NON-FLORAL PERFUMES

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THIS IS not an original theme. Many writers have touched on it before.[1] As far back as January 1939 an anonymous article appeared under the same title,[2] the following introductory paragraph from which epitomises the subject: "It is often asserted that, in spite of the enormous number of synthetic chemicals now used in perfumery, the art has its basis in flowers and their fragrance. Historically, however, it may be questioned whether this assertion is correct. The ancients made their perfumed oils mainly with the aid of spices and aromatic woods and resins; and, although the popularity of floral perfumes is impressive, there is, nevertheless, a big and increasing production of perfumes in which the predominant note is not a floral one."

It is interesting, however, to observe that the above-mentioned article is sub-titled, "a catalogue of a few materials with which the perfumer can reconstruct the odours of leathers, precious woods, balsams, spices, etc.", and most of the items quoted are proprietaries of well-known English and Continental firms, many of which have earned the esteem of perfumers during the past decade. The author rightly emphasises the difficulty of attempting to classify odours of a non-floral type and proceeds to give a brief dissertation upon some of the groupings as outlined by Cerbelaud in his *Formulaire de Parfumerie*.[3]

Those who are familiar with this classification of odours of the same and neighbouring tonality will perhaps recollect that the osmical panorama extends to no less than 45 groups but, broadly speaking, it is seen that this scheme lends itself to a division showing the "pure floral" or blossom elements as one third; the second portion of similar magnitude being devoted to the "pharmaceutical" essential oils of perfumery usage; while the remaining third embraces transitional groups and the folial, animal, fruity and other ancillaries.

These auxiliaries, as is well known, have become of increasing importance in modern perfumery composition and in almost every case they represent a "quality" rather than a specific odour and may perhaps be termed the perfumery "adjectives," or more succinctly expressed as "adjuvants."

The dictionary affords a particularly apt definition of an adjuvant

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as "something added to a prescription to aid the operation of the principal ingredient," and I think it well worth while to observe, in the fundamental non-floral character of these adjuvants, the function of the large range of pharmaceutical essential oils, gums, balsams and resins, and to realise just how closely Perfumery is still allied to the "art of the Apothecary."

Although it is perhaps due to the odour classification of Rimmel (1865) that the position and importance of the adjuvants became apparent, it is only when some attempt is made at segregation that a pattern begins to emerge from which the transition mechanism of one group to another begins to be obvious. The utility of this can also be perceived when hybrid effects are considered, for instance, in either allocating a niche to synthetics of unusual odour, or producing according to inclination, e.g., oenanthic-verdure or balsamic-honey notes.

The following order is suggested as a *cyclic* progression, as it will be noted from this sequence that the basic odour tone of any one group is not only largely dependent on, but is linked with that of the preceding group as well as the following.

THE ADJUVANT CYCLE

1. Folial-nutty	8. Woody
2. Verdure	9. Smoky
3. Oakmoss-lichen	10. Leather
4. Fern	11. Animal
5. Earthy	12. Resinous
6. Fungal	13. Spicy-nutty
7. Rooty	14. Balsamic
15. Herbaceous	19. Citrus
16. Amber	20. Fruity
17. Honey	21 Oenanthic
18. Aldehydic	1. Folial-nutty

Although each of the above groups will allow for some subdivision, it will be found that there are several sections which require more elaborate and detailed treatment, these are : (a) the folial nutty verdure, (b) herbaceous and (c) fruity groups.

The Folial-Verdure Group

The green or folial note is perhaps best represented by the aroma of violet leaves absolute, and usually in conjunction with such alkyne esters as methyl-heptine and methyl-octine carbonates, but there are, however, auxiliaries of a green character which have comparatively recently come into prominence, such as nonadienol and its aldehyde and "leaf alcohol" (β-hexenol and its homologues) as well as hexyl-heptyl esters and ethers. Upon these items many green-leaf coronal bases may be formulated, which when incorporated with due restraint in compositions, confer desirable light and subtle touches of greenery and freshness, free from the blatant and heady tendency of the alkynes.

Another group of verdure toners which can also be used with very pleasing and natural effects are combinations of the various acetals of phenylacetic, hydratropic, heptyl and methyl-heptylacetic aldehydes, especially in conjunction with the formic, acetic and propionic esters

of geraniol, citronellol and terpineol; and from such linkage are evolved bases with definite characteristics, such as the Verts de fleurs, de Lilas, de Gardénia, d'Oranger, des fôrets and so on.

