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Aromatic Pelargoniums

Introduction. In recent years the culture of horticultural plants has become increasingly popular. This trend prevails especially among city dwellers who perhaps have suddenly become conscious of the sterility of asphalt and concrete.

One of the flowers that is in increasing prominence is the geranium. Traditionally grown for Memorial Day decorations, the sturdy plants with their large clusters of flowers in shades of red and pink are now used in great numbers in parks, along streets and on corners of houses in some of the more venerable quarters of older cities.

The geranium with which we all are familiar is the zonal pelargonium, *Pelargonium hortorum*. There are, however, many other species in the genus. They are grouped into several types: the ivy-leaved, the regals, the uniques, and the scented-leaved. Each of these deserves to be popular on its own and was well-known in the gardens of our grandparents.

This paper is an introduction to scented-leaved pelargoniums. In essence it will have to be a defense of pleasant scents. Pleasant smelling substances were once utilitarian, being used to hide objectionable odors; today, however, soap and public hygiene have successfully removed many of the noxious odors of the past.

The perfumes, however, are still with us, now justified either as a custom or a pleasantry. Many perfume substances today are synthetic and are presented in even more artificial manner. Perhaps because of the crass commercialization of scents and the indiscriminate juxtaposition of scent and object, it seems refreshing to be able to smell a scent exuding from its natural source. This is the joy of carnations, cedar panelling, and scented-leaved pelargoniums.

The last have odors that variously evoke descriptions of rose, lemon, nutmeg, almond, peppermint, lime, coconut, apricot, strawberry, ginger, pine or camphor. The varieties all have attractive foliage and, although most have small flowers, they

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1 The terms geranium and pelargonium are often used interchangeably, but as *Pelargonium* is the proper generic name, I shall try to adhere to it.
are delicate and beautifully colored. Of the approximately 250 varieties known, about 75 are available to the home gardener. They are easy to culture, do well as house plants, and as Clifford (1970) so succinctly put it, "they are ideal for those whom the current time-saving techniques have left no time for anything".

From the expert gardener or the would-be-grower of something green, the group deserves attention.

**Pelargonium Botany.** The family Geraniaceae contains three genera: *Geranium, Erodium,* and *Pelargonium.* The names, derived from the three Greek words meaning crane, heron and stork, refer to the resemblance of the seed case to the slender bills of these three birds.

*Geranium* and *Erodium* both have regular flowers; that is, the petals (and sepals) all are of equal size and shape. In *Pelargonium* the flower is zygomorphic (Gr. *zygos* = yoke); in other words, the petals (and sepals) are of different sizes and so arranged that in only one place can a line be drawn to separate the flower into equal halves. *Geranium* and *Erodium* are easily separated. All ten stamens are fertile and bear anthers in *Geranium*; in *Erodium,* some of the stamens do not bear anthers.

Members of the genus *pelargonium* while exhibiting wide variations in plant and flower habit all are characterized, in addition to the beak-like fruit of the family, by a nectar tube. This distinctive feature of the pelargoniums is a tube that runs from the uppermost sepal along the flower pedicel and is attached to it. Although it varies in length, its location usually can be observed externally by a bend in the pedicel occurring at the end of the tube.

The pelargoniums are mostly restricted to South Africa. There are however several from Abyssinia, Kenya and Tanganyika, four from Australia, and one each from Asia Minor, Madagascar, St. Helena, Tristan da Cunha and New Zealand (Clifford 1970). Their usual habitat is desert-like, arid, stony and frost free.

**Early History of Pelargoniums.** The first record of a pelargonium in cultivation appeared in 1633. In his edition of Gerarde's "Herbal ...", Thomas Johnson noted that Tradescant had flowered "Geranium indicum nocte odoratum" the preceding year. Later, in 1668, the plant was listed in the catalog of the Botanic Garden at the University of Leyden.

Where Tradescant obtained his specimen is a mystery. Presumably it came from some British ship that had stopped at
Table Bay, the harbor of Cape Town, South Africa; the plant, *Pelargonium triste*, is common in the wild around Cape Town, and the harbor had been in intermittent use by the British, Dutch, and Portuguese ever since its discovery by the last in 1487.

It was not until the last quarter of the 17th century that collections of living plants were sent back to Holland in any quantity. In 1668, the printed catalogue of the plants growing in the Botanic Garden at Leyden listed only 1821 species; in 1687, the number of names had risen to 3029. In particular, in comparison to the one species of *Pelargonium* listed in 1668, ten pelargoniums were growing in the garden in 1686. From this time forward pelargoniums were to be important members of the European garden flora.

In 1724 some eight new species were recorded in cultivation for the first time in the Chelsea Physic Garden. Included among these plants were *Pelargonium odoratissimum*, the apple or nutmeg-scented geranium, and *Pelargonium vitifolium*, the balm-scented geranium. Who brought these to England, and when, is not recorded.

*Above:* Pelargonium graveolens

*Left:* Pelargonium crispum

*Both from* Geraniologia *by C. L. L’Heritier de Brutelle.* Paris, 1787–1788.
No more scented-leaved species appear to have been imported into England until Francis Masson was sent out from Kew to South Africa in 1771 or 1772. Masson spent five or six years there and travelled extensively. During this period he sent back to Kew the rose-scented *Pelargonium radens* (incorrectly called *P. radula*), *Pelargonium quercifolium*, and *Pelargonium graveolens*, as well as the lemon-scented *Pelargonium crispum*. Masson left South Africa in 1776, later returning. It may have been he who sent the peppermint-scented geranium *Pelargonium tomentosum* which appeared in England sometime before 1790.

*Pelargoniums* flower abundantly in the northern hemisphere summer. Hybridizing with ease, they are readily raised from seed. Once a collection of species has been gotten together, and the bees allowed to go about their business, the resultant seed will yield a myriad of hybrid forms. This is precisely what happened in the gardens and conservatories of Europe between 1750 and 1850. A multiplicity of forms appeared; some to survive for years, other to disappear quickly. There also arose a multiplicity of names, and the connections between names and plants was sometimes highly tenuous.

Between 1787 and 1838 seven monographic works were published in an attempt to keep up with the bewildering hordes of seedling pelargoniums. Different names were applied by different authors to the same plant, and identical names were applied by different authors to different plants. Hybrid seedlings were grown under the same names as their maternal parents. The resultant confusion still persists. For example: in some cases the plant which is called *Pelargonium* 'Attar of Roses' seems to be, instead, the old species *Pelargonium capitatum*; while the plant which is grown as *Pelargonium capitatum* is really a hybrid between *Pelargonium graveolens* and *Pelargonium radens* which is properly called *Pelargonium X asperum*. Likewise, at least some plants grown as *Pelargonium odoratissimum* are probably hybrid seedlings of that species with *Pelargonium exstipulatum* and should be properly called *Pelargonium X fragrans*. The clue is that true *Pelargonium odoratissimum* does not have lobed leaves.

Some relief may come from genetic studies of the genus. M. G. Daker (1969) has done chromosome counts of several pelargonium species and cultivars. He concludes that the majority of aromatics are derived from two species, *Pelargonium crispum* and *Pelargonium graveolens*, both with a base number of an $x = 11$. (The zonals and the ivy-leaved have $x = 9$).

Pelargonium X fragrans has an aberrant base number \( x = 8 \). Clifford (1970) suggests that this is a real species and not a hybrid. Pelargonium grossularioides, the coconut-scented pelargonium, is also unusual with a chromosome number of 38. Daker postulates this an allotetraploid resulting from an \( x = 8 \) such as Pelargonium X fragrans and \( x = 11 \) such as Pelargonium australe.

