THE GERANIUM FAMILY IN PERFUMERY

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A detailed examination of the members of the Geranium family, the classification of their odours and the derived essential oils with uses and applications in perfumery.

THE GERANIUM is one of those flowers of which the naming of the garden versions is somewhat confused, for what most people commonly call a geranium is not the geranium of the botanist. The familiar, showy, scarlet-flowered plants so widely used for bedding-out purposes are really pelargoniums, another branch of the same family.

The Geraniaceæ is an extensive family of herbaceous plants and shrubs originally introduced to this country from South Africa about 1675 and now acclimatised to the temperate regions of the northern hemisphere. It comprises some twenty genera and upwards of 750 species. Apart from the flowers it is the foliage which is of particular interest, for that of some species exhibits a pleasantly strong, aromatic resinous scent or a balsamic-citron nuance. In a few instances, however, somewhat nauseating odours are to be found. Furthermore, many of the genera have remarkable astringent properties, and the tuberous roots of some species are either edible or used medicinally—the term "alum root" for the dried rhizome of *Geranium maculatum* providing a case in point.

The true cultivated geraniums are hardy perennials or rock plants having bright crimson, scarlet, red, pink, lilac, mauve, blue or white flowers. Some of them are seldom seen unless in a special collection, and these, together with the many hybrids among the pelargoniums, are the particular interest of the British Geranium Society. There is quite an extensive literature on the subject, the source-book of which would appear to be the five-volume anonymous contribution upon the "Gerania" (London, 1820–1828).

Of the prototype, there are some 15 species of geraniums growing wild in Great Britain, some of which are rarely encountered these days, but of the familiar and easily recognisable plants, *Geranium Robertianum*, the little crimson herb-Robert, *G. pratense*, the blue meadow crane's-bill, and the pale lilac *G. molle*, the dove's-foot crane's-bill, are found in most fields and waste places.

ETYMOLOGY AND HISTORY

In compiling these studies,[1] the names of the wild flowers form a prelude to the examination of the genera within the N.O. under consideration. It is

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instructive to observe how frequently not only in the Latin and Greek substantives but in the homely country names as found in most European languages, the matrix is preserved and perpetuated in a brief description centred upon a fancied resemblance of some part of a plant to an animal. Thus we find such examples as adder's-tongue, colt's-foot, dogwood, fox-glove, hound's-tongue, snake-root, wolf's-bane and many others, while quite a number of avian references are also to be discovered. In this direction we have already seen mention of larkspurs and the ibis association with hibiscus, to which may now be added a botanically interesting trinity, because it is from the Greek, *geranos* = a crane, that this family derives its generic name, a further contribution being made by the sub-orders, the *Erodiums*, *erodios* = a heron, and the *Pelargoniums*, *pelargos* = a stork.

In miniature, the ripe seeds of these plants bear a superficial resemblance to a crane's head with its long bill. This fancied appearance was noted by Dioscorides (an army surgeon to Roman troops *circa* A.D. 55), who commented upon this class of what we now term "explosive" fruits, i.e., so great a tension is built up in the ripening capsules on a hot sunny day that they are suddenly ruptured and catapult the seeds to a considerable distance from the parent plant—a proclivity which is observed to a remarkable degree in another genus of this family, namely, the Impatiens or Balsams.

The Wild Geraniums

Attention is first directed to the prototype *Geranium Robertianum*, the familiar crimson- or purple-flowered herb Robert of the country roadsides and woodlands. There are several alternative suggestions to account for the choice of name, probably the most likely being its derivation from Robert, Duke of Normandy, for whom was written the celebrated medieval medical treatise—*Regimen Sanitatis Salernitanum*.

As I am beginning to find usual, the country names afford an interesting insight into the potentials of the family, for, in this case, the plant is aptly termed "red shanks" because of its very long, thin red stalks and, in autumn, a particularly bright crimson foliage; hence some of its other sobriquets, e.g., dragon's blood and blood-wort.

In this direction, it is recorded by the old herbalists that Nature seems to have set a blood-red seal upon several of her herbs to indicate their virtue of being able to stop bleedings, this and the tutsan (*Hypericum androsaemum*) have long been regarded as the two best remedies afforded by the fields for the rapid control of internal and external hæmorrhages.

This russet tinge and trend is still more notable in *G. sanguineum* and, as previously mentioned, it is not unduly surprising to find a name such as alum root bestowed upon the purple-flowered *G. maculatum*, when it is known that the rhizomes contain upwards of 30 per cent of tannic acid, thus provid-

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ing a further instance of natural astringents which may prove of cosmetic interest as an alternative to Witchhazel extracts for facial and other lotions.

Diversity of Odours

It is somewhat surprising to find the extent of the odour gamut among the geraniums and pelargoniums. E. J. Parry in the *Chemistry of Essential Oils* lists some 40 species based upon the odours as classified by E. M. Holmes in the *P. & E. O. R.* (1913, p. 372), while D. McDonald, in *Fragrant Flowers and Leaves* (1895), among some 30 entries, mentions some varieties not found in the later list. From these I have selected a representative collection, as is seen in the appended table.

