

AMERICAN HORTICULTURIST

AUGUST/SEPTEMBER 1980





COMING IN THE NEXT ISSUE

Victoria Padilla is recognized as an expert on bromeliads. She will share her knowledge with readers in the October/November issue when she writes about their history and development as popular house plants. In addition, look for George Taloumis' article on a charming Savannah townhouse garden and an article on new poinsettia varieties by another expert, Paul Ecke. Roger D. Way will write about new apple varieties and Mrs. Ralph Cannon will offer her choices for hardy plants for damp soils. And last but not least, look for a staff article on money-saving ideas for the garden. We've canvassed over 100 gardeners for their best tips. All this and more in the next issue of *American Horticulturist*.

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ON THE COVER: *Cyclamen hederifolium* photographed in Virginia (Zone 8). Read more about hardy cyclamens in Pamela Harper's article beginning on page 27. Photograph by Pamela Harper.



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Buyer Beware!

For all gardeners, spring is the most active period in the garden. In late winter garden catalogues arrive, and gardeners spend many a pleasant evening selecting seeds and plants that will go into their flower beds and vegetable plots. Since most serious gardeners depend heavily upon mail-order purchases, the proper identification and accurate description of catalogue offerings are essential to good garden planning. Fortunately, the great majority of mail-order seedsmen and nurserymen are conscientious businessmen who take great pains to provide their customers with accurate information. After all, the only way to build a successful business is to establish a group of well-satisfied customers.

Or is it? Unfortunately, we all see advertisements, usually in the Sunday supplements, which offer miraculous plants for sale with unlimited guarantees for claims that certainly exceed anything in the way of growth or flowering that any of us has ever achieved in our own gardens. The junk mail also seems to bring unsolicited nursery catalogues which offer similar wonders of the plant kingdom. And then there is the bargain garden. Why should you spend \$10 or \$20 for a single young tree or shrub when you can have a whole forest for \$1.98? If you are like me, and I know that most of you are from the many letters we receive at River Farm, you probably find such advertising personally offensive. It offers no danger to my pocketbook, for I would never consider placing an order with one of these unsavory nurserymen, but I am concerned about the ef-

fects it can have upon new gardeners who may not know enough to recognize the impossibility of the printed claims. Because of this concern, I spent a few hours looking into what could be done by serious gardeners to prevent their less knowledgeable friends from being hoodwinked.

The results of my inquiries were not encouraging. The Federal Trade Commission has issued "Guides for the Nursery Industry." These were published in the Federal Register in February of 1978, but they are not law. They are simply suggestions for procedures to be voluntarily followed. The guides cover such items as proper descriptions, accurate names, size and grade designation and source of materials. The guidelines are recommended by the American Association of Nurserymen as standards by which members should conduct their businesses. And members of the organization, by and large, do adhere to these ground rules. But all nurserymen are not members of this national organization, and there are no laws to back up the FTC "guides." The AAN does offer the following suggestions for gardeners and homeowners purchasing plants by mail:

1. *Beware of outlandish advertising claims relating to growth, flowering or fruiting of trees and shrubs, as found in such statements as "grows twenty feet in two months," "produces thousands of exotic blooms in a few weeks," or "supplies many bushels of fruit the first year." The clue to practically all misleading advertising is heavily exaggerated claims.*

2. *When advertising for plants makes exaggerated claims, before purchasing, check with established nurserymen, the Better Business Bureau, state extension services, botanical gardens or other reliable sources of information.*

3. *Sometimes common names that mislead the public are associated with plants, an example being the "amazing climbing vine peach," which is not a peach at all. This "vine" produces a hard, gourd-like fruit, not even edible except when canned as a preserve.*

4. *Question claims of "tremendous bargains." This can be done by writing the firm for its retail catalogue in which you can check regular prices.*

5. *If you have any doubt about the age, size, grade or quality of the plant, before purchasing write and inquire*

about it. Established nurserymen will supply this information.

6. *Pay particular attention to guarantees. For example, the nature and extent of the guarantee and how it will be honored should be disclosed fully in the ad. The advertiser's identity and mailing address should be fully given. The Federal Trade Commission has established "Guides Against Deceptive Advertising." Check with these, if possible, at a public library.*

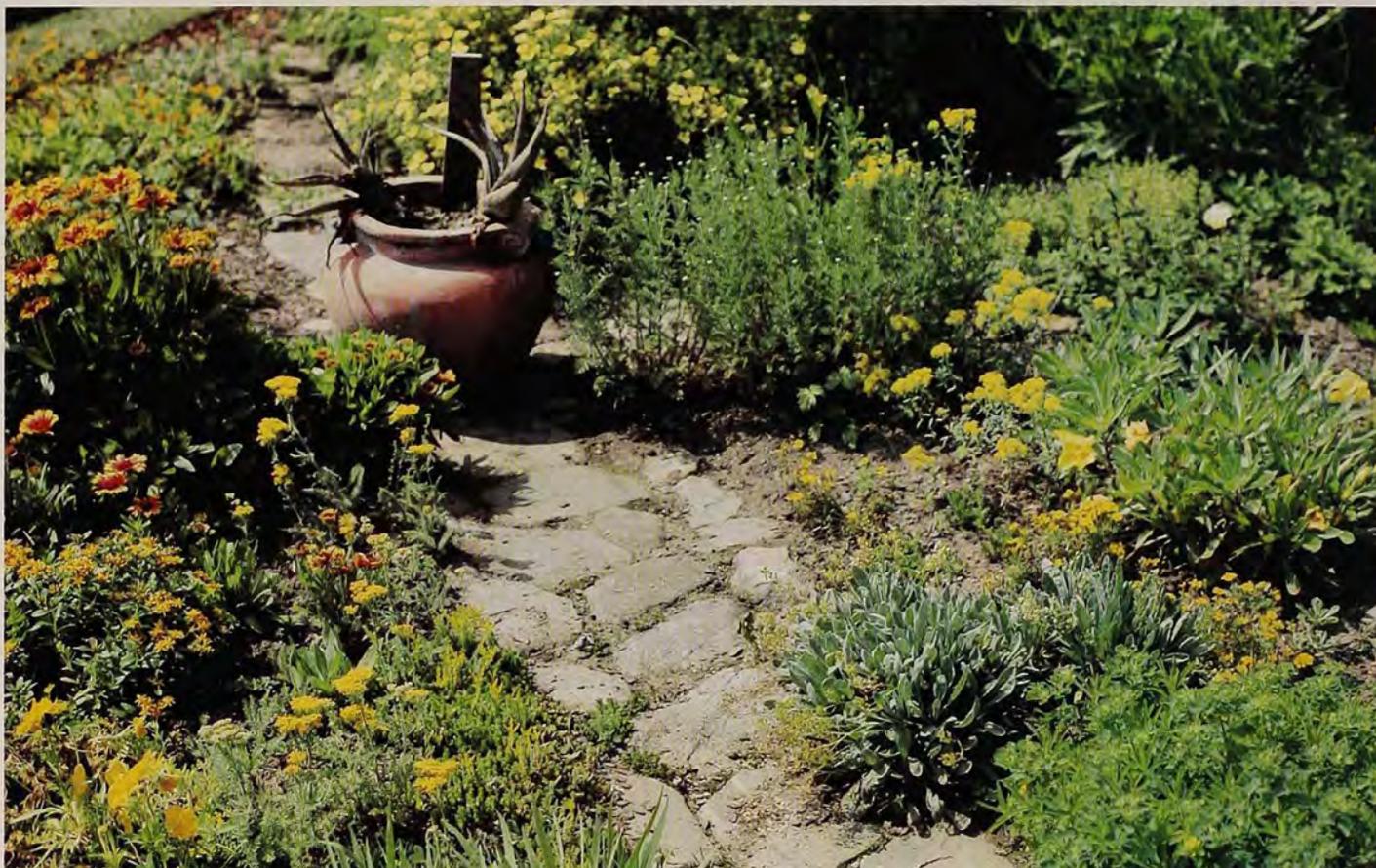
These recommendations put the responsibility on the purchaser. I wondered if there wasn't something more positive that could be done. The Postal Service is the answer. If you feel that a plant advertisement is fraudulent, you should write to your local Postal Inspector's office, or better yet, to the Consumer Protection Office, U. S. Postal Service, 475 L'Enfant Plaza, Washington, D.C. 20260. You must give them all the details of your objections to the advertised claim and include a copy of the advertisement or catalogue with your letter of complaint. If enough complaints are received action will be taken. But you must realize that the Postal Service can only act on truly fraudulent offers made by mail. For instance, the offer of a plant which is a combination potato and tomato (for a substantial price) isn't always a fraud. If you plant a few tomato seeds in a hole made in a potato, both plants will grow and will, in fact, naturally graft into a common plant. The resulting plant (plants!) won't take any less space to grow than two plants planted separately, and the results won't be any different, but the catalogue offer can't be termed really fraudulent, just expensive. For this type of sensational advertising, all you can do is warn your friends and write a letter of complaint to the nurseryman involved.

There are many strange and wonderful plants which we can grow in our gardens. It's a shame that some mail-order nurserymen can't settle for the truth. Since legal recourse seems to be limited, the best thing we can do as advanced gardeners is to educate our less knowledgeable gardening friends.

Gilbert S. Daniels

—Gilbert S. Daniels
President

HERBS ARE FOR BEAUTY



Elisabeth Morris

An old gardener for a lovely home once told me proudly that he took care of the grounds himself, “except for Miss Margie’s herbs.” Those he refused to touch he said, believing they were nothing but a bunch of weeds. Yet herbs can provide a full share of anticipated garden beauty. Whether they are plants for flower beds, foliage accents and groundcovers, or wild-flowers in a natural or naturalized area, one can have one’s herbs and use them too.

It becomes an absorbing project to track down herbs for beauty; a few are probably growing unsuspected in local gardens, their herbal qualities forgotten. In fact, the list can become so long that one asks, “Why

A monochromatic design approach was chosen for this herb garden at Capriland Herb Farm in Coventry, Connecticut. Only herbs in various shades of yellow grow in the plot.

bother to identify herbs among the garden plants?” These useful and often greatly enjoyed plants still enrich our lives, and following their journeys and traditions from country to country, deepen our understanding of plants and their close relationship to human life and spirit. As plants are lost through development and pollution, herbs are reminders of some of the oldest human conservation efforts; they were plants wanted for the future.

America, too, has herbs in its history. Medicinally, the Indians used many native plants, from the giant white pine to the low-growing partridge berry. The settlers had a special interest in starting a profitable plant trade (sassafras is an herbal example) and discovering successful dyes. The Shakers earned a chapter in history for themselves by building up an extensive business from Old World herbs and native plants they grew or collected. In one’s own

gardening and landscaping, one can keep entirely to herbal usage, selecting trees, shrubs and vines with herbal uses in mind. Given the right conditions, one can even plant a strip of lawn with chamomile or creeping thyme.

Uses of favorite flowers that were acknowledged herbs centered on fragrance and date back thousands of years. To our ancestors, fragrances—the sweet, the spicy and the pungent—were necessities of daily living. Whatever the part of the plant that was used and whether individually (costmary, lavender, rosebuds) or in mixtures (potpourris, sachets), herbs scented clothing and household linens and freshened the air. They were worn and carried. They repelled insects, especially moths in woollens (tansy, southernwood, pennyroyal). Some were believed to be therapeutic and others were thought to be able to ward off disease. Many a European lady, in her

stillroom, prepared perfumes, potpourris, cosmetics, hair rinses and soothing lotions and salves from flowers. Royal cooks made salads and cooked and flavored with flowers, and so did housewives. Rose, violet and calendula (*Calendula officinalis*) were kitchen herbs. Numerous flowers were ingredients for beers, wines, cordials and herb teas. They also were planted for bees to increase their wax and honey production. It is said that many gardens today lack fragrant plants, another reason for turning to herbs.

Two other leading purposes for growing herbs were for their flavor and use as dyes. Culinary herbs need not be leafy green confusion when one can plant colorful, flavorful nasturtiums, variegated pineapple mint, garlic chives, purple perilla, garden and clary and pineapple sage, borage, caraway thyme (*Thymus herba-barona*), wild marjoram and wild or alpine strawberries. Put in fennel and leek for height, and for near neighbors, daylily (*Hemerocallis fulva*) where there is sun and sweet cicely where there is shade. Dyes from herbs are returning to use with yarn and fabric and authentically restored antique textiles. (The herb soapwort will clean them.) The dye herbs are usually at the bottom of the list for garden beauty, but among the prettier ones are coreopsis, golden marguerite, dahlia, goldenrod, lily-of-the-valley, marigold, sunflower, lady's mantle, heather and zinnia.

Herbs introduce one to fascinating reading. They have never failed to go wherever Man has gone, even into Space. When a "home-like" taste was found to be important to the astronauts, herbs were added to space flight meals, among them rosemary, savory, parsley, garlic, thyme, sage and oregano.

At botanic gardens and historic sites, herbs are living illustrations for the stories these gardens have to tell. America lags behind in planting them for their beauty. Who, for instance, thinks of England's flower gardens without herbs? English gardens are sure to have lavender, rosemary and thyme. Silvery artemisias and lamb's ears, santolinas gray and green, dark germander and variously colored sages will be there to reinforce the succession of bloom with their foliage and to outline and fill formal patterns. Roses seem less regimented among flowering annuals and perennials, and small herbs charmingly surround sundials and sculpture. Herbs

complete a garden picture, from drifts of spring bulbs on. The bulbs could be herbal first choices—poet's narcissus and jonquil. Abroad and at home, summer stars the garden's prettiest flowers, again herbal if these are fraxinella, impatiens, pinks, cornflower, heartsease, peony, hollyhock, globe thistle, balloon flower, Madonna lily . . . all were used in gardens in the past.

In Colonial America, the indispensable herbs of the pioneer women came mainly from distant homelands. Native plants, because they were unfamiliar, were apt to win acceptance slowly. Gardeners today may not recognize Solomon's seal, butterfly weed, California poppy, Turk's-cap lily and bee balm as wild North American herbs.

If you would like to grow herbs for their beauty, write down the plants you think it would be nice to grow for their flowers and foliage. Check them against published herb lists, but read further. Some herbs are either toxic or strongly medicinal and thus hazardous to children and curious adults alike. Also, a name in an index might refer to a plant which has been mistaken for an herb. In a casual selection, the native countries of the plants and their records as herbs may range widely. An ancient Pompeiiian garden may give you ideas for a modern garden, and one still could grow much of Charlemagne's famous list. By Charlemagne's orders, recommended herbs for health and protection, special flowers and fruit trees were planted at the royal estates and elsewhere. His rose, usefully combining health (medicinal herb) and flower, was probably *Rosa gallica*. His houseleek (hen-and-chickens) guarded the home from fire and lightning and was planted not in the garden but on the roof. From past centuries and civilizations, one finds that herbs were used in religion, the arts, magic, myth and celebration. Note an herb's habits and its hardiness. Is it a plant of limy soils or of acid? Would it overwhelm another herb by growing rampantly?

A number of authors provide plans for an herb garden, but set aside a place for experiments with plants for their visual beauty, in form, texture and seasonal color. It is as satisfying to achieve a low underplanting as to create a tall background, to find a good groundcover as to design an effective border edging, and to grow a wild herb appropriately as to accent with an herb that has been centuries in

cultivation. The possibilities are almost limitless.

Flowers have instant appeal; attractive foliage revitalizes the garden when the flowers fade, and an autumn color change in an herb or its surroundings may produce foliage which takes on new beauty. Crimson blueberry leaves, for example (blueberry was used medicinally), combined with chartreuse-green golden feverfew, is a vivid fall display. A gray herb next to the blueberry bush would be striking, too. There are herbs one does not forget, out of sentiment and use and from a memorable garden visit. Bring herbs for their beauty into your gardening. If you cannot grow them in the ground, grow them in containers (lemon verbena, prostrate rosemary, scented geraniums—pelargoniums—to suggest a few). What opportunities they open for delight!

—*Elisabeth Morss*

Suggested Reading:

I. Helpful for Reference: *A Modern Herbal*, Mrs. M. Grieve (Dover Publications, Inc., reprint. See also their other reprints on herbs). *Plant Uses for the Past 500 Years*, Charlotte Erichsen-Brown (medicinal plants of northeastern USA and Canada, a 1979 Canadian book which will be listed in the USA.) *Minnie Muenscher's Herb Cookbook*, Minnie Worthen Muenscher (good cooking, good gardening, good sense). *Herb Gardens of Delight*, Adelmia G. Simmons (eight plot plans, each to a theme. See also her many books and pamphlets). *Wyman's Gardening Encyclopedia*, Donald Wyman (Comprehensive). *Sunset New Western Garden Book*. (Check plants for herb uses. Expanded 4th edition for more western states.)