The cultivar 'Endsleigh' has long been considered a variety originating from a cross between Pelargonium capitatum (hexaploid \( 2n = 66 \)) and Pelargonium quercifolium (tetraploid \( 2n = 44 \)). This would make 'Endsleigh' pentaploid (\( 2n = 55 \)). In fact, Daker found 54 chromosomes. This substantiates the proposed ancestry although one chromosome has been lost.
Ecology of Scent. Because of the many wild scented pelargoniums, the aromatic foliage must have some biological justification.

For plants in general, several hypotheses have been presented for the existence of essential oils. The first is that the oils are simply waste products being excreted by the plants. Although once popular, this catch-all explanation has generally been discarded and there is no reason to expect that it explains the oils in pelargoniums.

The second hypothesis is that the oils serve to attract pollinators. Because the aromatic pelargoniums do not have showy flowers and yet are adapted for outcrossing (the pollen maturing prior to stigma formation) it is reasonable that the foliage odor may serve to attract pollinators to the plant.

A third hypothesis is that the aromatic oils are allelopathic; that is, they inhibit the growth of other plants nearby. This has been studied on several aromatic herbs in the California desert (Whittaker 1970). It is true that the pelargonium oil does leach out of the foliage with rainfall and it may have some allelopathic effects in the soil. Plantations of pelargonium do contain weeds but there is no reason that the allelopathy could not be selective for certain species growing in association with pelargonium in its native habitat.

A fourth hypothesis is that essential oils serve to repel predators, either arthropod or larger animal herbivores. In their native environment pelargoniums are growing where vegetation is relatively scarce. Hence the pressure from herbivores may be strong enough to justify the development of repugnant oils that would discourage predators.

These last three hypotheses are not mutually exclusive and only further research will explain the biological significance of the essential oils.

Distribution of Varieties and Scents. The following is a list of aromatic pelargoniums and their scents. It has been synthesized from other lists in recent works on pelargoniums. Because of the problems with nomenclature and because many authorities only describe the scent, it is difficult to decide whether conflicting accounts of scents for the same named variety are due to improper naming of one of them or to justified differences in odor interpretation. The list does serve to emphasize the diversity of varieties and accompanying scents. Chromosome numbers (Daker 1969) are given where available and references to descriptions of each variety are coded with each listing.
<table>
<thead>
<tr>
<th>References</th>
<th>Taxon</th>
<th>Synonyms, proper or improper</th>
<th>Common name</th>
<th>Chromosome no. (2n)</th>
<th>Scent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,4,5</td>
<td><em>P. abrotanifolium</em></td>
<td><em>P. artemisiaefolium</em></td>
<td>Southernwood-leaved Geranium</td>
<td>32</td>
<td>Strong pungent diphenyl ether &amp; butyric ester with southernwood Pungent spicy</td>
</tr>
<tr>
<td>1,4</td>
<td><em>P. X acerifolium</em> (<em>P. capitatum × P. graveolens</em>)</td>
<td><em>P. citriodorum</em>, <em>P. aceroides</em></td>
<td>Maple-leaved Geranium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><em>P. albecens</em></td>
<td>?</td>
<td></td>
<td></td>
<td>Ladanum &amp; weak citronellal Lemon Spicy</td>
</tr>
<tr>
<td>1,2,5</td>
<td><em>P. X asperum</em></td>
<td><em>P. asperum</em></td>
<td>Not the ‘Australis’ offered in the U.S.</td>
<td>22</td>
<td></td>
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<tr>
<td>1,2,4,5</td>
<td><em>P. X blandfordianum</em> (<em>P. graveolens × P. echinatum</em>)</td>
<td><em>P. quercifolium</em> × Cape sp.</td>
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<td></td>
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<tr>
<td>1,2</td>
<td><em>P. Cordifolium</em></td>
<td><em>P. cordatum</em></td>
<td>Heart-leaved Storksbill</td>
<td>66</td>
<td>Slightly pungent Slight rose Slight pungent Strong lemon Pepper, southernwood, eucalyptus</td>
</tr>
<tr>
<td>1,2,3,4,5</td>
<td><em>P. citrosum</em></td>
<td><em>P. hermaniaefolium</em> or *P. ‘Lady Scarborough’</td>
<td>Curled-leaved Cranesbill</td>
<td></td>
<td>Lemon, citral</td>
</tr>
<tr>
<td>1</td>
<td><em>P. crispyum</em> ‘Gooseberry-leaved’</td>
<td><em>P. crispyum</em> ‘Major’</td>
<td></td>
<td></td>
<td>Slightly pungent Citral &amp; melissa Strong citronellal Strawberry Strong lemon</td>
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<tr>
<td>4</td>
<td><em>P. crispyum</em> ‘Maximum’</td>
<td><em>P. crispyum</em> ‘Minor’</td>
<td>Finger Bowl Geranium</td>
<td></td>
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<tr>
<td>Page</td>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Description</td>
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<tr>
<td>1,2</td>
<td><em>P. crispum</em> 'Prince Rupert Variegated'</td>
<td><em>P. decipiens</em></td>
<td>French Lace</td>
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<tr>
<td>2,4</td>
<td><em>P. cucullatum</em></td>
<td><em>P. X decipiens</em></td>
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<tr>
<td>1,3,4</td>
<td><em>P. X denticulatum</em></td>
<td><em>P. X decipiens</em></td>
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<td></td>
<td></td>
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<tr>
<td>4</td>
<td><em>P. X denticulatum</em></td>
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<tr>
<td>1,2,5</td>
<td><em>P. X denticulatum</em></td>
<td>*P. Fernaefolium'</td>
<td>Fern-leaved Geranium</td>
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<td></td>
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<tr>
<td>2,3,5</td>
<td><em>P. 'Endsleigh' (P. quercifolium × P. capitatum)</em></td>
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<tr>
<td>2,4</td>
<td><em>P. exstipulatum</em></td>
<td><em>P. odoratissimum × P. X fragrans</em></td>
<td>Nutmeg Geranium</td>
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<tr>
<td>1,2,3,5</td>
<td><em>P. X fragrans</em></td>
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<tr>
<td>1,2</td>
<td><em>P. X fragrans</em> 'Old Spice'</td>
<td></td>
<td>Spicy</td>
<td></td>
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<tr>
<td>1,2,4,5</td>
<td><em>P. glutinosum</em></td>
<td><em>P. viscosum</em></td>
<td>Pheasant's Foot, Clammy Cranesbill</td>
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<tr>
<td>1,2</td>
<td>*P. 'Godfrey's Pride'</td>
<td><em>P. capitatum</em></td>
<td>Rose Geranium</td>
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<tr>
<td>1,2,3,4,5</td>
<td><em>P. graveolens</em></td>
<td><em>P. terebinthinacea</em></td>
<td>Camphor Rose Geranium</td>
<td></td>
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<tr>
<td>1,2</td>
<td><em>P. graveolens</em> 'Attar of Roses'</td>
<td></td>
<td></td>
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<tr>
<td>1,2,3</td>
<td><em>P. graveolens</em> 'Camphorum'</td>
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<tr>
<td>1</td>
<td><em>P. graveolens</em> 'Elkhorn'</td>
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<td>1,2</td>
<td><em>P. graveolens</em> 'Giganteum'</td>
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<td>1,2</td>
<td><em>P. graveolens</em> 'Gray Lady Plymouth'</td>
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<td>1,2,3,4</td>
<td><em>P. graveolens</em></td>
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<td>1</td>
<td><em>P. graveolens</em> 'Lady Plymouth'</td>
<td></td>
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<tr>
<td>1</td>
<td><em>P. graveolens</em> 'Large Leaf Rose'</td>
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</tbody>
</table>

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Ladanum & citral
Balsam, fine rose or pine, mint
Citronellal, ladanum, butyric
Pungent

