robur 'Atropurpurea'	1	clay	moist	acid	sun	6b
Quercus robur 'Fastigiata'	6	silt-clay	moist to dry	neutral to acid	sun to shade	5b-7b
Quercus shumardii, Shumard Oak	8	silt-clay	moist to dry	neutral to acid	sun to shade	5b-9a
Quercus rubra, Red Oak	16	silt-sand	moist to dry	high lime to acid	sun to shade	4a-10a
Quercus velutina, Black Oak	9	silt-sand	moist to dry	neutral to acid	sun to shade	5b-7b
Robinia pseudoacacia, Black Locust	19	silt-clay	moist to dry	high lime to acid	sun to shade	4a-10a
Robinea pseudoacacia 'Decaisneana'	5	sand	moist to dry	acid	sun to shade	4a-10a
Robinea pseudoacacia 'Umbraculifera'	3	clay	moist	acid	sun	4a-6b
Salix alba, White Willow	12	silt-sand	wet to moist	neutral to acid	sun to shade	3a-7a
Salix alba 'Chermisina'	7	silt-clay	moist	neutral to acid	sun	3a-6b
Salix alba 'Tristis'	7	silt-clay	wet to moist	neutral to acid	sun	3b-7a
Salix alba 'Vitellina'	6	silt-clay	wet to moist	neutral to acid	sun	3b-6b
Tilia americana, Basswood, American Linden	17	silt-clay	moist to dry	neutral to acid	sun to shade	3a-9a
Tilia americana 'Fastigiata'	3	silt-clay	moist	neutral to acid	sun	4b-6b
Tilia cordata, Littleleaf Linden	16	silt-sand	moist to dry	neutral to acid	sun to shade	3b-8a
Tilia cordata 'Greenspire'	6	silt-sand	moist	neutral to acid	sun	4a-7b
Tilia cordata 'Pyramidalis'	2	silt	moist	neutral	sun	4b-5b
Tilia cordata 'Swedish Upright'	3	clay	moist	acid	sun	4a-6b
Tilia X euchlora, Crimean Linden	5	clay-sand	moist	acid	sun to shade	4b-10a
Tilia X euchlora 'Redmond'	5	silt-clay	moist	neutral to acid	sun	4a-6b
Tilia petiolaris, Pendent Silver-Linden	6	clay-sand	moist to dry	neutral to acid	sun to shade	6b-7b
Tilia platyphyllos, Bigleaf Linden	11	silt-sand	moist to dry	neutral to acid	sun to shade	5a-10a
Tilia tomentosa, Silver-Linden	9	silt-sand	moist to dry	neutral to acid	sun to shade	5b-10a

Tree	No. Reports	Soil Type	Soil Moisture	pH	Light Requirement	Hardiness Zones
Ulmus americana, American Elm	18	silt-sand	wet to dry	neutral to acid	sun to shade	3a-10a
Ulmus americana 'Ascendens'	1					4b
Ulmus americana 'Augustine'	4	silt-clay	moist	neutral to acid	sun	4b-7a
Ulmus americana 'Lake City'	4	silt-clay	moist	neutral	sun	3b-5a
Ulmus americana 'Moline'	5	silt-clay	moist	neutral to acid	sun	4a-6b
Ulmus carpinifolia, Smooth-leaved Elm	7	silt-sand	moist to dry	neutral to acid	sun to shade	5a-7a
Ulmus carpinifolia 'Bea Schwarz'	2	clay-sand	moist to wet	neutral to acid	sun	5a-6b
Ulmus carpinifolia 'Christine Buisman'	8	silt-sand	wet to dry	neutral to acid	sun to shade	5a-7b
Ulmus carpinifolia 'Pendula'	1	clay	wet	acid	sun	6b
Ulmus carpinifolia 'Umbraculifera'	1	clay	moist	acid	sun	6b
Ulmus glabra, Scotch or Wych Elm	6	silt-sand	moist-dry	neutral to acid	sun to shade	5b-8a
Ulmus glabra 'Camperdownii'	5	silt-sand	moist	neutral to acid	sun	5b-8a
Ulmus parvifolia, Chinese Elm	10	silt-sand	wet to moist	neutral to acid	sun to shade	6b-10a
Ulmus procera, English Elm	4	silt-clay	moist to dry	neutral to acid	sun	5a-7a
Ulmus pumila, Siberian Elm	11	silt-sand	moist to dry	neutral to acid	sun	3b-10a
Ulmus thomasii, Rock Elm	4	silt-sand	moist to dry	neutral	sun	4a-5b
Zelkova carpinifolia, Elm Zelkova	2					6b-7a
Zelkova serrata, Japanese Zelkova	11	silt-sand	wet to dry	neutral to acid	sun to shade	5b-10a
Zelkova serrata 'Village Green'	1	sand	moist	acid	sun	7b

PLANT HARDINESS ZONE MAP



Aesculus parviflora Walt, the bottlebrush buckeye, is the most distinct member of its genus, being the sole species in Section *Macrothyrsus* K. Koch. It is the only *Aesculus* whose seeds may be eaten with safety. Ordinarily, it is a spreading shrub of medium height, with showy flower panicles in early summer, several weeks later than those of any other eastern United States native buckeye. While several other of our native *Aesculus* species have hybridized among themselves (and *A. pavia* with the European horsechestnut, *A. hippocastanum)* no hybrid of *A. parviflora* is known. There is, however, a considerable amount of clonal variation both in the native woods habitats between Georgia, northern Florida and Mississippi, and in cultivation to the northeastern U. S. and southern Canada (U.S.D.A. Zone 5). The most showy in flower, as well as the most vigorous clones, are probably in var. *serotina* Rehder, the late bottlebrush buckeye, which occurs in Alabama with the species, but opens its flowers two or three weeks later (in mid-July at Urbana, Illinois).

Horticulturally, the late bottlebrush buckeye seems to be a sleeper, one of the really good woody plants for American gardens that has not been much publicized by writers, nor taken on by commercial propagators. Rehder described it in 1919; it was distributed by the Arnold Arboretum to other arboreta and botanic gardens in the northeast and midwest; though it has thrived in various northern sites as well as the species, I have yet to see *A. p. serotina* in any nurseryman's price list. Even Henry Hohman, whose estimated 12,000 taxa include *A. parviflora* as a valued shrub near his house, told me last year that he did not have the late variety.

A. parviflora serotina 'Rogers' is offered now to commercial propagators as a showy flowered cultivar which is especially easy to grow from root pieces, divided in early spring. It originated as a seedling grown at Urbana, Illinois from seed taken from a mature specimen in the Missouri Botanical Garden at St. Louis. Its inflorescences are abundantly produced and are longer than those I have seen on most other clones, even of the late variety. Unlike most other clones I have observed in either variety, it forms adventitious shoots both from the larger roots near the crown of the plant, and from severed root pieces farther out. Like other clones, it sometimes also layers itself naturally from prostrate branches arising in the crown region, but the true root-cutting method seems to offer the fastest and most economical method of increasing it for nursery propagation. The cultivar name honors Dr. Donald P. Rogers, Professor of Mycology at the University of Illinois, in whose front yard the original plant grows.

The buckeyes on this plant develop from a minority of the flowers that bear functional pistils, and mature here in September. The seeds are not bitter and can be peeled and eaten. If wanted for seed propagation, they can be planted immediately, or else refrigerated in sealed plastic bags for a short time. They lose their viability very quickly if dried, but germinate promptly if kept moist. Top growth is minimal the first fall; if mulched over winter, or (preferably) kept in a cold frame, the young seedlings can be transplanted the following spring. But, because seeds may be taken by squirrels, are something that must be handled without delay, and may not necessarily produce as uniformly desirable plants as the parent, root cuttings in spring are the method of choice for propagating this cultivar, *Aesculus parviflora serotina* 'Rogers'.

'Rogers', the First Named Cultivar of Late Bottlebrush Buckeye

*J. C. McDaniel**

Above: Aesculus 'Rogers'
Left: Root with shoot initiation

Photos by author

**Professor J. C. McDaniel, Division of Horticulture, University of Illinois, Urbana, Illinois, has in recent years intensively researched select forms of woody plants for possible use as garden ornamentals.*

Green is the color of hope

*Henry M. Cathey**

By tradition, the horticulturist has planted seed, taken cuttings, and grown and protected plants for food, utility and beauty.

Today, his job is bigger than the tradition. The environmental crisis is growing more threatening every day. The horticulturist can help meet that crisis. He can put greater horticultural knowledge and experience into man's efforts to improve the world he lives in. The world needs all of his techniques and skills to develop plants to survive in a changing environment, plants to meet changing life styles, and plants to fit the shrinking limits of available time and space.

What the world needs now is smog-resistant trees and shrubs, including plants for compact and often hostile areas.

Today's horticulturists are prepared for this role with their special knowledge of plant genetics, physiology, and pathology. Already they have made great advances. They have increased productivity, and bred pest and disease resistance into many horticultural lines. They have given us new ornamentals. They have learned how to induce plants to bloom on schedule so that florists can offer spring-flowering plants with the popular poinsettia at Christmas time and chrysanthemums the year round.

They have accommodated their work to new developments in other fields. For instance, they have adapted the fragile tomato, as well as other fruits and vegetables, to mechanical harvesters. They grow orchids in Hawaii and carnations in Colorado to take advantage of favorable growing conditions; then they use improved storage and transportation to get their products to market quickly.

To accomplish so much, horticulturists have had to overcome incompatability of seed plants; eliminate disease reservoirs of stock plants, utilize artificial soil mixes and fertilizers; and become manipulators of plant growth through the use of light, temperature and special growth substances.

While the horticulturist is seeking to improve our fruits, vegetables, and ornamentals, the rest of us are indirectly working against him. The public is taking out of production some of the best land for horticultural use. We are saturating our surroundings with machines, concrete, buildings, and with a rapidly developing excess of people.

Our planet contains a number of limited consumables. The major limiting consumable may be readily available carbon dioxide. To maintain the present level of photosynthesis on earth, we must recycle all of the CO_2 every 250 years. But this rate is being accelerated. Increased population and increased mechanization have caused our global society to tie up oxygen and to release CO_2 faster than in any previous generation. We are slowly changing the balance of life on earth. Furthermore, at this point in history, we do not know the long-term effects—on a global scale—of increased CO_2 levels, increased growth rates of plants, changes in temperatures in our urban areas, and the shift in the balance of nature.

We do know this: Photosynthesis is essential to life. And we know that:

1. Almost three-fourths of all photosynthesis occurs in water—in algae—so that most of our oxygen supply comes from tropical oceans.

2. Cultivated plants probably contribute less than ten per cent of the total photosynthesis.

3. Photosynthesis occurs only at a specific range of temperature, relative humidity, mineral nutrition, and so on.

4. Plant release of O_2 occurs only in sunlight. Thus, during part of each day (night), and part of each year (winter), plants do not add O_2 but actually remove it from the atmosphere.

5. The level of photosynthesis depends on light intensity and the CO_2 level. CO_2 is usually a limiting growth factor.

On the average day our environment contains 0.03 per cent CO_2. There are many intervals, during the daylight hours, when the level of CO_2 falls greatly, depending on the kind of plants and on other environmental factors.

Nevertheless, plants have a unique function in the recycling process. They recycle CO_2 and O_2, complementing the cycling of animal metabolism. However, plants contribute to the recycling system *only* when they are in active growth, with all of their green leaves carrying on photosynthesis.

The plot of grass in one's garden is not related to any specific group of people, as implied by the claim that fifty square feet of grass liberates enough oxygen to serve a family of four. Such claims are based on classic information from textbooks plus a slide-rule expansion to 365 days a year. Most plants grow in marginal circumstances. Since they give off O_2 only under the specific conditions described above they are efficient in the range of 3, 5, or 7 per cent of the classic ideal; routine slide-rule expansion is misleading.

Although plants cultivated by man contribute only a small percentage of the total photosynthesis on earth, these green plants are important to us because they live where we live. These green plants surround man, and help him and his habitat create the landscapes of earth.

The ability of plants to play their role in photosynthesis depends on the kind of plant and on light. Plants vary greatly in the minimum-maximum range of light levels they require to support their growth. For instance, beans need a minimum of 100-foot candles. Oaks can live in a range from 300- to 1,500-foot can-

**Henry M. Cathey, Acting Leader Ornamental Laboratory, Plant Genetics and Germplasm Institute, National Agricultural Research Center, Beltsville, Maryland.*

dles, pines from 300-to 9,000, and philodendron from a minimum of 25- to a maximum of only 500-foot candles.

Scattered remains of rubbish, floating in our air, filter out some light and retard the recycling of CO_2 and O_2. We are told that plants in our urban environment today are receiving sixteen per cent less light than they did a generation ago. This means that the efficiency of city plants is reduced, since they may be growing at a minimum or lower than the maximum light levels.

In the interest of improving our environment with plants, some mistakes have emanated from well-meaning but misguided assumptions and slogans. Let us consider a few, and also the positive approach that can be made.

"We should plant a tree." This is good advice in the right place. Ask the men and women who know—the horticulturists. Look to them and get involved in sensible gardening and sensible planting. There are organizations to suit all tastes; work with the ones that best suit you.

"Plants purify the air." This in itself is an oversimplification and can be misleading. Plants suffer in polluted air filled with chemicals that attack the life-support system of plants. These chemicals are by-products—wastes—of man's machines. Some may even be created in space by photochemistry. During the daylight hours, plants have their mouths, or stomates, wide open. They take up ozone, sulfur dioxide, peroxylacetyl nitrate (PAN), carbon monoxide, ethylene, and other harmful substances. Plants may not be fully effective in ridding the environment of these, but they trap and remove from the air much that is a threat and even potentially lethal.

Plants also help to recycle water. Man rejects water that is not palatable. Plants are just as demanding of good quality in water. Some of the materials dispersed and dissolved in water reduce its availability to plants, and thus limit plant growth.

The amount of water required by even one annual plant is enormous. For example, in one growing season a single tomato plant requires thirty-four gallons, one corn plant fifty-four gallons, and one sunflower plant as much as 130 gallons.

Of the total water required for each plant, less than five per cent is used directly to maintain its life processes. Plants lose water to the atmosphere as part of the recycling of the earth's "consumables." The remaining ninety-five per cent of the required water cools the surrounding areas and sets up the recycling—from contaminated to aerated rain water.

Plants can serve man in a other area of "pollution"—noise. Man and his machines generate a steadily rising din. Over the years, noise levels have increased to the point where they are producing both psychological and physiological problems for us. Green plants can be used in strips, buffers, and screens to deflect, absorb, break up, and muffle many of the sounds that make community living unpleasant and uncomfortable.