A Brief List of the Scented-Leaved Geraniums and Pelargoniums

Citrus scented :	
Abrotanifolium	Southernwood
Asperium	Verbena
Citriodora	Strong lemon
Variegatum	Soft, sweet lemon
Crispum major	Lemon-verbena
Crispum minor	Citronella
Prince of Orange	Sweet lemon
Lady Scarborough	Sweet lemon
Triste (Night-scented)	Lemon-balm
Rose scented :	
Capitatum	Rose and diphenyl oxide,
Graveolens	Rose and rue
Odoratissimum	Rose and tansy
Attar of Roses	Strong rose
Herbal type :	
Clorinda	Eucalyptus (cineol)
Endsleigh	Peppermint, Citronella
Moore's Victory	Ditto
Tormentosum	Ditto
Lady Mary	Ditto
Little Gem	Ditto
Balsamic type :	
Cedronellum	Balm of Gilead
Quercifolium	Balsamic-balm
Glutinosum	Labdanum type
Radula vitifolium	Ditto
Radula balsameum	Ditto
Miscellaneous :	
Fulgidum	Butyric
Exstipulatum	Pennyroyal
Glaucifolium	Clove-hyacinth
Atrum (night-scented)	Ditto
Unique aurore	Pungent aromatic
White Unique	Ditto
Pretty Polly	Almond scented

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This presents the pleasant nuances of rose, or rose in conjunction with lemon, citronella, eucalyptus, peppermint, pennyroyal, nutmeg, almond, clove, hyacinth and balsam; conversely, with the butyric element very prominent, we may record some decidedly unpleasant combinations, as we may note from such further epithets bestowed upon herb-Robert as "foxy-geranium" and "stinking Bob," for the foliage when bruised emits a stale, sickly, caproic and skatole-tainted effluvium, similar to the odour ascribed to badgers, weasels and foxes—a characteristic which is also observed with the foliage of some of the "musky" Erodiums, such pelargoniums as *P. fulgidum, P. abrotanifolium* and also with the deadnettle (*Lamium album*), the wood-strawberry (*Fragaria vesca*) and the weasel-snout (*Galeobdolon luteum*).

The Scented "Geraniums"

It is also remarkable that the botany texts concerned with Europe and N. America only afford information upon about a dozen species of the indigenous wild geraniums, and with the exception of the feral smell of herb-Robert, none of the remaining varieties exhibit the slightest approach to the geranium odour so familiar to us in our everyday work.

It would therefore seem that the scented varieties of our gardens have originated from acclimatisation and cultivation of stock transferred from the native habitat of South Africa, and sometimes exhibiting a prodigious growth (for I observe from *Garden Flowers in Colour*, by G. A. Stevens, published in 1939 by the Macmillan Company of New York, that: "The well-known bedding geranium of Northern gardens is a shrub in California, climbing up the sides of houses and over fences. Its round, velvety, scented foliage is particularly handsome and immune to insect pests, while its jolly, comfortable-looking flowers are exceedingly brilliant and long lasting . . . there are many different geraniums, and the plants which we commonly grow under this name are really pelargoniums. The true geraniums are mostly wildings, suitable for natural plantings or rock-gardens. None of them is very showy, although most species are acceptably pretty.").

From the country of their origin I have a note regarding one of the mountain geraniums, locally known as the Wilde Malfa (*P. cucullatum*). This is reported to grow into fair-size bushes about the size of a small hay-rick. To come to the more prosaic plants, however, I note that the earlier garden manuals list some sixty varieties of the "true" geraniums, among which the most important would seem to be the scarlet-flowered *G. odoratissimum*, described as the geranium-oil plant. There is also the large-rooted, purple-flowered *G. macrorhizum*, the blossoms as well as the leaves of which are described as having a "strong aromatic scent." This plant, within recent years, is perhaps more familiar to perfumers by its Bulgarian name of

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Zdravets, the foliage upon distillation yielding a greenish concrete having a heavy, persistent clary sage-amber type of fragrance.

Mention must also be afforded to another and somewhat unique fragrance to be found in the foliage of the scarlet-flowered *G. moschatum*, the muskiness of which is very similar to the odour of balsam Peru oil.

This brief survey, I believe, summarises all that can be usefully recorded regarding the genus Geranium, in so far that the geranium-rose fragrance does not appear in the native wild plants, but only, and then often in a somewhat limited degree, to stocks from warmer climates which have become naturalised to northern latitudes. It is instructive, however, to observe in the catalogues issued by the nursery gardeners that among the herbaceous plants scarcely any mention is afforded to the geraniums, other than perhaps a laconic entry such as : "*G. subcaulescens*, the true plant from the Grecian mountains. The flower stems radiate from tufts of silvery leaves and bear brilliant crimson flowers with a black centre."