Pennyroyal
Nutmeg
Spicy

Spicy

Ladanum

Mint
Rose
Rose & rue, peppermint
Camphor

Strong rose
Slight rose
Rose
Rose, peppermint?
Strong rose
<table>
<thead>
<tr>
<th>References</th>
<th>Taxon</th>
<th>Synonyms, proper or improper</th>
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<th>Scent</th>
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<td>1,2,3,4,5</td>
<td><em>P. graveolens</em> 'Little Gem'</td>
<td><em>P. terebinthinacem</em></td>
<td>Little-leaf Rose Geranium</td>
<td>88</td>
<td>Pungent</td>
</tr>
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<td>1</td>
<td><em>P. graveolens</em> 'Minor'</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1,2</td>
<td><em>P. graveolens</em> 'Red Flowered Rose'</td>
<td><em>P. graveolens</em> 'Vandasiae'</td>
<td>Slight rose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>P. graveolens</em> 'Rober's Lemon Rose'</td>
<td></td>
<td>Lemon rose</td>
<td></td>
<td></td>
</tr>
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<td>1</td>
<td><em>P. graveolens</em> 'Variegatum'</td>
<td></td>
<td>Mint rose</td>
<td></td>
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<tr>
<td>1,2,5</td>
<td><em>P. grossularioides</em></td>
<td><em>P. parviflorum</em> or <em>P. crispum</em> 'Variegatum', incorrect</td>
<td>Mint-scented Rose Geranium</td>
<td>38</td>
<td>Coconut</td>
</tr>
<tr>
<td>1,3</td>
<td><em>P. X jatrophaefolium</em> <em>(P. denticulatum × P. quercifolium)</em></td>
<td></td>
<td></td>
<td></td>
<td>Oily pungent</td>
</tr>
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<td>1,2</td>
<td><em>P. 'Joy Lucille'</em></td>
<td><em>P. tomentosum</em> × <em>P. graveolens</em></td>
<td>Lemon-scented Geranium</td>
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<td>Lemon</td>
</tr>
<tr>
<td>1</td>
<td><em>P. X limoneum</em></td>
<td><em>P. crispum</em> derivative</td>
<td></td>
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<tr>
<td>1,2,3</td>
<td><em>P. X limoneum</em> 'Lady Mary'</td>
<td><em>P. X limoneum</em> 'Lady Mary Fox'</td>
<td></td>
<td></td>
<td>Lemon nutmeg</td>
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<tr>
<td>4</td>
<td><em>P. 'Lady Lumsden'</em></td>
<td></td>
<td></td>
<td></td>
<td>Ladanum</td>
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<td>2,5</td>
<td><em>P. 'Mabel Gray'</em></td>
<td></td>
<td></td>
<td></td>
<td>Citrus</td>
</tr>
<tr>
<td>1</td>
<td><em>P. X melissimum</em> <em>(P. crispum × P. graveolens)</em></td>
<td></td>
<td>Lemon balm Geranium</td>
<td>22</td>
<td>Lemon balm</td>
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<tr>
<td>1,2</td>
<td>P. 'Mrs. Kingsley'</td>
<td><em>P. rapaceum</em>, P. 'Mrs. Kingsbury' (misspelled)</td>
<td>Slightly pungent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>P. 'Mrs. Taylor'</td>
<td><em>P. X nervosum</em></td>
<td>Pungent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,2</td>
<td>P. <em>odoratissimum</em></td>
<td>Lime-scented Geranium Apple-scented Geranium, Sweet-scented Cranesbill</td>
<td>Strong lime Apple, tansy, rose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,4</td>
<td>P. 'Old Scarlet Unique'</td>
<td><em>P. fulgidum variety</em> Butterfly Cranesbill</td>
<td>Pungent, butyric</td>
<td></td>
<td></td>
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<tr>
<td>1,2,5</td>
<td>P. <em>papilionaceum</em></td>
<td>Almond-scented Geranium</td>
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<td>1,3</td>
<td>P. 'Pretty Polly'</td>
<td>Oak-leaved Geranium</td>
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<td>1,2,3,4</td>
<td>P. 'Prince of Orange'</td>
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<td>1,2,3,4</td>
<td><em>P. quercifolium</em></td>
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<td>1</td>
<td><em>P. quercifolium 'Beauty'</em></td>
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<td>1,2,3</td>
<td><em>P. quercifolium</em> 'Fair Ellen'</td>
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<td><em>P. quercifolium</em> 'Fringed Oak'</td>
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<td><em>P. quercifolium 'Fringed Oak' × 'Fair Ellen'</em></td>
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<td><em>P. quercifolium</em> 'Skeleton's Unique'</td>
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<td><em>P. quercifolium</em> 'Staghorn Oak Leaf'</td>
<td><em>P. quercifolium</em> 'True Oak'</td>
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<tr>
<td>1</td>
<td><em>P. quercifolium</em> 'Village Hill Hybrid'</td>
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<tr>
<td>1</td>
<td><em>P. quercifolium</em> 'Variegatum'</td>
<td><em>P. quercifolium</em> 'Harlequin'</td>
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</tbody>
</table>

Almond Orange

Pungent Pungent Pungent Pungent Pungent Pungent Pungent Pungent Pungent Pungent
<table>
<thead>
<tr>
<th>References</th>
<th>Taxon</th>
<th>Synonyms, proper or improper</th>
<th>Common name</th>
<th>Chromosome no. (2n)</th>
<th>Scent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,3</td>
<td><em>P. radens</em></td>
<td><em>P. radula</em></td>
<td>Crowfoot Geranium</td>
<td>Pungent, mint, balsam</td>
<td>Lemon rose</td>
</tr>
<tr>
<td>1</td>
<td><em>P. radens</em> 'Skeleton Rose'</td>
<td><em>P. radens</em> 'Dr. Livingston'</td>
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<tr>
<td>1,2,3,4</td>
<td><em>P. Rollison's Unique</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>P. Round Leaf Rose</em></td>
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</tr>
<tr>
<td>1,2</td>
<td><em>P. X rutaceum</em></td>
<td></td>
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<tr>
<td>1,2,3,5</td>
<td><em>P. scabrum</em></td>
<td><em>P. graveolens</em> hybrid</td>
<td>Rue-scented Storksbill</td>
<td>22</td>
<td>Rose mint</td>
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<tr>
<td>1,3</td>
<td><em>P. scabrum</em> 'Apricot'</td>
<td><em>P. scabrum</em> 'M. Nonin'</td>
<td>Rough-leaved Cranesbill</td>
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<td>Rose</td>
</tr>
<tr>
<td>1</td>
<td><em>P. X scarboroviae</em></td>
<td><em>P. crispum</em> derivative</td>
<td>Countess of Scarborough Filbert-scented Geranium</td>
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<td>Filbert</td>
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<tr>
<td>1,3</td>
<td><em>P. Schottesham Pet'</em></td>
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<tr>
<td>1,2,3</td>
<td><em>P. Shrubland Rose'</em></td>
<td><em>P. tormentosum</em></td>
<td>Peppermint-scented Geranium</td>
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<td>Peppermint</td>
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<td>2,4</td>
<td><em>P. Shrubland Pet'</em></td>
<td></td>
<td>Ginger-scented Geranium</td>
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<td>Pungent, slight ginger</td>
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<tr>
<td>1,2,3,5</td>
<td><em>P. tomentosum</em></td>
<td><em>P. tormentosum</em></td>
<td>Three-pointed Cranesbill</td>
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<tr>
<td>1,2</td>
<td>*P. Torento'</td>
<td><em>P. tricuspidatum</em></td>
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</tr>
<tr>
<td>1,2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2,3,5</td>
<td><em>P. triste</em></td>
<td><em>P. vitifolium</em></td>
<td>Balm-scented Cranesbill</td>
<td>66</td>
<td>Sweet scented Citronellal &amp; caproic ester</td>
</tr>
<tr>
<td>1,2,4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

1. References:
1. Wilson, 1965
2. Clifford, 1970
3. Cross, 1951
4. Holmes, 1913
Geranium Oil. Although pelargoniums are largely associated with horticulture, they have been of considerable importance as a source of essential oil for the perfume industry. Only one actual geranium, *Geranium macrorrhizum*, a minor species, is used occasionally in Bulgaria and other Balkan countries (Guenther 1960); all others are pelargoniums. Although 99% of the oil comes from pelargoniums, the term geranium oil was used historically and is still employed today.