Further shadings of considerable value in muguet, mignonette, gardenia and tuberose compositions can be based upon some of the foregoing items by the addition, for instance, of di-hydro pseudo-ionones which give the deeper and richer tones of ivy-leaves, while the sweet, dry and powdery note of vine-leaves can be introduced with methyl heptenone and hexylenic aldehyde; finally, the dull and heavier nuances closely simulating chrysanthemum, dahlia and tomato foliage, which notes are so useful in the heavy undertones of the citrus-incense-rose fantasies, can find a ready counterpart in iso-amyl heptyl ether and neryl butyrate.

It is also interesting to observe at this point the interpolation of the "nutty" cadence, not the spicy-cachou aspect, but rather that inflection of the coconut, hazelnut and walnut tone, because the fundamental odour, based upon γ-nonyl and duodecyl lactones, plus the unctuousness of heptaldehyde acetals, and the amyl and butyl-benzyl ethers, can according to inclination either remain nutty, or emerge as an odour characteristic of decorticated twigs and the hollow stems of water plants.

For instance, the fragrance of iso-propyl phenylacetic, phenylpropyl, cyclamen and cuminic aldehydes, plus that of such alcohols as cedrenol, santalol, coriandrol, and esters like hexyl benzoate, all closely simulate the fresh, damp, sappy, pithy and cortexal odour.

This sapid, succulent odour tends towards the verdure note, which is rather that of the freshness of vegetation than the aroma associated with particular leaves, and is perhaps particularly well exemplified by appropriate dilutions of heptyl caproate or iso-propyl acetophenone (methyl-cumyl ketone), as well as by the more culinary odours of freshly sliced French beans, cucumber and melon rinds, which characterise such esters as hexyl caprylate and hexenyl formate.

There is also another folial shade which is a composite. This is to be found in the sweet, dry and powdery note of rose leaves and dried rose petals, to which, in particular, the phenylethyl and phenylpropyl acetates, propionates, cinnamates and the acetals of the corresponding aldehydes, are largely contributory.

Odours of Mosses and Lichens

The mousse de chêne odour borders on those of the verdure group and, although there are many botanical sources of the lichens from which the commercial extracts are manufactured, yet the characteristic odour can be observed in the methyl, ethyl and particularly the iso-butyl esters of everninic acid, as also in the p.-methyl, iso-propyl and iso-butyl quinolines.

Furthermore, farnesyl and fenchyl alcohols and their acetates also

contribute a considerable degree of tonal support, and this can be supplemented by galbanum, myrrh, scammony, patchouli and vetivert, but as the choice of commercially available oak moss extracts, resins and absolutes affords such considerable latitude, the perfumer who has in mind elegant creations of crêpe, chypre, fougère and similar fantasy perfumes is not particularly interested in synthetic imitations of this virtually indispensable item.

The Odours of Ferns

As is readily perceived, the fern odour links the verdure-lichen note with the earthy tones, and although the odour of the rhizome of the Male fern (*Dryopteris filix-mas*) is not very pleasant, somewhat resembling the oily dankness of octyl butyrate, yet the foliage odours of many other species of ferns is particularly attractive to the perfumer. Many examples of this are to be found in the *Adiantum*—the scented maiden-hair ferns, and particularly with the *D. aemula*—the hay-scented Buckler fern, and this coumarinic note is also well evidenced in the group comprising the Hound's or Deer-tongue family (*Liatris odoratissima*), as is seen by some of the common names of these plants; wild vanilla and sweet vernal.

From the perfumery angle, however, the scented-fern or fougère odour is fundamentally that of oak-moss allied with patchouli, as this combination seems to allow a gradual unfoldment of a peculiarly attractive sweet, velvety cassia-clove undertone, which when slightly augmented by a woodruff-vanilla shading and extended by lavender, constitutes a foundation upon which many interesting variations can be made. For instance, the replacement of the coumarin by some of the methyl- or hydro-coumarins, or simulations of Melilot, based upon di-methyl hydroquinone, Melilotal (p-methyl acetophenone) and anisyl esters, ethers and ketones, provides some very pleasing and intriguing notes.