Light upsets nature's balance. Man's need to see—to see movement of other men and machines after dark—has brought "moonlight" during the night hours over most of our urban environment. Ordinary mercury vapor lamps have been the standard urban lighting for many years. Although they have only slight effect on the growth and development of our green plants, the blue light emitted from them attracts night-flying insects from surrounding areas. The insects consume decorative plants, lay eggs for future generations, and disfigure the landscape.

To prevent this kind of pollution, many of our cities now are substituting so-called "color-improved" lamps for the blue ones. These are not the answer, either. They emit enough red light to cause the green leaves of many kinds of plants to hold on and delay the necessary onset of dormancy. Yellow lights generally are better because the red is at such a low level as to have little or no effect on plant growth. Night lighting with the wrong kind of lamps can greatly decrease the survival potential of some of our most desired trees and shrubs.

"Man will continue to find ways to adapt himself and his plants." This is an optimistic view. Man may be able to do some things to adapt himself, his plants, and his environment, to survive. Many plants are extinct today because they were not able to survive. Others such as the magnolia, dogwood, and the ginkgo, have survived many environmental changes and still are beautiful and widely used.

In this adaptation process Man can call upon all of his resources. But he must still look to the horticulturist to propagate, to grow, and to protect our plants.

The horticulturist will be pressed to select tolerant plants for even a scrubbed environment. The pressures will be so great that he will be impatient to wait for years to find out whether a seedling possesses desired color, form, resistance, sound baffling, and fragrance, as well as tolerance to polluted air, soil, and water. He will have to learn more about relating the early stages of plant growth to the desired performance of mature plants. He will have to develop plants that use inherent resources and characteristics to ward off pests and diseases. He must continue to look for plants for the consumer to plant EVERYTHING.

Green is the color of hope. In the green of our plants is the hope of survival. It begins in the hands of the skilled horticulturist but ultimately it moves through the hands of horticulturists to the hands of all people who grow plants—fruit, vegetables, ornamentals.

The decisions are in our hands, in our propagation beds, in our fields. In the seeds that we planted last week or the cuttings we shall make next week lies our hope for survival.

Strawberry 'Garnet'

Red Raspberry

Yellow Raspberry

Blackberry

Photos courtesy Experiment Station, Geneva, N. Y.

Home-grown Small Fruits

Strawberries, Raspberries, Blackberries, Blueberries, Gooseberries, Currants

*George L. Slate**

A small fruit garden properly planned and well-maintained can provide fresh home-grown fruit from the first strawberries of spring to the last autumn-fruiting raspberries of late October. For five to six months the fruit is there to be harvested.

The rewards of the small fruit garden are substantial. There is much pleasure and satisfaction in growing, harvesting and using home-grown fruit that is much superior in quality and freshness to that available in most markets. Fruits rate high nutritionally as well as gastronomically, and if there are children in the family an abundance of readily available fresh fruit is far superior to the trashy candies and dubious drinks that corrode teeth and damage digestions.

In the kitchen small fruits are canned, frozen, and made into jams, preserves, jellies and juices in great variety. There is nothing finer than strawberry shortcake made with ripe berries and biscuit dough, or blueberry pie without the blue glue-pie factory filling.

Spraying is not the "must" that it is with the tree fruits and when necessary it may be done with a knapsack sprayer. Cultivation is done with ordinary garden tools. Small fruits bear full crops early without the several years wait that the tree fruits require.

**Professor George L. Slate, New York Agricultural Experimental Station, Geneva, New York, is involved in the breeding and evaluation of small fruits for home gardens and for commercial production.*

Starting Your Garden

Plan your small fruit garden carefully. Impulse buying of berry plants at the garden store in the spring is not the way to start. Decide whether the proposed site is suitable, what fruits are to be grown and how many of each. Choose the varieties that are recommended locally, locate sources of plants and place your orders in late fall, not late spring. If you are not an experienced gardener, begin small; a dozen strawberry and a dozen red raspberry plants.

The Best Place

A home gardener has little choice of site and must make the best of what the property offers. The characteristics of your site must be considered as it is a waste of effort to plant where failure is likely. Minimum winter temperatures and unseasonably late spring and early fall frosts are hazards that occur in frost pockets (low places surrounded by higher land). On still, frosty nights the temperature may be several degrees lower at the bottom of a slope than farther up. Strawberry flowers are often injured by late spring frosts. Low winter temperatures in frost pockets can injure or kill raspberry canes.

Small fruits require full sun all day and bear very little fruit in shady situations. Root competition of large trees must be avoided. Eliminate perennial weeds; quack grass and bindweed, especially, as it is just about impossible to clean them out of an established planting. Usually the weed-infested planting is abandoned.

Old run-out raspberry and strawberry plantings usually harbor virus diseases and insect pests. So do wild raspberries in fence rows. These all should be eliminated before starting the new planting. Garden soils that have recently grown tomatoes, potatoes, peppers and eggplants may harbor the soil borne fungus disease, verticillium wilt, which is destructive to black raspberries and most strawberry varieties.

Soil should be well-drained and at least moderately fertile. If the water table is three feet down during the growing season drainage is probably adequate. Water standing on the surface more than a few hours during the growing season may injure or kill the plants. Ridging the soil to a height of six inches may help a bit in a marginal site.

Prepare the soil thoroughly as for a vegetable garden. If your site has been used for a garden for several years without the addition of organic matter, it may be worthwhile to grow orchard grass or timothy for two years, fertilize it heavily to secure maximum growth, and then turn it under. Manure is too expensive unless you can get it cheaply from a nearby stable or dairy. Perennial weeds, especially quack grass, Canada thistle and bindweed, can be cleaned out with herbicides the year before planting. If the soil is in good tilth, green manuring may not be necessary. The organic matter level may be maintained with mulches.

Small fruit plants should be purchased from a nursery specializing in their production, rather than from general nurseries whose interest is mostly in ornamentals. Order the plants in the fall, not in the spring, when the best varieties are likely not to be available. The kinds of fruits to be grown, the varieties and the number of plants needed should all be determined in time to place the order in the fall. Your County Agricultural Extension Agent is a big help with this step.

Virus-free nursery programs have been in effect long enough for ample supplies of virus-free plants of strawberries, raspberries, blackberries and blueberries to be available from most small fruit nurseries. On your order specify virus-free plants. Avoid plants from uncertain sources.

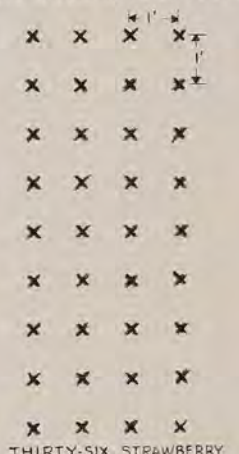
Strawberries

Most strawberry nurseries sell dormant plants which have been held in cold storage. Freshly dug plants, if they move quickly from the nursery to the planter, and are not injured by overheating enroute, usually are satisfactory.

Strawberries usually are set in the spring as soon as the soil can be prepared. The other small fruits can be set either in the spring or late fall before the ground freezes. I prefer fall planting, as the plants are freshly dug and have not spent the winter in a nursery cellar. There are many failures of spring set raspberry plants. Freshly dug spring plants are all right if handled quickly.

Protect fall-set plants against heaving out of the ground by frost action during the winter. Loose soil mounded up around the plants, or a large shovelful of sawdust or tree leaves, should prevent damage from freezing and thawing. Level the soil in the spring.

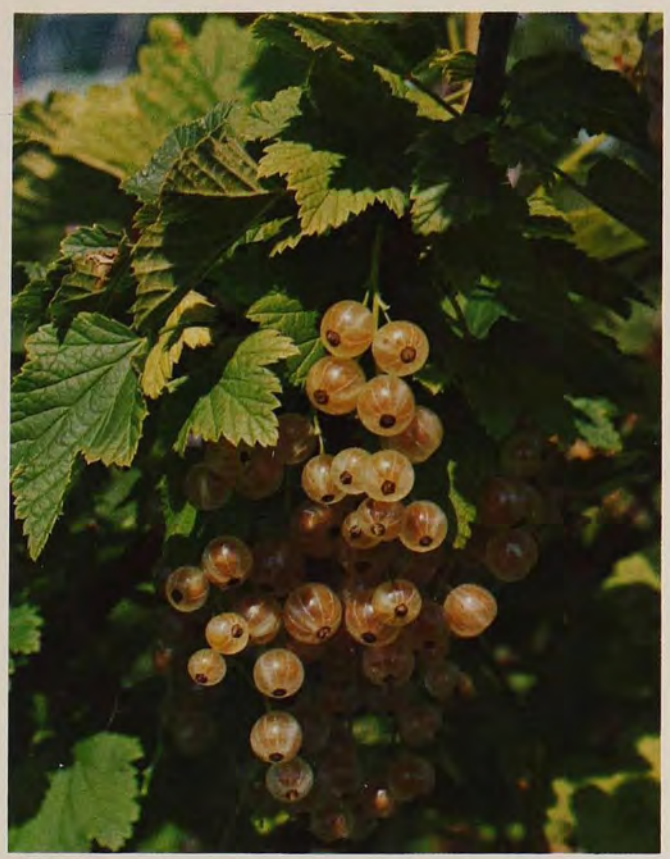
Strawberry plants usually are grown in matted rows. Set the plants eighteen to twenty-four inches apart, in rows three to four feet apart. Each plant sends out many runner plants and in fertile soils the resulting row is overcrowded. The crowded plants are small and in wet weather fruit rot can be serious. For the garden I prefer to set the plants in beds of four rows a foot apart and the plants one foot apart in the row. All runners are removed leaving only the original plants to fruit. This kind of a bed can produce very heavy crops of fancy berries.



THIRTY-SIX STRAWBERRY PLANTS SET IN "HILLS"

Raspberries, Blackberries, Currants and Gooseberries

Grow raspberries and blackberries in rows. Set plants of red raspberries and blackberries two feet apart in rows seven feet apart. After the first year many suckers arise; these should be restricted to a row width of about



White Currant 'White Imperial'

Red Currant 'Rondom'

Gooseberry 'Poorman'

Gooseberry 'Josselyn'

Photos courtesy Experiment Station, Geneva, N. Y.

one foot or an unmanageable thicket will result. Black and purple raspberries do not make suckers so space the plants about three feet in the row. Set currants and gooseberries three to four feet in the row and seven feet between rows. Blueberries eventually make large plants and need ten feet between rows and five between plants in the row. Blueberry plants are attractive enough to be part of a shrub planting, but they should not be crowded. Also they must be netted to prevent the birds from taking all the berries before they are ripe.

Culture

Summer care is mostly preventing weed growth and maintaining a good supply of moisture. If you cultivate it should be shallow and frequent enough to prevent much weed growth. Special selective herbicides are very useful in the fruit garden and save much labor. Instructions for use are on the package and they should be followed exactly to give good weed control without injuring the plants.

Simazine is useful for the bush fruits and Dacthal is suitable for strawberries. Both kill germinating weed seeds but are not effective on established weeds. If other chemicals are used, information should be secured from the agricultural extension service at agricultural colleges and in most counties.

Mulching is an excellent way to manage the soil. The mulch prevents most weed growth and conserves soil moisture. Tree leaves, hay, straw, sawdust and peat are all good. Some are a fire hazard. Black plastic mulch is good if the other materials are not available.

Fertilizers usually are not used the first year on the bush fruits. Thereafter, nitrogen is most likely to be needed. Soils known to be fertile may not need fertilizers. Plants making vigorous growth with large dark green leaves may not need fertilizers. If nitrogen is used it may be tried at the rate of eleven pounds of a ten per cent nitrogen fertilizer to 1000 square feet. Too much nitrogen may cause too vigorous growth of raspberries which will winter kill. Apply fertilizers in the spring about the time growth starts.

Fertilize strawberries soon after planting and again in late August. They should not be fertilized in the spring of the bearing year.

If rainfall is less than an inch a week, watering of strawberries may be necessary. Established bush fruits, if mulched, can get by with much less rainfall.

Everbearing strawberries require special care. They are best grown in hills and mulched with sawdust although other materials will do. Extra nitrogen is required if sawdust is the mulch.

Strawberry plants in the North should be mulched for winter with straw which should be applied to a depth of two or three inches before temperatures drop below 20° F. and after a few hard frosts.

Blueberries

Blueberries must be grown on acid soils with a pH of 5.0 or less. On sandy soils with a pH of 5.0 to 6.0 the use of sulfate of ammonia as the source of nitrogen will gradually lower the pH. Blueberries are very shallow rooted and easily injured by cultivation. A sawdust mulch is highly recommended for blueberries.

The choice of varieties contributes much to the enjoyment of the fruit planting. Varieties vary greatly in dessert quality and often the commercial varieties are not of superior flavor. The great variation in growing conditions in the United States makes it impractical to give variety recommendations for all areas. These should be obtained from the agricultural extension service at the state agricultural college and in most counties.

Fruit for the New York Region

For central New York (earlier southward) the small fruit season starts about June 10th with early strawberries and ends about July 4th with late varieties. 'Suwannee', 'Fairfax' and 'Fletcher' are the best flavored varieties. 'Catskill' and 'Raritan' are good garden sorts. 'Geneva' is everbearing and high in quality. Raspberries are for July and are best north of the Potomac and Ohio River Valleys. 'Taylor', 'Newburgh', 'Latham' and several from the Maryland Agricultural Experiment Station are all good. 'Bristol', 'Dundee', 'Allen' and 'Alleghany' are good black raspberries. 'Clyde', 'Sodus' and 'Marion' are good purple varieties very useful for culinary purposes. 'Darrow', the best blackberry, ripens in late July. 'Thornfree' and 'Smoothstem' are very sour blackberries to be grown south of Washington, D.C.

'Poorman', the best gooseberry, is not available from nurseries. 'Red Lake' and 'Minn. 71' are good currants.

Blueberries are the mainstay of the small fruit planting from mid-July through August. There are many good varieties. 'Earliblue', 'Berkeley', 'Bluecrop', 'Herbert' and 'Coville' are popular. Two should be planted to provide cross-pollination. From North Carolina south the rabbiteye varieties should be grown.

The new autumn-fruiting (everbearing) 'Heritage' raspberry bears a fine fall crop from late August (earlier southward) to frost. Often late October at Geneva, N.Y. It also produces a summer crop in mid-July.

AIR LAYERING OF PITTOSPORUM TOBIRA

*John H. Moon, M.D.**

P. tobira, the Japanese Tobira, grows twenty to thirty feet high and reputedly is hardy through the 10°f. to 20°f. range. A varient with variegated foliage is available.