II. Herb-Gardening Help: Relevant material published by The Arnold Arboretum, Brooklyn Botanic Garden, The Herb Society of America, *The Herb Grower* magazine, The National Arboretum in Washington, D.C., historic preservations that feature herb gardens and any local horticultural society, arboretum or garden center.

III. Rainy Day Reading: *A Chronicle of Herbs This Noble Harvest*, Anne Ophelia Dowden (beautifully illustrated introduction to herbs). *The Pleasure Garden*, Anne Scott-James and Osbert Lancaster (informal account of British gardening, a major influence).

POTTING SOILS AND POTTING PLANTS: WHAT YOU NEED TO KNOW FOR SUCCESS

At the end of every summer there comes a day when a gardener looks at potted plants and speculates about indoor greenery again. Should the palm be sent to the nearest nursing home lobby? Ought the *Spathiphyllum* that needs water twice a day be divided into several pots? What to do with the best ivy ever seen running down the porch steps, draping itself in every direction, even rooting into the mulch around the yews? Can the living room's one bright window really stand all those hoyas and spider plants? Could at least one of the 'Tangelow' impatiens be saved?

Gardeners who enjoy indoor plants have distributed recipes for concocting potting soils for generations. Almost every success story, if shared, describes a secret method, a special fertilizer, a marvelous ingredient from the kitchen, laundry or sometimes the garbage pail. Plants become heirlooms, their provenance lovingly recounted, their caretakers convinced that some particular revelation accounts for long life and vigor. For example, one fascinating Midwestern recipe, along with the usual eggshells, Epsom salts and household ammonia, adds salt and pepper to the mix. Coarsely ground?

But announcements from laboratories and research greenhouses are no less mystifying. Perhaps charity must prevail in a biological world where nothing is ever final, but a search for science in indoor gardening leads one to broken tablets at the foot of a horticultural Sinai. Two of the long proclaimed commandments, "Review the Literature" and "Read the Label," are shattered by conflicting publications and crushed by commercial suppliers whose packages do not inform.

Last spring, one otherwise illuminating writer advised readers to pot foliage plants in perlite and peat moss "with a dash of potting soil." Which potting soil? Whose dash? Like grandmother's recipes, never to be duplicated!

Again: "Plants from deserts often grow best with half their soils made up of coarse sand." Many gardeners have followed this



Illustration by Maryellyn Lynott

advice for years. But now Cornell has announced that cacti grow better in equal parts of sphagnum peat moss and perlite, watered and fertilized daily during the summer, less often during the rest of the year. So, should all those rules for potting succulents be unlearned? And then one reads that the mystery of soil mixtures is generally "bunk." But "there is a certain magic to mixing it . . . a question of feel and smell, not knowledge." So much for science!

But scientific research introduced artificial growing media, first to commercial growers and next to amateurs. Investigation into ingredients and fertilizers continues with international conferences, reports at almost every professional floriculture meeting, and scores of graduate students measuring and weighing, testing tissue and preparing intricate graphs. All this work gives few clues to gardeners

who cannot mix two ounces of some microelement into 1,000 gallons of water and rely on capillary watering to distribute the missing nutrient.

If scientists and commercial growers had solved all the problems, there would be no need for continuing discussion of peat (several kinds), bark (many tree species), vermiculite, perlite, styrofoam, washed sand, loam, leaf mold, bone meal, lime, superphosphate, treble phosphate, diammonium phosphate, fritted trace elements and even a little molybdenum. Psychologists counsel that every person needs to succeed at something, so one hopes that the simple business of growing a green plant on a windowsill through several seasons is not to become a source of failure and guilt.

There seem to be two questions for the amateur gardener to consider in all this oriental water torture of information.

Should one use a potting mix containing soil, even if modified, or is plant life safer and simpler with the cake-mix convenience of a sack of synthetic mix? (One feels sorry for city gardeners far, far from loam. And do they need to buy leaf mold and steamed manure in pretty little boxes, thereby convincing country cousins of their profligacy?) The second question that matters is what kind of fertilizer, on what schedule, should be added to confined horticulture for keeping plants clean and green.

The experience and advice of floriculturists at the University of Minnesota is that gardeners succeed when they pay attention to the essential principles of plant growth and then learn to use the potting mix and fertilizer they select. Neither science nor secret formulas have proved that there is only one way to grow beautiful potted plants. A growth medium must supply water, air and nutrients; anchorage, moisture, drainage and appropriate fertilizer can be provided in several ways. This is the science; the secret is the careful eye of the gardener who can recognize success or spot trouble quickly.

Some successful growers in the Midwest prefer to let no soil into their greenhouses. Fear of soil-borne organisms or unknown components in purchased loam (sometimes carried-over herbicides) are two reasons. Also, soil is heavy and difficult to mix with necessary amendments. Using artificial media means that fertilizing and watering can be exact, especially as experience is gained with a particular formula. Nitrogen, phosphorus and potassium, as well as microelements, can be supplied to the sterile materials in differing amounts according to the crop being grown. Plants grow well, tall floor specimens can be picked up and carried about, and smaller ones will not overburden tabletops or shelves. Customers can see the clean, absorbent surface of the mix. Some growers will not divulge the exact composition of the medium around the roots of their handsome plants, even when they offer plastic bags of it for sale to retail customers.

Synthetic mixes also are offered to home gardeners at discount stores, grocery supermarkets, hardware stores, gas stations, garden centers, florist shops and even elegant downtown department stores. The lightweight packages are easy to pick up and take home. Many are labeled "potting

soil" or "African violet soil" or "cactus mix," or more fancifully, with "magic" or "mystery" in the title. They surely are mysterious, because many have no explanation of materials used. Other more informative labels give a list of ingredients but omit proportions. Sometimes an included fertilizer is noted, without analysis.

The secret to buying packaged mixes is selecting one with all ingredients listed and percentages given. Thus, if acidity of sphagnum peat moss is needed for plants susceptible to iron chlorosis, the gardener can so choose. Every label should indicate the range of pH. Perlite is often used to improve drainage; it may not be desirable for some monocot foliage plants because of high fluoride content. However, if the growth medium pH is not already at the upper limit for the particular plant, adding some additional pulverized limestone will help tie up the extra fluoride. If fertilizer is included, the label should state analysis and length of time nutrients are expected to be available. Some slow release materials may supply fertilizer elements for six or more months; other formulations may be depleted in four to six weeks. With complete label information, one can turn to the literature with a chance to unlock both the science and secrets of potting soils.

The garden supply industry now owes consumers a complete and precise labeling standard. Failing that, regretfully, there ought to be a law!

For several years the University of Georgia Cooperative Extension Service has distributed Gerald Smith's report of an artificial soil mix developed by Cornell and made with materials easily available to home gardeners:

- 1 bushel shredded peat moss
- 1 bushel perlite or vermiculite
- ½ cup finely ground agricultural lime
- ⅓ cup 20 percent superphosphate
- ½ cup 8-8-8 or similar analysis mixed fertilizer
- 1 level teaspoon chelated iron.

This amount will make two bushels of mix. With minor differences, it has almost the same ingredients and proportions as advised by Henry Cathey in the *American Horticulturist* article, "Planting in Containers" (Vol. 56 #3).

Smith explains that "artificial mixtures are usually very low in trace or minor elements. Therefore it is more important to use a fertilizer that contains these trace

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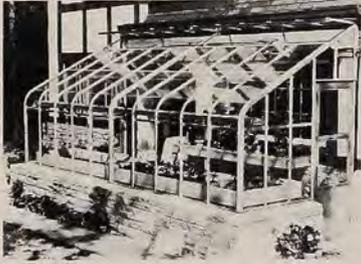
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THE INDOOR GARDENER CONT'D

elements than when plants are grown in soil." Uniform mixing is important, and moistening peat moss, vermiculite or perlite helps. Adding the chelated iron to the water is the best way to ensure uniform distribution. The home gardener must remember that artificial mixes do not hold fertilizer against leaching as well as loam's colloidal particles. After a month or two, plants potted in the Cornell formula will need fertilizing on a continuing schedule. Experience with a plant in its location, affected by light, temperature and humidity, must dictate the frequency, amount and analysis of fertilizer applied. One scientist recently advised using commercial house plant fertilizers at half the strength and twice the intervals suggested on their labels. (Why not change the labels and build profit from satisfied customers?)

Experience is also the key to watering artificial mixes properly. Vermiculite and peat hold moisture longer than a mixture containing perlite. No mix should become shrunken and crisp before watering. Dried-out peat moss is hard to moisten again, but a safe horticultural wetting agent added to the water helps the mix to absorb moisture. Plants must not stand in soggy pots, and home gardeners have trouble with leaching as effectively as greenhouse growers. Commercial growers water enough to wash fertilizer through the soil at every watering. Minerals not held on mix particles flow away into the drainage system, preventing build-up of fertilizer salts. Plants growing at home in closed containers or standing in an undrained saucer cannot lose these excess salts. So the gardener must take care to drain excess water and avoid overfeeding.

Growing plants in mixes containing loam, however, has not passed from the scene. The University of Minnesota's teaching collection of foliage plants is potted in a mix of equal parts soil, sphagnum moss, peat and coarse sand, enriched with 0-20-0 fertilizer, and heat treated to remove organisms. Because there are so many plants in the always scarce greenhouse space, pots are fertilized at monthly, or longer, intervals. The solution is a liquid 20-20-20 (NPK). The collection is watered with ordinary city water, containing chlorine and fluoride. Light conditions are usually excellent. Plants are grown for easy maintenance, with repotting done only when roots climb out of the tops of pots or through the drain holes beneath. Plants are usually repotted in pots one or two

sizes larger. Fresh soil of the original 1-1-1 pasteurized formula is used to fill the extra space. Not all the plants would win best in show, but they are in constant danger of being handsome enough to be stolen away without locks and vigilance.

The garden supply industry now owes consumers a complete and precise potting soil labeling standard. Failing that, regretfully, there ought to be a law!

Heat treated mixes containing loam can be bought from some garden supply outlets or greenhouses, and industrious gardeners can make their own. Pasteurizing loam is important. It is not hard to bake a small amount of moist soil in a shallow metal pan. A meat thermometer can be used to show when the temperature in the center of the soil mass has reached 160°F, where it should remain for 20 minutes. This baked loam will not smell like fresh bread, so peace-loving gardeners wait until unsympathetic family members are not at home.

The soil mixture advised by Richard Widmer, University of Minnesota floriculturist, for most house plants is:

- one to two parts garden soil
- one to two parts organic matter
- one part sand (particle size similar to salt)

He explains that one cup of steamed bone meal or 20 percent superphosphate (or ½ cup treble phosphate) should be added to the mixture. Organic matter may be either rotted manure, leaf mold, humus or acid (sphagnum) peat moss. If organic matter other than sphagnum moss is used, the quantity should be limited to one part. Widmer suggests that perlite may be substituted for sand except for "a few plants such as dracaenas and chlorophytums."

Widmer offers additional variations: "If you use peat moss, substitute a fertilizer such as 5-10-5 for the bone meal or superphosphate. If the garden soil is light or sandy, substitute peat moss for the sand or perlite. Acid peat moss should be used as the organic matter source for acid-lov-

ing plants such as azaleas, camellias, gardenias and citrus. A higher proportion of sand (up to 40 percent) is advisable for cacti and succulents."

Subsequent fertilizing for plants growing in this soil mix should follow the same careful observations as mentioned for synthetic mixes.

No matter which kind of growing media the gardener chooses, fertilizing can be done carefully enough to avoid constant repotting. Carefully chosen, often expensive, containers complementing both the plant and a room's furnishings are not conveniently replaced. Culture for minimum growth but handsome plants may be just as desirable as in a space-short greenhouse. The fertilizers added to both the mixes from Cornell and Minnesota will last from six to 12 weeks, but leaching and root uptake will require a new schedule after that time. Choose a quickly available liquid or water-soluble fertilizer, or stretch out the time with a liquid or dry, slow-release formulation. Learning to read the plant as well as the label will tell you how much and how often to fertilize.

The ordinary practice of watering also must be guided by an understanding of plant science, a keen eye and inquisitive fingertips. A thirsty plant usually signals the gardener with wilting leaves, too late for best care. Overwatering can produce the same wilting, because roots need air to function and it is not available in saturated soil. Many a plant lover at some time has repeated a dousing when drying would have saved a favorite specimen. When in doubt, experienced gardeners push fingers into the soil, and if damp particles stick to their hands, they wait to water.

Watering also affects the availability of nutrients, as has been noted. Plant roots take up minerals from the surfaces of soil particles, rarely from freestanding water in the soil. Fertilizer elements in this freestanding water are flushed away as the soil drains, even in a properly watered root ball. This is the reason that plant nutrition must follow a fairly regular schedule to replace those elements used by the plant and those elements flushed away during watering.

One mechanical problem remains. What about the plant whose roots have filled the liner of a priceless jardinière, perfect in its indoor setting? Fine plant, fine pot, but one has outgrown the other. If top growth can be selectively pruned away to match removal of edge-of-the-ball roots

(as is done in bonsai work), still leaving an appropriate shape and structure, then plant and pot can continue their close relationship. Clean hands, sterile pruning tools, re-sterilized liner and pot are part of the surgery. A recovery period in intensive care in a cool, well-watched room is helpful.

When repotting in a larger container is preferable, root pruning is not necessary unless there are broken tips to trim. Widmer advises removing the shoulder of soil around the top of the root ball, and any loose mix. A gradual, squeezing motion will remove soil without breaking young, white roots. Roots at the base of the ball can be loosened. Fresh soil mix should be put into the bottom of the pot, over the usual charcoal, sterilized potshard or stone to prevent losing soil through the drain holes. Firm fresh soil around the sides of the root ball after the plant is placed in its new pot. Open channels through the mix are always undesirable. Every pot needs some space at the top for watering, 1½ to 2½ inches, depending on the size of the pot.

Whenever repotting is done, cleanliness and sanitation are necessary. Wash new plastic pots with dishwashing liquid to remove any film and dust. Soak new clay pots in clean water to be moist enough so as not to absorb water from the soil mix. Any pot being re-used should be washed and disinfected. A soak in one part liquid chlorine bleach to nine parts water for five minutes will kill disease organisms. Dry the pot before using it. Potting tools, plant labels and the gardener's hands should be just as clean. Sanitation is an important part of growing indoor plants, as any greenhouse expert will advise. Trainees are usually set to washing pots, not as hazing, but to give them immediate respect for cleanliness.

Some aggregation of scientists, or perhaps a remarkable visionary, may in the future proclaim one final solution to all potting practices and problems. (Should that occur, most gardeners may not leave well-trod ways.) But in the meantime, fine plants can be grown if gardeners remember that they need water, nutrients and air in potting soil, along with appropriate light and temperature. A known soil mix and a known fertilizer are essential for intelligent plant care. Science and good gardening instincts are then bejoined together to increase the grower's skill. ☉

—Jane Price McKinnon

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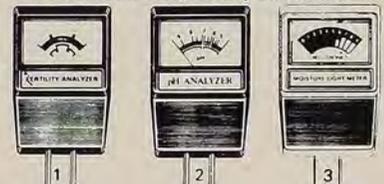


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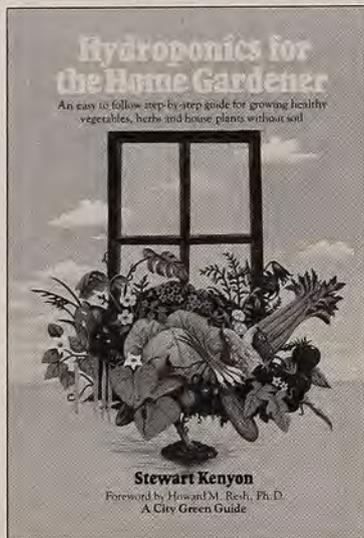


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HYDROPONICS FOR THE HOME GARDENER. Stewart Kenyon. Van Nostrand Reinhold Company. New York, New York. 1980. 146 pages; paperback, \$6.95. AHS discount price, \$6.10 including postage and handling.



This very clear and simple introduction to hydroponics should allow any interested individual to succeed with a simple indoor hydroponic garden. Specific suggestions on suitable vegetables and herbs, as well as clearly illustrated mechanical suggestions, should enable even the most unmechanical gardener to enjoy a substantial year-round crop with only limited space and equipment.

THE HOW AND WHY OF BETTER GARDENING. Laurence Manning. Van Nostrand Reinhold Company. New York, New York. 1957 (paperback 1980). 239 pages; paperback, \$4.95. AHS discount price, \$4.70 including postage and handling.

This is a botany book written for gardeners by a nurseryman. The well-written explanations of how and why plants grow are presented in terms clearly understood by anyone. The information presented can't help but make a better gardener out of any reader.