Furthermore, upon more deliberate consideration, it is noted that there are four adjuvants which are integral to the make-up of "fern-frond" perfumes, namely, a slightly herbaceous thyme note which may be obtained by the judicious addition of carvacryl acetate or benzoate; also the incidence of the odour of freshly bruised fern stems, which will be found in cuminic acetaldehyde; there is also a touch of the pungency associated with ethylamyl, methylhexyl and similar "lavender" ketones; and, finally, bearing in mind the relationship of the primeval giant ferns with the coniferæ—in iso-bornyl propionate will be found the requisite pine inflection to complete the fougère gamut.

The Earthy Odour

This is a somewhat recondite section and may perhaps be introduced by calling attention to a very apt excerpt from W. H. Hudson's "Hampshire Days." Writing in 1902, he says, "It here comes into

my mind that the very smell of the earth, in which we all delight, the smell which fills the air after rain in summer, and is strong when we turn up a spadeful of fresh mould, which the rustic calls "good," believing, perhaps rightly, that we must smell it every day to be well and live long, is yet after all, an odour given off by a living thing—*Cladothrix odorifera*—too small for human eyes . . . yet they are able to find a passage to us through the other subtler sense; and from the beginning of our earthly journey even to its end, we walk with this odour in our nostrils, and love it. . . ."

It would seem, however, that Dr. Hugh Nicol has assembled most of the references to the scanty literature on this subject, in an article published in 1933 and a later contribution entitled "The production of odorous substances by the aid of micro-organisms."[4] These papers contain many items of interest to the thoughtful perfumer. The second contribution mentions that the basic earthy odour has been ascribed to the *Actinomycetes* (or ray-fungus), but I think the point of outstanding interest is that dealing with the fungal decomposition of glucose, resulting in the production, not only of ethyl acetate, but of other sweet, ethereal "woody and autumnal" esters.

In practical perfumery, the earthy odour may perhaps be best described as a blend of the oakmoss fundamental, with a moderate ferny undertone which includes a trace of a sweet fungal element. Light touches of such bases add a desirable similitude of naturalness to folial compositions, and these in their turn can be used to impart a distinctive tonality to cyclamen, gardenia, mignonette, muguet and tuberose compositions.

In so far as synthetics are concerned, an unmistakably earthy odour is associated with iso-butyl quinoline and linalyl-heptyl ether, and this is even more evident when they are blended with fenchyl alcohol; but the approach to the odour of freshly turned earth can be simulated with greater fidelity by incorporating such elementary bases with anethole-containing oils such as dill or fennel, shading with basil, pennyroyal, rue and sage, and adding, as a final touch, a little of a rhodinol fraction exhibiting the characteristic wet-straw note.

The Fungal Aroma

This term needs a little clarifying, because the *natural* odour varies from the pleasantly culinary (and sometimes perfumed) aroma of the edible mushrooms to the unpleasant dankness of the poisonous toadstools; we have also the sickly sweetness exhibited by many types of mildew and the sour or vinous "secondary fermentation" odour associated with various moulds.

Furthermore, there is a wide diversity in these aromas in the fresh and damp stage as compared with those of the humus or air-dried spores, but from the perfumery viewpoint it is probable that the pleasant Champignon prototype is found to

best advantage in the cyclic ethylene-glycol acetal of hydratropic aldehyde and in the cruder and heavier note of the di-methyl acetal.

Upon careful selection, however, it is found that there are quite a number of the medial aliphatic esters which may be used in conjunction with the hydratropic and heptaldehydic acetals, particularly the secondary hexyl and nonyl acetates while, for example, definite shadings can be borrowed from the sour-earthy note of hexyl propionate, the sweet mushroom-honey tone of octyl propionate, the secondary-fermentation fragrance of phenyl-ethyl caprylate, the more floral, fungal-gardenia undertone of n-nonyl and n-decyl acetates and the peculiar fungal-rose-orange complex of nonyl caprylate.

The usage of such sweet, sickly bases is, as already indicated, that of an embellishment of the mossy and folial undertones, so that for practical purposes in perfumery, fungal and earthy tones can be regarded almost as synonyms.