Although they had been cultivated for their scent in Europe for more than a century, it was not until 1819 that the aromatic pelargoniums came to the attention of the perfume industry. They were first commercially grown in fields at the foot of the Maritime Alps near Cannes (Knuth 1921). By 1847 they were in regular cultivation both in Grasse, France and in several locations in the French Province of Algeria. In 1880 plantations were established on the French island of Reunion 500 miles east of Madagascar in the Indian Ocean at altitudes between 400 and 1200 meters where sugar cane, vanilla and manioc could not be grown (Perrot 1915).

Just which pelargoniums are now used, or have been used, for commercial oil production is conjectural, since most of the literature seems to have been produced by people not in a position to accurately identify the plants. It is certain that *P. X asperum* was the major crop in France before 1900. (*Revue Horticole*, 1893). It is also certain that *P. graveolens* was the plant grown in Kenya in the 1920's and 1930's (Hutchinson 1931). What other species or hybrids may be involved must wait until a taxonomist has an opportunity to study the plants.

It is surprising in view of the diversity of odor presented in the previous table that only those pelargoniums with rose scent are used. Holmes (1913) noted this as well, and proposed that others should be considered. The exclusive use of rose-scented pelargoniums is probably due to the extreme popularity and expense of the rose extract from Damascus roses, for which rose geranium oil was a cheap and acceptable substitute. For other scents, the pelargonium counterpart was probably not outstandingly less expensive.

Commercial Culture. For perennial growth, the pelargonium requires frost-free conditions, since a temperature of + 3° C. kills the plant. Hence it can be grown only as an annual in France, while in Africa the plants live five to ten years. Such regional variations result in differences in culture, but the basic technique was as follows:
The pelargonium was propagated by taking 10-12 inch cuttings. The best, it was reported, included a heel of old wood. These cuttings were then placed either directly in the field or spaced 8 inches apart in nursery beds. When the latter cuttings were rooted, they were set out, usually in late autumn (Bull. Imp. Inst. 1929). The spacing of the plant varied from 36” each way in S. France, to 12” apart in rows 30” apart in Algeria. The plants were kept weed-free and well-watered where irrigation was available, the application of water resulting in a greater volume of herbage with a slightly lower percentage yield of oil. In Algeria the plants were originally grown on dry slopes where the oil was reported as being of great delicacy. Once the plants became established on low-lying, humid soil, the three-fold increase in yield was balanced by a poorer quality in the “geranium irrigue” oil, and the superior product of dry land was apparently mixed with it to ameliorate the quality.

Depending on the locality, from one to three crops were harvested a year. When three were made in a given year, it was usually followed by two the next, thus making five cuttings in two years. If two cuttings were made, the first was in mid-April when the plants were in full bloom and their usual lemon-like odor had changed to a strong rose. The second would be during late October when the leaves had turned slightly yellow (Bull. Imp. Inst. 1932). A third cutting might be made in July if particularly good growth was achieved. In Reunion, the first of three cuttings took 60-70 cm. of growth, the second and third, 25-30 cm. (Perrot 1915). The cutting was done after several days of dry weather, as otherwise the oil yield was very low. Cutting was done by hand with sickles after the morning dew had dried. In Algeria in 1931 native boys were paid 5 francs per day, adults 10 francs per day, whites twice this rate, and the average cost of cutting one hectare (2.47 acres) was 400 francs or 40 man days for a native adult laborer (Bull. Imp. Inst. 1932).

The material was stored for 24 hours which permitted some fermentation. This released the portion of the oil stored in the form of B-geranyl glycoside (Guenther 1960). The whole plant, stalk and all, was steam distilled. The sizes of the stills varied from ones holding a 250-kilogram charge that one man could handle, to ones holding 20 metric tons of plant material equipped with electrically driven hoists.2 The yield of oil was

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2 Brown and Islip (1952) have written an elaborate treatise on stills for essential oils for anyone wishing more information on this subject.

reported as varying from 0.07% in Italy to 0.20% in some areas of France (*Amer. J. of Pharm.* 1918). A hectare in Reunion might yield as much as 30 kg. of oil per year but a more usual figure was 18 kg. (Guenther 1960). The yield depended on the age of the plantation.

Yield of Oil per Hectare (2.47 acres)  
**kilograms**

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>First Year</td>
<td>10</td>
</tr>
<tr>
<td>Second Year</td>
<td>30–35</td>
</tr>
<tr>
<td>Third Year</td>
<td>30–35</td>
</tr>
<tr>
<td>Fourth Year</td>
<td>25–28</td>
</tr>
<tr>
<td>Fifth Year</td>
<td>20–25</td>
</tr>
<tr>
<td>Sixth Year</td>
<td>15–20</td>
</tr>
<tr>
<td>Seventh Year</td>
<td>6–10</td>
</tr>
</tbody>
</table>

*From Guenther 1960*
Recent History of Production. In Algeria the production of geranium oil was 31,200 kg. in 1903 (Perrot 1915) and rose to 143 metric tons in 1928 (Guenther 1952). At this point it declined rapidly. This was partly due to the high cost of production, Algeria becoming no longer a colony and hence subject to the same labor laws as France. The gruesome years of war, rebellion and insurrection also took their toll as did increasing competition from the cultivation of grapes and vegetables in the same area (Guenther 1960). Production in the late 1950's was down to between 6 and 15 metric tons per year.

Production on the island of Reunion rose to 120 metric tons per year in 1936-1940 but by 1948 this had dropped to 34 tons. Guenther (1952) cites both the sugar industry luring away labor and the tremendous cyclones which ravage the island regularly. A cyclone on January 25, 1949 killed 150 people, destroyed 70% of the dwellings, 50% of the cattle and 80% of the pelargonium plantations (Guenther 1960). Arctander (1960), however, reports that Reunion in spite of the cyclones now produces 100 metric tons per year valued at 3-5 million U.S. dollars, one half of the world's production.

The French production of geranium oil is at an all-time low and still decreasing (Arctander 1960). Although its quality is high, high labor costs and continual pressure from resorts has virtually eliminated the industry (Guenther 1960).

The world's second largest producer is the USSR (Arctander 1960). Plantations in the Crimea and the Caucasus in 1959 produced 50-55 metric tons, all of which were used domestically.

A rather recent introduction is Moroccan geranium oil. Beginning in 1935, the industry capitalized on inexpensive female labor for harvesting and on modern distillery equipment, and under the management of a French essential oil producer after World War II rapidly became a major producer (Guenther 1960). Problems in establishing this industry included a swarm of locusts in 1947 that destroyed 50 hectares of nursery beds (Guenther 1952). In spite of this, Morocco is now the world's third largest producer after Reunion and the USSR (Arctander 1960).