Mention of the latter colour prompts a passing note, for it is remarked that *G. phoeum*, the dusky crane's-bill, is unique for the dingy and almost black hue of the blossoms, a proclivity which is also seen in the deep indigo tint of the flowers of *G. sylvestrum*, and the bluish black sombreness of the aptly named *Pelargonium nigrescens*, and is particularly evident in the blackish-purple flowers of *P. Zonal* var. *Meteor*, which yields easily a dark violet chromo-glucoside known as pelargonin.

Doubtless there is some botanically useful function served by such macabre-shaded blossoms, which from an æsthetic viewpoint one could perhaps associate with the asphodel, and perhaps it is fortunate that such hues are in a minority when compared with the almost universal preponderance of the neutral or creamy white and lightly tinted blossoms over all other colours.

The Pelargoniums

There are several classes of Pelargoniums, namely : (1) the ordinary scarlet-flowered ; (2) the zonal, or horse-shoe, also known as the bronze, silver, and gold-leaf tricolours ; of these there are hundreds of varieties, both single and double flowered—some 230 species and hybrids are recorded as being distributed throughout South Africa and about a hundred in New Zealand. Then there are (3) the ivy-leaved varieties which are mostly climbers ; while group (4) is the one of greatest interest to perfumers as this contains the lemon and rose-scented kinds remarkable for the fragrance of their leaves, and lastly, (5) the fancy, or large-flowered, also known as the "oak-leaved."

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The Geranium Oils

It will be noted, when the Labiate family is considered, that the essential oil is usually found throughout the green parts, but in some genera (for example, the Mints and Basils) it is concentrated in the inflorescence just before the flowers open. A similar mobilisation of the essential oil takes place in the Pelargoniums, but with this difference, inasmuch as the essential oil acquires a more flowery character as the buds open, by the transformation of the prevailing citral-type odour into a geraniol or rose-like fragrance. Hence the plant is gathered for distillation a little before the opening of the flowers and, although the petals yield no odorous product, in order to waste no time in detaching the flowers they are put into the stills with the leaves.

Reference to the literature from 1892 to date provides a considerable amount of information and some conflicting opinions, but to epitomise, it may be stated that the original South African parent plants have provided North-west Africa, Southern Europe and East Africa, and especially Bourbon (Réunion), with plantation stock specially selected from hybrids among *P. capitatum*, *P. odoratissimum*, *P. roseum*, *P. graveolens* and so on.

Specimens of the above-named, as grown in England, differ in many respects, but collectively, the foliage when fresh yields upon distillation the familiar brownish green geranium oil of commerce, which possesses a characteristic deep, sweet rose-like odour.

Furthermore, it becomes very evident upon examination of the analytical data given in the literature regarding the geranium oils, that this reflects the many differences in odour value according to the plant species, soil and climatic conditions prevailing in the locality of the plantations, variations which are immediately obvious upon odour comparisons between authentic samples from different sources.

It is therefore expedient to select for consideration here a well-defined type as a standard, for example, Oil Geranium Bourbon. This, incidentally, introduces into these essays[2] the first mention of probably the most important and at the same time the most widely used of our natural perfume materials, namely, the sweet, rose-smelling oils of geranium, the isolated alcohol, geraniol and its esters.

According to Piesse, writing in 1855, several varieties of geraniums bearing scent-yielding leaves were introduced into Europe from South Africa as far back as 1690, but it was not until 1847 that *P. capitatum*, the purple-flowered, round-headed geranium began to be systematically cultivated in the south of France for the purpose of extracting its scent-yielding principle, known then in commerce as otto of rose-leaf geranium.

It would appear that geraniol was first isolated from Palmarosa oil by Jacobsen in 1871 by adopting the unique property of calcium chloride to

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form crystalline magmas with certain alcohols, while Tiemann, in 1898, oxidised geraniol to citral and subsequently reduced this aldehyde and regenerated the alcohol.

Odour-Patterns

It is here instructive to recall Piesse's remark regarding this rose-leaf geranium, for he says: ". . . the leaves of this plant yield by distillation a very agreeable rose-smelling otto, so much resembling the real Otto of Rose, that it is used very extensively for the adulteration of that valuable scent. . . ."

I have used elsewhere the term "fragrance-pattern" and illustrated it by a diad or triad of well-defined floral types selected from the groups of fragrances arranged in tabular form according to my interpretation of their order of relative importance in perfumery compounding. This has been based upon a systematic analysis of several hundreds of the more characteristic type-formulæ as presented in the various perfumery recipe books from 1855 onwards, and almost automatically verified by the cumulative indices in my laboratory notebooks.

From this statistical data definite evidence emerges of what has often, but somewhat casually, been mentioned in the literature, namely, that there is scarcely a perfume base in which the elements of rose, jasmin or neroli do not appear in some form or other.

In my Tabulation of Blossom Fragrances, initial consideration is afforded to two groups each containing five basic odours, proportional admixture of which results in the evolution, first of the simple exotics and then the more complex floral odours, but whatever the angle of approach may be, it will invariably be found that attention gravitates towards the rose content.