The Rooty Complex

The rhizomic odour would appear to be a composite note based upon various proportions of the damp aroma associated with ferns, earth and fungus, with the peculiar dry and somewhat astringent tones of friable or crumbly earth, which in itself has a ligneous or powdered-bark back note.

In this group the synthetic adjuvants play a comparatively minor role, as the odour of wild parsnip-seed oil epitomises the ferny-earthy-fungal tone, and this gives better results than items selected from the comparatively narrow gamut of octyl and octyl-crotonyl acetates, butyrates, propionates and laurates.

From such a starting point, however, via the oakmoss "esters," the note begins to embrace the lichenol inflection of p-iso-propyl quinoline and the labdanol shading of iso-butyl cinnamate, but from here the balance of the tonal elements must be sought among the natural products.

Probably the most descriptive adjective which can be applied to the rooty group is "dank," and, if the term can be accepted, then "essence of dankness" is well exemplified by a blending of galbanum resinoid and *immortel* (everlasting) absolute, for in the latter is observed something of the liquorice note which contributes largely to fungal sweetness: a similar sweetening action is also noticed in the inclusion of the perfumed bdellium, sweet myrrh or bissabol opoponax.

From another angle of approach, Herabol myrrh, sassafras and asafœtida exhibit a dry, powdery ligneous astringency, thus beginning to verge towards the woody note, but also from this departure point is seen the advent of aromatic and spicy warmth via the ginger root, the methyl eugenol background of Canadian snake-root oil, leading to sumbul (musk-root), the musk lactones of angelica root and thence to the violet undertone of costus root and

iris rhizomes; and finally from the woody-rooty-cachou notes of calamus and patchouli to the familiar rooty-sandal fragrance of vetivert oil, its alcohols and esters; all of which, when supported by clove stem, cinnamon leaf and origanum oils, lead to a variety of pleasant aromas veering towards the woody note.

The Woody Odours

The odours of the "precious woods," particularly cedar and sandal, are very important in modern non-floral perfumery compositions and in this category, in view of the popularity of the citrus-incense-rose and "soir" perfumes, the vetiver note may be included.

Although it is perhaps the deep, sweet and peculiarly fragrant and persistent santal-type odour associated with vetiveryl acetate which has brought this ester to the foreground in recent years, yet it is important to realise not only the age-old Indian usage of khus-khus roots, but also the fact, noted by Piesse in his 1851 "Art of Perfumery," that in the early days of perfumery in England, extracts incorporating tinctures of vetivert roots, created quite a furore.

It would appear, however, that of the aliphatic esters, vetiveryl acetate is outstanding in representing the quintessence of the vetiver characteristic without the dull and sombre notes of the oil. The other esters, from the formate to the valerianate, incline to an over-fruity emphasis and, moreover, show a tendency to liberate the free acids, while the only other ester of interest is the phenylacetate, which reveals, above the fundamental note of the acetate, as may perhaps be expected, a remarkable sweet, fruity-honey fragrance.

Sandalwood Oil, E.I., like all the woody oils, is of considerable importance in perfumery, not only because of its blending and mellowing action, but also for its equally outstanding fixative properties, which are seen to a marked extent in compounds for creams, brilliantines, bath salts, talcum and face powders.

Although a deliberate overdose of sandalwood oil in a compound will result in an eastern or oriental type of aroma, yet in alcoholic perfumes the characteristic inflection of this oil is frequently obtrusive and more pleasing results are achieved with Santalol.

Here also, the acetate is the outstanding ester and is more stable and less fruity than the other aliphatics, but the crystalline phenylacetate, like the corresponding vetiveryl ester, is almost indispensable in powder perfumes and sachets.

Support from any of the synthetics is somewhat limited, but decahydro-β-naphthol formate, assisted by benzophenone and phenylbutyl carbinol, provides a starting point for industrial deodorants and some grades of soap perfumes, particularly in conjunction with Amyris (Oil Sandalwood, W.A.).