Congo geranium oil from the Zaire Republic, Kenya, Tanzania and Angola has been produced for some years and the production is increasing (Arctander 1960). This is oil from *Pelargonium graveolens* and is not to be mistaken for the oil from *P. radens* grown in Kenya, known as Mawah oil. Pelargoniums have been cultivated in Kenya since before 1914 (Hutchinson 1931). It is interesting that with the exception of Kenya, pelargoniums first went to Europe and subsequently were transported
south for cultivation. In Kenya the plants probably came directly from S. Africa. The term Mawah oil has been applied to the oil from both Pelargonium graveolens and P. radens. Today it exclusively refers to oil from the latter. The word “Mawah” is adapted from the Swahili word “Maua” the plural form of “ua” simply meaning flower (Hutchinson 1931). The odor of Mawah oil is “a bitter-harsh, leafy-woody, slightly earthy, but later toning out to more pleasant rosy, geranium type of odor” (Arctander 1960). It is not a substitute for geranium oil.

The “East Indian” or “Turkish” geranium oil is oil from the grass Cymbopogon Martini (Hutchinson 1931). French financing has established pelargonium plantations in El Salvador that are apparently now past the experimental stage (Arctander 1960).

In addition to Reunion, the USSR, Morocco, Algeria, El Salvador and East Africa, West Africa, Japan, Italy, Haiti, Corsica, Lebanon and India produce annual lots of 1-2 metric tons which are used locally (Arctander 1960).

Although little if any is produced in the United States today, there was once considerable pressure to establish domestic production of geranium oil.

In 1914 the Office of Drug, Poisonous and Oil-Plant Investigations of the Bureau of Plant Industry of the U.S. Department of Agriculture undertook the task of studying the feasibility of commercial production (Russell 1921).

Cuttings of Pelargonium odoratissimum (P. graveolens?) were obtained and rooted in Orlando, Florida, in the winter of 1915. Enough plants resulted to plant two acres. From successes and disasters (they all froze out the first year) growers were able to obtain a number of conclusions based on the plantings of 1917-1919. First, they found that the cuttings could be rooted directly in the field. Second, that the plants were frost susceptible. Third, although plants tolerated drought and wet weather well, 24 hours under water was fatal. Fourth, fertilization increased the yield of herbage with a slight decrease in percentage yield of oil. Fifth, because mowing machines simply uprooted the plants, cutting would have to be done by hand unless new machinery could be invented. Sixth, rains prior to harvest reduced the yield. Seventh, that their yield, 0.035% - 0.109%, was probably low but with even better yields the monetary returns per acre would vary between $15 and $24 per acre per year (Russell 1921). With this conclusion, hardly a promising one, the field was abandoned during the winter of 1919-1920.
In 1923 the Committee on Raw Products of the Association of American Manufacturers of Toilet Articles provided money for further research by the same department of the USDA. Enough plants were left from the previous experiment to set out 5,000 cuttings near Mt. Dora in Lake County, Florida, in 1924. This plantation failed to survive due to neglect. A second planting in 1925 died of drought. In 1928 new assistants were obtained; cuttings were established in 1929, and 0.39 acres planted. The first harvest was made in October 1928 and a second in June 1930 (Sievers, Lowman and Marshall 1932).

Experimental plantings were also set up at Harlingen and Raymondville in the Lower Rio Grande Valley in Texas. These plants froze out in December 1929.

Plantings in 1924 were undertaken in National City and San Jose, California. Mixups resulted in no yield from these plants. A cold spell killed all the plants in San Jose. Plants set out in Calipatria, California, died of summer heat.

In 1925 cuttings were set out on a fifth of an acre in the United States San Diego Acclimatization Garden at Torrey Pines, California. This planting was harvested in 1926, 1927, 1928, 1929, 1930 and 1931. Experiments were conducted on the effects of nitrogen fertilizers either alone or in combination with irrigation. In 1931 these experiments were shifted to a large ranch near Tustin, California. Four one-quarter acre plots were established and studies of the effects of soil type and irrigation were done.

The final conclusions of the investigators were that Texas and Florida were unsuited for commercial production because of frost. In southern California plantations would need irrigation, but if this were provided, three yearly harvests could be obtained on fertilized land. Based on a maximum yield of 25 pounds of oil to an acre, they concluded that the crop could only be grown with labor saving devices (Sievers, Lowman and Marshall 1932).

I have not heard of any further attempts to make this a profitable agriculture commodity in this country.

Although steam distillation was the only extraction technique used in the majority of localities, by 1937 in Grasse (Naves and Mazuyer 1947) a geranium concrete was being produced. A concrete is made by extraction with petroleum ether or benzene. The advantage of this technique is that the yield is somewhat improved. In 1937 fifty tons of herbage yielded 0.20-.25%.
The geranium concrete is a dark green or brownish-green waxy mass. The odor is an intense earthy-herbaceous, sharp-rosy, foliage green one with great tenacity (Arctander 1960). It is best for soap perfumes, adds body to rose perfumes and blends well with spicy additives. Morocco in the 1950's was the largest producer of geranium concrete, producing 5 tons per year.

In Morocco an alcohol extraction of geranium concrete also is done removing waxes and terpenes. When the alcohol is subsequently evaporated the product is known as geranium absolute. Usually a liquid, it is entirely soluble in alcohol and hence is ideal for fine perfumes (Actander 1960).

Although largely used for perfumes, geranium oil is occasionally used sparingly for flavoring with rich and sweet flavored materials such as vanillin, clove oil, patchouli oil and bergamot. Old fashioned toothpaste occasionally still contains small amounts of geranium oil (Arctander 1960).

The odor of raw geranium oil varies in different regions. In Reunion it is described as “very powerful: green, leafy-rosy, with a pronounced fruity-minty undertone and a rich, long-lasting dryout” (Arctander 1960). The Algerian oil is “lighter more rosy-leafy, less minty . . . and the rich, sweet-rosy dryout undertone is more pronounced” (Arctander 1960).

The variation in the oil produced in different regions may be due partly to differences in the variety of the pelargonium grown. Climate, however, also plays an important part. Experiments of the International Commission for Applied Ecology in association with UNESCO in 1957 established a series of plantings in the Middle Limpopo River Valley. The area is African savannah where the annual rainfall is less than 10 inches. Examination of oils from plants of the same variety grown in different locations within this area revealed surprising variation in oil type. The oil from plants grown on high land was distinctly related to the Algerian type while those plants growing along the river in an area of greater humidity produced oil with characteristics similar to Bourbon (Reunion) oil (Sholto-Douglas 1969).

Chemical Constitution of Geranium Oil. Geranium oil primarily contains geraniol and citronellol, the mixture of which makes up 75–80% of the oil. This percentage and the ratio of the two alcohols varies with the origin of the oil. These alcohols are usually found partly as esters with acetic, isobutyric, isovaleric and tiglic acids. In addition to these major components the following chemicals have been isolated from gera-
nium oil: dimethyl sulfide, ethyl alcohol, diacetyl, isoamyl alcohol, 1-α-pinene and β-phellandrene, d-3-methyl-1-pentanol, 3-hexen-1-ol, n-1-hexanol, methylhexyl carbinol, 1-isomenthone, linalool, α-terpinol, menthol, 2-phenylethanol, eugenol, sesquiterpenes, and sesquiterpene alcohols and a paraffin (Guenther 1960).

The physicochemical properties of the oil such as specific gravity, optical rotation, refractive index, ester and alcohol content vary with the origin and all are measured regularly as a check for adulteration. Adulteration can be very sophisticated and techniques for detecting it equally so.