The pittosporums are a group of large evergreen shrubs native to Australia, New Zealand, China, and Japan, with decorative foliage.

One kind, *P. tobira,* was introduced on to the Outer Banks of North Carolina about twenty-five to thirty years ago. The older bushes have trunks which measure six to eight inches at ground level in diameter. The ultimate height of shrubs in this area is difficult to determine, since they were originally used as foundation plantings and have had to be kept cut back to prevent their obscuring windows. The largest specimen I have been able to locate is fifteen years old and eighteen feet high.

The bushes are covered with tiny white fragrant flowers in spring, which fade to yellow as they age and are followed by green fleshy seed pods. The alternate leaves cluster almost in whorls along the shoots and are leathery and of a deep green color. They measure four to five inches in length and one to one and one-half inches across when grown in partial shade. In full sun, the leaves are somewhat smaller and their margins tend to roll inward.

P. tobira does not seed itself in this area and propagation has been by cuttings of half-ripe wood taken with a heel of old wood in late summer. The cuttings, placed in a semi-shaded situation in a mixture of half sand and half peat will root, if given proper care, in about two months. They then must be potted up to make additional root growth before they can be placed in their permanent situation.

Mrs. John Cronly Sr., Richmond, Virginia, suggested that the shrub might be air-layered to provide larger specimens with less attendant care. In October, 1970, I selected shoots of three different sizes and after girdling the cambium, packed the girdled area with damp unmilled sphagnum moss and secured the moss with heavy clear plastic fastened above and below with heavy twine. In June, 1971, the air-layers were cut from the parent plant. Only one had rooted. It was the largest one attempted and the branch measured five-eighths inch in diameter at the level of the layer and was twenty-four inches long. The green seed pods stayed on the cutting. Potted up in fine sand and kept watered through the summer the plant made heavier root growth and has continued to thrive.

This method of propagation of *P. tobira* requires refinement but is easy and can provide a quantity of shrubs large enough to satisfy most home owner's needs in an area where there are no commercial sources of supply. The shrub seems to be at least as tolerant of salt spray, poor soil, and wind as the bayberry and has no natural enemies, making it an ideal seaside planting in areas where the climate does not stay below freezing for any prolonged period of time.

**Dr. Moon, an enthusiastic home gardener living in Richmond, Va., submits this note for pittosporum growers.*

THE ANCIENT CURSE OF THE RHODODENDRON

*David G. Leach**

The green cloak of vegetation which beneficently mantles the earth has some painful traps for the unwary: poison ivy, stinging nettles, poison oak, the devil's walking stick and others similarly spined or daggered. These are the obvious malefactors in the generally benign world of plants, and then there are a few deceptive weeds and flowers of innocent appearance which are dangerously toxic if parts of them are eaten. Children are warned to avoid the beckoning blue blossoms like helmets with beaked visors on the venomous monkshood, and to shun the black berries which glitter invitingly on the notorious nightshade. But the rhododendron, the dramatically beautiful springtime feature of suburban landscapes, without evil reputation, has the most lurid past of all.

Rhododendrons and azaleas, both in the same genus of plants, contain one of the most deadly of the world's natural poisons. Its grim history coils back more than 2,400 years. In the ancient world the course of western civilization was affected by its lethal impact. In modern times victims of rheumatism and arthritis suffered appallingly for nearly a century after a German experimenter published an erroneous report that an infusion made from rhododendron leaves would cure the diseases.

Ironically, primitive peoples knew the poisonous properties of the rhododendron. The pounded pulp of the leaves was thrown into a pool of water to paralyze fish so that they could be caught on the surface. But the first man in recorded pre-Christian history to be ensnared by the insidious rhododendron was the brilliant Xenophon, intimate of Socrates, author and military leader. His *Anabasis* describes the retreat from Babylon of 10,000 Greek soldiers of fortune in 401 B.C., following the slaughter of their officers by the treacherous Persians. Trapped deep inside Asia Minor, surrounded by the enemy, the desperate Greeks elected Xenophon to take command. Taking a supreme gamble, he led them inland to the mountains of Kurdistan. In deep snows and bitter cold the starving soldiers fought their way through savage mountain tribes into Georgia and then Armenia.

Two days' march from Trebizond (Trabzon) on the Black Sea coast of Turkey, the army came near to disaster. In Xenophon's own words, "... there being great quantities of beehives in those villages, all the soldiers who ate of the honeycombs lost their senses, and were seized with vomiting and purging, none of them being able to stand on their legs. Those who ate but a little were like men very drunk, and those who ate much, like madmen, and some like dying persons. In this condition great numbers lay on the ground, as if there had been a de-

**David G. Leach, President, The American Horticultural Society, 1674 Trinity Road, North Madison, Ohio*

feat, and the sorrow was general. The next day, none of them died, but recovered their senses about the same hour they were seized; and the third and fourth day they got up as if they had taken a strong potion."

At no time in the retreat had the soldiers been so vulnerable. Had the harassing Colchian enemy attacked, one of the epics of military history would have become an anticlimax of accident, an obscure textbook footnote, instead of the stirring account of bravery, endurance and ingenuity spurring a determined army of the lost through two thousand miles of hardship in hostile lands to final success and reunion with Greece.

Xenophon's anguish as he faced catastrophe with his soldiers unaccountably stricken after months of battle and privation was all because of a rhododendron. The honey had been made from the poisonous nectar of the yellow-flowered Pontic azalea, *Rhododendron luteum*, which gilds the hillsides in springtime near Trebizond to this day, and brings harrowing illness and death to its peasants.

History is full of curious coincidences, and the Roman Republic

R. ponticum

was later to falter for a time because of the same rhododendron. In 67 B.C. Cicero had supported the transfer of army command from Lucullus to Pompey in perhaps the most skilful of his political speeches. And so Pompey, thirty-seven years old and the Alexander the Great of his day, embarked on a campaign to conquer Rome's ancient and inveterate enemy, the King of Pontus. His adversary was King Mithridates, one of the most formidable intellects and most dramatic personalities of the ancient world. Mithridates had mastered twenty-two languages. He was an art collector, a magician, a giant of a man, as famous for his strength, courage and skill with weapons as for his prodigious capacity for food and drink.

The campaign began auspiciously. Pompey's military genius steadily eroded the armed strength of Mithridates until the following year, when three of his armies camped near Trebizond, at almost exactly the same place where Xenophon's exhausted soldiers had stopped to forage for provisions three hundred and thirty-five years earlier. The drama was repeated but with an ending far different, described by Strabo in his *Geography*. After eating the poisonous honey the disabled troops were massacred by the Pontic army and it was to take Pompey three years to defeat Rome's wily enemy.

Almost certainly Mithridates knew of the toxic honey produced from the golden flowered azaleas of the Armenian hills. By a coincidence still more curious, his personal physician was Krateuas, a Greek expert on plants and their medicinal uses, considered to be the first herbalist of record. His drawings are reproduced in the most famous of all manuscript herbals, the *Juliana Anicia Codex*. Perhaps Mithridates lured Pompey to the Armenian hills, knowing that the Roman soldiers would scour the countryside for food, and be certain to find the poisonous honey.

In any case, had Pompey conquered Mithridates quickly; had he not made the agreements with the Eastern monarchs, the Roman government would not have denied him the official recognition which he expected upon his return from the Middle East. Perhaps Pompey, without bitterness and resentment, would not then have formed the secret alliance with Caesar and Crassus which led to the fall of the Republic and the rule of the dictator-Emperors. But whatever the strategy of the Pontic King, however directly

R. neriiflorum

Pompey's tragic course was affected by his delayed campaign in the East, the stream of history was nonetheless changed by a rhododendron.

A hundred years later the renowned Roman naturalist, Pliny, was writing, "Another kind of honey there is in the same region of Pontus . . . which because it driveth folke into a rage and madnesse, they call in Greek *maenomenon*. Some attribute the occasion hereof to the flower of the rhododendron whereof the woods and forests there be full. The nation selleth no honey at all, because it is so venomous and deadly; notwithstanding, they do pay for tribute a huge masse of wax unto the Romans every year."

Dioscorides, a Greek physician in the service of Nero and the greatest pharmacologist of all antiquity, whose *De materia medica* was the dominant herbal used by physicians for more than 1,500 years, wrote a half century after the birth of Christ: "About Heraclea Pontica in certain seasons of the year, the honey makes those mad who eat of it; and this certainly proceeds from the quality of the flowers from which it is distill'd. They sweat abundantly, but they are eas'd by giving them

rue, salt-meats and metheglin, in proportion as they vomit. This honey is very acid and causes sneezing. It takes redness from the face if pounded with costus. Mixed with salt or aloes, it disperses the black spots that remain after bruises."

A millenium and a half passed. Through the hush of the dark ages and the brilliant clamour of the renaissance few real advances were made in pharmacology. Following the invention of the printing press, the most useful guide for doctors that could be produced was still Dioscorides' *De materia medica,* issued in two editions in 1478, about 1,500 years after it was first written.

The earliest renaissance reference to rhododendrons is in *Medendi Ratio* ("An Account of Healing"), by Paul Aeginetes, published in Latin in Basle in 1538. It is now in the library of the Palace of Rectors in Dubrovnik, Yugoslavia. "Concerning poisoned honey", he wrote, "which is produced in Heraclea, those who ate or drank the honey . . . suffered the same unpleasant after-effects as those who took aconite". He is proud to be able to offer an infallible antidote: "A very sound remedy exists in aqua mulsa, which they swallowed, an undiluted drink mixed with the leaves of rue". Elsewhere he warned, "The bark of the Rhododaphne tears asunder; this taken internally is fatal".

By 1581 the rhododendron itself was generally known to be dangerous, at least to herbalists. Maplet, in his *Diall of Destiny,* cautioned, 'Rhododaphne which being taken inwardly, poysoneth".

In 1700 Joseph Pitton de Tournefort, the most eminent botanist in Europe before Linnaeus established the classification of flora, still in use today, spent three years in Greece and Asia Minor collecting plants at the direction of Louis XIV. M. Tournefort was professor of botany in the royal garden, a member of the Academy of Science, and the possessor of one of the most fertile minds on the Continent. It was he who persuaded the scientists of the eighteenth century that stones had life because, he said, "corals and other stony plants were of the same construction tho found in different countries".

As further evidence, he reported having seen "in some seashells very hard chalk and in others flint-stones of much larger size than the hole of the shell could admit; he thence infer'd that those substances could not be receiv'd therein anyhow, but when they were liquid or only in their first speck of entity, and that afterwards they must have enlarg'd and harden'd in proportion as they came to maturity".

Having entered a cave on the island of Candia, M. Tournefort found further proof in the names of previous visitors carved upon the walls. The names had originally been cut with chisels but were, at the time of his visit, as if embossed

R. thomsonii

in low relief, protruding from the stone. He was sure, therefore, that the stone had callused "in the same manner as it happens to trees whereon any letters have been cut".

In presenting his case before the Academy of Sciences, M. Tournefort produced stones which "had been broken . . . at the time of the rising of their sap; and nature herself had pieced them together again by a solder, which was nothing but a callus form'd by the nutritious juice of those stones, which after having rejoin'd and glu'd the pieces, had cover'd 'em over again for about the thickness of half a line".

"If", he concluded triumphantly, "we have not been able to find the seeds of stones, minerals or metals; that is no reason for denying their existence, since it is certain we have not yet discover'd seeds of mushrooms, truffles or mosses".

Eighteen years after his journey to the Near East his *Relations d'un Voyage du Levant* was published, a vivid recital of his observations and a diary of suspense relating to the perils of his journey. In it he weighed the writings of the ancient Greeks and Romans on rhododendrons and added an anecdote of his own: "I thought it (the Pontic azalea) so very fine that I made up great nosegays of it to put in the Bassa's tent; but I was told by the first officer of the household that this flower caus'd vapours and dizziness. I thought he rally'd very pleasantly, for the Bassa complain'd of those distempers. The first officer gave me to understand that he was in earnest, and assur'd me he had lately been inform'd by the natives that this flower was prejudicial to the brain. Those good people, from a very ancient tradition, grounded perhaps upon several observations, maintain also that the honey which the bees make after sucking that flower stupifies those who eat of it and causes loathings".

More than two hundred years later the honey produced in the lands surrounding the Black Sea was still an annual scourge. Dr. G. Mosolevsky of Sukham in Transcaucasia, writing in 1929: "Cases of poisoning are very numerous, particularly among the villagers in the mountains. Three to four hours after consuming honey suddenly slight vertigo comes on and instantly dis-

R. fulvum

appears. It is the first warning of approaching danger. Experienced people usually at once . . . purify the stomach by causing vomiting. If this is not done, after about half an hour a fresh paroxysm of vertigo follows —a much more violent one this time. The succeeding intervals grow shorter and shorter, the paroxysms more and more violent, till you feel that you are deprived of the ability to stand and must hasten to lie down. At the same time one becomes almost blind; the whole field of sight fills with the most intense whirls of bright golden-yellow colour. Some individuals speak of dark whirls".

The utmost weakening or derangement of the sense or sight is the outstanding characteristic of this process. Considerable weakening of the heart's action can be observed. In the worst cases convulsions occur, sometimes very violent ones: and a long swoon, resulting—if not in death—in the utmost weakness for a long time. Fatal cases occur most frequently among children. As for medical assistance, it is—with our exceedingly impassable roads—merely a distant *pium desiderium*".

Twenty-three hundred years earlier Aristotle, with some justification, had imagined that honey made from the Pontic azalea "depriv'd those of their senses who eat of it, and were in health before; and that, on the contrary, it cured those who were already mad".

In 1768, in St. Petersburg of Imperial Russia, John George Gmelin, a German professor of chemistry and natural sciences, who explored Siberia with Vitus Bering for ten years, published in Latin *Flora Sibirica,* which was to bring down upon the Europeans a curse lasting more than a century. He reported that a tea made from the leaves of the Siberian snow rose was used successfully by foresters in the East to alleviate rheumatic knee pains, and as a restorative after labouring at high altitudes. He was referring to *Rhododendron chrysanthum,* a dwarf species with white or yellow flowers which grows in the eastern reaches of Asiatic Russia. J. G. Gmelin's book was published posthumously but his notebooks had been inherited by his nephew, Samuel Gottlieb Gmelin, also a professor and botanist at St. Petersburg, who explored southeastern Russia with another famous botanist-author, Peter Simon Pallas, from 1768 to 1773. The nephew passed on to the chief health officer of Stettin in Germany, Dr. Alexander Bernard Koelpin, the information of medical interest which he had found in his uncle's papers.