Cedarwood Oil (*Juniperus Virgiana*) and Atlas Cedar (*Cedrus Atlantica*)

follow very closely the sandalwood oil pattern, and here also the acetate and the crystalline phenylacetate are the two most important esters, but it is interesting to note that there is something in the odour of these oils which seems to parallel the cortexal tone of cyclamen alcohol and aldehyde, and this same isopropyl fundamental can be observed in conjunction with the characteristic lignum note of furfural acrolein derivatives. Further details on this subject are available in a brief article by J. R. Byers, Jr.[5]

Bois de rose and the linalyl and terpinyl esters are too familiar to need detailed treatment here but, in passing, it may be noted that the basic rosewood odour is approximated very closely by that of isobutyl heptyl ether. Mention should also be made of guaiacwood (champaca) oil, in which the bland, cortexal-cyclamen note is evident in its characteristic tea-rose fragrance, which is still more pronounced in the acetic and phenylacetic esters of the alcohol.

Smoky and Tobacco-Leaf Odours

The destructive distillation of birch tree wood yields a tar, fractionation of which gives the Rectified Oil of Birch Tar of commerce. The odour of this oil resembles to a considerable degree the aroma of smouldering brush-wood, wafted from a distance. Cade oil, prepared in a similar way from various species of the juniper, lacks the slightly medicated guaiacol tone of birch tar and is perhaps more reminiscent of peat smoke under similar conditions, especially when the oil is blended with triethanolamine pyrolignate.

It is also interesting to note in passing that the hydrocarbon Cadinene is also present in such rooty and woody oils as camphor, cedar, galbanum, patchouli, savin, sassafras, santal and wormwood.

Variations upon the clary sage-coumarin-bergamot theme provide useful bases for bruyère, genista and gorse perfumes, when shaded with birch tar oil, and begin to show an approach to the cubitana or habana tobacco leaf note, while from the more pronounced peaty tone of cade oil, these bases—especially when used in conjunction with the cedryl and santalyl phenylacetates—result in compounds which exhibit a marked approach to the peculiar fragrance associated with Harris Tweed.

The Odour of Russian Leather

Although the characteristic aroma of Cuir de Russie can be achieved by simple permutations upon the birch tar-bergamot-petitgrain specification, and that of Peau d'Espagne by the further addition of sandalwood oil, there is always a certain aftermath of harsh undertones, and while variation to allow the inclusion of Castoreum eliminates this unwanted inflection to a large degree, yet even in comparatively small doses, the persistency of the animal-manure note is inclined to be obtrusive.

If, however, such basic composi-

tions also include *Pix Liquida*, the genuine Dalbrand or peasant-distilled Stockholm tar, prepared from the roots of the *Pinus sylvestris*, then a very satisfactory product results, especially if backed with olibanum.

In so far as synthetics are concerned, p-tertiary butyl phenol has a decided cuir aroma, although the chlorocresol type of back note is difficult to suppress, but in conjunction with amyl and anisyl formates, some of the p.-cresyl ethers and esters, economical versions of the leather motif can be evolved suitable for soap and industrial deodorant perfumes.

It is noted, however, that the bruyère-birch tar bases will blend particularly well with cinnamyl and geranyl acetates and, with a fair proportion of iso-butyl phenylacetate, exceptionally sweet and persistent top notes can be achieved.

The Animal Notes

It is noteworthy that, during the past few years, in the literature published in English, some twenty or so contributions have appeared upon such topics as "animals in perfumery" and odoriferous substances of animal origin—musk, civet, castoreum and ambergris.

From 1926, when Professor Ruzicka elucidated the constitution of civetone and surprised the scientific world with compounds containing very large carbon rings, so much progress has been made that there is no point in endeavouring to make a précis here, in view of the abundance of recent contributions on this subject. Reference should be made to the existing literature for details of new "nitro" musks, "muskat" from the American musk-rat, the odorous components of ambergris, and also information on the substituted indoles.

The Resinous Odour

The resinous note partakes somewhat of an osmical quality which is the direct antithesis of the bland unctuousness of the woody oils. It may perhaps be described as possessing a degree of harshness such as is observed with bromstyrole, decahydro-β-naphthyl acetate and the hexyl aldehyde acetals, but in odour alignment it would seem to correlate with a blend of methyl heptenone, terebene and olibanum, and this odour constitutes a prominent backnote in such oils as eucalyptus, rue, sage, pennyroyal, spearmint, sassafras, cinnamon-leaf and clove-stem.

The basic note is elevated in the juniper and cypress oils and is seen to full advantage in the depth and body of the *Pinus sibirica*, silver fir and other oils from the Austrian Tyrol. As an adjuvant in perfumery its use is somewhat limited to supporting components in the woody, smoky, leather and animal sections.