I therefore feel that in so far as the *essentials* of perfumery compounding are concerned, the prime odours should be regarded as having *odour-patterns*, reserving the term *fragrance-patterns* to define with some precision the osmical end-points of prime odour combination.

This approach opens a very interesting vista, because, for example, in the case of the rose, not only does the noun name and place the flower, but analysis of the essential oil derived from it reveals the type and quantity present of the dominant and recessive osmophores, from which, usually with a large measure of success, reconstitution of the otto of rose aroma is possible.

The Geranium Fragrance

Consideration of the geranium oils affords another opportunity of dealing with an important item in the commerce of perfumery raw materials and at the same time to appreciate the value of the data now available in the literature of the essential oils concerning their chemical and physical properties,

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which is of considerable help to the perfumer, for not only has he at his disposal from the various supply houses the segregated components of an essential oil in a high degree of purity but he can profit in several other directions.

Among these, for example, is the encouraging thought that he is not entirely dependent upon the geranium oils for his geraniol, as there are far more economical sources in the citronella and Palmarosa oils, which by processing yield isolates and esters closely approximating those found in geranium oil; but others, although alien, possess the family nuance and facilitate the production of compounded oils of outstanding strength and tenacity—an accomplishment, incidentally, which is aided by the incorporation of such purely synthetic aromatics not found in nature as benzo- and rose-phenones and diphenyl-oxide and -methane, which possess characteristic rose-like and geranium-leaf odours.

I think that geranium oil may be regarded as one of Nature's masterpieces, and one which, early in the experience of the student-perfumer, will amply repay the effort of a prolonged study.

Bourbon and Other Geranium Oils

Reference to the literature will indicate somewhat prosaically (in round figures) that the total alcohols in Bourbon geranium, regarded as geraniol, will vary between 65 and 70 per cent; the ester content, calculated as geranyl tiglate, about 25 to 30 per cent, while the apparent citronellol is approximately 40 to 50 per cent.

This is laconic and not particularly interesting, but a closer approach reveals what may perhaps be aptly termed an osmical panorama, for in the foreground, and supporting the geraniol and citronellol, we find the presence of small quantities of terpineol, linalol, bornyl, amyl and hexyl alcohols.

In the background are the particularly reactive acids—acetic, butyric, caproic, tiglic and valeric—which in liaison with the alcohols are capable of theoretically engendering upwards of thirty esters. Of course, such a comprehensive inter-esterification does not take place in the plant; nevertheless, it is as well to bear in mind that some of the more probable formulations, for example, the acetates and valerates of amyl alcohol, borneol and terpineol, are so powerful that their natural (or intentional) incidence must be in such small traces just evident enough to be regarded as modifying agents.

To add to the complexity of constitution, yet obviously playing an important part in the composure of the fragrance, are the trace elements—citral, menthone, pulegone, pinene, phellandrene and their isomers.

Geranium Bourbon is also remarkable for the relatively small amount of terpenes it contains, and, in my opinion, the potential of the full depth and beautiful fragrance of this oil is seen in two directions, firstly in the terpene-

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less oil, and secondly the result from careful fractionating which yields the rhodinol of commerce.

Without attempting any comment upon the unsettled question of the chemistry of the rhodinols, it may be noted in the pelargonium and in other *flower* oils that geraniol is associated with the laevorotatory form of citronellol. The proportional balance in the Réunion oil may be regarded as 50 : 50 ; whereas the oils of African origin average about 80 : 20 ; those of French distillation showing approximately 70 : 30 ; and the Spanish oils 60 : 40, noting in passing that it is usually the French oil which is distilled over rose petals to yield the beautiful *Geranium sur Rose.*

It would therefore appear that this equipoise in the Bourbon oil provides an ideal foundation for simulations of Bulgarian otto of rose, while increasing the content of *l*-citronellol emphasises the lighter and sweeter nuances of rose centifolia, Damascene, the moss and the tea roses.

The "Grass" Oils

It is also instructive briefly to review several of the economical sources from which the geranium oils of commerce are obtained and to note the variations in the odour-patterns of these oils which are distilled, not from leaves, but from flowering grasses. In order of importance these are Palmarosa and the Java, Ceylon and Formosa citronella oils.

Distillation in India of *Cymbopogon Martini* var. (Motia-grass) yields Palmarosa or "Turkish" geranium oil (containing from 75 to 90 per cent of free geraniol) which has a fine, soft, mellow rose-geranium odour singularly free from unwanted alien off-notes, which is not unduly surprising when it is noted that the *addendum* is brief, consisting chiefly of small quantities of the acetic and caproic geranyl esters, methyl heptenone and dipentene.

Another example from a similar species known locally as Sofia-grass yields ginger-grass oil, but in this instance the geraniol in a much smaller yield is associated with an entirely different framework formulated around the presence of carvone, dihydrocuminol, phellandrene and dipentene, from which emerges a strong and somewhat unpleasant herbal back-note which is difficult to eliminate from the geraniol even by repeated fractionation.