On October 10th, 1776, Dr. Koelpin began treating fifteen of his arthritic patients with tea prepared from dried rhododendron leaves which he had received through Professor Pallas from Siberia. With German thoroughness, he kept a daily diary. His first patient drank two ounces each morning for the first twelve days with no effect. On the thirteenth day he was given four ounces without result. On the fourteenth day the amount was increased to eight ounces. Within two hours the sixty-eight-year-old patient was violently ill and in a short time he lost consciousness. His pulse was weak and slow; his heart skipped every fourth or fifth beat. Dr. Koelpin carefully noted that the body felt cold and clammy even though the room was overheated. He left instructions that he was to be notified of any change and then returned in late afternoon when no word was received. By that time the patient was normal except for a feeling of constriction in his chest.

The treatment was continued. On the fifteenth day the patient continued to complain of tightness in his chest and the following day he had severe diarrhoea. By the seventeenth day the chest pain was so severe that the wretched patient described it in terms of a wood-chopper flailing rhythmically with an axe beneath his breastbone. Koelpin noted that the pulse was weak and decided to

R. barbatum

reduce the daily morning tea to two ounces. Even so, the chest pain persisted.

For the next several days vomiting was so violent that Dr. Koelpin discontinued the medication, whether by necessity or out of consideration his diary does not note. After two days the patient was told to resume the morning tea at eight o'clock. By ten he was nauseated, the tightness in his chest was severe, breathing was painful and he went into convulsions as he was telling Dr. Koelpin of the pain in his arms and legs. A short time later he lost consciousness. The pulse was feeble. When he revived late in the afternoon the base of his palm was numb and remained so until the following day.

On October 27th, seventeen days after the treatment was started, the patient reported that his arthritic pain had disappeared and that he was comfortable except for the tight-

ness in his chest. The morning tea was continued, but a few days later his pulse slowed alarmingly. He felt intoxicated, and by the end of November he was near unconsciousness again, with a halting, irregular pulse and excruciating pain beneath his breastbone. During December the patient's breathing became so slow that he was near suffocation, and Dr. Koelpin prudently decided in early January, three months after it was begun, to stop the medication. The patient lived for nine months afterwards, his arthritis somewhat improved.

Fourteen other suffering rheumatics were given the rhododendron infusion with much the same hideous result, described in lurid, conscientious detail by the German doctor. Two of them died, but the physician thought that the tea was not responsible. Dr. Koelpin felt that the treatment in his eleventh case was particularly successful in relieving the pain of arthritis and so he published, in 1779, his treatise for the guidance of the medical profession, *Praktische Bemerkungen über den Gebrauch der Sibirischen Schneerose* ("The Use of the Siberian Snow Rose in Arthritis"). In it he recorded his observations and reassured other doctors that, rumours to the contrary, they need not fear that their patients' mental condition would be affected by the snow rose (Rhododendron) tea. He also warned them against impatience with weak, old or long confined patients who took much longer to respond favourably, and he commented that sometimes temperamental persons were not improved at all.

In the long and venomous history of the pretty but pernicious rhododendron its narcotic properties provided one note of comic relief. In 1768, Catherine the Great, a devoted student of human anatomy, employed a German botanist, Peter Simon Pallas, as a naturalist on a six-year expedition to explore the empire to the frontiers of China, and she subsequently underwrote the cost of publishing his book, *Flora Rossica,* in 1784. It was extraordinarily handsome for its time, bound in royal red morocco leather with Catherine's coat of arms, the imperial double eagle, emblazoned in gold on the cover. Graceful, sophisticated coloured drawings illustrated many of the plants described in Latin by Pallas, with Russian sub-titles.

G. W. Steller, yet another botanist and explorer in the German colony which formed the scientific community in Russia in the eighteenth century, had edited the later volumes of J. G. Gmelin's *Flora Sibirica* after his death. Pallas described, in *Flora Rossica,* Steller's experience with a pet deer which ate about ten leaves of *Rhododendron chrysanthum*. "After a few minutes the animal began to beat the ground, to dash its head and to stagger. In a short time it fell on its knees, trying in vain to rise again, nor was it revived with milk but, overcome by a deep drunken sleep remained on the ground for several hours . . . and trembling from time to time in its sleep. However, after it awakened, it was as before—cheerful, nor did the rhododendron ever affect it again."

But Steller's servants on the expedition had seen the cheerful deer, too, and thereafter he had an exasperating time keeping them sober. They were "intoxicated very often because of the pleasure of the boiled down drink of leaves". Steller probably did not know that the Armenians had, for centuries, added small quantities of honey made from the Pontic azalea to alcoholic drinks to intensify their effect.

Dr. Steller later described, in his *Beschreibung von dem Lande Kamtschatka* ("A Description of Kamtschatka", 1774) how the local wild deer on the Siberian peninsula after eating rhododendron leaves "became intoxicated, fell down and went to sleep. When the native people find an animal so affected they tie its legs together until the effect is over and then kill and eat it. But if they kill it while the animal is sleeping or mad, anyone who eats the meat will have

Photo by author

Rhododendron chrysanthum

the symptoms of madness."

The 1779 book by the German Dr. Alexander Koelpin recommending a tea made from the leaves of the poisonous Siberian snow rose (*Rhododendron chrysanthum*) for the treatment of arthritis had an almost hypnotic effect upon the doctors of Europe, eager as they were for any remedy that might aid their afflicted patients. Eerily, it somehow persuaded them to ignore the grisly side effects which were dutifully documented and diverted their attention instead to the reported cure however tenuous the evidence of it.

The medical profession at the time had not too long before struggled free from an arcane morass originating in sorcery and superstition. Within the century witches had been as knowledgeable as doctors in plant therapy. All medicine was derived from vegetable sources. The properties of plants had been described in books by the herbalist-physicians as "medicinal and occult." The science was yet to come. The well intentioned Dr. Koelpin doubtless had a vision of epiphany: opening the gates to heaven for the suffering. But he opened the gates to hell instead.

No one knows how many thousands, or tens of thousands, of tormented arthritics were subjected to the appalling rhododendron tea treatment as a result of the distribution of Dr. Koelpin's book to physicians throughout the continent. Rhododendron leaves were shortly included in the Pharmacopeia at Edinburgh. By 1793 Woodville remarked in his *Medical Botany* that they were "very generally employed in chronic rheumatism in various parts of Europe."

R. campanulatum

Certainly the prostrating therapy travelled quickly across the Atlantic, because Professor B. S. Barton in his *Collections,* a compendium of information on medically useful plants published in 1794, mentions " ... the *Rhododendron chrysanthum,* which has lately acquired much reputation in the cure of chronic rheumatism." Jacob Bigelow, professor of Materia Medica at Harvard, published his *American Medical Botany* a few years later in which he refers to the familiar rosebay rhododendron of the North-east, *R. maximum,* as possessing astringent properties, and to prove his belief that it was not poisonous described how he "swallowed a green leaf of the middle size, so large that it required some resolution to masticate so unpalatable a morsel, but have found no ill-effect whatever to result from it."

The account of the determined, black garbed New England professor browsing soberly at his desk on a rhododendron leaf evokes an entertaining mental image. But the brave Dr. Bigelow was wrong. A single leaf of the American rosebay would have produced no illness. As late as 1905 a British author, William Watson, was writing: "A decoction of *Rhododendron chrysanthum* ... is now used in some European countries ... in the treatment of rheumatism and other affections of the joints and muscles ... and in the United States a decoction of the leaves of *R. maximum* is occasionally used for the same purpose." Dr. Koelpin's chamber of horrors had expanded into a corridor of suffering which extended for a hundred and fifteen years.

Professor Pallas, unhappily, furthered the legend of relief from arthritis by the drinking of rhododendron tea. In his beautiful book he wrote: "... the medicinal value of this rhododendron has become especially famous. I have concluded that its use is harmless, because the inhabitants of the woods of Tatarus, near the ridge of Sajanense, are accustomed to use the ripened leaves continually after the manner of tea and praise them for assisting in health. I have observed that a great many inhabitants of Siberia, having been cured from very serious gouty ailments—rheumatism, nay, even venereal diseases, by a boiled-down drink of the leaves—have readily returned to this excellent domestic remedy."

"I ... when the opportunity was given, not only have proved its great usefulness, but also when an abundance of the *Rhododendron chrysanthum* leaves had been brought from eastern Siberia, gave the opportunity to my old friend Dr. Koelpin of confirming the values of this shrub by repeated experiments, nor did I stop until it might always be on hand in the future for the relief of sick people. It is now sold by public pharmacists everywhere for the price of a ruble a pound."

"Dr. Koelpin has explained the use and effects of rhododendron in his own work. It confirmed to a very great extent what I previously reported; he explained that it is very beneficial for rheumatism and especially for chronic arthritis; that it also helps the pain of gout, even of the plague itself." Pallas overlooked Dr. Koelpin's report that the tea, held in the mouth, relieved toothache as well.

On August 15th, 1796, Athony Hove, a Polish born gardener en route to Bombay to obtain seeds of cotton for the West Indian colonies, at the direction of the Royal Botanic Gardens at Kew, wrote from Odessa a letter which is still in the Banks

R. arboreum

Correspondence at the famous botanic garden near London. In it he described the Pontic azalea, *R. luteum,* notorious in antiquity, and continued, "The inhabitants use the leafs and buds as tea, especially after being fatigued with labour, they refresh themself with great and speedy surprise, it stupifyes them for an hour or so, and throws them in to a sleep, on awakening they resume their work without the least appearance of bad effects.

"In Chronik Rheumatik disorders they use it with greater success of which I was not only an eye witness but have been self cured of a violent Rheumatik pain in arms and thighs which I had some time contracted by sleeping on the swampy grounds, and could not get rid of it until I dranck of this decoction."

"On drinking of it an English pint, I found myself quite restored in less than twenty-four hours, during the process I found myself in a kind of anxiety and great uneasiness, which lasted above an hour, and then it abated gradually, afterwards I fell asleep for two hours, on awacking I found myself in an abundant perspiration and quite recovered of the pain, much strengthened without the least symptom of headack."

"They likewise, use it in Syphylitic cases, with what success I had not so much opportunity as yet to determine, but as the disease is not very common amongst them, although they are frequently visited by the Russian Armys, I am led to credit their relation."

Two years later Hove sent a plant to Watson's Nursery in Islington which shortly flowered in a greenhouse, and so, at last, the dangerous *R. luteum* was seen in bloom in the western world.

The use of the Pontic azalea in the Ukraine and of the evergreen *R. chrysanthum* in eastern Siberia, 4,000 miles distant, to ease rheumatic pain seems an unlikely coincidence. But the buds and leaves of the alpine rose, *R. ferrugineum,* were gathered in the Alps and used in Italy for the same purpose. In Japan the older generation, even today, make a tea from *Rhododendron degronianum* which grows there, and dried leaves of *R. brachycarpum* have been commonly sold for centuries in Chinese drug shops for the treatment of circulatory disorders, a remarkable prescience in view of later developments. The rolled-up leaves of *R. brachycarpum* are also smoked for the relief of asthma. In China rhododendron leaves are used to adulterate conventional tea. Southward, snuff is made in India from the powdered leaves of *Rhododendron campanulatum,* which is common on the lower slopes of the Himalaya. Two other sorts are used as stimulants.

The world-wide use of rhododendrons for medicinal purposes and as an intoxicant goes back many thousands of years, but it was not fully explained until Dr. S. W. Hardikar of the Pharmacological Laboratory at the University of Edinburgh published, in 1921, an exhaustive study of rhododendron poisoning. He reported that the active agent causes "a narcotic action upon the higher centres of the brain." Whether intoxicant, pain killer or deadly poison depends upon the size of the dose.

R. ferrugineum

Dr. Hardikar began his massive study because, he said, "Some time ago some sheep in the neighbourhood were reported to have shown symptoms of poisoning from eating rhododendron . . ." In his published paper is a terse summary of the effect of injecting .28 milligrams of the rhododendron extract into a female rabbit in his laboratory. In twelve minutes respiration declined from thirty to six per minute. Twelve minutes later the animal was paralyzed. Convulsions occurred an hour and a half from the time of injection and the rabbit became comatose. It was found dead in the laboratory the following morning.

Domesticated animals have been scourged by rhododendrons from pre-historic times. Those who wrote of their direct effect upon man also reported on the indirect effect through the loss of livestock by poisoning.

An issue of *The Botanical Magazine* in 1799 quotes the same Professor Pallas who extolled a tea made from the Siberian rhododendron as a cure for arthritis: ". . . goats, kine and sheep on eating its leaves have been poisoned thereby." In his description of the Pontic azałea (*R. luteum*) Pallas had written: "The leaves, which smell pleasant and are bitter at first, when the pastures are not yet green, are often eaten by goats with an intoxicating effect: even the intoxicated cattle and sheep die thereupon." His contemporary colleague, G. S. Steller, across the continent at the Pacific limit of Asia, saw "a goat, which, by eating the plant, was seized in a few minutes with tremblings, sopor, etc." related Woodville in his *Medical Botany* of 1792.

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Forty-six years later John Lindley published in London his *Flora Medica* and included in the directions for medicinal use of the Siberian rhododendron a comment on the Pontic azalea that "goats which browse on the leaves . . . suffer in consequence, and that . . . cattle and sheep perish."

In mid-century Sir Joseph Hooker led a plant hunting expedition to Sikkim which resulted in the publication in 1849 of *Rhododendrons of the Sikkim Himalaya*. He described one of his discoveries, the beautiful bell-flowered cinnabar rhododendron (*R. cinnabarinum*) as being "universally considered poisonous to cattle and goats." J. G. Millais produced a notable volume on rhododendrons in 1917 in which he commented ". . . the leaves of many species are poisonous to animals. *R. ferrugineum* causes losses in the Alps; sheep, goats and cattle are poisoned and sometimes killed by *R. ponticum*." He describes the near-fatal effect on a baker's horse which had nibbled two shoots of *R. ciliatum* "in a gentleman's drive." "In England", wrote Watson in 1905, 'rhododendrons are not usually eaten by animals, not even by rabbits and hares, but when they have been eaten by accident their effect has been noxious."

Half a world away the sole species which is found in Afghanistan, *R. afghanicum,* is notoriously virulent. It has been a curse of shepherds for centuries. In 1965 an explorer in New Guinea, Michael Black, wrote of an orange flowered rhododendron common in the Central Highlands: "It has a reputation throughout the country of being exceedingly poisonous to livestock, and I was told of three mules which had recently expired after eating small quantities of the foliage."