THE POCKET GUIDE TO INDOOR PLANTS. George Seddon. Simon and Schuster. New York, New York. 1979. 144 pages, softcover, \$4.95. AHS discount price, \$5.70 including postage and handling.

The pocket-sized format plus the descriptions, illustrations and cultural directions

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for about 350 popular house plants enable this little book to serve two functions. In addition to its obvious use as a reference work, this is a good book to take with you when you go shopping for more house plants. A quick referral will give you all the information you need to make a proper decision as to whether or not to add a new plant to your collection.

OF REGIONAL INTEREST

THE GARDENER'S CALENDAR FOR SOUTH CAROLINA, GEORGIA AND NORTH CAROLINA. Robert Squibb. University of Georgia Press. Athens, Georgia. 1980 (first published in 1787). 189 pages; hardcover, \$9.95. AHS discount price, \$10.20 including postage and handling.

WILDFLOWERS OF THE OUTER BANKS—KITTY HAWK TO HATTERAS. The Dunes of Dare Garden Club. University of North Carolina Press. Chapel Hill, North Carolina. 1980. 165 pages; paperback, \$6.95.

GARDEN GUIDE TO WOODY PLANTS. Sally L. Taylor. The Connecticut Arboretum. New London, Connecticut. 1980. 102 pages; paperbound, \$2.50 plus 60¢ postage.

NATIVE PLANTS FOR USE IN THE CALIFORNIA LANDSCAPE. Emile L. Labadie. Sierra City Press. Sierra City, California. 1978. 251 pages; paperbound, \$8.95. AHS discount price, \$8.85 including postage and handling.

ATLAS OF THE FLORA OF PENNSYLVANIA. E.T. Wherry, J. Fogg and H. A. Wahl. Morris Arboretum of the University of Pennsylvania. Philadelphia, Pennsylvania. 1979. 390 pages; paperback, \$9.95 plus \$1.50 postage.

SOUTHERN LIVING GARDENING—TREES AND SHRUBS, GROUNDCOVERS, VINES. Southern Living Magazine Staff. Oxmoor House, Inc. Birmingham, Alabama. 1980. 260 pages; hardcover, \$17.95. AHS discount price, \$14.30 including postage and handling.



Each of these books is of particular interest to residents of a limited portion of the United States. In each case either the title or the publisher's location clearly indicates the regional interest. All of the titles are self-explanatory and each book is considered by this reviewer to offer good value for the money and to be worthwhile for gardeners in the region.

PROFESSIONAL PUBLICATIONS

GREENHOUSE MANAGEMENT. Robert W. Langhans. Halcyon Press. Ithaca, New York. 1980. 239 pages; hardcover, \$14.50.

PRODUCING VEGETABLE CROPS (3rd Edition). George W. Ware and J.P. McCollum. Interstate Printers and Publishers, Inc. Danville, Illinois. 1980. 607 pages; hardcover, \$14.60. AHS discount price, \$12.90 including postage and handling.

TURFGRASS MANAGEMENT. A. J. Turgeon. Reston Publishing Company. Reston, Virginia. 1980. 391 pages; hardcover, \$15.95. AHS discount price, \$14.80 including postage and handling.

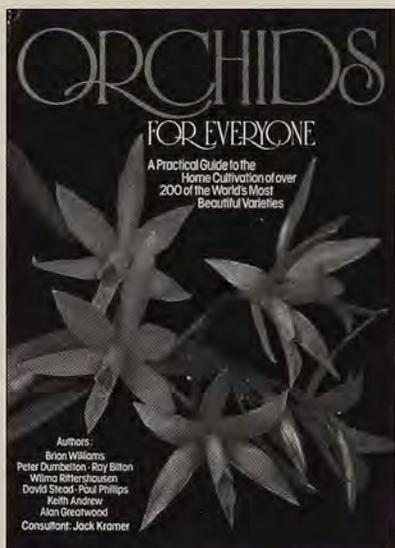
All three of these books are intended as textbooks for university courses aimed at the training of professional horticulturists. As such, they deal mainly with production on a commercial scale rather than the more

limited activities of the home gardener. However, these texts and others like them, when intelligently interpreted for the home gardener's reduced scale, can provide a wealth of information and an understanding of basic principles which can greatly benefit even the most limited home gardening efforts.

MORE ORCHID BOOKS

MINIATURE ORCHIDS. *Rebecca Tyson Northen.* Van Nostrand Reinhold Company. New York, New York. 1980. 189 pages; hardcover, \$26.95. AHS discount price, \$20.10 including postage and handling.

ORCHIDS FOR EVERYONE. *Brian Williams et al.* Crown Publishers. New York, New York. 1980. 208 pages; hardcover, \$15.95.



ORCHIDS, THEIR CULTIVATION AND HYBRIDIZATION. *Lee Chew Kang.* Eastern Universities Press. Singapore. 1979. (Available through International Scholarly Book Service, Inc. Forest Grove, Oregon.) 94 pages; hardcover, \$15.00. AHS discount price, \$13.25 including postage and handling.

Northen's *Home Orchid Growing* has been the number one primer for orchid fanciers for many years. *Miniature Orchids* is a work of comparable quality and should be the second book purchased by anyone interested in orchids. As the title indicates, all of the hundreds of species described are miniature plants (under six inches in height),

so that many different kinds can be enjoyed in a very small space. Cultural hints, well-written descriptions and lots of black and white and colored photographs introduce the reader to a broad selection of the highly varied members of the orchid family.

Orchids for Everyone is a well produced and beautifully illustrated guide for the beginning orchid grower. If you have a friend or relative who has shown any weakness toward the orchid mania, this book would probably tip the tables and lead them to a fascinating, life-long hobby.

Kang's *Orchids* has the usual introductory chapters on background and cultivation. Its real value, however, lies in the descriptions, lists of hybrids and excellent colored illustrations of *Phalaenopsis*, *Vanda*, *Arachnis*, *Ascocentrum* and *Renanthera* orchids which are so popular in Southeast Asia. For the advanced orchid grower or orchid book collector, this is a worthwhile addition to the library.

A COLONIAL NURSERYMAN'S CATALOGUE—BULBOUS FLOWERS. *Henry Budden.* Oxford University Press. New York, New York. 1980. 109 pages; hardcover, \$15.95. AHS discount price, \$15.60 including postage and handling.

Henry Budden was a 19th-century nurseryman in New Zealand. This little book is a well produced, full color facsimile edition of an 1880's catalogue of introduced bulbs together with contemporary descriptions. A biographical essay by his granddaughter puts the whole work in perspective and opens up another of those often missed insights into the history of horticulture and the love of plants. Definitely a collector's piece.

PLANTS OF THE GODS. *Richard Evans Schultes and Albert Hofmann.* McGraw-Hill Book Company. New York, New York. 1980. 192 pages; hardcover, \$34.95. AHS discount price, \$32.70 including postage and handling.

This beautifully produced and sumptuously illustrated book has been written by a botanist and a biochemist. It will undoubtedly become required reading for all anthropologists. It is an in-depth study of the way in which men have used more than 90 hallucinogenic plants in various cultures of our world. Historical, phys-

iological and anthropological details tell a story that should hold fascination for anyone interested in plants.

THE ENGLISHWOMAN'S GARDEN. *Alvilde Less-Milne and Rosemary Verey (editors).* Merrimack Book Service. Salem, New Hampshire. 1980. 156 pages; hardcover, \$24.95. AHS discount, \$17.95 including postage and handling.



The story of 36 beautiful English gardens is told by each owner—plant likes and dislikes, climatic and architectural problems, gardening practices, as well as the history of each garden make for a series of interesting accounts. The many colored photographs show the end result. Of particular interest to me were the large number of these gardens that had been developed or rejuvenated since World War II. Like a pleasant walk through a garden with its owner, this new work should give you lots of ideas and inspiration. ☼

—Gilbert S. Daniels

Error: In the June/July issue, the discount price for *An Illustrated Treasury of Orchids* was listed incorrectly as \$23.25. The correct discount price for this book is \$15.61.

Instructions for ordering books by mail: Send orders to the attention of Dotty Sowerby, American Horticultural Society, Mount Vernon, VA 22121. Make checks payable to the Society. Virginia residents, add 4% sales tax. When a discount price is not listed for a book, please add \$1.25 to the price listed to cover the cost of mailing and handling.

THE MADDER FAMILY

FIRST OF A TWO-PART SERIES



Illustration by Alice R. Tangerini

The madder family is so closely associated with history and commerce that it is difficult to decide which dramatic member or historic connection should take precedence in recounting the family story. Coffee, quinine, dyes and medicines are all derived from plants of this family. Alto-

gether, there are about 5,000 species—trees, shrubs and herbs. Although the family is generally considered more important commercially than from a garden standpoint, some of the species with showy flowers, such as the gardenia, have economic value too, and they certainly add a wealth of

beauty and fragrance to the gardener's world.

Some of the identifying characteristics of the madder family are: leaves opposite or whorled; stipules (leafy appendages) present and sometimes fused and leaflike; the flowers, growing in clusters or sometimes in globose heads, composed of four or five sepals, four or five petals, four or five stamens and a simple style. The fruit may be a capsule, berry or drupe.

Quinine is one of the prominent examples of the economic utility of plants of this family. The discovery of quinine is said to have been as important in the history of medicine as was that of gun powder in the history of war. The source of quinine is the bark of several species of the genus *Cinchona*, evergreen trees native to the Andes and belonging to the madder family, the Rubiaceae.

Lost in unrecorded time is the true tale of how a Peruvian Indian found that the bark of certain trees, cinchonas, could be used to produce a preventive and palliative for the chills and fevers of malaria.

Legends have grown about how the secret of *Cinchona* passed from the Indians to the Spanish conquerors. Eighteenth- and nineteenth-century history records the attempts and successes of the French, Dutch and British to bring plants and seeds out of South America to establish vast plantations in their Far East colonies.

As the bark of cinchonas, known as Peruvian bark, moved into medicine and commerce, it was destined over the years to save millions of lives and relieve immeasurable suffering.

Laboratory synthesis of quinine, which is an alkaloid of the bark, was achieved in 1944; along with other synthetic drugs developed during World War II, it almost replaced quinine. However, during the 1960's, several strains of malarial parasites developed resistance to synthetic drugs but remained sensitive to quinine. Quinine was therefore reinstated in some parts of the world as the drug of choice.

Persons with a caffeine dependency may be of the opinion that coffee should head the list of important family members. It is an alkaloid derivative of the coffee bean

and is used as a stimulant. Trade in coffee is of major importance to the economy of some nations. And in many instances, the Rubiaceae is identified as the coffee family.

The earliest known cultivated coffee is *Coffea arabica*, which is reputed to have originated in Ethiopia. Most of the 25 species of *Coffea* grow wild in the tropics of the Eastern Hemisphere. *Coffea arabica* is now cultivated as a crop plant chiefly in Latin America. Temperate zone gardeners know it as a sizable pot plant boasting glossy, dark-green leaves with wavy margins and small, white, fragrant flowers which even "in captivity" can produce colorful red berries.

The dye plants in the madder family are chiefly *Rubia tinctorum*, madder, and *Uncaria gambir*, gambier. It is from the genus *Rubia* that the family takes its Latin and its common name. Madder is grown for the red dye which is extracted by grinding the root. A long economic and socio-cultural history is associated with the production and use of this dye.

Madder dyeing of cotton originated in India; from there it was transmitted to other parts of the East and became known as Turkey red—the traditional color of the Turkish fez. It was eventually carried to Europe by the French. Turkey red was one of the most sought-after colors of the 19th century.

In Europe, madder became a plant of great economic importance. It was a principal source of wealth in Holland during the 15th, 16th and 17th centuries. We are told that the French Revolution ruined French madder farmers, who were by then top producers, and that they were later rescued by a decree of Louis Philippe, which made red caps and trousers mandatory for his army. In England, imported madder was used for dyeing the red British army uniforms.

Madder was never cultivated to any great extent in America although Thomas Jefferson urged it, as did Bernard McMahon, noted American horticulturist of the early 19th century. The madder used in the United States was imported from Holland and France.

The year 1869 marks the end of large-scale production of madder, for it was in that year that artificial madder dye was synthesized and fields of madder were abandoned.

Madder dye is gone, but sweet woodruff

(*Galium odoratum*), an herb of the madder family that grows in many gardens, is a potential substitute as a fairly good source of red dye in some recipes.

A related dye plant, gambier (*Uncaria gambir*) was used in black-silk dyeing as

The discovery of quinine is said to have been as important in the history of medicine as was that of gun powder in the history of war.

late as the first quarter of the 20th century, mainly because it could be applied along with metallic salts in weighting silk. The resinous astringent extract of *Uncaria* is used medicinally as well as in dyeing.

Medicinal or healing properties of plants of the madder family are described in most early references and records of use of these plants. The dried rhizomes and roots of a Brazilian herb, *Cephaelis ipecacuanha*, are the source of ipecac, used medicinally to promote sweating and for gastric complaints. In the native tongue, ipecacuanha means "roadside sick-making plant."

In the Rubiaceae there seems to be something for everyone. Over 60 genera are listed as cultivated plants. Coffee, quinine and dye plants are in a utilitarian category. But the economic worth of the ornamental group is also considerable.

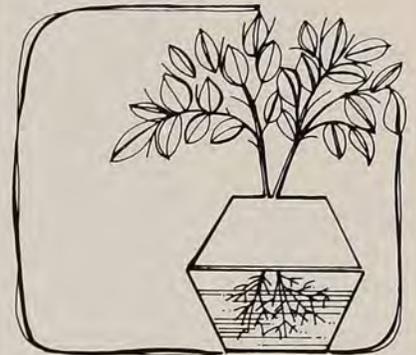
The array of ornamentals includes plants for outdoor culture in frosty regions; a hardy shrub with fragrant flowers; many valuable, colorful, tender species for the greenhouse or outdoors in warm climes; a rare shrub native to the southeastern United States; a couple of small woodland subjects and a creeping herb grown as a pot plant novelty.

Whether you like the exotics, prefer house plants, emphasize native plants, seek a rock garden or herb garden, or want one gardenia, this family can supply it and present multiple choices for further temptation. A future column will give attention to the diversity of the ornamental species of Rubiaceae to bring full circle the contrasts of the strange relatives in this family. ☼

—Jane Steffey

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Broad-leaved Evergreens

Now that the energy squeeze is forcing many of us into smaller homes, our gardens are becoming smaller, too, but nevertheless, people want interesting plants about them. Even time for gardening seems to be diminishing. For these reasons there is nothing better for small space gardens than the broad-leaved evergreens—those plants that have green foliage all year, many of which need only minimum care to be kept looking their best.

TEXT AND PHOTOGRAPHY
BY DONALD WYMAN

Many of these evergreens have interesting flowers and fruits as well as varied leaf texture, which is always an asset. Unfortunately, there are fewer species of evergreen plants in the North than there are



in the South, but altogether there are a good many varieties from which we can choose.

Everyone knows the boxwoods that luxuriate in the South, yet there are a few varieties that will withstand temperatures of -30° F in the North. One, named 'Vardar Valley', grows about two to three feet high and three to four feet across in 20 years. It is a variety of the more tender English box (*Buxus sempervirens*) and was first found in the Balkans in 1935. Another is the variety 'Welleri', selected by the Weller Nursery of Holland, Michigan, which withstands the same temperatures and is of about the same height and width

as 'Vardar Valley'. A third is 'Inglis', a Midwest selection introduced about 10 years ago. Admittedly, these are not offered by every nurseryman, but they are available and are worth searching for by Northerners who want box in their foundation plantings.

An excellent groundcover now becoming available is the 'Skogsholmen' cotoneaster, a selection first introduced in Sweden about 20 years ago. An excellent planting of this foot-high, small-leaved evergreen can be seen in the Royal Botanic Gardens at Hamilton, Ontario, Canada. 'Skogsholmen' is well worth trying, for it has glossy foliage all winter.

The winter creeper (*Euonymus fortunei*) and its several varieties of low evergreen forms make fine groundcovers. Some have very small leaves like 'Minima'; others have larger leaves like 'Colorata', which turn purplish in the fall and retain this color all winter. The old-fashioned favorite *E. vegeta*, or evergreen bittersweet (now classified under *E. fortunei*), is hardy as far north as Boston, but sometimes it may lose its leaves during severe cold. There

Continued on page 36

Two broad-leaved evergreens which are ideal for many small space gardens are left, *Pieris japonica*, and right, the rhododendron cultivar 'Album Elegans'.