Java citronella, distilled from *C. nardus*, is interesting for several reasons, firstly because it introduces us to a very important source of a fine quality geraniol, and secondly, whereas this alcohol is found in liaison with *l*-citronellol in Bourbon geranium, in the Java oil its companion is the aldehyde *d*-citronellal to the extent of about 35 per cent of each. This aldehyde, when reduced, provides the *d*-citronellol of commerce, but it must be observed on comparison that there is a considerable odour difference between the relatively coarse rose-type scent of the *dextro*-version and the refined, suave and sweeter rosy fragrance of the *laevo*-modification.

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The odour-framework, which with the terpenes constitutes the remaining 30 per cent in the make-up of the Java oil, according to the literature, is seen to comprise some thirty items, but just how some of these contribute towards the composite aroma it is difficult to assess, and although the presence of citronellyl and geranyl acetates is noted, yet some inter-esterification is probable from the occurrence of butyl and amyl alcohols which donate certain fruity notes. These are complemented by green nuances, following the incidence of hexanol, hexenol and methyl heptenone, while traces are found of cadinol, methyl eugenol and citral.

All of these, be it noted, are very powerful osmophores, and must therefore blend to effect a profound modifying action upon the basic odours of the two main constituents.

Citronella Ceylon. A brief glance at the build-up of Ceylon citronella (ex *Andropogon nardus*) reveals another storehouse of ancillary aromatics. This oil is important commercially as an economical source of a second-grade geraniol and *d*-citronellal, the approximate balance of these constituents being as 30 : 10, but the incidental components only amount, however, to about a dozen items. These comprise, in addition to the acetic esters, methyl eugenol and methyl heptenone, common to both oils, but the incidence of small amounts of such dominant osmophores as borneol, camphene and thujyl alcohol is sufficient to repress the more delicate fragrance, due to traces of a nerol-linalol complex and farnesol ; hence in comparison with the odour of the Java oil, that from Ceylon is crude and heavy, being somewhat unbalanced by the background of herbaceous elements.

The Formosan oil inclines closely towards the Java type, and is interesting for the formulation of economical, yet powerful bases for industrial perfumes, as well as being an important commercial source of the aromatic isolates and their derivatives : geraniol, citronellal, citronellol, the corresponding esters, hydroxycitronellal and synthetic menthol.

Interesting Fragrance-Patterns

One of the most interesting natural associations of geraniol, and incidentally a pattern which with variations is typical of quite a number of fragrant Australasian flora, is to be found in the foliage of *Boronia Muelleri* (N.O. *Rutaceae*), in which the rosy geraniol note is complemented by an aromatic-balsamic nuance of the fennel-myrrh type, backed by pinene and refreshed with geranyl acetate. From this ensemble a very pleasing and intriguing bouquet emerges.

In the antipodes there are quite a number of these fragrant Boronias with distinctive and well-defined odours, *B. citriodora*, for example, yields an oil containing upwards of 80 per cent of *l*-citronellol, another source of which is *Eucalyptus citriodora* ; while *Verbena* (Aloysis or Lippia) citriodora,

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with its high citral content, is a further example of the lemon-citronella scent found associated with geraniol and/or its esters.

Among the myrtles (N.O. *Myrtaceae*) are found the eugenol-containing clove and pimenta trees, the oils of which have a high content of this phenol alcohol. It is, however, from the small white flowers and the foliage of *Myrtus communis*, the well-known evergreen shrub in its natural habitat, that, in my opinion, the component balance of eugenol and geraniol is so adjusted by Nature as to engender an initial spicy-rose scent, which is supported and sustained by the presence of myrtenol, nerol, cineol and cinnamic aldehyde—a grouping which may thus be selected as a prototype bouquet which may be conveniently described as the *Myrtle Bloom Fragrance.*

With some modifications, this nuance is found extensively in other genera of this N.O., for instance, among the widely spread Australian melaleucas, the well-known "bottle-brushes" of which *Callistemon salignus*, the white or willow bottle-brush, is a typical example.

The same spicy-rose motif is also characteristic of several members of the N.O. *Calycanthaceae*, for example, *Calycanthus Floridus*, the Carolina allspice-tree and *Chimonanthus fragrans*, the Japanese variety, while similar sweet odours which perfume the air for a considerable distance around are the proclivity of *Elaeagnus hortensis* and other varieties of this "wild olive" family, which, like the myrtles, are prolific in their tiny white flowers from which such a continuous volume of powerful fragrance is disseminated.

The Ubiquitous Geraniol

The above examples are representative of the presence of geraniol in sufficient proportion in the several fragrance-patterns to exercise a modifying effect upon the other osmophores present and thus engender a natural bouquet, and it is therefore instructive to learn, upon referring to the conveniently arranged lists now available in the several "Aromatic Codices" that, progressing through the alphabet from acacia to zdravets, the incidence of geraniol in flower absolutes and essential oils extends to some fifty items—a magnitude which is shared only with linalol. Moreover, it is remarked in the literature, albeit somewhat laconically, that geraniol is extensively used as a base for many types of floral compounds, but it may not perhaps be realised until an audit is made from a comprehensive range of contemporary type-formulæ (such as is to be found in Jellinek's *Practice of Modern Perfumery*) that the incidence of geraniol and/or geranium is seen in more than half of the examples.