Spicy and Nutty Aromas

A brief investigation into Spices and Condiments shows that the former may be regarded as aromatics used for flavouring and, of these,

four are of common everyday usage, namely, clove, cinnamon, ginger and nutmeg, but they are of somewhat secondary importance in perfumery. The dividing line, however, between spices and condiments is indefinite and, generally speaking, mustard, red, white and black pepper and horse radish, are referred to as condiments.

One outstanding property shared by both groups is concomitant with the medical quality of being carminative, that is, capable of producing an internal sense of pain-relieving warmth, and also as rubefacients, in the form of alleviating embrocations and liniments.

It is observed in the folial group that the aromatic counterpart, in contrast to the nutty or cortexal inflection, is found here, particularly in the almond, cachou and nutmeg and in oils expressed or distilled from barks, berries, seeds, pods and roots, and it is further noted that the spices will align in complementary or supporting pairs, namely, cinnamon-pimento; clove-caraway; almond-vanilla; ginger-pepper and cachou-nutmeg.

Although the warm, spicy note is a fundamental of eastern or oriental perfumes and contributes largely to the background of such non-floral perfume-types as ambre, chypre, fougère, erica and origan, yet pleasing combinations are also observed with the woody oils and light touches from these groupings can be used very effectively with the more delicate blossom compositions, the function of cinnamon in hyacinth and patchouli in white rose bases being well-known examples.

In so far as support from the synthetics is concerned, cinnamic and benzoic esters are either too fruity or tend towards the balsamic note, so that for practical purposes the clove epitomises the typical spice odour through the eugenols and their esters and ethers, although it is known that resorcinol and thymol ethers and esters, substituted cinnamic and benzyl aldehydes, and various piperonal derivatives, contribute largely to the make-up of the above-mentioned five-fold grouping, but for details of recent work upon the organic chemicals having a cinnamic odour, the paper by Dr. Carl Bordenca should be consulted.[6]

The Balsamic Fragrance

It is very probable that the prototype of the pure balsamic note is to be found in Balsam of Peru, and it would seem that it is the cinnamic osmophore which is largely responsible for this sweet, fragrant note. Although not definitely spicy, the balsam partakes somewhat of this character, which is combined with an herbaceous shading similar to that of clary sage.

Balsam of Peru is remarkable for the complexity of esters, aldehydes and lactones which contribute to its make-up and, furthermore, an outstanding characteristic of the balsam and the oil distilled from it, is the mild, but persistent and peculiarly sweet, mellow, velvety tone which it is able to confer upon com-

pounds varying in texture from light floral to heavy exotic.

Examination of individual benzyl and cinnamyl cinnamates and cinnamyl benzoate, and various combinations of these, indicates that to them the dominant note is evidently due, but it would seem that the inclusion of phenylethyl and phenylpropyl cinnamates contribute respectively a desirable spicy, rose-honey and aromatic-hyacinth nuance, also the somewhat elusive *velouté* note can be achieved with the aid of methyl and ethyl cinnamates and cedryl and santalyl butyrates and phenylacetates, while final additions of vanillin, benzaldehyde, coumarin and melilotal in small quantities, complete a simulation in tonal agreement with the natural product.

If the cinnamic motif in the above is replaced by a benzoic sequence, then the cadence, although still sweet and bland, inclines, as may be expected, towards that of Siam Benzoin, including the resinous colophony note and the characteristic almond-vanilla undertone.

Balsam of Tolu follows a similar pattern, but although the reputed mild hyacinth fragrance may occasionally be found, most samples seem to incline more towards a typical toluol-varnish odour, which is also found in the terebinth note of Mastic and, similarly, the "naphtha rubber-solution" association of Styrol is very pronounced in some specimens of styrax balsam ex *Liquidamber orientalis*.

Olibanum, with its resinous fir-tree and frankincense odour, and the sweet myrrh or opoponax, complete the brief list of natural resinous materials which have a balsamic odour. It is possible, however, to accentuate satisfactorily the characteristic note by fortifying one or more of the balsams with phenylethyl and phenylpropyl cinnamates, which procedure incidentally subdues the slight chemical back-note which these esters frequently possess and impart to compositions.