In the United States, Chesnut's *Preliminary Catalogue of Plants Poisonous to Stock* lists the common West Coast rhododendron, *R. macrophyllum,* as being injurious to sheep in Oregon, and the only western native azalea, *R. occidentale,* is indicted by Professor Pommel of Iowa State College as being toxic to livestock in California. In the East, the famous Catawba rhododendron, *R. catawbiense,* of the North Carolina mountains, is equally guilty. So the toll of domestic animals by the deceptively beautiful rhododendron has been world-wide and all but unknown to millions of home owners who treasure them in their gardens.

But perhaps the strangest application of the rhododendron to animals was proposed by a Japanese nurseryman in the Royal Horticultural Society's *Lily Year-book for* 1964. He suggested that lilies would not be devoured if they were planted among rhododendrons, thus turning to advantage the usual aversion of animals to the shrub.

The discovery of the effect of digitalis upon the heart stimulated a great wave of scientific investigations into medicinal plants in the latter half of the nineteenth century. In 1882 Dr. von Eykman isolated the active principle in rhododendrons from a related Japanese plant and named it asebotoxin. Five years later Plugge found it in rhododendrons and gave it the name andromedotoxin. Finally, in 1899, Dr. Konstantin Archangelsky at the Laboratory for Experimental Pharmacology in Strassburg isolated andromedotoxin, along with rhododendrin and rhododendrol from the leaves of *R. chrysanthum,* the infamous snow rose of Dr. Koelpin's book. It was a classic investigation. Methods for the segregation of the compounds were given, their physical and chemical properties defined. Andromedotoxin was shown to produce in dogs paralysis, vomiting, dyspnoea, convulsions and, finally, death from respiratory failure. But most important of all, he observed the profound depression of blood pressure in a dog after being given small doses of andromedotoxin.

R. cinnabarinum

In a high voltage industrial society where hypertension has been a major medical problem, Dr. Archangelsky's challenging observations were inexplicably ignored. For nearly a quarter of a century no further investigations were carried out, and then a study was made by Dr. S. W. Hardikar at the Pharmacological Laboratory of the University of Edinburgh only to determine the action of the toxin which had poisoned livestock in Scotland. Dr. Hardikar was the first to isolate pure crystalline andromedotoxin. He described in detail how it depressed respiration, slowed the heart with an accompanying toxic action on it, paralyzed the skeletal muscles and caused vomiting. Again, the provocative reduction in blood pressure was noted in his published report.

In 1953 a group of investigators at Emory University School of Medicine, in co-operation with the National Heart Institute, repeated the Hardikar experiments, this time largely on dogs. The results were much the same but the techniques used were more sophisticated and they were able to show that some of the effects were not caused in the manner suggested by Hardikar. The depression of blood pressure was studied intensively and the discovery was made that the fall in pressure was by no means due entirely to the slowing of the heart action. Thus, after a strange hiatus of sixty years, Dr. Archangelsky's ob-

R. ciliatum

servations of 1899 were at last on the threshold of contributing to mankind's welfare.

The door was now open and a brilliant group of researchers at the National Institutes of Health in Maryland entered it eagerly. Their first publication, *Andromedotoxin: A Potent Hypotensive Agent from Rhododendron Maximum,* described how a dose as small as one part in ten millon of andromedotoxin lowered the blood pressure of dogs by as much as forty per cent. The next paper showed exactly the site of effect in the circulatory system and proved that the action was entirely reflex in nature. At the same time, the structure of the andromedotoxin molecule was partially determined.

Two groups of researchers at Nagoya University and Okayama University in Japan made a critical contribution when they provided, in 1961, a structural formula for acetylandromedol, as it is now called. And finally, in 1962, an American investigator completed the long search when he determined in detail the stereochemical structure of the acetylandromedol molecule.

So a final, paradoxical chapter is about to be added to conclude one of the strangest stories in the annals of medicine. At last, after twenty-four centuries of vicious affliction, the beautiful but baleful rhododendron can be converted from a bane to a blessing for mankind. With a model from nature of the acetylandromedol molecule, research chemists can now modify it for the relief of one of the world's most pernicious illnesses, high blood pressure.

But there is yet a footnote to this curious history. In 1949 a Turkish investigator discovered a method of detecting acetylandromedol in honey made from rhododendron nectar. Extracts of suspect honey are injected into mice and guinea pigs. Their response to the poison confirms, in modern terms, the observations of Pliny, the great naturalist of the Roman Empire. The research was done in Northern Turkey, near the shores of the Black Sea, at almost exactly the same place where the armies of Xenophon and Pompey had come to grief two thousand years and more ago.

Addendum

Not all rhododendrons contain acetylandromedol, at least in their nectar, and, as a practical matter, the hazard to humans from any source but honey is infinitesimal. There are some authentic reports of bees being poisoned by rhododendrons, which I find puzzling, and I believe that toxic honey must be extremely rare in western Pennsylvania because I seldom see honey bees "working" the flowers of the evergreen species and hybrids despite the presence of an apiary nearby. Bumble bees visit the rhododendrons in such large numbers that the flowers are bruised by them, but the honey bees largely confine their attentions to fragrant deciduous azaleas in my plantings. Almost no scented evergreen rhododendrons can be grown in the cold climate at Brookville. However, honey bees will consume the nectar of evergreen rhododendrons in a laboratory as they evidently do in nature in other climates. Some strains of honey bees are presumably immune to the toxic nectar, whereas others are not.

It is obviously prudent for growers of rhododendrons, and especially for those with sizeable plantings of *R. luteum* or other fragrant deciduous azaleas to be wary of honey produced in nearby hives. In a report published in the *Journal of Pharmacy* and *Pharmacology* in 1959, researchers at the University of Glasgow and the West of Scotland College of Agriculture found that *R. thomsonii* and its hybrids secrete nectar which is especially and virulently poisonous. Their findings can be summarized as follows:

Highly Toxic

R. thomsonii
R. arboreum
R. niveum
R. prattii
'Red Admiral'
'Fiery Cross'
'Barclayi'
'Red Star'
'J G. Millais'
'Ascot Brilliant'

Intermediate

R. barbatum
R. sinogrande
R. fulvum
R. macabeanum
'Abbott'

Non-Toxic

R. fictolacteum
R. sperabile
R. neriiflorum
R. sperabiloides
R. scyphocalyx
R. haematodes
'Dicharb'
'Redwing'
'May Day'

The parentage does not necessarily indicate whether a hybrid will be toxic. 'Redwing', for example, derived from three poisonous species out of the four in its ancestry, is innocuous.

In western Pennsylvania animals generally avoid browsing on rhododendrons if there are alternate plant food sources available, but the literature cites many cases of poisoning of ruminants, and there can be little doubt that rhododendrons are a hazard to livestock.

PLANTS AND LIFE STYLES

*Frances Jones Poetker**

**Miss Frances Jones Poetker, a Cincinnati, Ohio, florist, presented an unusual and thought provoking program at the Twenty-fifth Horticultural Congress in Miami, Florida. Miss Poetker not only designs table arrangements along conventional lines, but she also uses foliage and flowering plants, grouped or arranged, to create living designs in the home.*

I have been asked to do something which no reputable florist should be asked to do. To tell you how not to arrange flowers. It will probably be a most unpopular presentation for those of you who are hardcore flower arrangers. But for those of you who have always said, "I can't do a thing with them,", I hope it will be most interesting.

In flower design it is the hand which needs knowledge and experience in doing. Our minds can conceive, our eyes can criticize, but our hands must know what to do. You may read and appreciate a musical score, but until the digital dexterity is equal to the power of the eye and the mind, you haven't really come to creative fulfillment. Very often the tools, the raw materials, are all around us. But they do need an educated eye, and then hands to bring them all together.

"Plants and Life Styles" is my theme to be related to ecology, and to a consideration of plants as a background for art, and plants as related to a study of light, color and texture, horticulture, and new varieties.

Let me give my own reactions to plants. First, plants are alive with color. However, I shall write mainly about foliage and very few blooming plants as a developing and continuing life style for all of us; I thought that this restriction would be quite a limiting factor, but it is not, because so many foliage plants have such delightful unrecognized color.

Photos by Joe Migon

Arranged plants.

Arranged Plants

I will start with plants of some of the most colorful crotons. These are small crotons which are well within the pocketbook range of most people. I have these arranged in a foil-lined wooden bowl. The technique of assembling lovely plants in a bowl is a very simple one. Select a bowl of the correct dimensions, and place a combination of small plants inside the container. Roehrs' dieffenbachia is included for an area of greater clarity of leaf surface contrasting to the crotons. The bowl is a large one. I have often used a handsome, old, Hawaiian storage bowl, and assembled great masses of small potted plants in that to convey the mood of a particular season. Do not hesitate to use a combination of all green plants and blooming plants with colorful foliage plants.

In this second case, I wanted to convey a mood of excitement. The exotic quality, which really is Florida, is emphasized by adding to the plant group a specimen of *Oncidium papilio*, the butterfly orchid. Here is one reason for the use of common names. Occasionally they are so accurate and they are expressive to people for whom scientific terminology would not be as vivid. This

Single plant with accessories.

Orchid plants, grouped.

sort of plant grouping is the easiest kind of arrangement that you can make as a life style. It is easily done by the new collector, because one can go into almost any flower shop and find materials as colorful and as handsome as these, and then when the occasion is over, dismantle the arrangement.

Single Plant With Accessories

Another possibility is using one handsome plant, such as the *Cissus incisa,* grape-ivy. All four species of *Cissus* lend themselves to the use of amplifying materials. I have placed one plant on a woven tray. Never hesitate to use these simple materials which are at hand and which you like because they are part of your environment, part of your natural setting, and because you like their textures. It is a simple tray, and on it next to the grape-ivy, are some of the osage-oranges which tumble down our Ohio hills. This green fruit is delightful and visually effective. I find that when I am filling these big bowls and trays with plants and flowers I never have quite enough material so I supplement with fruits, cones and pods. Choose these to give highlights because you will find that there is not enough contrast in the plant materials and you must arrange them as though you were painting with flowers. You must arrange darks and lights, create highlights, bring your own sunlight in. Always try for an interesting highlight so that you have a touch of light in the arrangement. In this case the light is reflected onto the leaves of the grape-ivy. So that the marvelous bronzy look on the tips of the leaves is seen, I have included a few brown pine cones, a few seed pods, a few brown-topped dried mushrooms. The whole thing is an assemblage, a combination of textures, simple objects, color, light and shadow and it involves the eye and the attention in a very interesting way.

Orchid Plants, Grouped

I have combined beautiful miniature bronze and reddish orchids on the end table. They show that it is possible to assemble a group of small orchid plants to make one total picture. I think that you will also enjoy seeing the orchids used in conjunction with a small Japanese desk screen. We all have prized mementos of travel experiences, but we often feel that they cannot be displayed without seeming to be ostentatious. Using them in conjunction with flowers is one of the happiest ways to show them. It gives you an opportunity to recall the beauty and excitement you have known in your travel experiences. It also brings color, interest and design to the materials. *Asparagus myriocladus* has a Oriental quality. It's tactile value is

The Proteas, fresh and dried.

The large arrangement.

exceptional. It is so soft and so feathery that it makes you wish to touch it. One of the reasons we use beautiful plants is this impelling desire to feel; to have the sensation of touch, place them close at hand on an end table, on an incidental table, or in an adjacent wall area. I like to use hanging arrangements more than almost any kind, because they bring the foliage and flowers to eye level, or just above eye level, in an area of the room which may be dull and needs enlivening. It is possible to use sections of bamboo or sections of logs as containers for hanging arrangements. This sort of thing, filled with a small orchid, such as the one *Ionopsis* that we have here, could be absolutely spectacular.

The Proteas, Fresh And Dried

I would like to show examples and arrangements of relatively new varieties of interesting materials, not necessarily growing green plants, but also flowering ones. Let me introduce you to the proteas. They are grown in limited quantities in Southern California and shipped from Santa Barbara. Some actually are imported from Africa and some from Australia, but these in my photos are California ones. I combined a lichened log from Kentucky with the proteas because the rhythmic growth patterns are so similar and so beautiful. Somehow with the excitement of the petaled overlay of the proteas with their marvelous misty pink beauty, I always think of Aurora, the "rosy-fingered messenger of the dawn". Perhaps I am being unnecessarily poetic about all this, but I think if you enjoy and find verbal pleasure in the things which give you pleasure of the eye, then the whole experience is twice as worthwhile. Here is a dried protea arrangement. The protea is the national flower of South Africa. A light colored background enables one to see the absolute geometric perfection of the flower and leaf pattern. I used some dry Cecropia leaves (*Cecropia peltata*) at the base of the arrangement because that fingered look seemed to go very well with the overlapped petal pattern of the proteas. Extending from the base of this arrangement I placed a net-like basket, because I liked the texture and the flowing line it has with the protea and a lettuce coral which gave me a reflection spot.

The Large Arrangement

In this large basket arrangement are very subtle variations of color in what is a fairly limited palette. It is not exactly a monochromatic arrangement but it is limited in color. There may be people who have not seen that marvelous African

Banksia is a member of the Protea family.

The Bromeliads.

tree, the leucadendron, (*Leucadendron argenteum*), which forms the bulk of the design. As you can tell from the foliage, this is the silver tree, and it grows under xerophytic conditions. The leaves cling together, the white hairs reflect the light. We see it does have an almost silvery luster justifying the name; again the common name is justified. The pale color reflects the light instead of absorbing it. This foliage is extremely durable. It turns gradually into a more beigy, silvery gray as it dries. This branch is new and fresh and lovely. It is from California, but most of the leucadendron stock is imported from Africa, and recently some from Hawaii. The individual leaves are useful in small arrangements.

Banksia

Banksia is a member of the protea family. The complicated flower, quite beautiful and subtle in it's greyish-green coloring, is very effective in a contemporary home. It's so strong in itself that the less intricate the arrangement the better. This arrangement is made of just a single stem. The fact is that it serves much as a piece of sculpture would, as any great art work would do. I am not saying that any handsome flower arrangement doesn't do this, but banksia has a special, dynamic quality about it. It literally seems to move and breathe, and there is in it a feeling of enormous excitement. This is part of the joy of using new and spectacular varieties. Do you get something of that sensation from it? Do you feel as though you've encountered an exotic, new area? This is what live plants and interesting new materials can do for you. They are part of our life style of today thereby giving us enormous variation.