Because of the normal association of scent with the beauty, colour and shape of flowers, regarding which the premier position is usually accorded to the rose, we have ample evidence of the usage made by the earlier Eastern civilisations of rose-water and rose-perfumed oils and unguents, while the

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popularity of this beautiful primal fragrance is still being maintained, judging by the frequency of its choice for perfuming creams, brilliantines, lipsticks, face and talcum powders and other toilet and cosmetic specialities which depend for their fragrance upon economical, powerful and persistent compounds based upon geraniol.

It may therefore be regarded as a fortuitous proclivity of geraniol that it possesses an osmophore which is already so close to the nuance of the rose ottos that, given a little support from *l*-citronellol and phenylethyl alcohol, the basic outline of the rose otto fragrance-pattern is comparatively easily approached. The final touches towards achieving an ideal simulation which is æsthetically satisfying must, of course, depend entirely upon the perfumer's inspiration and his skill in selecting and deciding upon the proportional balance from a very brief but carefully chosen list of natural and synthetic aromatics—according to the type of rose bouquet he wishes to emulate.

The Genus Erodium

There are about a dozen wild Erodiums indigenous to Europe, bearing mostly lilac or purple flowers. Probably the most common is *E. cicutarium*, known in this country as the hemlock stork's-bill, but in North America it is variously termed common heron's-bill, pin-clover, pin-grass or Californian wild musk. *E. moschatum* is the musky stork's-bill, Muscovy or ground needle. Both these plants possess foliage somewhat clammy to the touch (*cf.* Cistaceae) and on further handling emit a strong scent which is described in the garden books as "musky."

Here I think we have evidence of a similar balsamic-labdanum nuance which has already been noted with some of the Pelargoniums, rather than any suggestion of the vegetable "musky" odour characterised by the musk mallows.

The garden manuals list some forty varieties of annual and biennial Erodiums having mostly blue or purple flowers with at least some suggestion in the foliage of an aromatic redolence, but this appears to be more marked in some of the naturalised tropical species, for example, *E. malapoides* and *E. Reichardi*, which have a very sweet resinous-balsamic odour.

Some Lesser-known Plants Allied to Geranium

Some members of the Geranium family on their own terrain have gradually adapted themselves to the peculiarly dry conditions of the Karroo—the high pastoral tableland of South Africa. One unique specimen known as kaarsbossie or the candle-bush (*Sarcocaulon* (*Burmanii*) *Patersonii*) is a small spiny shrub bearing white flowers and remarkable for the fact that the succulent branches, even when quite fresh and green, contain so much oil that they will burn like a torch. This genus is allied to the *Monsonia*, of which

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there are some half a dozen cultivated varieties, with white, red or purple flowers, the foliage exhibiting a pleasant balsamic-citrus redolence, while *Floerkea prosperpinacoides*—known as the false mermaid—is a solitary species of a North American genus, having minute white flowers and slightly unpleasant-odoured foliage. *Balsamina* is a discarded synonym of *Impatiens*, giving name to the sub-order of the Balsams. These are of East Indian origin, now naturalised in Europe and North America, and are tender herbs, the succulent stems of which are laden with a bland aromatic watery juice.

The generic name *Impatiens* refers to the characteristic already noted among the crane's-bills, namely, the elasticity of the valves of the seed pods, which discharge their contents to a considerable distance when ripe or touched. *I. noli-me-tangere* (touch me not) is the only English species which is indigenous to Europe, but they are very numerous in India, some 125 species having been recorded.

The wild balsam is almost a rarity in the English countryside, but is an elegant plant some two feet high bearing large flowers of a delicate yellow hue beautifully spotted with orange, while the somewhat larger plants in North America are known as "jewel-weeds," and from the proclivity mentioned are listed in the wild flower books of that country as "snap-weeds."

The garden manuals list some thirty varieties of hardy and half-hardy annuals and generally feature the double camellia-flowered balsams of the nurseries, but these plants—with their fine spikes of waxy-textured blossoms which may be pink, rose, scarlet, violet, yellow or white—do not, so far as I can ascertain, possess foliage with any pronounced aromatic proclivity. It is therefore to some of the tropical varieties, such as *I. cornuta*, the red-flowered horned balsam of Ceylon and *I. sultani*, the scarlet-blossomed Zanzibar balsam-shrub, to which attention may be directed.

It is first, however, opportune to take a brief glance at the generic name, as this reveals several hints which aid our understanding of the aromatic-citrous nuance found within the Geraniaceae. Although the Anglican word is obvious in the Latin (*balsamum*) and the Greek (*balsamon*), yet the root is to be found in the Hebrew (*bosem*), which would appear to have from its meaning as the "chief of oils" a rather special significance. Conversely, when the odour balance of this complex is reversed and the emphasis is upon the citrous side, the redolence is then a particularly apt description of "balm," a word which is derived from the Aramaic—*bolsmin*—meaning a sweet, leafy scent.