The Herbaceous Complex

In order to ascertain a probable prototype "herbal" odour it is necessary to examine some fifty species of plants, the essential oils from which can be roughly segregated into culinary and medicinal groups.

It also becomes obvious that the make-up largely contributing to the "herbal" odour of both these groups depends considerably upon the fundamentals of those items at the beginning and the end of the cyclic adjuvant sequence, namely, the folial-verdure-fern and the citrus-fruity-œnanthic.

Incidentally, in the "Herbals" of Culpepper and Gerard, "*Sylva*," and other writings of John Evelyn, the diarist, the records of the Chelsea "physick" and other well-known botanical gardens, there is a wealth of information for the student of perfumery to draw upon. In published records of the medieval period may also be observed the association of the still-room and the herb garden and the division therein afforded to

the culinary side, for instance, sage, savory, tarragon, chervil, mints and parsleys and also to the "simples" or remedial herbs—chamomile, dill, fennel, pennyroyal and rue, together with some consideration for the "sweet aromaticks"—lavender, rosemary, balm and bergamot for use in sachets, pomanders and pomatums.

From the perfumery viewpoint, however, some endeavour to epitomise must be attempted, and it is interesting to note that Cerbelaud, in his "classification," devotes no less than five sections to the *Umbellifers*. Although this family includes about twenty of the more important "herbals," nevertheless, upon formu-

Labiatae

Verbena	Balm, Bergamot, Savory, White Horehound
Pulegone	Garden mint, Water mint, Spearmint, Peppermint, Pennyroyal
Carvone	Thyme, Marjoram, Hyssop, Basil, Sage, Clary sage
Camphor	Lavender, Rosemary

Umbelliferae

Aromatic	Angelica, Sweet Cicely, Chervil
Anethole	Caraway, Cummin, Coriander, Dill, Fennel, Anise, Lovage
Apiol	Carrots, Parsley, Celery, Parsnip
Roots	Hemlock, Asafœtida, Galbanum, Sumbul, Opoponax, Ammoniacum

Compositae

Southernwood
Chamomile
Tansy
Tarragon
Marigold

Miscellaneous

Borage (Boraginaceæ)
Salad Burnet (Rosaceæ)
Rue (Rutaceæ)

lating a more detailed catalogue it is noticed that approximately the same number can be found among the *Labiatæ*, concluding with several of the *Compositæ* and a few examples from miscellaneous families.

Arranged in the previous sequence it is noted, as with the spices, that certain groupings with dominant characteristics emerge and within these room can be found for the miscellaneous items.

A consideration of this listing would seem to indicate that the fundamental of a typical culinary "Herbal" note is most likely to be found in a balance between the carvone and anethole bearing plants, for instance, in sage-thyme and dill-coriander.

In so far as the synthetics are concerned, and after reviewing the list of some seventy items which possess green-leaf and herbaceous odours, these would appear to be more suitable for the construction of folial, verdure and fern aromas or, to put it briefly, as with the oakmoss and lichen group, more satisfactory results can be obtained from a few simple permutations upon the essential oils from some of the plants listed above, rather than elaboration from the synthetic aromatics.

The Amber Fragrance

Most perfumers have their own special interpretations of the indispensable Ambreine note and it is interesting to observe just how many of the adjuvant fundamentals contribute to its tonal make-up. For instance, we find the resinous *Labdanum Crete*, the rooty vetivert and the woody santal and cedar esters, balsamic vanillas, spicy patchouli, and the warmth of clary sage, as well as the musky cadence of angelica and ambrette oils, the fragrant top-notes from the rue aldehydes and ketones, and finally the floral sweetness of rose, iris and jasmin.

From such a wealth contributed by the natural materials, assistance from synthetic products only seems justified when economical versions have to be considered and, in this direction, isoamyl and isobutyl cinnamates, supported by the nitro musks, are probably the most suitable diluents.

The Aroma of Honey

This note is one of the most useful in the gamut of the adjuvants and, moreover, comparatively simple in construction, being based upon various combinations of the aliphatic, aromatic and woody alcohol phenylacetates plus a trace of diacetin.

Such compounds are almost universal sweeteners and impart depth, body and tenacity to every base in which they are incorporated, but probably the outstanding quality observed (after the sweetness) is the ability to enfold, subdue and mellow the "medicated" after-odour found with so many of the synthetic aromatic chemicals of the ether, phenone and ketone class.