Medicinal Use of Pelargoniums. Although neither geranium oil nor geraniol is recognized as having medicinal applications in the United States, Watt and Breyer-Brandwijk (1962) discuss several medicinal uses of aromatic pelargonium species by tribes in southern Africa. In general the pelargoniums are used by the natives for relief of diarrhea and dysentery. Some species are used for treating syphilis. Pelargonium fumaroides is claimed to bring on the menstrual flow and with celery or mint is used for abortions. Among the aromatic pelargoniums, P. alchemilloides, the Clammy Cranesbill, is reported used by the Xhosa as a paste for healing wounds. A decoction of another variety of this species is supposedly used by the Sotho of Basutoland to wash feverish patients. P. cucullatum is used as a decoction for colic, nephritis, and in suppressing the urine. The root of this species is used to cure diarrhea, the leaf as a dressing for open sores and an antispasmodic. P. grossularioides is used to stimulate expulsion of the placenta, the onset of menstruation and parturition. The Nama apparently also use it for anemia, fever and general weakness. In the Malay archipelago it is used as a menstrual stimulant and an abortive (Watt and Breyer-Brandwijk 1962). A curious mechanical danger associated with some of the pelargoniums is that the points of some fruits are sharp enough to enter the flesh and kill sheep (Pammel 1911).
Pelargonium odoratissimum

Pelargonium inquinans

*Both from Horti Elthamensis Plantarum Rariorum by J. J. Dillenius. London, 1732*
Pelargoniums in the Home. For the individual gardener, aromatic pelargoniums are pleasantly easy to grow. Cultural requirements are basically those used for the other cultivars as well.

Propagation is ordinarily done by cuttings either from your own or someone else's plants. Although seeds may be available for some varieties, they do not always come true and the majority of the seedlings grow very slowly. Cuttings are made with a sharp knife from the soft green wood of well-grown, stocky plants at a time when the plant is making good growth. The cut should be made just above a node and preferably where the remaining node faces outwards (the resulting shoot producing a more pleasing parent specimen). The cutting is then trimmed off just below a node, as the roots only develop from the node and any material below this will simply rot. Cuttings should be about three inches long or should contain about three nodes. All but the new top leaves and perhaps one mature leaf should be gently stripped off.

Rooting can be done in water, in moist sand or perlite, or in compost. Jiffy-7™ Peat Pellets are popular self-contained peat-filled compressed tablets that swell up when soaked and are very good for rooting cuttings provided they are not overwatered. The major cause of death of cuttings is “black leg” wherein the stem simply rots completely. The fungus causing this can be stopped by using a fungicide in the water or by being careful not to overwater.

When the cutting has developed roots it should be potted up. The British favor a soil mix of their own called John Innes Compost Mix. For Americans a suitable equivalent is the Cornell Mix. A peck of this can be made by mixing four quarts of vermiculite or perlite, four quarts of shredded peat moss or sphagnum, two level tablespoons of ground limestone, and four level tablespoons of 5-10-5 fertilizer (Carleton 1967). As to the fertilizer any composition will suffice as long as the last figure is similar to the first, i.e., 10-10-10. Avoid lawn fertilizer, 30-10-10, which is unnecessarily high in nitrogen.

For the city dweller who is not prepared to mix his own soil, the pre-mixed Jiffy Mix™ can be purchased, and when mixed two parts Jiffy Mix™ to one part perlite or vermiculite is an ideal, clean, sterile, easy-to-handle substitute.

The rooted cuttings should be potted in three-inch pots. Clay pots are better aerated and hence need more watering than those of plastic. The current trend is to switch entirely to the
plastic. This simply requires a little less water and a slightly better drained potting mix with more perlite, vermiculite or sand. When the roots of the young plant appear through the holes in the bottom of the pot, or it is clearly outgrowing the pot, it should be repotted in a four-inch pot. This is usually large enough unless you wish specimen plants; then larger pots may be used.

Outdoors all the aromatics except for Pelargonium tomentosum thrive best in full sun. Indoors they should be placed where they get as much sun as possible. Should sunlight be unavailable, artificial light when properly used can produce startling results. Perhaps the best new book on this subject is by Kranz (1971). Lamplight gardening, as they call it, can be done under the purplish Gro-lux fluorescent lights or under cool white fluorescent lights. Since scented pelargoniums are not grown for their flowers and rarely bloom in winter, the requirement for incandescent lights with the fluorescent is superfluous. Cool white fluorescent lights six inches apart and hung twelve inches over the plants will permit them to grow normally without any sunlight. Incandescent lights alone do not provide enough intensity.

I have postponed the subject of pinching back or stopping the young plants because the ultimate desired shape will delimit the approach. For specimen plants, stopping the young cutting once it is established will cause it to branch; subsequent stopping of these branches will result in a lovely bush shape. This of course depends on the variety. Pelargonium X fragrans will produce an upright bushy plant while P. tomentosum tends to be viney and runs along the ground.

The scented-leaved pelargoniums as well as the zonals make impressive standards. A standard is a plant with a single tall stem capped with a ball of foliage. Varieties of P. graveolens and P. quercifolium make excellent standards. Lateral buds should be pinched off at the main stalk as they develop and only when the desired height has been reached should the top be pinched back. Standards can be produced with stems as high as six feet but a more modest height would be desirable for beginners. Stake the plants well, for standards are very susceptible to wind damage.

Many of the Pelargonium crispum varieties and others with small leaves can be made into bonsai. For those with similar patience some plants can be espaliered on walls and fences.

The plants always make impressive growth in the summer and by winter there are too many to take indoors. Cuttings may be taken in August and the parents discarded. During the win-
Right: Pelargonium capitatum. From Horti Academici Lugduno-Batavi Catalogus ... by Paul Hermann. Leyden, 1687.

ter pinch them back occasionally and turn them so they do not grow lopsided. The major insect pests of the indoor aromatic is the white fly. This is difficult to eradicate but Malathion is effective if the treatment is repeated within a week. There are other occasional pests but to enumerate them would make their occurrence appear more than rare.

Indoors the simple presence of healthy plants is reward enough regardless of display technique. Usually they are crowded up against the window so as to obtain the maximum light on those dark winter days. Although the plants will not thrive except in a sunny window or under artificial light, the owner should not hesitate to move them to a dim location for a special occasion. The few hours spent away from good illumination is not damaging and will provide a special delight.

Outdoors the gardener is free to devise all types of display. Planters, tubs, hanging baskets all can be used. The individual habit of each of the aromatics may suggest its own best display. The important thing is to grow them close to the path or within people's reach, for it is through rubbing or crushing a bit of the foliage that one most appreciates the aromatics. They are perhaps most popular in gardens for the blind where they can be smelled and enjoyed by the sightless.

*Non-commercial Uses.* Although geranium oil production is not practical in the home, there are numerous uses for the leaves of the scented pelargoniums. For those who still remember the sentiments that scents once were given, a sprig or leaf can be used as a messenger: rose for preference; nutmeg for unexpected meeting; and lemon for expected. It now has become traditional to place a leaf of rose geranium in the bottom of the glass when making apple jelly. Not only is the deeply cut leaf attractive but it adds a delightful accent to an otherwise bland jelly. The tiny leaves of lemon scented *Pelargonium crispum* are floated in finger bowls, and hence its name, the finger-bowl geranium. Crushed leaves of rose, lemon and peppermint-scented geraniums when boiled in water produce an extract that is a delightful addition to tea, either hot or iced. Branches of a scented pelargonium can be used in flower arrangements. Not only do they replace the function of the florist's asparagus "fern" but their aroma adds much to the bouquet, if its flowers were chosen for color rather than scent.