The Bromeliads

As a background for these bromeliads I made a combination of pillows, silks, geodes, and textured accessories, including even an Italian jointed armature that an artist can use for a model in sketching. All of these things made a group which is attractive. You may have just one isolated plant but augmented this way you make a still-life. It sounds awfully labored but it is relatively simple. Yet it really is a still life, composed of lovely things. Any bromeliad may be used as a natural vase for cut flowers, especially anthurium and spray orchids.

All plants are so exciting—even their names are exciting. It's an armchair adventure and it certainly will be an arranging adventure if you take advantage of all the textures, all of the colors, and all of the novelty to make your own more beautiful life style. ◈

'Angel Unawares'

'Sterling Silver'

'Angel Unawares' is genetically a "blue" iris but an inhibitor gene blocks the development of delphinidin. Blue and violet colors of other irises pictured here are due to the presence of this one anthocyanin pigment, delphinidin, in varying concentrations and modified by the presence of other pigments as flavones, carotenes and xanthophylls.

Photos by author

'Galilee'

'Babbling Brook'

'Polka Time'

'Dark Fury'

BEARDED IRIS FLOWER COLORS

A Study of Pigmentation in the Flowers of the Tall-bearded Iris

*Norlan C. Henderson**

Flower colors are produced by pigments which are specific chemical substances occurring in various parts of the cells and under genetic control. Color patterns also are genetically controlled, limiting the distribution of pigments to particular cells. Although hundreds of articles have been published on plant pigments (I have a bibliography of forty-seven pages on the carotenoids alone), very little has been done on iris pigments.

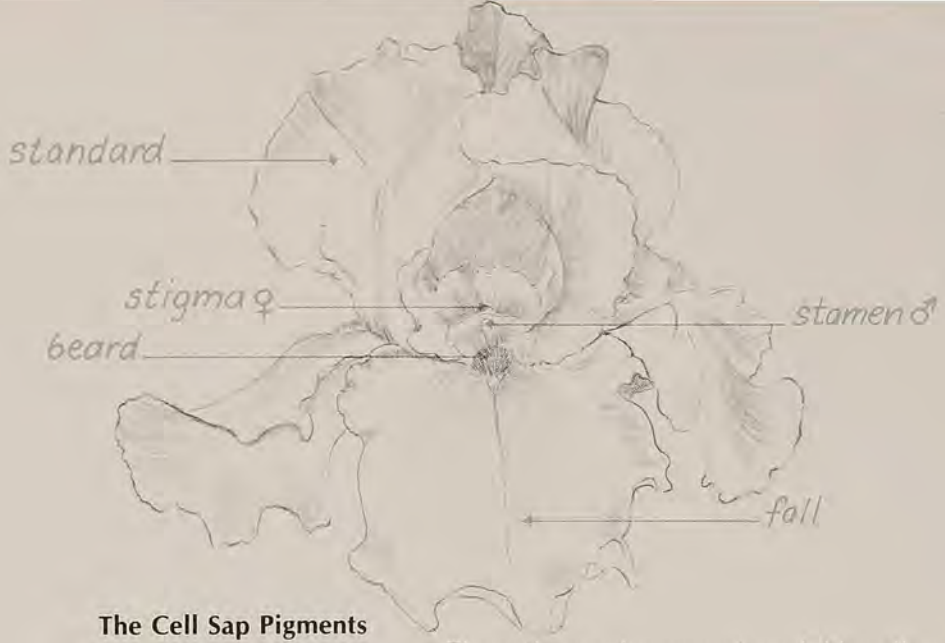
When we began this study on color and color-pattern inheritance nearly twenty years ago, we thought we had two pigments, a yellow and a blue-violet and that all of the various colors were produced by these either singly or in combination. Since the modern tall-bearded irises are tetraploid, this gave us a number of possible combinations based upon dosage-effect. As colors were improved and clarified and new "breaks" were discovered, the concept that a much more complex system was involved became increasingly persistent.

Structurally plant pigments fall into three groups: chlorophylls, flavonoids, and carotenoids. Their locations in the cells of the higher plants place them in two groups: the cell sap pigments, flavonoids, dissolved in the vacuolar sap only; and the plastid pigments, chlorophylls and carotenoids, that occur in small formed bodies (plastids) in the cytoplasm.

Chlorophyll-a and chlorophyll-b were noted in every iris flower tested, but were limited, visually, to the bases of the standards and falls and along the larger veins. Since these do not play a major role in flower pigmentation in iris and because of their universality we have planned no study of them. (If a true green flower is ever developed the chlorophylls will undoubtedly be the pigments responsible.)

Our study, therefore, involves the other two groups, each of which is divided into two subgroups which we have treated separately. The flavonoids are divided into the flavones and the anthocyanins; the carotenoids into the carotenes and xanthophylls.

*Dr. Henderson is Professor of Botany, University of Missouri-Kansas City. He maintains a symposium collection garden of tall-bearded irises that includes all of the Dykes Medal winning cultivars. He carries on an extensive breeding program for pigment and genetic research, as well as to create outstanding new garden irises.



The Cell Sap Pigments

The anthocyanins are water soluble cell sap pigments responsible for the scarlet, crimson, mauve, violet and blue colors of flowers and other organs of the higher plants. There are six principal anthocyanins each with several color variations produced by the addition of various sugars attached to the molecule at three different substitution points. Because of the instability of these molecules the sugars were removed by hydrolysis and the aglycones or anthocyanidins were studied. Delphinidin is blue to deep blue-violet; cyanidin and malvidin are purple to red-violet; petunidin and paeonidin are crimson, and pelargonidin is scarlet.

The flavones are water soluble cell sap pigments occurring in all parts of the higher plants. They range from colorless to pale yellow and are especially abundant in white, ivory or cream colored flowers. In the more intensely colored flowers the flavones may occur as co-pigments. For example, as a co-pigment with delphinidin a blueing effect is evident. About seventy different flavones have been identified. All fluoresce under ultraviolet light.

The carotenes and xanthophylls are fat soluble plastid pigments which range from yellow to red or brownish in color. The carotenes have the formula $C_{40}H_{56}$ With a slightly different arrangement of the atoms in the molecules of the several forms. The xanthophylls differ in the presence of two or more atoms of oxygen in each molecule. By 1950 approximately eighty different carotenoids had been identified.

How many of these various pigments occur in the tall-bearded iris? How do they behave genetically? How do the various pattern or distribution genes affect them individually? What is the visible expression of them in various combinations?

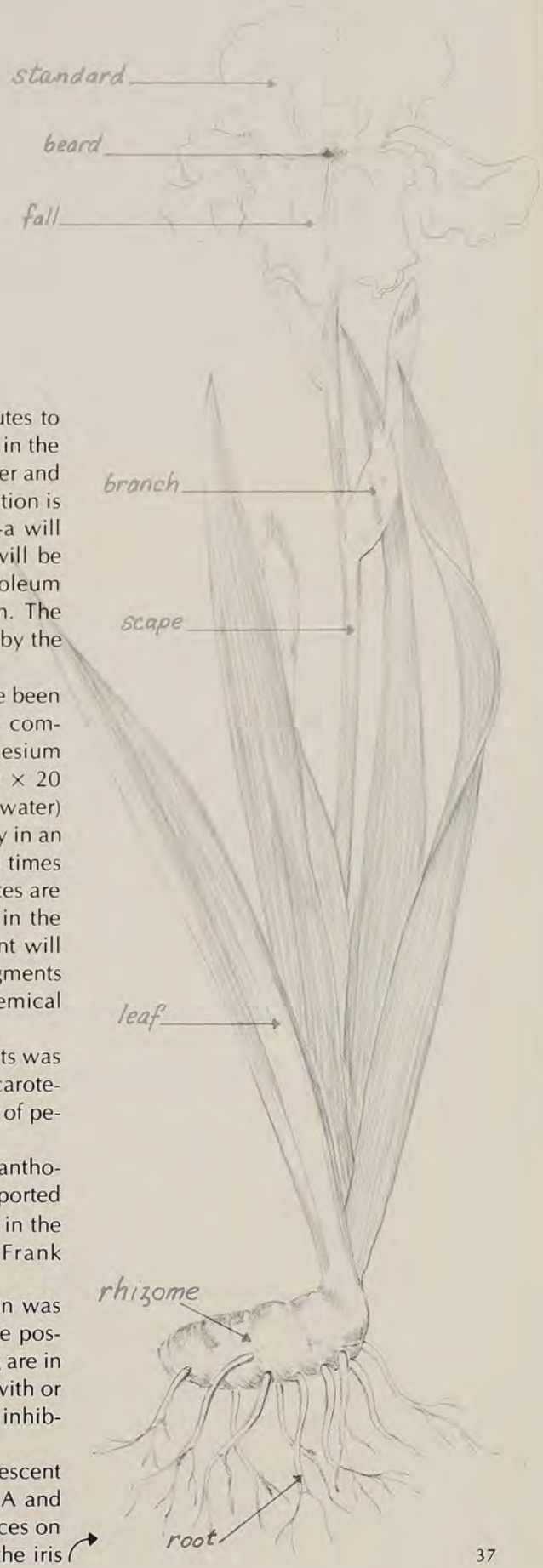
Obviously our first question has to be answered before the others can be attacked.

Isolating the Pigments

Thin-layer chromatography was selected as the quickest and most economical method of separating and identifying the pigments and has proven to be quite satisfactory. Several different methods of extraction were attempted, different substances were used as layers on the plates, and different solvents were tried for separation of the pigments on the plates in an effort to establish the most efficient technique for our needs. Unfortunately no one method will suffice for all groups of pigments.

If one flower is to be used for the study of all pigments, extraction with 85% acetone can be used. If the flavonoids alone are to be considered, the process is much shorter and quicker if extraction is made with methanol.

The standards and falls (or separately if of different colors) of the iris flower are pulverized in an 85% solution of acetone, then filtered in a Buchner funnel to remove the plant residues. The extract is added to petroleum ether in a separatory



funnel, rotated to mix the two solutions and then let stand for a few minutes to permit the solutions to separate. The chlorophylls and carotenoids are held in the petroleum ether and the flavonoids are left in the acetone layer which is lower and can be drawn off to be used in the flavonoid analysis. A 92% methanol solution is added to the petroleum ether and mixed. The carotenes and chlorophyll-a will remain in the petroleum ether, and the xanthophylls and chlorophyll-b will be picked up by the methanol. Chlorophyll-a can be removed from the petroleum ether by the addition of a methyl alcoholic potassium hydroxide solution. The xanthophylls can be "purified" by being dissolved in ethyl ether and then by the addition of methyl alcoholic potassium hydroxide to remove chlorophyll-b.

Although a cellulose layer was used in the flavonoid studies, it has since been shown that a silica gel plate will suffice. The silica gel plate seems to be completely adequate for all except a portion of the carotenes for which a magnesium oxide layer was used. The plates are prepared by coating a glass plate (20 × 20 cm.) with a slurry (of a specially prepared silica gel or other powder with water) spread evenly over one side to a thickness of 0.25 mm. and dried thoroughly in an oven at 110° C. The pigment solutions are spotted along a base line several times and air dried between spottings until a good concentration is built. The plates are then placed in an enclosed, sealed glass chamber with a pool of solvent in the bottom. (Vapors from the solvent have saturated the chamber.) The solvent will move as a liquid up the plate, the layer acting as a wick, carrying the pigments with it. The pigments will move at different rates depending upon their chemical structure and thus separate at different levels along the line of ascent.

For the flavonoids, on a cellulose layer, the solvent giving the best results was formic acid, hydrochloric acid, and water (in a ratio of 10:1:3). For the carotenoids, on either a silica gel or magnesium oxide layer, a solvent composed of petroleum ether and benzene (1:1) was used with good results.

Werckmeister (1960, 1969) reported that delphinidin was the only anthocyanidin known to occur in the tall-bearded iris, that malvidin had been reported from four species of beardless iris and that none of the others were known in the *Iris* genus. Wynne (1966) found malvidin in the tall-bearded variety 'Frank Adams'.

In each of the instances where malvidin has been present, delphinidin was also present. Since malvidin is a methyl ester of delphinidin, it may not be possible to separate them in a plant breeding program. Several lines of breeding are in the process at present in an attempt to establish a line containing malvidin with or without delphinidin and to see how it behaves with the various pattern or inhibiting genes known to modify delphinidin.

Howard (1969) found that the flavones separated into four distinct fluorescent spots on the plates. Mangiferin was orange, irigenin was violet, apigenin A and apigenin B were blue. Very little is known about the effect of these substances on the visible expression of color. Since no one of them was found in all of the iris

tested, we can assume that they are inherited separately. Very briefly here are the results of this study:

'Aztec Copper' had irigenin only
'Gold Sovereign' had apigenin B only
'California Gold' had mangiferin and apigenin B
'Ebony Echo' had irigenin and apigenin B
'Vice Regal' had irigenin and apigenin A
'Orange Parade' had mangiferin, irigenin and apigenin B
'Pinnacle' had irigenin, apigenin A and apigenin B

None of the iris tested had all four flavones, nor were any completely without flavones.

Although Werckmeister (1960, 1969) reported the presence of lycopene in tall-bearded iris, no other work on the carotenes of this group of iris had been published. Jensen (1971) found beta-carotene in every variety tested. Here are some of his reported results on the carotenes:

'Amandine' had beta-carotene only
'Brown Thrasher' had beta-carotene and gamma-carotene
'Bravado' had alpha-carotene, beta-carotene, and gamma-carotene
'My Honeycomb' had beta-carotene and lycopene
'Jungle Fires' had alpha carotene, beta-carotene, and lycopene
'Orange Parade' had alpha-carotene, beta-carotene, gamma-carotene, and lycopene.

Lycopene is the red pigment of tomatoes; the other three are yellow or orange. In no instance did we find lycopene alone. Whether it will ever be possible to produce a truly red Iris from this pigment is not known. With the exception of beta-carotene, for which we have no allele, all the others suggest separate genetic possibilities.

The preliminary studies on the xanthophylls are now in progress by Mr. Larry Vining. He has already shown the presence of four xanthophylls in 'Ola Kala' and a completely different one in 'Rippling Waters.' These five xanthophylls have not been identified at the time of writing. The fact that these five are found in two different varieties without duplication indicates a contrasting genetic study is possible. Further analysis of other varieties may give additional xanthophylls.

Our findings to date have verified the complexity of the color situation with fifteen pigments instead of the two we thought we had. Although nothing has been clearly demonstrated on the genetics of yellow in the Iris, these results pretty well negate the suppositions and suggestions that have been discussed.

So far we have been searching. We selected flowers which we suspected had some of the pigments that we wanted to identify. We have probably missed some. It would have been impossible to have covered all of the varieties that are available at the present time. Looking back we find that not one single variety was checked for all four sets of pigments.

