Training the ABC's of Perfumery

The training of staff at
TCFF, (Thai-China Flavours and Fragrances Industry Co. Ltd., Ayuthya, Thailand)
with guest post-graduate students and professors from major universities in Thailand, on
"The Perfumery Business".

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"Letting a hundred flowers blossom and a hundred schools of thought contend is the policy"[i]

Introduction

The training of any discipline is never an easy task. This is the case even when there are clearly defined rules and parameters such as in language training. Perfumery is one language in which even the most basic concepts have not yet been clearly defined, leaving us without definitive understandings of perfumistic terms. An individual's understanding of odours, smells or aromas is usually the result of his culture, personal experience and environment rather than training.

There also appears to be an underlying feeling that until the biological mechanism of smell is fully understood then a unified language is perhaps impossible or of limited use. However, try describing 'Debussy's - L'Apres-midi d'un faune' in terms of wavelength, pitch, amplitude or Van Goughs "Sunflowers" using the RGB colour system. Our true understanding is not as greatly enhanced as we might hope, in knowing and being able to measure the science of sound and light objectively. I contend in the art, or is it science? of perfumery that it is not necessary to wait for the coffin to be closed on the precise anatomy of olfaction and gustation before we can make good use of a language of smells.

A language hoping to be useful should be relatively easy to grasp and learn, be flexible, offering the user a tool for deeper research and understanding. The seeds for the system that I have been teaching since 1992 are based on old knowledge and follow the general principle laid out in Haarman & Reimer's "Book of Perfume"[ii] . Without a mention of benzyl salicylate (orchid) or cis-3-hexenol (leafy-green), the book showed us that the words and terms for adequate odour description already exist in the English language without requiring the use of new words or chemical nomenclature.

In my classes there are often three or four languages used between the students. Some of the students are learning for sales positions, some are learning for applications work or compounding, others are university academics but the prime target group are those training to be perfumers. I teach principally in English, but Thai, Mandarin, Cantonese and Japanese represent the native languages of the students. Whilst looking for common ground upon which to start it became quickly apparent that every student was been able to recite the English alphabet, A-Z, consistently, even some students who had had only 6 years of compulsory schooling behind them.

So combining the two factors, H&R and A-Z. I have been teaching an odour classification system based on 26 easy key words running through the alphabet A-Z. These act as aide memoirs and overcome to a large extent the problems that some researchers[iii] [iv] [v] have come across in their attempts to give labels that are easy to learn and remember .

Odour descriptions can suffer damage from grammatical rules imposed by the English language, in particular I refer to placing an adjective before a noun so that the secondary classifier comes before the main classifier. This means that in the following description "***modern fresh aldehydic floral***" the main classifier is "floral" followed by aldehydic then fresh and modern. Perfumery is a vague science and language can be used to hide the uncertainty that often exists in subjective evaluations. There is always the fear that if we quantify a description it is far more vulnerable to attack. I recommend that my students, *fearlessly*, describe in a manner that demonstrates a quantifiable element and gives a more precise picture of their appreciation of the smelling experience. The result is that the above description is written ***Floral, aldehydic, fresh, modern***. Descriptions in this form translate across cultural and language barriers far more successfully than *flowery* English descriptions.

The system goes on to teach students to take the quantifiable aspect a few stages further by applying proportionate values to the descriptive terms and relative values for intensity. By adding quantifying factors to the odour description (sub-classification, intensity and length of life) the description becomes far more vivid than a simple verbal description and makes way for some fairly advanced manipulation of the description for analytical and creative purposes.

The approach adopted here is a pragmatic one [vi], born of the desire to teach the art of perfumery systematically. It has been developed for its speed in training and it's flexibility in use. Whilst we may wait for a perfect understanding of the mechanism of smell I suggest this workable approach can lead to a reasonably complete odour classification system for use in initial perfumery training and as a tool for more advanced activities. This is merely one contending voice to describe a hundred flowers.

Most students starting training are initially aware of only "like" and "dislike", a few are able to relate to specific food, flower and household smells but within a few hours of using the system most can classify odours qualitatively and quantitatively.

Step 1 : Let's start at the beginning with the "a-b-c" 's :

The A-Z system originally began as a way to avoid unnecessary duplication of work by perfumers. I have lost count of the number of times I have been asked for a match of a specific famous, market-leading soap fragrance, and how many times I have started making them from scratch. In the more common methods of archiving samples, they are stored in a numerical, product or chronological system. In these filing systems, similar smelling perfume samples are kept in completely different locations. Even when samples were cross-indexed, marketing and evaluator personnel would tend to select samples from a very narrow range that they were familiar with. By contrast, it was found that when perfume samples were archived according to their smell characteristics (jasmins sitting next to other jasmins on the shelves), staff were more likely to consider a wider range of alternatives to fulfill an enquiry.