PADUA

TEXT AND PHOTOGRAPHY BY DAVID W. LEE

In the shadow of the great Basilica of Saint Anthony of Padua is a modest garden whose importance goes far beyond its two hectares of land. The botanical garden of Padua was founded in 1545 by officials of the Medical Faculty of this Italian city's famous university, where Galileo taught and where Petrarch and Dante wrote. Many private gardens were founded earlier by individuals and royalty, but they were at most collections of interesting and attractive plants. The garden at Padua was the first scientific institutional garden, and it is by far the best preserved. Today it conserves the same organization and original stonework. A visit to this beautiful little garden is a visit to the scientific foundations of the European Renaissance, providing clues to the curious as to how the science of botany developed during that time.

Professor Franco Bonafede, who occupied the first professor's chair in Europe specifically designated for a lecturer on medicinal plants, founded the garden as a means of demonstrating medicinally valuable plants or "simples." In those times there was little love lost between apothecaries and physicians. The latter often accused the former of substituting cheaper and less potent plants and not even knowing the identifications of other medicinal plants. Thus the garden at Padua was a teaching tool to help young physicians recognize medicinal plants. Botany as a scientific discipline developed out of this concern about medicinal plants, with its first publications being herbals.



ABOVE: The main entrance to the Padua garden. RIGHT: The circular wall of the original garden, with the greenhouse protecting Goethe's palm on the left.

Padua was an important city in the 16th century. It had fallen under the influence of the powerful city-state of Venice in the previous century. Since Venice had no university, that of Padua became the intellectual center of the Venetian Empire. Medical students came from all over Europe to study at Padua, and they had ample opportunity to become familiar with the garden. Soon its fame spread throughout Europe and other universities started their own: Pisa two years later, Leiden in 1587, and Montpellier and Heidelberg in 1593. From its very beginning the garden at Padua became a valuable teaching resource for generations of medical students. Even today the main entrance pre-

serves the original regulations, admonishing visitors not to break branches, pick plants, walk on the flower beds or disobey the director. These rules were written in Latin, a language which all students and other visitors understood, as it was the scientific language of the Renaissance.

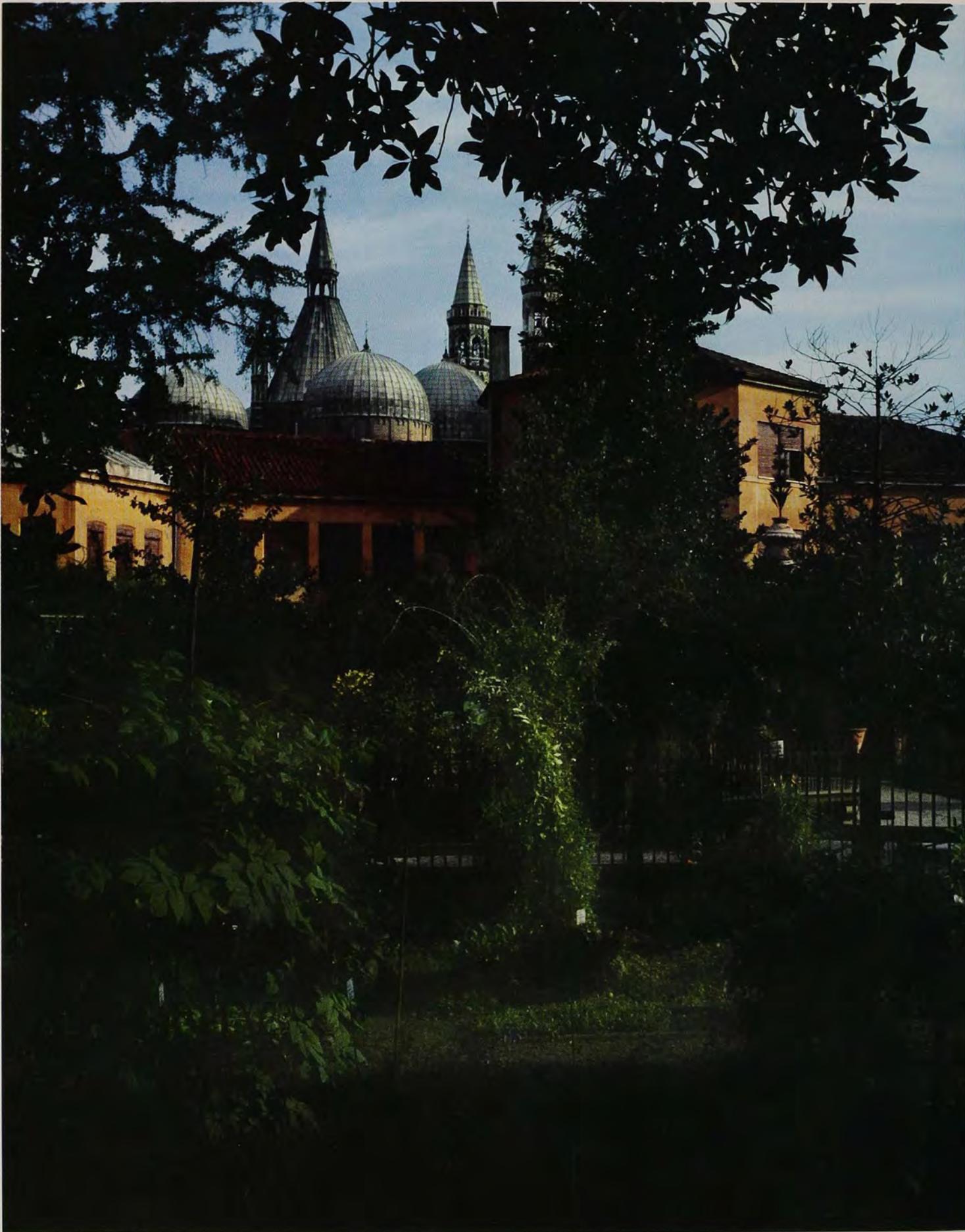
The garden also became a repository of the strange and exotic plants brought back by Venice's wide-ranging merchants and the university's alert faculty. This was the age of exploration, and expeditions not only searched for mineral wealth but also for new plants, which might become sources of medical treatment, dyes, perfumes, spices or food. After all, Columbus' motivation for exploration was to find a short

route to the spices of the East, and the Dutch became a wealthy and powerful nation after breaking the Arab monopoly on the spice trade. Renaissance botanical gardens had a direct economic interest and importance, and the garden at Padua rapidly swelled from new additions brought back from the four corners of the world. The number of varieties of plants in the garden increased from around 1,500 in 1552 (officially some 1,200 varieties when the first catalog was published in 1591) to a maximum of some 16,000 species in the 19th century. Among early additions to the garden were the lilac (*Syringa vulgaris*), first introduced from Eastern Europe in 1565 and later spread over the rest of Europe; the sunflower (*Helianthus annuus*), brought from the new world in 1568; sesame (*Sesamum indicum*), brought from the old world tropics in 1590; and rhubarb (*Rheum rhabonticum*), brought from East Asia in 1612.

Perhaps the most important of Padua's contributions to the introduction of exotic plants was the potato (*Solanum tuberosum*). Brought back from the South American Andes, it was introduced to Padua in 1590 and thence spread to many other places in Europe. Even today one can see the small-tubered plants that must be very similar to those first planted almost 400 years ago, and only remotely resembling today's improved varieties.

Few of the garden's early plant introductions survive today. The oldest is an ancient chaste tree (*Vitex agnus-castus*) planted in 1550 and still growing next to







Perhaps the most important of Padua's contributions to the introduction of exotic plants was the potato. Brought back from the South American Andes, it was introduced to Padua in 1590.

the main entrance. A giant ginkgo tree was planted in 1750. The famous palm of Goethe, surrounded by its own cylindrical greenhouse, is well over 400 years old. This ancient specimen of the dwarf palm (*Chamaerops humilis*) was the pinnacle of Goethe's quest for the perfect and archetypal plant.

Besides illustrating the origin and development of botany during the Renaissance, the Padua garden also reflected the more general Renaissance passion for reason and order. The garden was filled with plants of medical importance and also with strange exotic plants that tickled botanical curiosity. These plants were planted in beds in a precise geometric pattern which exists intact today. The general organization of the garden was set out by the architect Giovanni Moroni, who was in the process of designing the neighboring church of Saint Giustina at the time the garden was formed. Today even the stones used to divide the parcels of earth are still in place, and these divisions define a tiny, orderly and circular world, aligned to the points of the compass.

Adjacent to the original gardens, and still in excellent condition today, exists what must be the oldest botanical institute, where first construction began in 1564. The Institute, presently devoted to such research as the physiology of algae and plant taxonomy and ecology, preserves additional insights into the early history of the garden and

Once inside the garden, the Basilica of Saint Anthony can be seen rising majestically in the background, partially hidden by buildings of the Botanical Institute.

the development of European botany. The library houses ancient books (some of the first produced by the printing press) and old collections of pressed plants whose labels predate the binomial scientific names of Linnaeus.

Padua is only a short distance from Venice, much less beautiful than the latter city, but interesting for its long intellectual and artistic traditions. For someone interested in horticulture, a visit to this small garden at Padua is a return to an era when the excitement of the Renaissance was causing a revolution in the ways that man viewed and studied plants. Few gardens have as rich a history, and none as early an origin as that at Padua.

How to visit the garden: Padua is less than an hour by bus or train from Venice. One can stay in Padua (there are many hotels) or easily make a day trip from Venice. The garden is about a five-minute walk from Padua's main tourist attraction, the Basilica of Saint Anthony. It is open weekdays and Saturdays from 9 a.m. to 12:30 p.m. and from 3 to 6 p.m., and on Sundays from 10 a.m. to 1 p.m. The garden is closed from the first of November to the end of March. More serious horticulturists who may want to visit the adjoining Botanical Institute and library, or visit the garden during the off season, should write the Director, Prof. Luigino Curti, Istituto di Botanico E de Fisiologica Vegetale, Via Horto Botanico, Padua, Italia, to make advance arrangements. The Institute (but not the garden) is closed during part of the summer. ☼



Malak

Bulbs That Last And Last

BY ISABEL ZUCKER

Every year for 32 years, usually during the last week in April, a 10-foot-long, not-too-straight row of narcissi starts to bloom in my front yard. These are of the variety 'Diana Kasner'—fragrant, with flaring white petals and palest yellow cups. They were the first bulbs planted in this garden.

I had bought 25 bulbs, thinking that to be "only a few" until I mentioned this to a friend, far wealthier than I, who said that she'd bought "only a few"—three—because she understood that this variety multiplied rapidly. She was so right.

These bulbs are crowded and should have been lifted, split and replanted long since, but every year I look at them and they are so pretty just as they are, with flowers crammed together, that I decide to leave them alone. After all, any plant that demands nothing and takes care of itself is an asset to any garden.

My six-acre garden is north of Detroit

in Michigan, in Zone 5b of the Plant Hardiness Zone Map published by the United States Department of Agriculture. Most winters the temperature drops to about -8°F , and occasionally we have a winter low of -15°F . Summer temperatures may go to 90°F , and we usually have a drought, which may last six weeks, in August or September.

The ice-age glaciers which once covered this area conveniently left five different soil types in this acreage, all of which test as circumneutral, about pH 6.5. Our house is built into a hill, the dome of a lateral moraine formed when a glacier pushed material to either side while cutting the valley below, with its stream, a part of the River Rouge system.

For all of these 32 years I have been planting and transplanting bulbs before, during and after our house was built, sometimes in autumn when they should

be planted, other times when they shouldn't according to the "experts," but mostly when I happened to have time and was able to discover where they were growing. This article is a sort of chronicle of which of my bulbs survived, how long they have stayed in my garden and my other experiences with them.

The same autumn that 'Diana Kasner' was planted a friend gave me, as a "new garden" gift, 25 bulbs of another narcissus named 'Clamor'.

Since I'd had to give my husband and son a sales talk to get them to dig the sod from this former farm and make a bed large enough for the 'Diana Kasner' bulbs, I planted those of 'Clamor' in individual holes in a wooded area where I had no heavy sod to contend with.

They bloomed nicely for the first five years and still send up leaves every spring, but there are now only occasional flowers. So you see, there is a big difference between bulbs that stay with me and bulbs that stay and *flower*.

The next few years were devoted to moving shrubs from the old garden to the new, and it wasn't until our house was finished that the next bulbs were planted. These were snowdrops, of which I dug a handful, split them and set them on either side of our brand new front doorstep. Since the house faces south these bloom extra-early, a week or more before others in the garden. And, through the years, they've seeded in a dozen different spots, seeming to favor light shade for their new abodes.

Those beside the doorstep never had been lifted or divided until the autumn of 1979 when my Chinese dogwood (*Cornus kousa*) planted at one side of the step died and had to be replaced. In digging the dead plant and making a hole for the new, I unearthed literally hundreds of snowdrop bulbs.

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Malak

FAR LEFT: *Anemone blanda* 'Radar'. LEFT: *Tulipa tarda*.

Many gardeners today, if they read enough of the horticultural literature available, are familiar with terms such as tissue culture propagation, meristem culture or a number of other names for plant propagation by new "scientific" cloning techniques (as opposed to the old cloning methods). But few gardeners really know how the process works. The principle is relatively simple, but the steps necessary to actually clone plants in such amazing numbers are complex, requiring laboratory standards of cleanliness and chemicals with names almost impossible to pronounce. In the interest of science, and in spite of these verbal obstacles, we asked authors Haramaki and Heuser to describe this cloning process step-by-step for our readers. Such technological developments make it apparent that the future is here—most likely, many of the plants purchased by gardeners today come not out of the ground, but out of a test tube.

Recently in the news we have been hearing about the possibility of cloning humans by taking a few cells from a person and producing one, a thousand or a million persons identical to the donor. In horti-

culture we have been doing this for centuries by taking cuttings and producing millions of new plants which are identical to the original plant.

In recent years horticulturists have been using only a few cells, or at least only a small section of tissue, to be developed into complete plants. Propagators place a sterile piece of tissue in a sterile nutrient medium and grow it under aseptic conditions. Variations of this process have been called meristem culture, mericlone, tissue culture, test tube plants, callus culture, short tip culture, single cell culture, anther culture, embryo culture, micrografting, somatic hybridization and a host of other names. Basically, these processes can be grouped under the term micropropagation since new plants are being reproduced starting with only a few cells in each case.

Plant tissue has been grown in aseptic culture for about 50 years; it has been only 20 years since these techniques have been used to reproduce complete plants.

There are a number of reasons for producing plants through micropropagation: one is to produce and maintain sources of

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Photography by Chiko Haramaki



Plant Propagation

The Future is Here



LEFT: Primarily herbaceous flowering and foliage plants are being micropropagated today. At left, tiny *Lythrum* and daylily explants are in the rapid multiplication stage. Each shoot can develop into a new plant as long as aseptic conditions, which inhibit bacterial or fungus growth that kills the developing plants, are preserved. ABOVE: The fully-grown daylily above, a product of tissue culture propagation, is indistinguishable from a daylily propagated by older methods.



Hardy Cyclamens

TEXT AND PHOTOGRAPHY BY PAMELA HARPER



“Hardy” is a relative term, with no precise meaning in a climate as varied as that of the United States. Florist’s cyclamen can be grown in San Francisco gardens. No cyclamen can survive a Minnesota winter. In between come several miniature species, of which *Cyclamen hederifolium* is the easiest and hardiest. In Zone 6 and up, you will have no problem growing *C. hederifolium*. In Zone 5 the scale is evenly balanced. Colder than that and the dice are weighted against you, but that outside chance just might come off in a very sheltered site.

This species, native to Greece and Italy, used to be called *C. neapolitanum* (of Naples), and it is still so listed in most books and catalogues. A 50-year-old cormlike tuber, flattened round in shape, will be larger than a saucer and bear upward of 100 flowers—a plant to bequeath to your heirs. Seeds average 20 to a pod, so the progeny of such a matriarch would number over a million. Such abundant increase ought to have resulted in gardens submerged in a sea of cyclamens, but few gardeners have seen one, let alone a hundred. Obviously, this plant needs publicity.

In my garden (Zone 8), *C. hederifolium* opens its slender, pointed buds from Sep-

tember through November. The flowers resemble those of the florist’s cyclamen, but are smaller and daintier, less than an inch across and held four inches above the ground. In her poem, “The Garden,” Sissinghurst’s Vita Sackville-West likened the twisted, reflexed petals to the laid back ears of a frightened baby rabbit (“Only the little frightened cyclamen with leveret ears laid back looks fresh and young”). The color, less variable than in other species, is a delicate, translucent pink, and the white form is a purer white than that of other species. In October the leaves emerge, enchanting in their varied shape and intricate triangular patterning in shades of green and silvery gray. They carpet the ground through winter, dying away in early summer.