This folial fragrance is perhaps best typified by the herbaceous perennial common to the Mediterranean, namely, *Melissa officinalis* (N.O. *Labiatae*), the lemon-balm, or sweet honey-plant, deriving its name from the fondness of bees (Greek : *melissa* = a bee) for its flowers. This plant, as well as the Moldavian balm and the variety known as "balm of Gilead" are particularly

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common to country gardens in Southern England, and a slight bruising of the foliage immediately releases a sweet lemon-verbena fragrance.

The particular reference to "balm" as anything which heals or soothes pain arises from the query made in Jeremiah, viii, 22: "Is there no balm in Gilead; is there no physician there? . . ." and although it would appear that balm and balsam are in ordinary parlance interchangeable terms, yet from the perfumery angle we must allocate to them very special meanings, more particularly as I find in the botanical texts a considerable divergence of opinion.

For example, balm of Gilead (or Mecca) may properly be described as the thick syrupy liquid extracted from the sticky, resinous and balsamic-odoured buds of *Populus balsamifera*, N.O. *Salicaceae*, while balsam of Mecca (or Roghen) would seem to be more correctly listed under *Balsamodendron Gileadense*, N.O. *Amyridaceae*, the Abyssinian myrrh trees, amongst which are found *B. mukul*, the Bdellium of the Scriptures.

Due allowance should, however, be afforded to our understanding of the odour and physical appearance of the familiar balsams of Copaiba, elemi, Peru and tolu, and so on, belonging to the N.O. *Leguminosae* and originating in South America, as compared with the *materia medica* of Biblical times, for other authorities consider as the source of the Gileadense balm, trees indigenous to the Syrian–Grecian archipelago, such members of the N.O. *Anacardiaceae* as *Pistacia lenticus*, the lentisk or common mastic tree, and *P. terebinthus*, the Algerian or Barberry turpentine tree, from which were obtained, by natural or artificially induced exudations, fragrant products of a liquid, balsamic or resinous consistency which underwent certain changes upon ageing and/or exposure to air.

This listing may be concluded with mention of *Balanites* (or *Ximenia*) *Aegyptiaca*, N.O. *Olacaceae*, the Persian zachun-oil tree, and particularly *Cedronella tryphylla*, N.O. *Labiatae*, named from the Greek: *kedron* = the cedar, in reference to the fragrant resinous scent of its foliage. This latter plant, also listed as *Dracocephalum canariense*, dragon's-head balm, is said to have extensive usage among Indian women of to-day, as providing an excellent and fragrant shampoo.

Balsamita—a True Balsamic Fragrance?

Although we may observe within the Geraniaceae instances of the varying proportional mergers of the balmy lemon-verbena nuance with the benzoin-labdanum type of balsamic fragrance and various balsamic-vanilla shadings among the spice trees and myrtle blooms, yet for a long time I have held the opinion that somewhere there should be found a source to yield an untrammelled "quintessence of balsam," and this I believe to exist in a herb seldom seen these days and difficult to locate in the literature.

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I refer to *Chrysanthemum balsamita*, also known as *Balsamita vulgaris*, N.O. *Compositae*, and bearing the almost forgotten names of maudeline, alecost or costmary (Costus Maria), *Costis* being a generic Greek term for certain spicy roots, and in the days when ale was home-brewed, costmary was usually added to impart an agreeable sharp tang to the beverage, hence the name alecost.

Costmary is a shade-loving plant growing some two feet high, bearing insignificant greenish white flowers. The scent of the living plant has been described as giving an initial impression similar to that of a weak mint sauce, but the foliage, upon bruising, reveals a unique fragrance which I can best liken by a liaison of iso-butyl cinnamate and methyl ionone slightly shaded with carvone.

We may perhaps recollect that the advent of clary sage into perfumery was as recent as 1909, and it is very probable in my opinion that should this equally modest herb—or some of its near relations, such as *B. cornuta*, the red-flowered Asiatic "horned balsam"—ever achieve commercial importance, it would prove to be a valuable alternative to clary sage, for among the other virtues which I believe it to possess, a hint from an old Herbal indicates that not only does it confer a delicious scent to potpourri, but intensifies the fragrance of all the ingredients therein.

Balsamic Epitome

I have taken this opportunity in dealing with the balsams on their own terrain to digress somewhat upon the balm and balsamic motif, because, although prior consideration has already partly positioned this redolence in the essay upon Labdanum and Cistaceae,[3] as well as the balm and balsam liaison as noted in the Hypericaceae (St. John's-worts), I would regard these sources as a prelude to a longer chapter, for among natural fragrance there is considerable evidence of the balm or lemon-verbena nuance, either dominant or merging with the balsamic, while the transition of the latter into the "aromatic" by the gradual acquisition of such osmophores as vanilla, cinnamon and clove provides the pattern for an extensive range of tropical blossom odours in many of which the citrous element again emerges.