The next step will be to take several of the newer varieties of different colors and make complete pigment analyses of them to see if particular color combinations can be linked directly with a specific set of pigments. An attempt should be made to isolate the pigments in particular cultivars then bring them together in various combinations to see what the results will be.

Literature Cited

Howard, Stephen R. 1969. The appearance of flavone compounds in the flower of the tall-bearded Iris. Unpublished thesis, University of Missouri—Kansas City, Kansas City, Missouri 49p.

Jensen, Roger D. 1971. The chromatographic analysis of the carotenes in 38 varieties of tall-bearded Iris. Unpublished thesis, University of Missouri—Kansas City, Kansas City, Missouri 28p.

Werckmeister, Peter 1960. Iris color and pigments. Bulletin of the American Iris Society 158: 25-33.

Werckmeister, Peter 1969. Red Irises and cyanidin. Bulletin of the American Iris Society 194: 7-13.

Wynne, Johanne 1966. Chromatographic analysis of the anthocyanidins in 28 varieties of tall-bearded Iris. Unpublished thesis, University of Missouri—Kansas City, Kansas City, Missouri 32p.

'Buttered Popcorn'

'Coronado's Quest'

All of the irises on this page show different expressions of various combinations of yellow pigments, mostly carotenes and xanthophylls. 'One Desire' and 'Orange Parade' also contain lycopene. 'Royalaire' and 'Paris Lights' have, in addition to the carotenoids, a good concentration of delphinidin. Similar pigment mixtures result in other colors; tan, brown, bronze and so on. Photos by author

'Orange Parade'

'Royalaire'

'One Desire'

'Paris Lights'

BOOKS

Frequently publishers send copies of recently published books to the American Horticultural Society office. Members of A. H. S. may borrow books from the collection, as from a lending library. The following publications have been received in the past few months.

The American Camellia Yearbook, 1972. Edited by Joseph H. Pyron. The American Camellia Society, Publishers, 1971. 302 pp.

Backyard Vegetable Gardening For The Beginner. Hugh Wiberg. Exposition Press, New York, 1971. 105 pp.

Cacti And Succulents Indoors And Outdoors. Martha Van Ness. Van Nostrand Reinhold, New York, 1971. 112 pp.

Capability Brown And Humphry Repton. Edward Hyams. Charles Scribner's Sons, New York, 1971. 248 pp.

A Classification Of The Eucalypts. L. D. Pryor and L. A. S. Johnson. The Australian National University, Canberra, 1971. 102 pp. Paperback.

The Care And Feeding Of Trees. Richard C. Murphy and Wm. E. Mayer. Crown Publishers, New York, 1969. 164 pp.

Common Wild Flowers Of Minnesota. Gerald B. Ownbey, Illustrated by Wilma Monserud. Univ. of Minn. Press, Minneapolis. 1971. 331 pp.

Decorating With Plant Crafts And Natural Materials. Phyllis Pautz. Doubleday & Co., Inc., New York. 1971. 239 pp.

The Dictionary Of Roses In Color. S. Millar Gault and Patrick M. Synge. Grosset & Dunlap, New York. 1971. 191 pp.

Environmental Affairs, Quarterly Of Law And Science, Vol. 1:3. Sikora, Ruckelshaus et al. The Environmental Law Center, Boston College Law School. 1971. 693 pp. Paperback.

First East African Horticultural Symposium. Commission For Tropical and Subtropical Horticulture. International Society For Hort. Sci. 1971. 212 pp. Paperback.

Plants Poisonous To People: In Florida And Other Warm Areas. Julia Morton. Hurricane House, Miami. 1971. 116 pp. Paperback, spiral bound.

Camellia Nomenclature. Edited by William Woodroof. The Southern California Camellia Society, Inc., Lynwood, Ca. 1972. 187 pp. Paperback.

Propagating House Plants. Arno Nehrling and Irene Nehrling. Hearthside Press, Great Neck, N. Y. 1971. 292 pp.

1967–69 Research (Report) Summary. Alberta Horticultural Research Center. Alberta Dept. Of Agriculture. 1971. 80 pp. Paperback.

Roses. F. Fairbrother. Penguin Books. Baltimore. 1971. 200 pp. Paperback. In collaboration with The Royal Horticultural Society, London.

Seed Germination Of Rock Garden Plants. Edited by Dara E. Emery. American Rock Garden Society. 1971. 46 pp. Paperback.

Shakespeare's Flowers. Jessica Kerr. Thos. Y. Crowell Co., New York 1969. 85 pp.

Symposium On Vegetable Storage. D. Fritz, Chm. International Society For Horticultural Science. 1971. 164 pp. Paperback.

Thomas Jefferson's Flower Garden At Monticello. (2nd Edition) Edwin M. Betts and H. P. Bolton. Univ. Press of Virginia. Charlottesville. 60 pp. Paperback.

Wild Wealth. Paul B. Sears et al. Bobbs-Merrill Co., Inc. Indianopolis. 1971. 321 pp.

Wildlife And Plants Of The Cascades. Charles O. Yocom and Vinson Brown. Naturegraph Publishers, Healdsburg, Cal. 286 pp. Paperback.

Your Lawn: How To Make It And Keep It. (2nd Edition) R. Milton Carleton. Van Nostrand Reinhold, New York. 1971. 127 pp.

Gardening Indoors Under Lights (new, revised). Frederick H. Kranz and Jacqueline L. Kranz. Viking Press, New York. 242 pp.

Gartenbauliche Versuchsberichte 1971. No author cited. Landwirtschaftskammer Rheinland. 1971. 309 pp. Paperback.

A Good Life For More People (1971 Yearbook of Agriculture). Published by the U. S. D. A. 1971. 391 pp.

Growth And Development Of Trees: Vol. I. T. T. Kozlowski. Academic Press, Inc., New York. 1971. 443 pp.

Hanging Gardens: Basket Plants, Indoors And Out. Jack Kramer. Charles Scribner's Sons, New York. 1971. 101 pages.

Heaths And Heathers. Terry L. Underhill. David & Charles. Newton Abbot, Devon., Eng. 1971. 256 pp.

Herb Gardening In Five Seasons. Adelma G. Simmons. Hawthorn Books, Inc., New York. 1971. 353 pp.

Insects Of North America. Alexander B. Klots and Elsie B. Klots. Doubleday & Co., New York. 1971. 250 pp.

The Miniature Flower Arrangement Book. Margaret Best and Godfrey Best. Charles Scribner's Sons, New York. 1971. 164 pp.

Miniature Plants Indoors And Out. Jack Kramer. Charles Scribner's Sons, New York, 1971. 110 pp.

Plant Disease Handbook: Revised Third Edition. Cynthia Westcott. Van Nostrand Reinhold, New York. 1971. 843 pp.

Plant Speciation. Verne Grant. Columbia University Press, New York. 1971. 435 pp.

Principles Of Turfgrass Culture: John H. Madison. Van Nostrand Reinhold, New York. 1971. 420 pp.

Garden Terms Simplified. A. J. Huxley. Winchester Press, New York. 1971. 115 pp.

Gardening And Home Landscaping. Jack Kramer. Harper & Row, New York. 1971. 336 pp.

What Flower Is That? Stirling Macoboy. Crown Publishers, Inc., New York. 1972. 317 pp.

The Sweet Apple Gardening Book. Celestine Sibley. Pencil sketches by John Kollock. Doubleday & Co., Inc., New York. 1972. 212 pp.

The Decorative Art of Dried Flower Arrangement. Georgia S. Vance. Doubleday & Co., New York. 1972. 194 pp.

The Complete Rosarian. Norman Young. Edited by L. A. Wyatt. St. Martin's Press, New York. 1972. 286 pp.

The Arnold Arboretum–The First Century. S. B. Sutton. William L. Bauhan, Inc., Peterborough, N. H. 1971. 72 pp.

Shoot Tip Multiplication of Orchid Clones, Part II

The Status Of "Meristem" Propagation Through 1971*

Frederic J. Bergman

The same techniques that maintain sterile cultures when orchid seed is sown should be used for shoot tip cultures. To prepare for mericlone propagation, the technician steam sterilizes all equipment to be used or washes it with a ten per cent Clorox solution. His working area is laboratory clean, and to reduce drafts he works under a glass or plexiglass hood. His hands and arms are bathed in the Clorox solution just before work begins. The orchid plant that will supply the explants is treated as follows:

Cut the new growth from the mother plant and remove all loose scales and roots. Wash the growth with soap and water and dip it in seventy-five per cent ethyl alcohol for a few minutes. Then soak it in a saturated calcium hypochlorite solution (60 grams per liter) for twenty minutes and rinse with sterile water. Dry with sterile filter paper. If a large growth is used, most technicians remove outer green tissues and repeat the calcium hypochlorite soak. Eventually, the apical and axillary buds are exposed.

A modification of the sterilization process is based on Clorox solutions. Remove the first of three or four outer leaves from the new growth and soak the reduced shoot in a ten per cent Clorox solution for fifteen minutes; remove two more leaves and soak the growth in five per cent Clorox solution for five to eight minutes. Remove the remaining leaves and excise the buds, soaking them in a one per cent Clorox solution for three minutes. The explants now are ready to be cut to their final size before placing the pieces on nutrient medium.

Often explants sterilized with chlorine products blacken, apparently due to the formation of toxic oxides that develop on the cut surfaces. To prevent this, remove the excised buds to sterile water, and complete the final dissection under water. If explants blacken, Morel recommends transferring them to fresh media at intervals of a few days until growth begins.

The Nutrient Solutions

Many of the traditional orchid nutrient solutions and other tissue culture solutions have been tested for mericlone culture of orchids, and most of them give reasonably good results. Several researchers report satisfactory development of explants in Knudson's C solution. Toshio Murashige states that any good nutrient medium containing sucrose should be satisfactory. He recommends the addition of growth regulators (auxin type or cytokinic type) and vitamins. The auxins normally used are indole acetic acid (IAA), naphthene acetic acid (NAA), and 2,4-D. These compounds stimulate the formation of root systems. The addition of cytokinics (kinotin or benzyl adenine) stimulate leaf and stem formation. Vitamins can be added individually or as complex mixtures such as protein hydrolysate or yeast extracts. The most important vitamins in tissue culture appear to be thiamine and inositol.

Other organic derivatives have found favor in orchid tissue culture. Coconut water, malt extract, amino acids, and nucleic acid derivatives (especially adenine), appear more frequently in current literature. Morel suggests the use of auxins, cytokinins, coconut water or corn endosperm extracts. Lindemann substituting casein hydrolysate for coconut water. White mentions the benefits of malt extracts, malt steep liquor, tomato and orange juice, and tissue extracts. He further states that tissue cultures may benefit from the addition of kinetins, gibberellic acid, and DNA. Two combinations that have been found to be successful and which are synergistic are 2,4-D with coconut milk and IAA with kinetin. When

**Mr. Eugene Memmler, photographer, who furnished the photos that illustrated Part I of Mr. Bergman's article, sent in a note, see Mericlone Advances in the Gardener's Gazette, on Dr. Toshio Murashige's mericlone research at the University of California.*

working with rooting hormones it is necessary to transfer the tissue to a nutrient solution without hormones soon after rooting.

Many of the organic supplements including components of coconut milk are heat sensitive and are altered by heat sterilization. The best procedure when working with substances of this type is filtration sterilization. Filtration sterilization is performed by dissolving the organic suppliments in water. The solution then is forced through a sterile filter with a pore size so small that microorganisms are excluded. A convenient system for filtration sterilization consists of a standard syringe with a Luer-type outlet, a Swinny or Swinnex filter holder, and a suitable filter such as the Millipore MF-GS.

The filtration sterilization technique also is recommended for inorganic nutrient solutions where there is a danger of co-precipitation of certain ions during heat sterilization. Much of the data on media and their preparation and sterilization is included in the seventy-two page booklet, *American Orchid Society Meristem Tissue Culture*, published by the American Orchid Society, Cambridge, Massachusetts.

With the nutrient medium determined (either liquid or an agar gel), prepared, and, under sterile conditions, divided among small flasks, introduction of the explants can proceed. Most investigators culture their explants (first phase) and multiply the subdivided protocorms (second phase) on the same medium. Wimber and Lindemanm report the use of a different medium for the second phase. A third medium may be used for differentiating the subdivided protocorms. While some technicians use solid medium for all three steps (in some cases, the same medium for the first two or for all three phases) investigators working with cattleyas use liquid media for explant and protocorm culture and solid media for differentiation.