The system also gave perfumers quick access to similar, previously completed fragrances, allowing them to learn from archived samples rather than continually re-inventing the same wheel. It was then that raw materials could also be grouped in a similar fashion, so that for example, woody smelling aroma chemicals were kept with other woody smelling materials.

As I became increasingly involved in training, I looked for a simple nomenclature that non-native English speakers could adapt to quickly. These groups were listed from A-Z, and the terms went through a period of evolution until it was found that certain names were easy to understand and remember, ensuring that the full range of odours could be covered by the system.

It was found that they could also be arranged roughly in terms of their appearance in the evaporation stages of a perfume.
A-H loosely represent notes apparent in top notes.
I-S represents middle notes
T-Y represents the later stages of evaporation.

However, as in any two-dimensional representation of a multi-dimensional property, it can never be completely accurate at every level, and a little latitude is requested. Names were chosen to be general rather than specific ("dairy" rather than butter or milk) to avoid having too many specific connotations (Butter with butyric esters, milk with lactones etc.). To be too specific would be too create such a long list of groups that it would defeat the purpose. Names were modified not only to fit conveniently in the A-Z arrangement, but also to indicate the wider meaning of each group. The term "aliphatic" has been chosen rather than "aldehydic" to represent the "fatty" characteristic of straight chain aldehydes, alcohols and fatty acids. Herbs are differentiated from spices as cool or hot respectively to help students separate them as two distinct groups, rather than confusing both as condiment smells. Jasmin, Muguet (the French is used to stop the confusion with other lily species) and Rose are kept as specific groups because, not only are these odours well-known and recognised, but they also form the central theme in the clear majority of fragrances. "Queen" of the Orient was chosen to embody the concept of the rich, exotic character of benzoin and other resins. Solvents and other low-odour additives, such as anti-oxidants were relegated to solvent with a "Z" ("Zolvent") to ensure that they could be conveniently grouped together at the end of a formula in line with the convention of formula writing.

SYSTEMATIC ODOUR CLASSIFICATION GROUPS FOR PERFUMERY

A-Z	Classification	Common Description	Key Reference Materials
A	**ALI-FAT-IC**	Fatty, Waxy, Soapy, Clean	Aliphatic Aldehydes, Alcohols
B	**Berg - ICEBERG**	Cooling, Borneol,Mint,Camphor	Menthol, Camphor, Eucalyptol
C	**CITRUS**	Sour, Sharp, Citrus peel	Citral, Orange, Lemon, Lime
D	**DAIRY**	Milky, Cream, Butter, Cheese	Diacetyl, Butyrate Lactone Valerate
E	**EDIBLE**	Vegetable, Nut, Fish, Meat	Thiazoles, Pyrazines, Sulphides
F	**FRUIT**	Sour, Sweet fruits, Strawberry	Allyl caproate, Verdox
G	**GREEN**	Cut-grass, Leaves	cis-3-Hexenol, Triplal
H	**HERB (Cool)**	Cool Herbaceous notes	Lavender, Sage, (Terpene based?)
I	**IRIS**	Orris, Violet	Ionones, Methyl Ionone,
J	**JASMIN**	Fruity, Oily, Narcotic, Jasmin	HCA, Benzyl Acetate
K	**KONIFER**	Pine, Pineneedle	Terpineol, Bornyl Acetate
L	**LIGHT Chemical Floral**	Fresh light floral chemical	Linalool, Vertenex, DMBC
M	**MUGUET**	Lily of the Valley, Green, Fresh	Hydroxy, Lilial, Lyral
N	**NARCOTIC**	Heavy Sweet Florals, Absolutes	Narcissus, Ylang Ylang, Tuberose
O	**ORCHID**	Aromatic, Deep floral	Salicylates, Benzoates
P	**PHENOL**	Phenol, Medicinal, Honey	p-Cresol, Ethyl Phenyl Acetate
Q	**Queen of the ORIENT**	Resin, Balsam	Benzoin, Tolu, Terpenes
R	**ROSE**	Rose Otto, Absolute, Geranium	Citronellol, PEA, Rhodinol
S	**SPICE (Hot)**	Hot Culinary, Spice	Clove, Cinnamon, Thyme, (Cyclic?)
T	**TAR SMOKE**	Smoke, Tar, Burnt	Cade, Birch Tar
U	**Urine Faecal ANIMAL**	Animal, Faecal, Leather	Civet, Castoreum, Ambergris
V	**VANILLA**	Sweet Edible, Vanilla	Vanillin, Coumarin, Heliotropin
W	**WOOD**	Wood, Oily,	Cedar, Santal, Vetivert, Patchouli
X	**X-rated MUSK**	Sexy, Musk, Sensual, Sweet	Musk Ketone, Galaxolide
Y	**EARTHY MOSSY**	Yeast, Fungal, Moss, Marine,	Oakmoss, Calone
Z	**ZOLVENTS**	Odourless Solvents, Solubilisers	DEP, DPG, IPP, Ethanol,PG