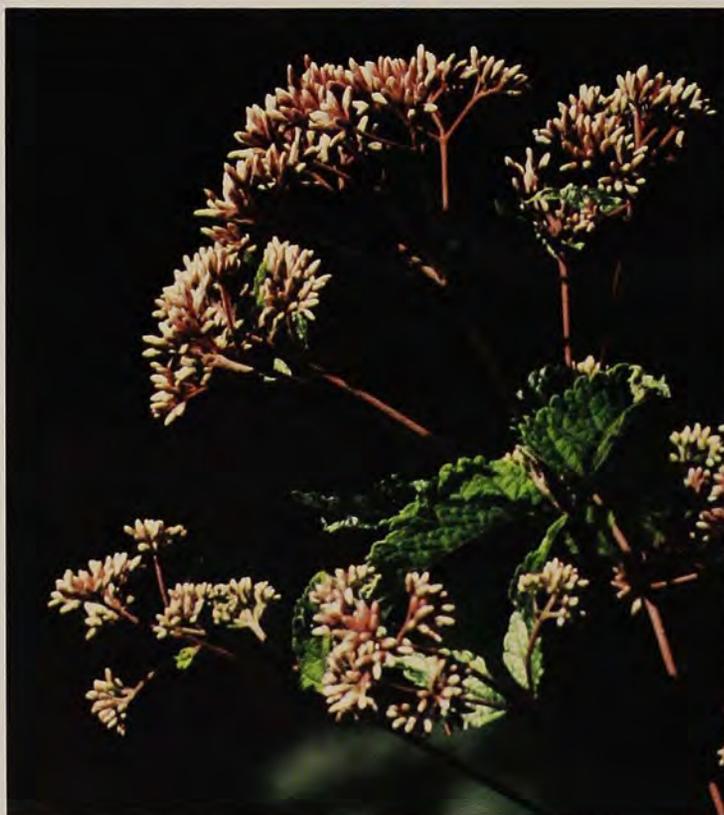
I was dismayed to read in a recent article the statement that this cyclamen should be planted rounded side up in damp soil. Cyclamens are rugged and take a lot of killing, but—upside down in the wet soil they abhor—that should do it. Planting

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LEFT: *Cyclamen hederifolium* photographed in Virginia (Zone 8). ABOVE: *Cyclamen europaeum* growing against a tree stump in a woodland garden in Seattle.

Summer Meadows

TEXT AND PHOTOGRAPHY BY MARTHA PRINCE



What is a meadow? “A tract of low or level land producing grass for hay.” That may be the dictionary definition, but how dull and utilitarian! I have searched my gardening and horticultural reference books in vain. To me, a meadow has to do with sunny summer afternoons and buzzing bees and flowers sprinkled in tall green grass. It is a place to spread a blanket, gaze placidly at acres of sunlight and do absolutely nothing.

This meadow is not the “Alpine meadow” (I can find some references to that). The plant treasures of the high meadows, such as those in the Rockies, are exquisite miniatures not easily usable except in perfectly maintained rock gardens or in cool greenhouses. A meadow, for most gardeners, should be something *possible*; after it is established, it should be easy to maintain. Most of the meadows I know were for hay once, but no longer are. Land that is stabilized as “open,” perhaps by long years of grazing, tends to stay that way. Wildflowers come into the grass, but trees are slow to encroach. A meadow started afresh will cost the gardener some time at the beginning; tree saplings will invade. A yearly mowing (or scything) in autumn will not be enough at first. The reward, however, can make the effort well worthwhile—something lovely and essentially work-free.

My favorite meadow is in Maine. A little dirt road dips between birch woods on both sides; it is so narrow that the slim birches meet for a canopy. This deeply shaded tunnel opens into a large oval of sunlit grass. The vista is unexpected, and a delightful surprise. The view from the main road gives no clue. We have owned the meadow for a

ABOVE LEFT: Yarrow, *Achillea lanulosa*.
LEFT: Joe-Pye weed, *Eupatorium maculatum*.
RIGHT: Oxeye daisy, *Chrysanthemum leucanthemum*.





What are good meadow flowers? I could answer, "Any kinds you want," and not be too far wrong. There are no rules.

dozen years but are not sure of its complete history. There was a farmhouse which burned more than 30 years ago (the stone cellar is still there), and we know from the deeds that the farm dates back for more than 100 years. Near the old foundation are currant bushes, a pear tree and some daylilies. The meadow is edged with a forest of oak, birch and spruce; within its boundaries are one oak, two beautiful clumps of white birch and three mounds of lilacs—one double purple, one single lavender and one white. The only thing we have had to pull out, in a real tug-of-war, is the invasive and stubborn *Spiraea latifolia* (known as meadowsweet or hardhack). In another location I might like it, but as a woody, twiggy plant it is not for a meadow. Meadows should be pleasant to walk in with sandals and bare legs. I do not know the grasses, but meadow grass should be soft; luckily for us, the grass there is perfect. We have some good flowers but want more.

In Georgia we have the beginnings of a meadow. This was never a grazed location, rather a long-ago tennis court and part of a lawn. How good a meadow it will make I cannot be sure, but so far there are at least no tree-invaders. This is true despite the surrounding oaks and Chinese chestnuts. At least five appropriate flowers are already blooming at the edges.

What *are* good meadow flowers? I could answer, "Any kinds you want," and not be too far wrong. There are no rules. It doesn't matter if you have both perennials and self-sowing annuals, both native wildflowers and naturalized aliens. They must be tall enough not to be buried in uncut grass, hardy for your climate, resistant to insect problems and disease, sun-loving, tolerant of imperfect soil conditions (you will not be fertilizing or liming) and attractive. Coarser growth habits than you would want in a garden border are quite acceptable. Of course, the flowers should all be "true to seed." You *want* the plants to go to seed, and there would be little point in buying special

hybrids or cultivars and having them revert. If you are starting a meadow from an old lawn or clearing, I'd suggest you let it grow untouched for a season, to see what is there. Seeds and plants are available at some nurseries; others can be collected along roadsides and in waste places. In autumn, I always seem to have my coat and jacket pockets full of seed envelopes! I'm sure I could, in one afternoon, dig at least a dozen species I like from the vacant lots, parking areas, ditches and construction sites. Such collecting is not harmful, as is the wanton digging of woodland wildflowers. This sort of treasure hunt can be fun. We once did a photographic series on vacant lots—billboards, junked cars, rear-ends of stores; the flowers we found were beautiful. A wildflower is a weed only when it is in the wrong place.

Here is a sampler of meadow possibilities. I am only choosing flowers I've liked in some of the meadows I know. There are many, many more.

● **Carrot—or Parsley Family**

Daucus carota, Queen Anne's lace, is an immigrant, but a most welcome one to America's roadsides and meadows. The flowers look like flat, white saucers, prettily sprinkled everywhere. Have you noticed that the tiny center flower in each circle is usually purple?

● **Loosestrife Family**

Lythrum salicaria, the purple loosestrife, may be called a pest by some, but to me this European immigrant is one of the handsomest plants for large meadows. Tall, with dense and striking terminal clusters of blossoms, it paints many New England meadows with color. In Massachusetts, the roadsides and low open hills where the loosestrife grows are very special. Loosestrife prefers moist locations, but I know several of its chosen habitats which are dry.

● **Pea—or Bean Family**

At least three of the genera in this family have species I'd want in any meadow—the vetches (*Vicia*), the lupines (*Lupinus*) and the clovers (*Trifolium*).

Vicia cracca, really a climber which seldom has anything to climb, is called cow vetch. The lavender pea-flowers are in long, dense clusters. With attractive,

delicate-looking segmented leaves and curly tendrils, it is another welcome alien. One often finds this planted by highway departments along road embankments. The look is soft, billowy and inviting.

Among the lupines, most gardeners grow only the Russell hybrids. Two native species, one eastern and one western (naturalized in New England), are my candidates for the meadow. First, *Lupinus perennis*. These flowers are usually blue, but may be found in pink or white. Larger is the Washington lupine (*L. polyphyllus*). I have waded waist-deep in these lovely flowers when visiting California; somehow they were introduced into Maine a long time ago and are quite common in the wild. There are annual lupines, also, and I would not want to offend any Texas readers by omitting *L. subcarnosus*, the bluebonnet.

Among the clovers, the loveliest for meadows is the red clover, *Trifolium pratense*. It is not red, but a light purple or a pinkish lavender. And oh, how fragrant! No wonder bees flock to it. I'm glad they do—one of the great breakfast pleasures is clover honey on hot biscuits. Emily Dickinson wrote: *There is a flower that bees prefer, And butterflies desire; To gain the purple democrat The humming-birds aspire.* Do not be prejudiced against it because of your battles with lawn clover, a low and very different species.

● **Primrose Family**

Plant names can sometimes cause confusion. In this family the genus *Lysimachia* is called "loosestrife," which is the English name of a quite different family (see above). Whorled loosestrife is a tall but unusually dainty plant; five-petalled yellow flowers having red centers are held out from the axils of the whorled leaves. This is *L. quadrifolia*. In our Maine meadow it blooms along the edges where it gets a bit of shade. Whorled loosestrife is native as far south as Georgia; I know it there in some hilltop clearings.

Lysimachia terrestris is aptly called swamp candles. This is for the damp meadow only, and the flowers (borne in

a dense, narrow spike) are showier than those of *L. quadrifolia*. The yellow candles are very pretty. Range is similar.

● Milkweed Family

Butterfly weed is one of the few meadow plants considered for garden use. *Asclepias tuberosa* has brilliant orange flowers, sometimes verging on red or yellow, which are arranged in umbels (as in "umbrella"). The flowers are fascinating to examine close up. Five petals are sharply reflexed downward below an upright crown, or corona. I have painted butterfly weed several times, but I can never include quite all the details. There are curved "horns" inside the corona which I can only capture if I enlarge the flower. Black butterflies would be the perfect addition to a photograph of butterfly weed, but somehow they always escape. You can find plants in many places where digging would be acceptable, but the roots are deep and tough. When I was a little girl, I was told the root goes all the way to China. Several nurseries list *A. tuberosa*, and I would suggest ordering plants.

● Mint Family

Here are several meadow possibilities. I would choose, first, *Monarda didyma*, the bee balm. Dense, shaggy-looking flower clusters are a strikingly brilliant red. If your area is host to the ruby-throated hummingbird, these will invite him to dine in your meadow. Much like *M. didyma*, except in color, is *Monarda media*, called purple bergamot. Both of these tall, native species are garden-worthy.

● Lobelia Family

If you have a moist location, nothing could be more striking in late summer and early fall than the brilliant red cardinal flower (*Lobelia cardinalis*). I give slide talks on wildflowers occasionally, and a projected photograph of a single flower always brings forth "ooohs" and "ahhhs." A picture appeared in *American Horticulturist* for fall, 1978 (Vol. 57, No. 5). The Georgia meadow in which the photograph was taken is a low, moist one. It is really a woodland clearing nestled in the curve of a small stream. There it grows with a blue companion, *L. puberula*. I prefer this species to the larger, coarser and showier *L. siphilitica* with which more people seem familiar.

● Daisy Family

This family, botanically the Compositae, has more appropriate flowers to offer



A Monarch butterfly on goldenrod (*Solidago* sp.).

the meadow gardener than any other, but then, it should. This is one of the largest family of wildflowers we have. The word "composite" explains itself. Tiny flowers of one kind form the disc, and flowers of another kind form the rays surrounding it. Take a look through a X8 magnifier at one of the flowers of a large-disc species; if you choose a fresh flower (with the ray flowers in good condition) the disc flowers will be closed. You will see that the arrangement is in neat spirals, an example of Nature's mathematical precision. There are so many genera and species that some exasperated botanists greet a plant, handed to them for identification, as "ADC" (Another Damned Composite").

The goldenrods (*Solidago* sp.) are easy to recognize as a genus but are almost impossible for the nonbotanist to separate into species. There are so many. Some are larger and showier than others; both growth habit and blooming times differ. One handsome, upright, terminal-flowered species is *S. speciosa*. A flat top is seen in *S. rigida*; in *S. caesia* the flower heads grow in little tufts all along the upper stem, at the leaf axils. *S. nemoralis* bears its flowers in a graceful, plume-like array. As these tough perennials grow in many neglected vacant city lots and numerous roadside ditches, it should not be too difficult to find and dig a plant or two you like. In a few years you may have more than you want.

Three other genera have yellow-flowered species most of us know. A favorite of mine is the fall-blooming golden aster (*Chrysopsis mariana*), which is not an aster at all. It is one of the flowers waiting at the edge of our meadow-to-be in Georgia. I like *Coreopsis auriculata* for a bit of early-summer gold. The most-loved of the coneflowers is *Rudbeckia hirta*, the black-eyed Susan. This happy species brightens meadows all summer long and well into autumn. I have painted the cheerful, sunny faces several times. The most-loved of the asters is the New England aster (*Aster novae-angliae*). The beautiful, rich purple shames some of its good but paler or smaller-flowered relatives.

Chrysanthemum leucanthemum (the white-flowered yellow flower, by its name!) is our dear, familiar oxeye daisy. I imagine daisies are the favorite summer flower of most children, just as violets are in spring. I don't care that people pull them up or call a meadow of them a daisy field (a somewhat derogatory remark).

Achillea is another white composite I like. *A. lanulosa* (yarrow) has flat-topped flower clusters and fern-like leaves. A weed? Perhaps.

I like thistles (*Cirsium*), as do the bees and butterflies. A year or so ago I spent a frustrating afternoon trying to photograph a Monarch butterfly on a purple puff. I even poured sugar-water on it. No matter at which thistle I aimed

the camera, the self-willed butterfly sought another. However, the prickles make thistles wrong for a walkable meadow. Still, in the Composite family, a resemblance (at least in the pinkish-purple color, and in the puff effect of the flower clusters) can be had in some species of *Liatris*. These are called blazing-stars or gayfeathers. Northern blazing-star (*L. borealis*) is the one most "thistly" looking. Other species are nice too. Some have more closely-packed spikes of flower heads (as *L. spicata*).

The genus *Eupatorium* has several candidates. I like the white snakeroot (*E. rugosum*) with fluffy-looking white heads. It prefers the shady edges of the meadow. If cows or sheep should ever graze there, however, beware. Have you heard of "milk sickness"? The cows get sick and so would you if you drank their milk.

The Joe-Pye weeds are handsome, with sturdy-looking purple or pinkish flower heads, but they are a bit tall for any but large meadows. *E. maculatum* is attractive. It is listed, usually, for damp places. There is a lot of it in a damp meadow near our home on Long Island. I am especially intrigued by the purple-red stems with very rugose, deep-green leaves; I photographed, close-up, a portion of the stem with the lower parts of a few leaves. An enlarged print is quite interesting.

Cichorium intybus is the chicory, that bluest of all blue weeds. Admittedly, the growth is scraggly, but the flowers are as perfect a blue as you can find in any flower. It is an alien, but is at home anywhere and everywhere.

The hawkweeds (*Hieracium*) are European immigrants. Some really are weedy looking, but the color of devil's-paintbrush (*H. aurantiacum*) is a fine red-orange for good display. After all, in a meadow where intrusiveness is not necessarily a vice, weeds can be called wildflowers again. I certainly intend to allow them into our Maine meadow.

And that is enough for the daisy family!

I have listed perhaps only two dozen of the possible meadow plants. Even so, no meadow could have all of them. No one should. Some meadows may be bright, colorful and cheerful (perhaps with chicory, Queen Anne's lace and black-eyed Susans), or be peaceful, with just the green and white of grass and daisies. Meadows can be whatever you like or need the most. A meadow is a state of mind, I think. ☻

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MULCHES

Mulching is one of the most beneficial gardening practices, yet is one of the most neglected in the culture of landscape plants. Most herbaceous plants, even most trees and shrubs, benefit by a mulch, no matter how hardy they appear to be.

Mulches are used to conserve moisture in the soil, to retard drying and to slow the rate of evaporation. Organic mulches will absorb and hold water, and this attribute is especially effective during dry periods.

Mulches also help maintain a more uniform soil temperature by reducing the rapid changes that occur at the soil surface. The soil temperature under a mulch insulation may be five degrees cooler in summer than that of an unmulched soil. In winter, soil does not freeze so deeply under a mulch, which is important for shallow-rooted plants, for some evergreens and for those plants in areas of borderline hardiness. In unfrozen soil, the water needed by evergreens is still available. Alternate freezing and thawing in soils is reduced by the insulating effect of mulching, thus reducing damage to roots, which is important to shallow-rooted plants.

Other reductions in soil erosion and water runoff occur as a result of mulching. At the same time, mulches act to prevent crusting and compacting of the soil surface. Organic materials, particularly, help keep the soil surface loose as they protect it from puddling and packing during heavy rains. Since soil structure is not destroyed, good aeration is maintained. This improves absorption and percolation of water in the soil.

Humus (organic matter) added to the soil through organic mulches also influences physical properties such as soil structure, texture, aeration and waterholding capacity.