If these honey bases contain phenylacetic acid and some *p*.-methyl quinoline, the note begins to

become more pomade-like and waxy, but the civetal backnote, although at first not particularly prominent, has a tendency to become very obtrusive.

The Aldehydic Notes

As with the fixatives, most perfumers have evolved their own special aliphatic aldehyde complexes of general purpose or individual floral tonality, and work in this direction within the past decade has been made easier by the purity and stability of the materials which have become available.

The normal range cannot, of course, be extended, but interesting auxiliaries have occasionally appeared; for instance, the di-methyl and di-ethyl acetals of octyl, decyl, undecylenic, cinnamic and amyl-cinnamic aldehydes and citral, which suggest many probable uses not possible with the aldehydes themselves. Furthermore, there are also a number of newer allyl and cyclohexanol esters which afford considerable support to the earlier bases of the fruity pseudo-aldehydes.

The Citrus Odour

The incidence of some of the above-mentioned lemon and orange acetals, decyl acetate and methyl undecylenate and also the *alpha* and *beta* nerol esters, enable considerable improvements to be effected upon certain of the eau-de-cologne formulations resulting in a marked increase of the freshening factor.

This is also observed with the advent of the *nardenised* versions of terpeneless oils, from which also emerge floral tones of unsuspected sweetness, delicacy and purity.[7] Because of the greater importance of the Citrus odour in toilet waters, this item has been segregated from the following section.

The Fruity Gamut

It is remarked, in the metamorphosis of blossom fragrances to the finality of fruit odours, that the fruity gamut passes through the stages of unripe, ripe, over-ripe and even rotten and, furthermore, the size and texture of the fruit itself is important enough to receive some consideration. For instance, the large and hard fruits which contain very little juice—such as apples and pears, may be contrasted with the smaller and softer berries and currants, and also with lemons, limes, grapefruit and oranges—all of which yield a considerable amount of fragrant juice when subjected to light pressure.

The fruity nuance is of considerable importance when one comes to give the final touches to the simulation of blossom fragrances and particularly in modern fantasy compositions, but it is not always easy to decide upon the most suitable fruity inflection to be employed. The term "fruity" is in fact too general to be of practical utility and guidance for specific purposes. It is observed, as with the spices and herbals, that various complementary and supporting groupings are possible, which are more effective than

single entities. The following sequence covers the fruity gamut from the coarse and pungent to the milder and more delicate tones :

Group I : Banana-pineapple ; apple-pear ; peach-apricot.

Group II : Citrus (as lemon-orange) ; greengage-gooseberry ; plum-blackberry.

Group III : Grape-currants; strawberry-raspberry ; cherry-mulberry.

The amount required for imparting the requisite light fruity nuance to perfume bases is very small. Reference to the literature upon the flavouring essences indicates the complexity of these compositions, approximately two hundred esters, ethers, aldehydes, ketones, phenones and lactones being employed, the majority of which are outstanding in their aromatic strength and pungency. Consequently, for floral embellishment, considerable skill has to be exercised in order to reduce the blatancy of these compositions to a threshold minimum.

In addition to the allyl and cyclohexanol esters and newer anthranilates, there have been quite a number of complex organic chemicals of flavour importance which have become prominent during the past decade and some of these, chiefly lactones, are remarkable in containing within themselves tonal qualities hitherto only achieved by admixtures, in small proportions, of a considerable number of materials.

The Oenanthic Note

The vinous or cognac fragrance, although particularly useful in fortifying the fruity adjuncts, can without exception be used to embellish any of the other adjuvants and in particular the folial, verdure and herbaceous groups.

The characteristic aroma is based largely upon oenanthic ether and other heptyl esters ; simple and substituted aliphatic anthranilates, and particularly phenylethyl anthranilate and phenylethyl pelargonate. Supplementary aid is afforded by many of the caprylates and caprinates, also the di-methyl acetals of hexyl, heptyl and decyl aldehydes, and complex esters such as amyl capryl-caproate, from which many œnanthic shadings can be made, varying in tone, for instance, from vinous-honey to the dry, powdery notes of grapevine leaves, thus returning us to the odours of the folial group, which headed this sequence of non-floral adjuvants.

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