The following table summarizes the composition of a number of nutrient media used for orchid tissue culture:

NUTRIENT MEDIA USED FOR TISSUE CULTURE OF ORCHIDS

Values in g/L	Knudson C	Morel	White's/ Lamport	Knudson C/Morel[1]	White's/ Torrey	White	Tsuchiga/ Wimber	Lindemann Starting	Lindemann Maintenance	Vacin & Went (V-W)	Murashige-Skoog (M-S) Modified	Modified Heller's
$(NH_4)_2SO_4$	0.50	1.00		0.50			0.50	1.00	1.00	0.50		
$CaCl_2 \cdot 2H_2O$											0.44	0.075
$Ca(NO_3)_2 \cdot 4H_2O$	1.00	0.50	0.20	0.50	0.20	0.30		0.50	0.50			
$NaH_2PO_4 \cdot 2H_2O$			0.0165		0.0165	0.019						0.125
Na_2SO_4			0.20		0.20	0.20						
NH_4NO_3				0.50							1.65	
KNO_3			0.08		0.08	0.08	0.525			0.525	1.90	
KH_2PO_4	0.25	0.125		0.25			0.25	0.135	0.135	0.25	0.17	
KCl		1.00	0.065	0.25	0.065	0.065		1.05	1.05			0.75
$MgSO_4 \cdot 7H_2O$	0.25	0.125	0.360	0.25	0.360	0.75	0.25	0.12	0.12	0.25	0.37	0.25
$FeCl_3 \cdot 6H_2O$												0.001
$FeSO_4 \cdot 7H_2O$	0.025			0.025							0.0278	
$Fe_2(SO_4)_3 \cdot 6H_2O$			0.0025		0.0025	0.0025						
$MnSO_4 \cdot 4H_2O$	0.0075		0.009	0.0075	0.0045	0.005		0.000068	0.000068	0.0075	0.0223	0.00001
KI			0.0015		0.00075	0.00075		0.000099	0.000099		0.00083	0.00001
H_3BO_3			0.003		0.0015	0.0015		0.001014	0.001014		0.0062	0.001
$CuSO_4 \cdot 5H_2O$						0.00001		0.000019	0.000019		0.000025	0.00003
$CoCl_2 \cdot 6H_2O$											0.000025	
$Na_2Mo0_4 \cdot 2H_2O$											0.00025	
$ZnCl_2$											0.00393	
$ZnSO_4 \cdot 7H_2O$			0.003		0.0015	0.003		0.000565	0.000565			0.001
$Mo0_3$						0.000001						
$CaHPO_4 \cdot 2H_2O$							0.20					
$FeC_4H_40_6 \cdot 3H_2O$							0.03	0.0054	0.0054	0.028		
$AlCl_3$								0.000031	0.000031			0.00003
$NiCl_3$								0.000017	0.000017			0.00003
$Ca_3(PO_4)_2$										0.20		
$NaNO_3$												0.60
			2	2	2	2	2	2	2		2	2
Water (ml)	1000	1000	800	900	1000	1000	1000	850	850-950	1000	1000	1000
Coconut water (ml)			200	100				150	50-150			
Sugar	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.50	20.0	20.0	30.0	30.0
Agar	17.5	–	–	–	–	5.0	12.0	–	–	16.0	10.0	10.0

[1]See Table for Organic Supplement

[2]May add 0.5 g NH_4SO_4 in place of NH_4NO_3

ORGANIC SUPPLEMENTS

Values in mg/L	Knudson C/Morel	White/ Lamport	White/ Torrey	White	Tsuchiga/ Wimber	Lindemann Starting	Lindemann Maintenance	Murashige Skoog/ Modified	Modified Heller's
Indoleacetic acid (IAA)	1.0					0.1			
Napththaleneacetic acid (NAA)							0.186		
2,4-D								1.0	1.0
Glycine		3.0	13	3.0				2.0	
Ca pantothenate		0.1					0.476		
Thiamine HCl		0.1		0.1			0.338		
Cysteine HCl		1.0							
Hypoxanthine			2.5						
Aspartic acid			6.0						
L-Arginine HCl			7.8				13.20		
L-Cystine			1.5						
L-Glutamic acid			14				14.70		
L-Histidine			2.6						
DL-Isoleucine			10.4						
L-Leucine			15.6						
L-Lysine			15.6						
DL-Methionine			13.0						
L-Phenylalanine			2.5						
Nicotinic acid				0.5			1.231		
Pyridoxin (B_6)				0.1			0.205		
Tryptone					2000				
Kinetin						0.2	0.215		
i or m Insitol							18.016		
Folic acid							4.414		
Biotin							0.024		
Guanylic acid							181.60		
Cytidylic acid							161.60		
Gibberellic acid							0.346		
Na_2 EDTA								74.6	
6-benzylamino purine (benzyl adenine)								0.5	0.5
Thiamine								0.4	1.0

Incubation, Temperature, and Light

Planted flasks with an agar gel nutrient medium are held motionless in an incubator. Liquid cultures generally are placed in a shaker. The type of shaking action does not appear to affect the results as both roller type and horizontal shakers have been used. The shaking rate used by various investigators ranges from one-fifth revolution per minute to 160 revolutions per minute. Lance Birk reports satisfactory results by simply shaking the flasks several times each day by hand.

The temperature used for orchid tissue culture ranges from 22° C. to 32.2° C. Apparently satisfactory cultures result from incubation anywhere in this range.

Different researchers use differing light intensities and photoperiods. Usually the reported intensity is in the 100 to 200 foot candle range; Wimber reports using less than 100 foot candles and Jasper reports using 1,800 to 2,000 foot candles. Many researchers use a continuous photoperiod, but several recommend a sixteen hour photoperiod.

Summary of Steps

The process of multiplying orchid clones by use of shoot tip culture can be summarized in the following steps:

1. Clean all glassware thoroughly.
2. Select and prepare the culture medium using solid or liquid medium for cymbidiums and liquid medium for cattleyas and dendrobiums.
3. Adjust the medium pH to 5.2.
4. Place the desired amount of medium in a stoppered flask and sterilize in an autoclave or pressure cooker at twenty pounds for fifteen minutes.

5. Add under sterile conditions, filter sterilized heat sensitive nutrient chemicals.

6. Select a growth several inches long and excise the apical and axillary buds under sterile conditions.

7. Place the explants on the nutrient medium.

8. If a liquid medium is used, agitate gently.

9. Maintain a temperature of 26° C., and illuminate continuously at 100 to 200 foot candles.

10. After protocorms form, and just as differentiation starts, remove the explants and section each protocorm into four to six pieces under sterile conditions.

11. Resow sectioned pieces on fresh nutrient medium.

12. Repeat steps 8, 9, 10, and 11 until the desired number of protocorms have been produced.

13. If working with liquid medium, transfer pieces of protocorm to solid (phase three) medium. For solid medium culture, stop sectioning and sow the divisions on phase three medium.

14. Treat the flask in the same manner used for orchid seedlings.

Some Late Developments

Gordon Dillon, in 1964, suggested the possible use of culturing tissue from root tips, flower stem nodes, and incipient flower buds; all of these are potential sources of meristematic tissue that should differentiate when mericlone techniques are applied. In 1970 Churchill, Ball and Arditti published their method for producing orchid plants from tissues excised from the leaf tips of seedlings. Today it appears that it will no longer be necessary to excise tissues from apical and axillary buds to obtain tissue for clonal multiplication. There is an indication that it should be possible to take tissue from almost anywhere on a mother plant, culture it, break it down into single cells using trypsin, and then to cause the single cells to multiply and differentiate. One commercial grower forsees the development of orchid "tissue banks" where superior clones would be maintained in the protocorm stage. If the clone, in a grower's greenhouse, became virus infected, reserve protocorms could be withdrawn from the "bank" and caused to differentiate, supplying disease-free plants for commercial use. ◈

Orchid propagation traditionally has been accomplished by two methods; raising plants from seed, and dividing mature, or almost mature, plants. Orchids are monocotyledonous plants. Most grow, iris-fashion, with a rhizome (horizontal, modified stem) which produces leaves on the upper surface and adventitious roots on the lower surface. The "front" end of the rhizome usually is growing, actively. Occasionally the rhizome branches. A grower with a strong orchid plant has only to sever the rhizome, making a division with three or four leaves and a few roots, to have a new plant. Adventitious buds develop on the older portion of the original plant, and it, too, soon resumes growth. But this is a slow way of propagating orchid plants.

A recently introduced technique consists of making "cuttings" under sterile conditions of just a few cells. Specialized cells are not suitable for this highly refined method of propagation; rather, clumps of relatively young, unspecialized (undifferentiated) cells are taken from within the bud at the end of the rhizome. These small pieces of tissue are transferred to a sterile culture medium. They can be redissected as they enlarge due to cellular proliferation. Then, by altering the chemical nature of the culture medium, these bits of tissue can be made to go through a series of developmental changes that closely resemble the germination of an orchid seed. Eventually, each becomes a new plant that exactly resembles its parent.

The author has reviewed the history and background of orchid tissue culture in two articles, the first of which appeared in the *American Horticulturist*, Vol. 51, No. 2.

Gardener's Gazette

"Flora Europaea"

A supranational atlas is being produced, in which all the flora of central Europe will be charted. Apart from Austria, where the undertaking is being coordinated, participant countries are the Federal Republic of Germany, the GDR, Switzerland, Liechtenstein, Italy, Yugoslavia and Czechoslovakia. Denmark, Holland, Belgium and Luxembourg will make the results of their virtually completed work available. Other nations are also to be encouraged to collaborate. A total of 700,000 square kilometres have to be covered. If the aim of producing a practically complete map of the flora of central Europe is fulfilled, we shall possess a standard botanical work kept permanently up to date by supplementary and explanatory volumes. Apart from botanists, the following disciplines will profit greatly from the atlas: climatologists—to have a precise picture of plant communities in similar climatic situations; soil scientists—to gain information on the sub-soil; agriculture—for indications of possible new exploitable areas; nature conservancy— for the rapid pinpointing, registration and protection of species which are threatened or of special interest; geographers —to trace the effects of the Ice Age and other major climatic changes, and not least, floristics experts and plant sociologists. For the Federal Republic, scientists of the Institute of systematic-geobotany at Göttingen University have to date established 1800 instances of higher plants in the area of Lower Saxony. They intend to register a total of some 2600 higher plant species in the Federal Republic. The German Research Association has provided the funds for this study—**Kulturbrief** Vol. I, No. 2

Mericlone Advances

Advanced research in the area of mericlone propagation has been progressing rapidly at the University of California under the direction of Dr. Toshio Murashige. Dr. Murashige's improved technique has developed over fifty formulas applicable to more than fifty horticultural varieties of plants. His formulas contain thirty-two different chemicals instead of the usual five found in the Knudson C formula. All of his chemicals are of the reagent grade instead of CP (chemically pure) less pure variety. His formulas cause the plants to self-divide as miniatures, instead of requiring the technician to dissect the "meristem" ball.

Proceedings Published

Proceedings of The 18th International Horticultural Congress, published in five volumes are available at $40.00 per set, from The Organizing Committe, 18th International Horticultural Congress, c/o Prof. K. Mendel, Volcani Institute of Agricultural Research, P.O.B. 6, Bet-Dagan, Israel.

Agricultural Research Service Reorganized

Recently the Agricultural Research Service of the U.S. Department of Agriculture was reorganized. The new organization structure is designed to meet current demands and to provide greater efficiency in service.

The previous organization consisted of a discipline-oriented structure with four deputies, fifteen divisions and more than fifty branches and special laboratories. The new structure is a line and staff organization. Four regions have been established to provide field service of varying nature; the regions are the Northeast Region, North Central Region, Southern Region and Western Region.

Horticulturists generally deal with research and information personnel at Beltsville. The changes (given only in part, due to length) are presented below:

Agricultural Environmental Quality Institute
L. L. Danielson, *Acting Chairman*

Agricultural Marketing Institute
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Medicinal Plant Resources Laboratory
R. E. Perdue, *Acting Leader*

Germplasm Resources Laboratory
G. A. White, *Acting Leader*

Ornamentals Laboratory
Henry M. Cathey, *Acting Leader*

Turfgrass Laboratory
D. L. Klingman, *Acting Leader*

Applied Plant Genetics Laboratory
C. H. Hanson, *Acting Leader*

Fruit Germplasm Development Laboratory
D. H. Scott, *Acting Leader*

Tobacco Germplasm Development Laboratory
T. C. Tso, *Acting Leader*

Vegetable Germplasm Development Laboratory
R. E. Webb, *Acting Leader*

For a complete breakdown of the various Institutes and Laboratories opening at the Beltsville facility, write to A. A. Hanson, Acting Area Director; Northeast Region; United States Department of Agriculture; Beltsville, Maryland 20705

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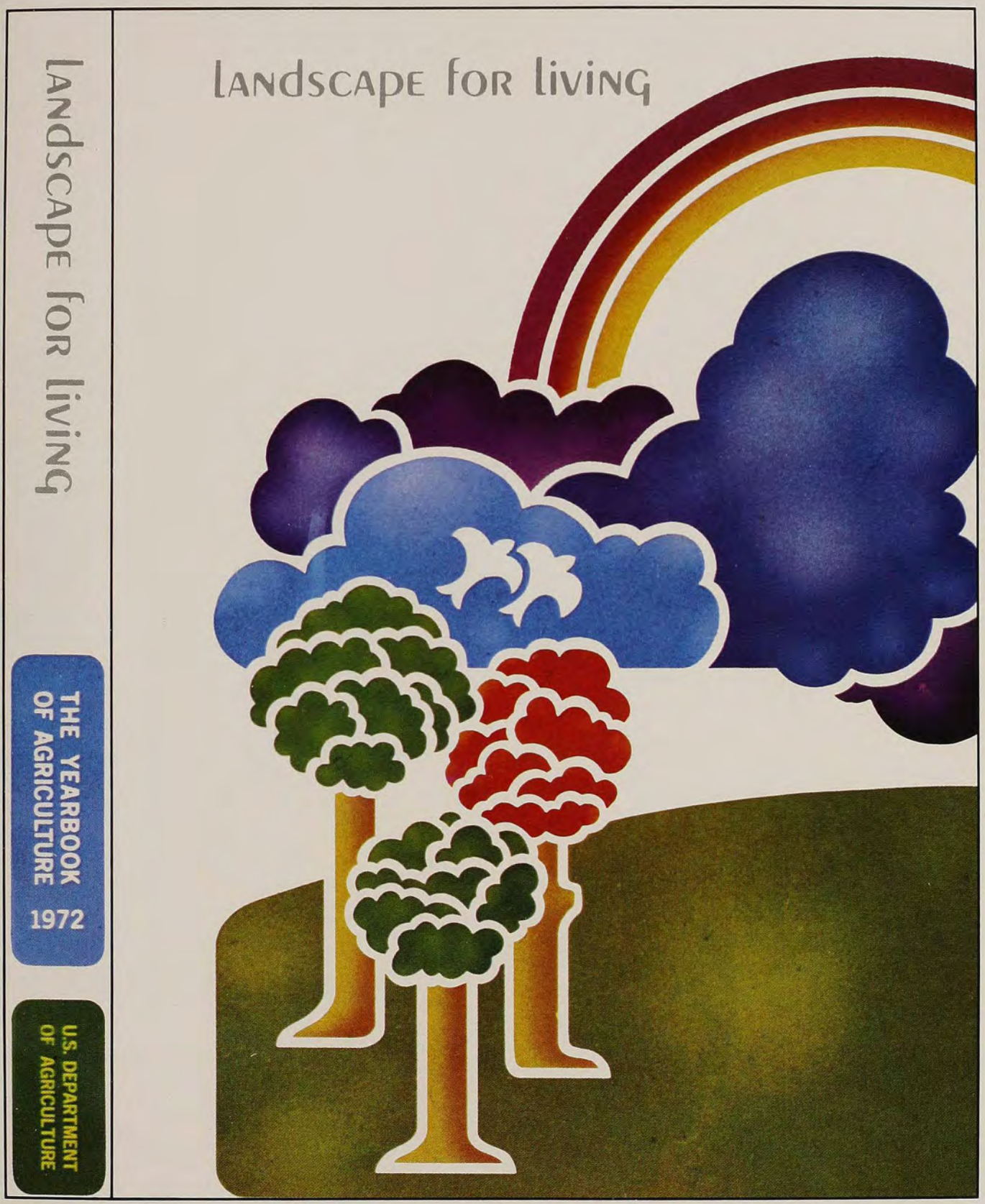

The 1972 Yearbook of Agriculture, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price $3.50