Weed problems also can be reduced when the mulch itself is weed free and is applied deeply enough to prevent weed seed germination or to smother existing smaller weeds. Such a practice saves the time and labor of hand weeding.

Mulches create a pleasing appearance in the landscape by providing a cover of uniform color and interesting texture. Dark-colored mulches serve as a contrasting



Photography by David F. Hamilton

Bark is an attractive and functional mulch for this planting in Winter Haven, Florida.

background to heighten the visual effect of flowers and plant material.

Fruit and flower quality also may be influenced by mulching. Fruits and flowers of plants such as strawberries, peonies, tomatoes and chrysanthemums, when mulched, are less prone to mud splattering during heavy rains and to infection from soil-borne diseases spread by splashing water.

Despite these beneficial effects, mulches have limitations and should be used properly. Mulches cannot smother large weeds. Neither can they diminish plant diseases and, with the possible exception of polyethylene film or aluminum foil, they cannot reduce insect attack. Rodents often find havens in mulches, especially during the winter.

Mulches do not have any marked influence on the mineral content of plants. However, depending on the nature of the mulch, the nitrogen content of soils may require corrective actions by the gardener. Organic materials, if they are essentially fresh and undercomposed, will be acted on by soil microorganisms and will utilize available soil nutrients in the upper soil layers. To avoid this competition, nitrogen must be added before applying the mulch. Partially decomposed organic mulches may not require extra nitrogen.

Time of Application

The time of year to apply mulching material depends on its purpose. Is it functioning as a growing mulch or as a protective mulch?

Growing or cultural mulches: These are normally applied during the planting and growing season. Most organic mulches are applied to established ornamental plantings in midspring when the soil has warmed sufficiently for active root growth. If you are applying an organic mulch to newly set vegetable or ornamental plants, do so after they are put into place and thoroughly watered.

Growing or cultural mulches may be partly or entirely removed at the end of their immediate usefulness (growing season), or they may be incorporated into the soil for their permanent effectiveness as humus. Seldom is their entire removal recommended.

Winter or protection mulches: These are applied in early fall or before the onset of frost to reduce winter injury to plants. In early spring as soon as new growth begins to appear and all danger of hard freezing weather is past, remove most of the winter mulching materials at two or three weekly intervals so that plants may become adjusted to their environment. This is particularly true with most herbaceous perennials, roses and newly planted shrubs and evergreens.

Characteristics of a Good Mulch

Each mulching material has its advantages and disadvantages, so it is you, the gardener, who must make the decision as to which to use. In general, a mulch should be economical and accessible, be easily applied, incorporated or removed, stay in place, and be relatively free of noxious weed seeds. It should not be offensive to you or neighbors, and should not harbor insects, diseases and rodents beyond your ability to control them.

Mulch materials will be either organic or inorganic. Organic materials vary from fresh materials to those well decomposed. They absorb and hold moisture and, when completely decomposed, they add small amounts of nutrients to the soil. The amounts are generally so small, however, that the mulch does not function as a fertilizer.

Organic Mulches

Leaves—whole or shredded—are used rather extensively in areas with many trees. They are probably the most inexpensive material available. Mix leaves with some other light material such as straw and make certain they are partially rotted before use.

This prevents them from becoming a compacted, soggy mess which will cause injury when applied over tender herbaceous perennials. Avoid leaves collected from streets frequently treated with oil or calcium chlo-

Mulches do not have any marked influence on the mineral content of plants. However, depending on the nature of the mulch, the nitrogen content of soils may need adjustment.

ride. Both oil and salt are toxic to plants. Very dry leaves can present a fire hazard. Leaves also harbor insects, diseases and weed seeds and rodents. Corrective action may be necessary to prevent depletion of soil nitrogen when using leaf mulches. For woody perennials and trees, leaves are probably one of the best short-term mulching materials.

Evergreen boughs or pine needles are usually recommended for winter protection of newly-set or somewhat tender ornamental plants. Though not always available, they are comparatively cheap in many areas. Pine needles decompose slowly, but they do increase soil acidity, which is beneficial for many plants. They are easily handled and give a very pleasing appearance. However, evergreen boughs or branches do constitute a fire hazard when dry.

Peat moss is a direct source of organic matter and can greatly improve the physical condition of soils. Sphagnum peat moss increases soil acidity, while hypnum peat moss is usually neutral or slightly alkaline, but it decomposes much faster and is less fibrous. Peat greatly increases the waterholding capacity of soils, but when the surface of a peat mulch becomes very dry, it will shed water, necessitating stirring. Carelessly tossed cigarettes can ignite peat, but it smolders rather than flames. Fine peat will often be blown away in windy weather, but chunky peat will hold. Self-seeding of some plants may occur in peat. While peat is usually easy to handle and has a pleasing appearance, it is often rather expensive.

One of the most versatile materials

available for use by the landscape gardener is bark. Because of its many gradations in particle size, the species from which it came and the variable treatment given it before marketing, bark may be successfully used for improving soil mix, adding organic matter to the soil, erosion control, decorative ground covering—for almost any purpose. Readily available in metropolitan areas at competitive prices, bark is most commonly found in three-cubic-foot bags, although certain types can occasionally be purchased in bulk volume from some garden centers. For landscape use, three grade standards have been adopted based on the particle size. The grades are decorative bark, soil conditioner and base or shredded bark.

Sawdust, wood shavings and other wood refuse are very commonly used in some areas. When available, they are usually relatively cheap. Nitrogen deficiency of plants is almost certain with sawdust mulches if fertilizer is not applied regularly. The alleged toxicity of sawdust is usually due to a nitrogen deficiency in the soil, which results from the microbial decomposition of the material. These materials should be decomposed two to three years before being applied, and a two-inch mulch is about the maximum for most plants.

Straw from wheat, timothy, oats, rye and barley can be used for winter protection and as a summer mulch. Though generally available and comparatively cheap, straw is highly flammable. Unless chopped into short lengths, it decomposes rather slowly. Humus is dramatically increased by straw mulches and, subsequently, so is the waterholding capacity of soil. Additional nitrogen applications are necessary to prevent nitrogen deficiency of plants mulched with straw. Straw does harbor insects, diseases, weed seeds and rodents.

Grass or lawn clippings can be used to a limited extent. They should be applied loosely because they mat when wet. Extra nitrogen fertilizations may be required. Lawn clippings often contain seeds of noxious plants such as dandelion, common plantain and crabgrass.

Manures, packaged and mixed, are sometimes used for mulching. Though a good soil builder, their disadvantages often outweigh their advantages. The source of supply is very limited and generally expensive. They may harbor insects, disease and weed seeds. Manure can be very ob-



Pea gravel, a decorative mulch, covers a series of steps adjacent to a planting in Columbus, Indiana.

jectionable to apply, as well as being unsightly. It also decomposes rapidly and has to be replenished frequently.

There are numerous other organic mulches available only in certain locales. These are often plant processing byproducts such as corncobs, hulls (cottonseed, chocolate, buckwheat, pecan, peanut), hops, tobacco stems, mushroom compost, paper pulp and leaf mold. Muck and poultry litter are also occasionally used. However, disadvantages of such mulches often outnumber the advantages. Most of these byproducts carry insects and diseases and harbor rodents. They often tend to have offensive odors and require extra applications of nitrogen.

Inert (Inorganic) Mulch Materials

Crushed stone, gravel chips and pebbles are materials that may be used for the effect they create. The material may be colored to blend in with features of the home, patio or landscape. When used near lawn areas, there is some danger that rotary mowers can "throw" the stones and cause injury. These materials are impractical for the vegetable garden.

Polyethylene film and polyethylene-coated paper are popular as mulches not only in the garden but also around the home where they are used underneath stones, wood chips or other such materials. Clear polyethylene should not be used because it allows weeds to grow beneath it. Opaque polyethylene is easy to handle and can be lifted and used more than one

season, especially if heavier plastic is used. However, it does crack easily, permitting weed growth. It is relatively expensive, and it is not biodegradable.

Newspaper and other shredded papers are sometimes used as mulch because they are readily available and inexpensive. However, some papers contain dyes which now are considered to be pollutants. Newspaper does decompose rapidly, but it should be incorporated in the fall or it becomes a rodent harborer.

Asphalt, as a light spray, and asphalt paper is sometimes used by landscape contractors, but it is impractical for the home gardener.

Fiberglass mats also are occasionally used. They are expensive and difficult to handle due to the eye irritation they cause.

Aluminum foil is used to some extent in vegetable plantings. Some claims of increased growth and increased insect resistance have even been made. This is probably due to the reflective effect and the increased light on the underside of the foliage. However, aluminum foil is expensive.

Mulches can be of invaluable help to the gardener, but he needs to know their advantages and disadvantages, the best time to use them and the type of mulch to apply for a given situation. By applying the information covered in this overview of mulches and their uses, every gardener should be able to benefit from their application. ☼

—David F. Hamilton

Continued from page 17

are also the dainty 'Gracilis' or 'Silver Queen' cultivars, both with white-marked leaves—always interesting for color variation wherever they are used.

The box huckleberry (*Gaylussacia brachycera*) is worth searching out also. It is rare, slow-growing and only about 18 inches tall. Ball shaped, it is very dense in habit and stands out in winter.

One plant that bears special mention, and it is only available today from one or two nurseries, is the dwarf form of the drooping leucothoe (*Leucothoe fontanesiana* 'Nana'), only about two feet tall and six feet wide after 20 years of growth. It has all the many excellent characteristics but none of the disadvantages of the native leucothoe—good, waxy, white flowers on the underside of arching branches in the spring and glossy, green foliage sometimes tinged with red, but smaller and less leggy than the native species. Though hard to come by, it is worth searching out and does not require renewal pruning as does the species.

For strictly acid soil areas the little, low, evergreen mountain cranberry (*Vaccinium vitis-idaea* var. *minus*) is a low, mat-like groundcover, requiring acid, moist soil. This plant is outstanding when its red berries are evident in the fall.

Such broad-leaved evergreens as rhododendrons and the native mountain laurel are grown in many places where acid soil is available. Special mention might be made of the efforts of the Weston Nurseries of Hopkinton, Massachusetts, which selects and grows some of the striking red-flowered forms of this native American plant. These will become the very popular varieties of the future, when present experimental efforts are completed for propagating these varieties asexually.

Other good evergreen choices for small gardens are old-fashioned favorites like the American holly (hardy north to Boston) and its close but not so well-known relative, the longstalk holly (*Ilex pedunculosa*), with leaves about the size and shape of those of mountain laurel. The longstalk holly is a tree form, eventually growing about 30 feet tall, with clusters of red, long-stalked berries that can remain on the tree all winter if there are not too many hungry birds in the area. A native of Japan, it is hardy in the same area as the American holly and is dioecious, so both male and female plants should be

grown to ensure berry formation.

Two other popular plants for the North should not be overlooked, namely the mountain andromeda (*Pieris floribunda*), which eventually grows about six feet tall, and the Japanese andromeda (*P. japonica*), about nine feet tall. The latter is the more interesting, with pendulous clusters of waxy, white flowers similar to those of blueberries, and glossy, evergreen leaves. The mountain andromeda has upright flower clusters and leaves that are not glossy; both species are supposed to grow well in either alkaline or acid soils.

Finally, for the northern gardeners, there are the cultivars of Japanese holly (*Ilex crenata*); some are low and moundlike in habit ('Helleri', 'Green Cushion' and 'Stokesii'), others are taller in habit ('Convexa' and 'Microphylla'). A 40-year-old plant of *I. crenata* 'Convexa' will become approximately nine feet tall and 24 feet across, and *I. crenata* 'Microphylla' eventually grows about 20 feet tall.

Fortunate are those who live in the South, for they have many broad-leaved evergreens from which to choose. First and foremost would be that glorious evergreen tree, the southern magnolia (*Magnolia grandiflora*), with leaves five to eight inches long and large, conspicuous flowers as much as eight to 10 inches across. Camellias, too, are well known and widely used. The English holly, more tender than the American species, seems to be more at home in the northwest Pacific Coast area, but where it has suitable atmospheric moisture, it makes a fine tree specimen in the South as well.

The glossy-leaved Japanese privet (*Ligustrum japonicum*) is a fast growing shrub, eventually reaching a height of 18 feet, with leathery leaves two to four inches long. Another privet, sometimes called the glossy privet (*L. lucidum*), although its slightly larger leaves are not as glossy as those of Japanese privet, can grow 30 feet tall. Both plants make good evergreen "fillers" and fine clipped hedges.

A plant that frequently blooms all summer is the glossy abelia (*Abelia grandiflora*). Popular from Florida to New York and on the Pacific Coast as well, the slightly pink, tubular flowers are three-quarters of an inch long with one to four flowers in a cluster. The glossy, evergreen leaves, about 1½ inches long, turn slightly bronze in the fall and keep that color all winter. Glossy abelia makes a fine specimen or hedge.

For red berries in the fall, the aucuba and the skimmia are widely used in the South. The Japanese aucuba (*Aucuba japonica*) is taller, growing up to 15 feet with thick, glossy, evergreen leaves up to

One plant that bears special mention, and it is only available today from one or two nurseries, is the dwarf form of the drooping leucothoe (Leucothoe fontanesiana 'Nana'), only about two feet tall and six feet wide after 20 years of growth.

seven inches long and with brilliant red berries. However, the sexes are separate, so both male and female plants should be grown to ensure fruiting. The foliage may burn in the full sun, therefore, partial shade is desirable. The Japanese skimmia (*Skimmia japonica*) also has red fruits and sexes separate, with bright, evergreen leaves three to five inches long and brilliant red fruits up to one-third inch in diameter. It is handsome, especially if grown in partial shade. Its near relative, *S. reevesiana*, is only 1½ feet tall, but it has perfect flowers so that all plants fruit, an asset in the small garden.

Boxwood and its many varieties are much used throughout the South. Here, this plant really comes into its own. Grown in the same areas is the thorny elaeagnus (*Elaeagnus pungens*), with intensely fragrant, small, white flowers in early fall. The leaves are 1½ to four inches long, and the plant has a vigorous habit of growth. This Japanese shrub, eventually growing 12 feet tall, is probably the most popular of the evergreen shrubs now used in the South.

Slightly taller (up to 18 feet) is the holly osmanthus (*Osmanthus heterophyllus*), with prickly, lustrous, dark-evergreen leaves, very much resembling those of holly. However, these leaves are opposite, while those of holly are borne alternately along

the stem. The flowers, appearing in July, are small but fragrant, and the plant grows well in sun or shade. As a clipped hedge it does well indeed.

Another popular plant in the South is the Japanese pittosporum (*Pittosporum tobira*). Eighteen feet high, with thick, rubbery, evergreen leaves which are four inches long, this plant serves well as a clipped hedge. It is available from many nurseries. The cherry laurel (*Prunus laurocerasus*) is also widely used as a hedge. It has lustrous, evergreen leaves four to six inches long and one-half inch wide, and small, white flowers which appear in May and are borne on erect panicles. Either as a specimen plant or in a clipped hedge it has merit, for its habit of growth is very dense. A cultivar of this species, 'Otto Luyken', is only a foot high and twice as broad, and the species *P. schipkaensis* is hardy as far north as Boston if planted in a protected place.

The Chilean pernettya (*Pernettya mucronata*), one of the very few Chilean plants grown in North American gardens, is a fine, low evergreen, about 1½ feet tall with lustrous, evergreen leaves about three-quarters of an inch long. Its bright-red fruits, which grow in clusters, are each about one-half inch in diameter. Although the flowers are perfect, several forms should be grown together in the same planting to ensure good fruiting. Grow them in full sun, for if grown in the shade they get leggy and require frequent correctional pruning. The fruits are effective through the fall and winter.

Last on my list of evergreen plants for areas other than the cold North is the David viburnum, which is very popular in the coastal area of the Pacific Northwest. It makes a handsome groundcover, not over three feet tall, and should be grown as such, not as an individual plant. It is a quick-growing "filler" and serves well in many situations.

Many of the plants mentioned here are available in local nurseries throughout the areas where they are grown. Most are available from specific nurseries noted in the Brooklyn Botanic Garden bulletin, "Plants and Gardens", Vol. 33, No. 2, Summer 1977 (write BBG, Brooklyn, NY 11225). One not so recorded is *Buxus* 'Vardar Valley', grown by the Weston Nurseries of Hopkinton, Massachusetts (write Weston's in Hopkinton, MA 01748). All have merit where they prove hardy and are worth a little trouble to locate. ☛

Continued from page 23

As there would be a lapse of some weeks before a new dogwood would arrive, I picked up all exposed bulbs and bulblets, put them in a frisbie the dogs had ruined and placed it on a shelf by the kitchen door so I wouldn't forget to replant the snowdrops.