Young plants make lovely gifts for new brides, apartment dwellers and others. Their ease of culture should permit everyone to have several on hand for such gifts. There is really no
limit to the uses of these plants; their lovely foliage in its myriad forms and scents invites creative approaches. One common use is in a potpourri. I give Helen Van Pelt Wilson's (1965) recipe below:

On a dry day after several days without rain collect leaves of rose scented *P. graveolens* varieties, some lemon scented *P. × limoneum* and *P. crispum* and a very few peppermint *P. tomentosum*. These should be spread on some screens to dry in the shade. By turning them regularly they should dry in a week. Add a fixative, orris root or benzoin or styrax at a rate of one ounce to one quart. Place these leaves in a jar and add spices at a rate of one tablespoon for one quart of leaves: cloves, cinnamon, allspice, mace, and powdered nutmeg may all be blended. Fill jars two-thirds full and stir well. Cover tightly and let stand for six weeks, stirring every few days. When opened the jars will provide a potent and long lasting aroma largely of pelargonium.

This has been a discussion of one group of pelargoniums, those with unusually scented leaves. I have tried to present some of the facts about their biology, history and cultivation and to convey something of the enjoyment obtained by growing them. Since the latter is largely subjective and emotional, I may have restrained myself too much. I can only urge everyone to consider growing these plants either singly or in a collection. They have had a showy history, a neglected present, and merit a popular future.

**ROGER SWAIN**

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Lilies and the Arnold Arboretum

No article with this title could possibly start without reference
to E. H. Wilson and the Regal Lily. Despite all that has been
written and said about this lily and its introducer, the full story
of its impact on gardens and gardeners will probably never be
fully documented. Up until recently, at least, Regal Lilies were
still growing in the garden by the house where Wilson used to
live at the Arnold Arboretum in Jamaica Plain.

A very good example of Wilson’s writings and feelings about
the Regal Lily first appeared in “The Lilies of Eastern Asia". In
“that little-known hinterland which separates China proper
from the hierarchy of Lhassa . . . there in narrow, semi-arid
valleys, down which thunder torrents, and encompassed by
mountains composed of mud-shales and granites, whose peaks
are clothed with snow eternal, the Regal Lily has its home. In
summer the heat is terrific, in winter the cold is intense, and at
all seasons these valleys are subject to sudden and violent wind-
storms against which neither man nor beast can make head-
way. There, in June, by the wayside, in rock-crevices by the
torrents edge, and high up on the mountainside and precipice
this lily in full bloom greets the weary wayfarer. Not in twos
and threes but in hundreds, in thousands, aye, in tens of thou-
sands. Its slender stems, each from 2 to 4 feet tall, flexible and
tense as steel, overtopping the coarse grass and scrub and
crowned with one to several large funnel-shaped flowers more
or less wine-coloured without, pure white and lustrous on the
face, clear canary-yellow within the tube and each stamen fila-
ment tipped with a golden anther. The air in the cool of the
morning and in the evening is laden with delicious perfume ex-
haled from each bloom. For a brief season this lonely, semi-
 desert region is transformed by this Lily into a veritable fairy-
land.”

A hundred miles or so to the southwest, Wilson discovered
another lily new to science which he named “in compliment to
the late Mrs. Charles S. Sargent, artist and lover of flowers,
the wife of Professor C. S. Sargent, the famous dendrologist and
Director of the Arnold Arboretum of Harvard University.” This
lily, L. sargentiae, along with L. regale, and L. davidii were intro-
duced to American gardens by Wilson. Also, he was responsible for *L. henryi* becoming common in cultivation.

The Regal Lily was discovered in August, 1903. In 1908 Wilson shipped a few bulbs back to the Arnold Arboretum and to some friends, but in 1910 he succeeded in introducing it in quantity to America, and the stock passed from the Arnold Arboretum to Farquhar and Co. in Boston. Perhaps Wilson should have the last word, here, about this lily. He felt “it will thrive where the common Apple can be successfully grown.” He said that under cultivation it had “behaved royally, being equally indifferent to winter colds, summer droughts, and deluges and has flowered and fruited annually.” He pleaded with the gardener that “all who possess or will possess this treasure not to ruin its constitution with rich food.”

Although the Regal Lily has been superceded in favor with many gardeners by the fine modern trumpet strains of lilies, there are still gardeners who cherish and grow *Lilium regale* in its pristine, true species form and consider it still one of the best of all lilies.

II

In the fall of 1962 the, so-called, “Lily Demonstration Plots of the Arnold Arboretum” were established at the Case Estates in Weston. This was a cooperative effort between the New England Lily Group of the North American Lily Society and the Arnold Arboretum. Seventeen societies, nurseries or individuals contributed the bulbs to the test garden. Included were a wide range of species and cultivars.

For a period of nearly ten years, various observations were made on this collection. Dr. Donald Wyman has turned over to the writer all the literature accumulated by him and his workers which was recorded during this period. One entire issue of *Arnoldia*, Vol. 20, No. 10, November 6, 1964, was devoted to a detailed study of about 250 species and cultivars in the collection that had been studied up to then. Dr. Wyman called this article “Lilies In Their Order of Bloom”. The name of each lily, the week the first flower opened, number of days in bloom, number of flowers per stalk, size of flower, height of stalk, color of flower, and shape of flower were recorded. A few copies of this popular issue are still available at the Arboretum.

As the years went by it became obvious that certain lilies in the plot were better “doers” than others. The idea arose that this group of lilies could be of great value to the average gardener, who could not bother with fussy lilies and who would like to know which ones could be relied upon to perform well under average or even poor garden conditions.
E. H. Wilson and lilies, just after he received honorary doctorate from Trinity College, Hartford, Conn. Arnold Arboretum photo, 1930.
In the last few years no effort was made to give special care, fertilizer or insect repellent to these lilies. Some died out completely, others lived on in quite undesirable stages; but others thrived and even increased to large clumps, performing well in full sun, surviving drought, animal predation and about every evil that could befall a lily.

During these years of experimentation a misunderstanding arose with the New England Regional Lily Group. Because of the unpleasant appearance of these beds, at one of their meetings in 1971 the President of the group stated that “the lily display at the Case Estates is a disgrace.” After some discussion of who initiated the planting and who was supposed to care for it, it was suggested that the NERLG name be removed from the display and that the Case Estates be asked what could be done about maintenance. The many visitors who saw the lily beds and made notes on those that did well, and those that did not, under trying conditions have profited by what may have appeared shabby at the time. It is significant that no crosses of *L. auratum* by *L. speciosum* were among the survivors.

For the first time the final results of this experiment are offered to the gardener for what they are worth. Only those that did very well are considered here. Those followed by an asterisk did exceptionally well.

*Adagio*  
‘Alcan’ *  
‘Amber Gold strain’ *  
‘Black Beauty’ *  
‘Bright Star’ *  
Burnished Gold strain  
‘Canary’  
‘Corsage’ *  
Destiny’  
‘Discovery’  
‘Dora Pinow’  
‘Enchantment’  
Golden Clarion strain  
Golden Showers strain  
‘Greatheart’ *  
‘Harmony’  
‘Life’ *  
‘Luna’ *  
‘Mystic Star’  
‘Overture’  
*L. pandalinum giganteum*  
‘Red Bird’  
‘Shuksan’  
‘Sonata’  
‘Stardust’ *  
Sunburst Pink strain  
‘Sunlight’  
‘Tarantella’  
‘Thunderbolt’  
*L. tsingtauense*

During the same time period, another group of 17 cultivars and species were planted at the Case Estates for testing in heavy shade beside what is known as the “wood road”. Of these, the Bellingham hybrids, *L. tsingtauense*, Gay Lights, and *L. hansoni* have persisted under “natural conditions” and are still performing well.
Lilium ‘Corsage’. Photo G. Pride.
A Lilium × Parkmannii hybrid. Photo: G. Pride.
Our most recent and continuing involvement with lilies concerns a remarkable collection of “Parkmannii hybrids” now being tested at the Case Estates. At their request, an agreement was made in the fall of 1971 with the Sun Valley Bulb Farms, Inc. of Oregon. They would supply us with 600 bulbs of this famous cross, and we would observe these plants for a period of 4–5 years doing nothing special in fertilizing, spraying or in any way “fussing” with them. Generally these lilies, which are called in the trade “Oriental hybrids,” are considered very susceptible to disease, and some nurseries have them plastered with insecticide and fungicide from the time they come out of the ground until they die down in the fall to avoid disease.