Minor Members of the Geranium Family

Among the lesser-known members of this unique family are the *Limnanthes* (Latin: *limnus* = a marsh). These are dwarf hardy annuals known as the Californian marsh flowers, of which *L. Douglasii* is a typical example. As found in the wild state, particularly in South-East England, its pretty little yellow and white flowers have earned for it the local name of "eggs and bacon." This plant, as well as *L. rosea* and *L. alba*, is a favourite with the bees and possesses a sweet melissa-like fragrance—a further example of the incidence of the citrous nuance found within this N.O.

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The Oxalidaceae

It is perhaps a little strange to find that *Oxalis acetosella*, the familiar sorrel of our woodlands and hedgerows, belongs to the Geranium family, the names in most languages being indicative of the sour acid juice in the delicate shamrock-like leaves.

Originally also from South Africa and bearing white or pale tinted flowers often streaked with mauve, it is a large genus containing some 30 wild and over 150 cultivated species. It is, however, only occasionally among this array that there is any suggestion of scent. *O. odorata* and *O. montana* exhibit a faint, nondescript "neutral" perfume, but this is more evident in the South African *O. magellanica*, which inclines to a lily-honey fragrance, while the South American *O. enneaphylla* has characteristic waxen-white petals which emit a decided almond-like scent.

The nasturtium of the flower gardens is another example of misnaming, for the term rightly belongs to the watercress family, N. O. *Cruciferae*. We find that from the Latin : *nasus* = nose and *tortus* = tormented, is indicated the proclivity of an acrid nose-stinging pungent smell—this mustard-like odour peculiar to the cresses being shared by the Tropaeolum, the Indian cress, yellow larkspur or garden nasturtium. The botanical name through the Greek and Latin refers to a trophy from the fancied resemblance of the shield-shaped leaves and the helmet-like flowers.

Apparently this was originally a Peruvian climber renowned for the glowing sunny brilliance and beauty of its scarlet-orange, trumpet-like blossoms, of which *T. majus*, the large, and *T. aduncum*, the canary creeper, are probably the best known, while the seeds pickled in vinegar have for long been known as "false capers." The content of traces of benzyl isothiocyanate, which is more evident in the roots, accounts for the "mustard and cress" association.

With regard to fragrance, a cluster of blossoms on a hot sunny day may give the impression of a very faint, nondescript scent, but under similar circumstances, if left in a covered jar for a few hours, it is likely that the slightly medicated odour of phenylethyl cyanide will be observed. Although a fairly large genus, the only species I can trace with any definite evidence of a perfume is *T. tuberosum*, the Peruvian tuberous-rooted nasturtium, the red and yellow blossoms of which have a similar lily-honey fragrance as noted with *Oxalis magellanica*, which incidentally is just perceptible in the aquatic *Hydrocera* (or *Tytonia*) *natans* and *H. triflora*. These are the East Indian water balsams, bearing large white flowers variegated with red and yellow.

Fruits in the Geranium Family

It may perhaps be a little surprising to find edible fruits within the Geranium family, nevertheless, indigenous to India may be found two small,

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but very interesting trees, as instanced by *Averrhoa carambola*, the kumrunga, which grows to a height of about 16 feet and is remarkable first for the beauty of its crowded clusters of small pale rose-coloured ribes-like flowers which produce fruit the size of a lemon. These, when well-ripened, have a strong and agreeable quince-like scent and something of a nutty peach flavour. Belonging to the same genus is *A. Bilimbi*, the bimbling or cucumber tree, which flowers in a similar way to the above, but the fruit is of the form and size of a gherkin, with a smooth, thin, pale green, translucent rind, like that of the white grape. When ripe it is as soft as butter, with a flavour like an unripe gooseberry and afterwards acquiring the aroma of strawberries.

Summary

It is evident from the statistical data that Geranium and/or geraniol are extensively used as the basis for the formulation of all kinds of artificial floral oils and fancy bouquets while the rose odour is particular to the Pelargoniums, which occupy the dominant position in the Family, and with one exception the remaining items recorded may be regarded as of minor importance.

This study has directed attention to one of the modest members of the family around which some genera from other N.O.s have been arranged, a sector which may perhaps conveniently be named as the *Balsamina*, and from this group at some time there may become available a companion to clary sage. Regarding this latter herb, with its musky-amber character, W. A. Poucher, in Volume I, makes a very interesting remark, for he says: "It is this aroma which is so distinctive in fine quality essential oils, such as certain varieties of geranium and neroli, and which is absent in synthetic aromatic chemicals, as instanced by geraniol and nerol (in comparison)." Although we have observed the balsamic-labdanum redolence to be an integral part in many of the pelargonium oils, yet by removing this somewhat heavy nuance and replacing it with an *Essence of Balsamina*, some remarkably interesting results might, in my view, become apparent.

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[1] Maurer, E. S., *The Essentials of Perfume Compounding*, Part 2 of which, "The Natural Orders," is currently being serialised in *Soap, Perfumery & Cosmetics*.

[2] *Ibid.*, a series in which this paper will eventually take its place as the nineteenth essay.

[3] *Ibid.*, July, 1956.

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