Contrary to the dictum that one must never allow bulbs to dry and then expect them to survive, these, dug in August and replanted in late September, came up in spring and many bloomed. Some of these bulbs had a further journey since I gave the largest to our youngest grandson, hopefully a gardener in the making, who took them home to Pennsylvania where he reported that they, too, bloomed.

The bulbs mentioned so far were planted in more or less small, isolated areas. The real bulb moving, replanting, buying and planting started when more civilized areas were ready.

These were, at first, just narrow borders along either side of the front path, 30 feet from house to drive, and slightly wider beds stretching right and left from the path bounded by a low wall that separates the drive from the dooryard garden I'd always wanted. The reason I wanted it here is one every gardener will appreciate. In our former garden I'd found that the plants I saw most often and therefore enjoyed most were those I passed during the frequent walk from back door to garage.

Our present garden is arranged differently, as are the buildings, so that while my most frequent walk is still from kitchen door to garage, I pass part of the front yard instead of the back.

At first I planted water-lily tulips (*Tulipa kaufmanniana*) in the beds along either side of the front path. These bloomed well for four years. Then I tried the variety of *T. kaufmanniana* called 'The First' with the same results. Next I shifted to *T. praestans* 'Fusilier', changing the color scheme from creamy yellow to bright red.

The latest planting has stayed longest—for 10 years. There is an inner row of 'Red Emperor' tulips, an outer one of blue hyacinths; a brilliant picture for late April. These are followed by impatiens or begonias or both for summer color, the plants set out between the bulbs before their leaves disappear entirely.

There are now a few gaps in these rows due to bulbs dying or being inadvertently ruined by being chopped into pieces with

a vagrant trowel, but the picture is still pretty. Hyacinths and tulips have both increased to clumps, hence there may be three tulips or half a dozen hyacinth flower stems to a group. I like these smaller, daintier flowers better than blooms from last-fall-planted bulbs. For one thing, the smaller flower clusters are not top-heavy and thus are not broken by wind, though I regret that the dogs, running heedlessly across the path, sometimes damage them.

Into the crossway beds went first bulbs of two favorite narcissi from our former garden—oldtimers still listed in today's catalogues—'Trevithian' and 'Mrs. R. O. Backhouse'. 'Trevithian' is a jonquil hybrid which bears several butter-yellow flowers to a stem; outer petals are almost flat, the trumpet medium in size. Exceptionally long stems and true jonquil fragrance make this variety especially good for cutting.

'Mrs. R. O. Backhouse' was once famous as *the* pink daffodil. The perianth is white, the trumpet is first pale apricot-pink deepening in color as it ages. Since the pink fades least if flowers are in shade, I planted the bulbs where the shadow of the garage shades the blooms until noon.

Both of these narcissi have been lifted, and bulbs have been divided three times during the 27 years since they were planted. Each time there have been extras to give away.

At the same time I moved narcissus bulbs I also moved a handful of bulbs of a favorite tulip species, *Tulipa tarda*. This has slender leaves, almost parallel with the ground, which form a rosette, and star-shaped flowers of yellow near the center, white at the tip. The bulbs have greatly increased and seedlings grow nearby, some even in the gravel of the driveway. Except to admire them when they bloom, no one has ever paid any attention to these little tulips.

I had planned to have groups of blue and white anemones next to and flowering with *Tulipa tarda*. In anticipation I planted a dozen bulbs of each color. The scheme was delightful the first year after planting, but from then on only the white, *Anemone blanda* 'White Splendor', appeared. Elsewhere I tried pink-flowered anemones, with the same negative results.

Then, several years ago, Michigan State University published a list of bulbs and corms (anemones grow from corms which, though different, are handled like bulbs and hence are included with them) that

were repeatedly unsuccessful in their plantings. This included most of those sorts I'd tried with subsequent failures. And it included all cultivars of *Anemone blanda* except 'White Splendor' and 'Radar'. Of course I promptly bought corms of 'Radar' and agree with the University's findings. 'Radar', too, continues to flower and I'll buy more. Flowers, described in some catalogues as red and white, are really lavender tinged deep rose with a white center—effective with the white and yellow of the nearby anemones and tulips.

Also on the list of nonperformers from the University were brodiaeas with which I'd had disastrous results—plant in autumn, nothing in spring—time after time. So, this publication relieved me and I no longer blame myself for the repeated failures.

Other bulbs were later bought and planted in the bed I've been describing—large-flowered tulips, which bloom for from three to five years, and a number of species, none of which lasted as long as does *T. tarda*.

In the bed on the opposite side of the front path there have been many plantings, one after another. This bed is partly under a five-trunked silver maple. From a small tree 32 years ago it has grown to a large one, spreading its branches and its roots and thus making it difficult for even bulbs to thrive underneath.

However, *Puschkinia scilloides libanotica*, the Lebanon squill, in palest blue, blooms there for at least three or four years, and snowdrops flower year after year well before there is any shade. At the moment I'm in the process of turning the area into a hosta planting.

Certainly no one should complain of the bulbs that they can't grow when there are so many that need only to be planted. Down the slope from my maple tree to a lawn below there are little stone steps. On either side of these I planted snowdrops and winter aconites (*Eranthis hyemalis* which grows from corms), both moved from our former garden. Here they have taken care of themselves, increased and seeded, so that from a handful of each I now have a solid planting two feet wide and 10 feet long.

At the foot of the steps is a group of *Scilla campanulata*, the correct name of which is *Endymion hispanicus*. I planted bulbs 15 years ago and you'd never guess that they were lifted, split and replanted just two years ago, they are so thick. Their

blue flowers last only a week, but stems are long enough for cutting.

Further west from the steps is a bed next to the playhouse which was moved from our former home and now has been used and loved by two generations of youngsters. A low wall keeps lawn mowers from this bed and in it, with summer-flowering hydrangeas, are many small bulbs: blue- and white-flowered grape hyacinths (*Muscari botryoides* and *M. botryoides* 'Album'), *Scilla siberica*, the Siberian squill, and various glory-of-the-snow (*Chionodoxa luciliae*) cultivars in white, pink and blue.

The nicest thing about these little bulbs, aside from the fact that they require no care, is that they spread. It is not unusual for me to see a lone bloom of one or another in an out-of-the-way spot, often a long way from where they were planted.

In moving about the garden you and I have now arrived at the "bed" garden, a way of ensuring masses of flowers all season in as small a space as possible since my time for weeding is severely limited by job and housekeeping.

Here, among peonies, irises, phlox, hostas and many other perennials, are bulbs. Among them are crown imperial (*Fritillaria imperialis*), which definitely does not stay with me. Planted in autumn it blooms beautifully the first spring. Thereafter it produces leaves but no flowers. Yet, in our former garden 10 miles away I had bloom year after year! On the other hand the little guinea-hen fritillarias, *F. meleagris*, naturalize and increase with no care at all, even in grass under a tree!

The same one-year-bloom-and-only-leaves-afterwards plagues me with the hardy amaryllis or naked lady (*Lycoris squamigera* or *Amaryllis hallii*) and both spring- and summer-flowering snowflakes (*Leucojum vernum* and *L. aestivum*).

Bulbous irises are one of my favorites. In the bed garden are several varieties each of Dutch and Spanish irises that have been there at least 12 years, forming clumps which are split only if I happen to notice one when weeding. While I love the clear yellows and purples of some varieties, I'm particularly partial to 'Purple Sensation', with violet blue standards and falls with a yellow blotch-edged gentian-blue, and 'Oriental Beauty', with lavender-blue standards and creamy-yellow falls blotched deeper yellow.

Spanish irises bloom after Dutch irises, thus prolonging the season. But long be-



A narcissus oldtimer, 'Trevithian'.

fore these are in flower *Iris reticulata* has blossomed. Its common name, "netted" iris, confuses many. Just pull down gently on one petal and the netting will be revealed. This iris, in place for 15 years, has now formed clumps which produce many flower stems.

Three beds in the bed garden are devoted to lilies. I cannot remember the vast number of species and varieties that I have grown, but I know that the Bellingham hybrids are the longest lasting. It is certainly 20 years since the first bulbs were planted and I now have a whole bed full, having lifted and divided the bulbs every four years.

Madonna lilies (*Lilium candidum*) also have a good record for staying with me. Several clumps have been in residence for 15 years. Other lilies last from three to six or eight years. Their chief enemy in my garden is rabbits which, given a chance, eat the leaves to the ground as soon as they sprout. For this reason the lily beds are bordered with chicken wire, which doesn't add to the beauty of the garden but does permit me to grow lilies.

On the opposite side of the house from the bed garden there are a flagstone terrace with a flower border around half of it and a wildflower garden in the shade of trees. Five years ago I planted in the wildflower garden several West Coast erythroniums (adder's-tongue or dog-tooth violet) and

trilliums (wake-robin). While native species of both grow in our woods, I never had grown or knew anything about these westerners. To my surprise and pleasure they produce more flowers with each passing spring.

In the border I have grown a number of ornamental onions (alliums) over the years. Alliums, with me, are a sometime thing. Those that have done best, from the viewpoint of staying with me, are *A. karataviense* and *A. ostrowskianum*, both of which grow and flower for three or four years before disappearing. *A. moly*, the golden garlic, said to naturalize well, is erratic. Although leaves appear regularly, bulbs bloom only once in two or three years. And *A. giganteum*, which is so lovely for cutting, blooms but once.

My prize allium, which so far has stayed with me, was purchased at the rare plant sale in Seattle, Washington, at the Congress of the American Horticultural Society in 1973. Labeled *A. crenulatum*, it grows about six inches high, blooms rosy-lavender in September to October, and has now formed a clump so it is ready to lift and divide.

I sometimes wonder if the loss of allium bulbs is due to chipmunks which live under the terrace flagstones or red squirrels which occupy nearby birdhouses (one squirrel to a house). Do they eat the bulbs? I know that the fox squirrels, which live in our woods, eat the crocus corms during winter. Of thousands planted under hickory trees in that area only a handful bloom in spring. Those are Dutch crocuses. Meanwhile, the species crocuses planted near the playhouse up on the hill bloom yearly and have done so, some for 10, some for 20 years!

My husband has claimed for years that I am "God's gift to the nursery business" because I buy so much nursery stock. What he says about my bulb buying is too ribald to print. But I'm gradually reforming and buying fewer bulbs while depending more and more on those that stay with me. ☼

Some mail-order sources for bulbs: de-Jager Bulbs, Inc., 188 Asbury St., South Hamilton MA 01982; Geo. W. Park Seed Co., Inc., Greenwood SC 29647; John Scheepers, Inc., 63 Wall St., New York NY 10005; Van Bourgondien, 245 Farmingdale Rd., Babylon NY 11702; Mary Mattison vanSchaik, Cavendish VT 05142; Wayside Gardens Co., Hodges SC 29695.

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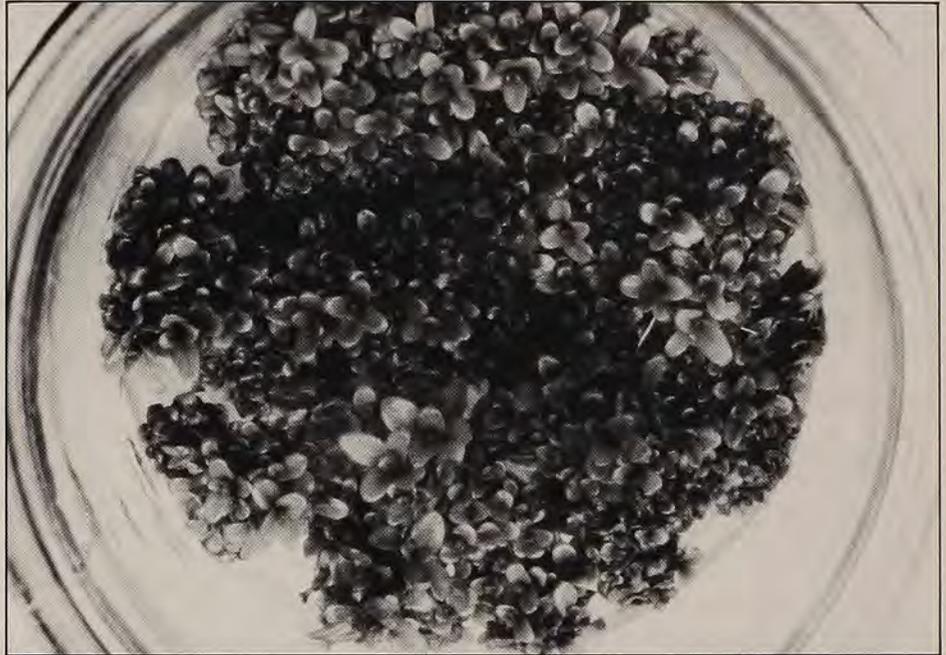
disease-free plants; several techniques assure production of plant tissue or organs that are free of virus, fungi and bacteria. Another reason is to rapidly multiply plants which are normally slow to propagate by conventional methods. True-to-type cactleya orchids, for example, were divided once a year to produce another plant, but it is theoretically possible to produce a million new orchid plants in one year starting with an excised bud from the original plant. Another benefit of micropropagation is that it conserves space. Instead of maintaining rows of stock plants for cuttings and scions, with tissue culture a single plant could supply all the needed propagules. Tissue culture can additionally be used to produce homozygous plants for plant breeding through anther culture. New cultivars have been formed with the use of callus culture. The induction of mutations has been speeded up in some cases.

Formerly the micropropagation of plants was limited to research institutions, but today there are a number of commercially operated laboratories engaged in this operation. In the United States most of these firms are located on the West Coast or in the southeastern states. The plants being propagated are primarily herbaceous flowering or foliage plants. Only a few woody perennials are being reproduced. In Italy, strawberries and fruit trees are being micropropagated on a commercial scale.

Nutrient Medium Requirements

The basic nutrient medium used in micropropagation contains inorganic salts, sugar, vitamins, growth regulators and water. Although a number of inorganic nutrient salt media have been devised, most of those in use are modifications of the Murashige and Skoog high salt medium, which has worked on a wide range of plant species. The inorganic nutrient salts contain all of the major and minor nutrient elements required by plants. Sugar, a carbon source, provides a readily available supply of energy for the growing tissue. Sucrose is a most suitable carbon source. Thiamine is the most commonly added vitamin, while pyridoxine and nicotinic acid, which frequently improve culture growth, are also used.

Auxins and cytokinins are the most common growth regulators added to the solution. Their proper balance and selection is essential in the production of shoots



and roots. Indoleacetic acid, indolebutyric acid, naphthaleneacetic acid and 2,4-dichloro-phenoxyacetic acid are auxins which aid in callus and root formation and development. Cytokinins such as kinetin, 6-benzyladenine and 6(γ,γ-dimethylallylamino)-purine and adenine sulfate are used to stimulate shoot formation and development. Gibberellins stimulate growth. Other compounds used include inositol and the amino acids. Occasionally, undefined organic supplements such as coconut milk, orange juice, tomato juice, banana puree, casein hydrolysate, yeast extract and malt extract are included in the nutrient medium.

Propagators use deionized or distilled water to dissolve the nutrients. Most make stock solutions of the inorganic salts and vitamins at 100 times concentration and store them in the refrigerator. Auxins such as naphthalenlacetic acid are dissolved initially in a small amount of ethyl alcohol and diluted with distilled water. Cytokinins, such as kinetin, are dissolved in a small volume of 0.5 normal hydrochloric acid or dimethylsulfoxide and are diluted with distilled water.

Media Preparation

Many commercial propagators use packaged nutrient mixes which are available for a number of different media and contain all the necessary components. Whether using commercial mixes or stock solutions, the components are dissolved or diluted with distilled water and the pH is



ABOVE: *Lythrum* explants in the rapid multiplication stage before they have been separated for propagation in individual flasks. BELOW: This daylily explant, growing *in vitro*, shows new shoots, callus and roots.

adjusted to 5.7 for semisolid media and to 5 for liquid media. The pH can be adjusted with 1.0 normal potassium hydroxide or sodium hydroxide to raise it for a more basic solution, or with 1.0 normal hydrochloric acid to lower it for greater acidity. If a semisolid medium is desired, agar is dissolved in the solution and then heated. When it becomes translucent, the medium is poured into culture containers such as tubes, vials, flasks or mason jars. After capping, the medium is sterilized at 121°C (250°F) for 15 minutes at 15 pounds pressure. Once cooled to room temperature, the medium is stored in the refrigerator.