A talk given by the writer at the national meeting of the North American Lily Society in July 1971 stressing the need for disease resistance in lily breeding programs led to this agreement. Very few East Coast lily fans seem to grow these beautiful speciosum-auratum hybrids. Because of their lack of disease resistance, they fail to live on year after year. Good lilies should form clumps in five years from a single bulb. The plan is to divide the bulbs of the survivors between the bulb company and the Arnold Arboretum at the end of a five-year period. They will be used for further breeding work and testing.

During the flowering season from June to August in 1972 and 1973, when this large bed of lilies was in bloom, they created a sensation. Mostly in shades from white through pale pink to deep rose, with flowers from L. speciosum size up to about 1 foot in diameter and with a heavy, sweet fragrance, they were the center of attention.

Even during the first year, dozens of them died. It was not unusual to have a lily die out completely while another seedling a few inches away was not only living but increasing. Most of those that survived increased noticeably in height and performance the next year.

In a way, it is appropriate that we be involved with perfecting this type of lily. The first cross made and the flowering of what is perhaps the most famous of all lily hybrids took place in Jamaica Plain a few hundred feet from where the Arnold Arboretum is now, at a time just before the Arnold Arboretum was conceived. It occurred in the garden of Francis Parkman, whose home was on the shore of Jamaica Pond. Parkman, who was also a professor of horticulture at the Bussey Institution, started experimenting with hybridizing lilies in the 1860’s. His main concern was to combine “the two superb Japanese lilies, L. speciosum and L. auratum”. After several years of

Test bed of L. × Parkmannii at Case Estates. Photo P. Bruns.
hard work and considerable patience, he flowered this now-
famous seedling. Parkman described this remarkable flower
with restraint by saying, it "opened on the seventh of August
and proved a magnificent flower, nine and a half inches in
diameter, resembling L. auratum in fragrance and form, and
the most brilliant varieties of L. speciosum in color. In the fol-
lowing year, it measured nearly twelve inches from tip to tip of
extended petals, and in England it has since reached fourteen
inches. A colored plate of it will be found in the Florist and
Pomologist of March, 1876, and engravings of it have appeared
in the Gardeners Chronicle and other horticultural publications.
The stock has been placed in the hands of Mr. Anthony Wa-
terer, the distinguished nurseryman who has given it the name
of L. Parkmanni."

Accompanying the plate of Lilium × Parkmannii in the
Florist and Pomologist for 1876 was a comment by the editor
which is well worth repeating, "the limits of our ordinary page
are so inadequate to represent the aspect of this noble flower,
that we have found it necessary to adopt a double-page illus-
tration, which we think will show that we have by no means
been guilty of exaggeration in describing Mr. Parkman's Lily
as magnificent, and one of the grandest flowering plants yet
introduced to our gardens."

Mr. Parkman increased this one bulb to a stock of about 50
by bulb scale propagation and sold the whole lot to Mr. Anthony
Waterer of England for $1,000.00. It flowered for Mr. Waterer
in 1875. The published color reproduction of the lily was made
from his plants. However, disease took its toll and all bulbs of
this remarkable lily died before it could be placed on the mar-
ket.

Through the years many hybridizers attempted to re-create
this hybrid but all failed until 1914 when a Mr. O. S. Hayward
of England succeeded in making the cross again. E. H. Wilson
described it then as Lilium × Parkmannii var. Haywardii and
wrote that "Mr. Hayward is to be congratulated on his tri-
umphant success." Since this time the cross has been made
many times, and the resulting seedlings have ben crossed and
recrossed. The collection we are testing is essentially this type.

Visitors coming to the Case Estates to see these lilies should
remember that they are involved in an experiment that may
eventually lead to some new, fine, hardy lilies that can be en-
joyed widely here in the East with less danger of loss from di-
sese. Let the beauty of the survivors compensate for the dead
and dying that may be seen nearby.

GEORGE H. PRIDE
Monarch butterfly

Song sparrow. Photos: R. Weaver.
A Group of Outstanding Goldenrain Trees (Koelreuteria paniculata) Along Boston’s Fenway

Among the very fine and unusual trees planted in Boston’s Back Bay Fens is a group of four Goldenrain Trees (Koelreuteria paniculata), located near the intersection of Boylston Street and the Fenway, close to the Willow Oak that was featured in the first article in this series on outstanding trees of the Boston area (Arnoldia 33(5): 292–294. 1973). The best specimen in the group, and a truly outstanding one, stands 46 feet tall, with a spread nearly equal to the height and a trunk diameter of 22 inches. Another tree just beside this one, shorter and not in as good condition, has a trunk diameter of 24 inches. These are the largest specimens of this species that I have seen in Massachusetts, and they were probably part of the original plantings in the Fens.

The Goldenrain Tree, the only arborescent member of the primarily tropical Soapberry Family that is hardy in the Northeast, is native to Japan, Korea, and western China. It was introduced into cultivation in 1763, but in most parts of this country it is still relatively rare. However, it has several attributes which would argue for its being planted more often. The mustard-yellow flowers borne in large, open, upright clusters appear in June when few trees are in bloom. In fact, this is one of the very few hardy trees with truly yellow flowers. The inflated, papery fruits, green changing to brown, are also conspicuous and attractive, and they frequently persist well into the fall. The trees grow well in a wide variety of soil types.

Goldenrain Trees are escaping from cultivation in several parts of the United States. Seedlings have been found in three places in the Boston area: in the Fens, here at the Arnold Arboretum, and on the Harvard campus along Memorial Drive in Cambridge. There are also a few saplings at the last site. However, all groups of seedlings are growing in close proximity to mature trees, so it appears that the Goldenrain Tree is not becoming truly naturalized in Boston.

RICHARD E. WEAVER, JR.
Koelreuteria paniculata. Photo: N. Page.
Arnoldia Reviews


Originally issued in 1953 as a guide to common as well as unusual house plants, this 8th edition, profusely illustrated with photographs, presents a changed format and benefits from the corrections of nomenclatural errors. The volume is compact and reasonably priced. Illustrations are grouped in eighteen categories and a few general plates are in color. Cultural directions are given in an introductory section and each illustration is accompanied with a graphic symbol designed to suggest a house plant, or one better grown in a greenhouse; also, the requirements of temperature, light, moisture, and soil type. An alphabetical index of scientific names supplies each with a modicum of miscellaneous information and is followed by an index of common names. A handy, useful, and recommended volume continuing an admirable tradition of illustrative plant handbooks.

Richard A. Howard


Not to be equated with other recent books on the popular subject of container gardening, this little English volume offers a comprehensive treatment of an art which originated in ancient Greece and continues to flourish in the Mediterranean area.

Few gardeners have access to the traditional earthenware and terracotta pots which the author describes, and many of the plants she recommends are unsuited to our climate; but the classic concept of a pot garden is a valid one, distinct from today’s ubiquitous redwood and plastic planters.

Anyone interested in creating an adaptation will find this a useful guide, as will the potter in search of authentic and pleasing designs. These are copiously illustrated in over 100 black and white photographs which underscore the need for artistry in the selection, planting, and placing of garden pots.

Jeanne S. Wadleigh
ARNOLDIA is a publication of the Arnold Arboretum of Harvard University, Jamaica Plain, Massachusetts, U.S.A.