Sanitation

Aseptic conditions are necessary in all aspects of micropropagation. The parts to be cultured are selected from plants grown preferably in greenhouses or other reasonably clean areas. Plant organs free of insects, diseases and mechanical damage are desired. Since plant parts that are propagated will usually carry fungi, bacteria or virus, the initial requirement in tissue preparation is to rid the plant part of these organisms. Propagators place virus infected plants under high temperatures for several weeks to inhibit virus multiplications. The shoot tip still continues to grow, however, and is usually free of the heat inhibited virus. The shoot apex, consisting of the meristem and a few primordial leaves, is used as the explant. The plant parts are sterilized by soaking in a five to 10 percent solution of a commercial liquid bleach containing sodium hypochlorite for five minutes. Other disinfectants such as 70 percent ethyl alcohol or calcium hypochlorite can be used. Propagators usually autoclave glassware and equipment for 30 minutes at 15 pounds pressure at 121°C. Transfer chambers where the plant materials are dissected are kept clean of dust and other debris. Most chambers have positive pressure with microbial filtered air as well as germicidal lamps. All dissecting tools such as forceps, scalpels and dissecting needles also are frequently disinfected with a 70 percent ethyl alcohol solution. Personal cleanliness on the part of the propagator is important to reduce bacteria spread, as well. A propagator should trim and clean his fingernails, wash his hands and arms with soap and water, then disinfect them with alcohol before working in the propagating room.

The Isolation and Culturing of the Explant

A wide variety of plant parts have been used as sources for explants; most commonly, shoot tip or vegetative buds have been used. Other parts have included flower buds, leaves, petals, stems, roots, bulb scales, cotyledons, embryos, anthers and runners.

After the plant part has been surface-sterilized with a 5 percent Clorox solution and rinsed several times with autoclaved distilled water, it is ready to be dissected.

Propagators trim the plant part to remove most of the exterior leaves in the case of shoot tips or to remove cut surfaces

on leaf sections which may have been damaged by sterilization. The trimmed plant parts, which are called explants, may range in size from 0.2 mm to 20 mm. Cultures from larger explants are more likely to be contaminated while those from smaller explants are harder to get established. Workers often place the explant in a disinfectant solution again for one minute before it is placed in the culture tube.

These new cultures are placed in a controlled environment with the temperature at 25°C (77°F), and at low light levels of 100-150 foot candles for 16 hours per day. After a clean culture has been established and starts to grow, it is generally transferred to another medium containing ample amounts of a cytokinin to induce adventitious bud formation and development. These shoots are separated and a number of them are placed in each large flask, which contains a medium that favors root initiation and development as well as further shoot growth. These jars are then placed under higher light intensities (500-1,000 foot candles) to precondition the plants before they are removed from the containers and transplanted into soil. The potted plants do best when placed in high humidity chambers such as a fogged house, shaded plastic tent or a mist house until the plants become established in the soil. Then the humidity can be gradually reduced and the light intensity increased.

Each year the variety of new plants which has been successfully propagated by tissue culture increases many fold, but they have been primarily herbaceous flowering or foliage plants or vegetables. Lack of success in micropropagation of woody plants, such as redwood, fig, heavenly bamboo, apple, aspen, birch, rose, elm, orange, rhododendron and eucalyptus, is due to problems of dormancy, maturity of the tissue, cyclic growth patterns and the production of toxic substances by the culture. Propagators are overcoming these limiting factors by using juvenile tissues, seedlings, seed parts, pretreatments and a daily change of nutrient solutions.

With the advances now being made, tissue culture of plants has become one of the most significant developments in the history of plant propagation. The increasing number of new plants which can be tissue cultured, the new techniques and the better understanding of the biological processes involved are rapidly changing the methods of plant propagation used in the nursery industry. ❁



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them topsy turvy is an easy mistake to make if the tubers are dormant. The smooth, rounded side goes down. The top is usually slightly concave, with little knuckles from which will come leaves and flowers. The roots, deceptively, rarely come from the bottom of the corm, sometimes from the top, usually from the sides. Therefore, what is under the tuber (it can even be rock) is less important than what is on top. Cover them with an inch or two of leafy or peaty soil, under which both flower and leaf stalks will radiate out as much as six inches before emerging. In cool summer regions this species can stand full sun, but shade is usually preferable.

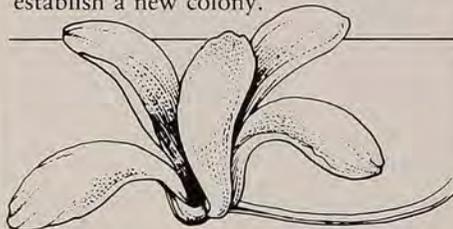
The best place for *C. hederifolium* is around the base of deciduous trees and larger shrubs. It will even grow in the permanent gloom beneath conifers. Only when mine were lost to sight under a spreading juniper hedge did I retrieve them (still flowering) and replant them under an oak. Dry shade spells death to many plants; it is a marvel that so fragile looking a flower will thrive there and self-sow.

Cyclamen flower stalks have an intriguing way of coiling, springlike, around the ripening seed capsule. Years ago, as the pods on my first cyclamen were fattening, I read that this spring uncoiled again when the seeds were ripe, catapulting them far afield. I haunted the area where the plants were growing for the next few weeks, eager to watch this Jack-in-the-box performance. It was a non-event. John Gerard, in his 16th-century herbal, explained what really happens:

There succeed (the flowers) little round knops or heads which contain slender browne seeds: these knops are wrapped after a few daies in the small stalkes, as thred about a bottome, where it remaineth so defended from the injurie of winter close upon the ground, covered also with the green leaves aforesaid, by which meanes it is kept from the frost, even from the time of his seeding, which is in September, untill June; at which time the leaves do fade away, the stalkes & seed remaining bare and naked, whereby it injoyeth the Sun (whereof it was long deprived) the sooner to bring them unto maturitie.

Just so. But mine come to maturity without benefit of sun, the oak having by then leafed out to shade the site. During this summer dormancy I top-dress the bed

(about one year in three) with half an inch or so of sifted leaf mold. In October, seedlings appear by the hundred, packed closely together on top of the parent tuber. Unwilling to let "survival of the fittest" prevail (there can never be too many cyclamens), I wait until I hold in my hand a cluster of rounded leaves from which dangle pearly tubers on threadlike two-inch stalks. These are dibbled in at the outer edges of the patch, or wherever I want to establish a new colony.



The roots of cyclamens, deceptively, rarely come from the bottom of the corm, sometimes from the top, usually from the sides.

My first *C. hederifolium* tubers cost 4¢ each from an English Woolworth's and measured three inches across. Those days are gone, but this species is neither rare nor exorbitantly priced. Expect to pay \$1.00 for a flowering tuber about an inch across, \$1.50 for the white form. Or grow them from seed, to flower the third year (Editor's note: to find out how, read Elizabeth Corning's article on sowing seed for winter bloom in the June/July 1980 issue of *American Horticulturist*). It is worth paying more for larger corms, because small ones may be dug up by squirrels and chipmunks. Alternatively, cover the bed with wide mesh chicken wire or plastic netting, sifting leaf mold over it so that it does not show. Flowers and leaves will make their way through the mesh. Specialist growers ship the corms at a suitable planting time. Most books say that dormant corms are slow to establish (if at all), but I have had no trouble with them. Space them six inches apart.

There are other cyclamens for other seasons, none quite as hardy as *C. hederifolium*. In my own garden five species keep up between them an almost constant succession of flowers. If *C. hederifolium* does well for you, try next the summer

and early autumn flowering *C. purpurascens*, long known as *C. europaeum*. The heart-shaped, silver-marbled leaves are almost evergreen, the bright-pink shuttlecock flowers slightly fragrant. All my cyclamens are in the same place, in dry shade under an oak, and they do well there, but this species roots from the bottom and would probably be better still in a fairly deep, humus-rich soil. The tubers of this and the following species do not grow nearly as large as those of *C. hederifolium*. Plant them one inch deep and about four inches apart.

C. coum (Zone 6) has plain, green, rounded leaves and chubby flowers of magenta, paler pink or a purple-stained white, huddled close to the ground for protection, as well they might in January and February. I prefer *C. x atkinsii* similar but with marbled leaves and a flowering time which comes two weeks earlier. In my garden the white, rose and deep-pink forms are intermingled and I think they look prettier this way, enhancing each other, than in patches of separate colors. These winter cyclamen are drought tolerant and will naturalize under trees. The front of a shaded border would be another good place, or perhaps at the foot of a boulder (shaded side) in the rock garden. They take well to pot culture and give early bloom in the cool greenhouse.

C. repandum, least hardy of the species I grow, has survived 5°F. The ivy-shaped leaves, gray patterned but less markedly so than those of *C. hederifolium*, emerge in March, followed a month later by flowers of that brilliant magenta I find distasteful in the moss pink (*Phlox subulata*), but very attractive in a cyclamen because of its delicacy of shape and texture and the translucence of its petals when lit by gleams of sun.

Gerard, describing the "Vertues" of cyclamen wrote that:

Being beaten and made up into trochisches, or little flat cakes, it is reported to be a good amorous medicine to make one in love, if it be inwardly taken.

I nibbled one—it tasted too nasty for further experiment. Besides, I love cyclamens for themselves. ☼

An excellent mail-order source for cyclamens (many species) is Edgar L. Kline, 17495 S. W. Bryant Road, Lake Grove OR 97034.

PRONUNCIATION GUIDE

Guide to Botanical Names in This Issue

The accent, or emphasis, falls on the syllable which appears in capital letters. The vowels which you see standing alone are pronounced as follows:

i—short sound; sounds like i in “hit”
o—long sound; sounds like o in “snow”
a—long sound; sounds like a in “hay”

In many cases there are several ways of pronouncing the same word. This guide attempts to convey the most generally accepted version.

- Abelia* a-BEEL-ya
Achillea lanulosa a-KILL-ee-ah lan-yew-LOS-ah
Allium crenulatum AL-ee-um kren-yew-LAY-tum
Allium giganteum AL-ee-um ji-GAN-tee-um
Allium karataviense AL-ee-um ka-ra-tav-ee-EN-see
Allium moly AL-ee-um MOLL-ee
Allium ostrowskianum AL-ee-um oss-tro-ski-A-num
Amaryllis hallii am-ah-RILL-iss HALL-ee-eye
Anemone blanda ah-NEM-o-nee BLAN-da
Asclepias tuberosa ass-KLEE-pee-us too-bur-O-sa
Aster novae-angliae ASS-ter NOV-ee ANG-li-ee
Aucuba japonica aw-KOO-ba ja-PON-i-ka
Buxus sempervirens BUCK-sus sem-per-VEER-enz
Calendula officinalis ka-LEN-dew-la o-fiss-i-NAYL-iss
Cephaelis ipecacuanha se-FEEL-iss i-pi-ka-KWAN-ah
Chamaerops humilis KAM-er-ops HEW-mill-iss
Chionodoxa luciliae ky-on-o-DOCK-sa loo-SILLY-ee
Chrysanthemum leucanthemum kris-AN-thee-mum loo-KAN-thee-mum
Chrysopsis europaeum kris-OP-sis your-o-PEE-um
Chrysopsis mariana kris-OP-sis mare-ee-AYN-ah
Chrysopsis hederifolium kris-OP-sis head-er-i-FOL-ee-um
Cichorium intybus si-CORE-ee-um in-TY-bus
Cinchona sin-KONE-ah
Cirsium SER-see-um
Coffea arabica KOFF-ee-ah ah-RAYB-i-ka
Coreopsis auriculata kor-ee-OP-sis aw-rick-yew-LAY-ta
Cornus kousa CORN-us KOO-sa
Cyclamen atkinsii SYKE-la-men AT-kins-ee-eye
Cyclamen coum SYKE-la-men KOOM
Cyclamen neapolitanum SYKE-la-men nee-ah-pol-i-TAY-num
Cyclamen purpurascens SYKE-la-men pur-pur-AS-enz
Cyclamen repandum SYKE-la-men re-PAN-dum
Daucus carota DAW-kus ka-RO-ta
Elaeagnus pungens ell-ee-AG-nus PUN-jinz
Endymion hispanicus en-DIME-ee-un hiss-PAN-i-kus
Eranthis hyemalis air-AN-this hy-MAL-iss
Euonymus fortunei yew-ON-i-mus FORTUNE-eye
Euonymus vegeta yew-ON-i-mus VEDGE-i-ta
Eupatorium maculatum yew-pa-TOR-ee-um mack-yew-LAY-tum
Eupatorium rugosum yew-pa-TOR-ee-um rew-GO-sum
Fritillaria imperialis frit-ill-AY-ree-ah im-peer-ee-AYL-iss
Fritillaria meleagris frit-ill-AY-ree-ah mell-ee-A-gris
Galium odoratum GAY-lee-um o-door-A-tum
Gaylussacia brachycera gay-lew-SACK-ee-ah brack-i-SER-ah
Helianthus annuus he-lee-AN-thus AN-yew-us
Hemerocallis fulva hem-er-o-KAL-iss
Hem-er-OCK-a-liss FUL-va
Hieracium aurantiacum hy-er-ACE-ee-um aw-ran-TY-ah-kum
Ilex crenata EYE-lex kren-A-ta
Ilex pedunculosa EYE-lex pe-dunk-yew-LOS-ah
Iris reticulata EYE-riss re-tick-yew-LAY-ta
Leucojum aestivum lew-KO-jum ess-TIV-um
Leucojum vernum lew-KO-jum VER-num
Leucothoe fontanesiana lew-KO-tho-ee fon-taynes-ee-A-na
Liatris borealis ly-A-tris bor-ee-AL-iss
Liatris spicata ly-A-tris spy-KAY-ta
Ligustrum japonicum li-GUS-trum ja-PON-i-kum
Ligustrum lucidum li-GUS-trum LEW-si-dum
Lilium candidum LIL-ee-um CAN-did-um
Lobelia cardinalis lo-BEEL-ya car-di-NAY-liss
Lobelia puberula lo-BEEL-ya pew-BEAR-yew-la
Lobelia siphilitica lo-BEEL-ya siph-i-LIT-i-ka
Lupinus perennis lew-PINE-us per-EN-iss
Lupinus polyphyllus lew-PINE-us pol-ee-FIL-us
Lupinus subcarnosus lew-PINE-us sub-car-NO-sus
Lycoris squamigera ly-KOR-iss skwa-mi-JER-ah
Lysimachia quadrifolia li-sa-MACK-ee-ah kwa-dri-FO-lee-ah
Lysimachia terrestris li-sa-MACK-ee-ah ter-REST-ri
Lythrum salicaria LITH-rum sal-i-KAY-ree-ah
Magnolia grandiflora mag-NOL-ya grand-i-FLOR-ah
Monarda didyma mo-NARD-ah DID-i-ma
Monarda media mo-NARD-ah MEE-dee-ah
Muscari botryoides mus-KA-ree bot-ree-OY-deez
Osmanthus heterophyllus oz-MAN-thus het-er-o-FIL-us
Pernettya mucronata per-NET-ee-ah mew-kro-NAY-ta
Phlox subulata FLOCKS sub-yew-LAY-ta
Pieris floribunda PY-er-iss flor-i-BUN-da
Pieris japonica PY-er-iss ja-PON-i-ka
Pittosporum tobira pit-TAHS-por-um
Pit-o-SPOR-um tow-BEER-ah
Prunus laurocerasus PRUNE-us law-ro-SER-ah-sus
Prunus schipkaensis PRUNE-us skip-KEEN-sis
Puschkinia scilloides libanotica push-KIN-ee-ah sill-OY-deez
lee-ban-AH-ti-ka
Rheum rhaponticum REE-um ra-PON-ti-kum
Rosa gallica RO-za GAL-i-ka
Rubia tinctorum REW-bee-ah tink-TOR-ee-um
Rudbeckia hirta rood-BECK-ee-ah HER-ta
Scilla campanulata SILL-ah kam-pan-yew-LAY-ta
Scilla siberica SILL-ah sy-BEER-i-ka
Sesamum indicum SES-ah-mum IN-di-kum
Skimmia japonica SKIM-ee-ah ja-PON-i-ka
Skimmia reevesiana SKIM-ee-ah reevz-ee-A-na
Solanum tuberosum so-LAY-num too-bur-O-sum
Solidago caesia sol-i-DAY-go SEEZ-ee-ah
Solidago nemoralis sol-i-DAY-go neem-o-RAY-liss
Solidago speciosa sol-i-DAY-go spee-see-O-sa
Solidago rigida sol-i-DAY-go RIDGE-i-da
Spathiphyllum spath-i-FIL-um
Spiraea latifolia spy-REE-ah lat-i-FO-lee-ah
Syringa vulgaris si-RING-gah vul-GAY-riss
Thymus herba-barona TY-mus HER-ba ba-RO-na
Trifolium pratense try-FO-lee-um pray-TEN-see
Tulipa kaufmanniana TOO-lip-ah koff-man-ee-A-na
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Uncaria gambir un-KAY-ree-ah GAM-beer
Vaccinium vitis-idaea minus vack-SIN-ee-um VY-tus-eye-DEE-ah MY-nus
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The new Paperwhite Narcissus from Israel (left), and the older French strain.

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