Step 2 : Odour profiles of single materials

Even a single aroma chemical rarely exhibits a single facet in it's odour. For example, most would agree that Phenyl Ethyl Alcohol displays primarily a rose character but many find it has a green note, others comment on it's phenolic or chemical aspects. Naturally this can lead to confusion about where to place a material in the classification system. However, if relative proportions are allocated to each facet that the student observes then classification falls into place quite easily.

The reference raw materials are subjected to olfactory examination on paper smelling strips (blotters). Later new materials are introduced that have more complex odour profiles. Students quantify the materials odour in terms of their fit to the 26 (A-Z) odour groups. (e.g., PEA might be classified as R, Rose 70% G, Green 30%.).

Students should understand the subjective nature of odour description and that there are rarely wrong answers in the process. The teacher merely offers stepping stones and miles stones along the path to guide them, but they must ultimately believe their own perceptions. This is particularly difficult in Asia where paternalistic cultures lead younger students to expect that teachers will give them the answers rather than allowing them to rely on their own discoveries.

Material	Quantified description
Phenyl Ethyl Alcohol	Rose 70% Green 30%
Vetivert Oil Java	Woody 85% Earthy 10% Tar 5%
Lavender Oil	Herb 60% Light Floral/Chemical 30% B -Ice 5% Spice 5%
Bergamot Oil	Citrus 58% Light Floral/Chemical 40% Herb 2%

Step 3 : Relative Impact - a measure of 'strength'

Having learnt to classify the odour qualitatively the student continues the process to add a quantitative factor. That is, to evaluate the relative strength of one aroma chemical or essential oil to another. The expression 'impact' has been used in preference to 'strength' because 'strength' creates the impression that a material with a low impact has little effect on a compound. Every perfumer is very aware that Sandalwood may have a low impact when compared to, let's say, Amyl Acetate, but in use has probably more effect on a given fragrance over its lifetime (top-note to bottom-note). It has "push" rather than "punch", "torque" rather than "speed".

A simple but effective method of calculating relative 'impact' strengths of raw materials is introduced. This gives students an easy relative strength index and enables them to say that cis-3-Hexenol is a 'strong impact' material or Hydroxycitronellal is a relatively 'weak impact' material. This method relates each materials impact using Linalool Synthetic as the reference material. Furthermore by quantifying that cis-3-hexenol has 7 times the impact of Linalool and that Hydroxycitronellal has 1/5 of the impact of Linalool then cis-3-hexenol has 7 / (1/5) = 35 times the impact of Hydroxycitronellal. This allows for easy calculation of accords between materials without relying on true threshold or vapour pressure values that can be time consuming and hard to reproduce even in the best kept companies with modern and expensive resources. Linalool Synthetic was chosen as the control reference material as it is readily available, being one of the most abundantly used raw materials in perfumes and flavours and because the quality from the major suppliers does not vary greatly (Givaudan, BBA. Linalool from natural sources is not suitable). In terms of its impact it falls about midway in the range of materials used by the perfumer.

Ten drops of Linalool are counted onto a smelling strip (We have found a disposable toothpick gives adequately small droplets or for even more accuracy a micro syringe can be useful). Ten drops of the comparison material are dropped onto a second strip. The two strips are compared on the top-note immediately after the material has been absorbed by the smelling strip. . Linalool is given the arbitrary value of 100 and a relative value to the comparison material is estimated by the tester, if it is weaker. If the comparison material is deemed to be 5 times weaker then it has a value of 20 (1/5 of 100). In the event that the comparison material is stronger it is usually necessary to place 1 droplet at a time, then compare the two samples. The strength will usually fall between two figures and an estimate is applied. For example it may be found that the strength of one droplet of cis-3-hexenol is not quite as strong as the 10 droplets of Linalool but that 2 droplets is stronger. The relative strength is then determined to fall between 5 times stronger than Linalool but not as much as 10 times stronger. An estimate of 7 times stronger is decided upon and cis-3-hexenol is given the relative impact value of 700 (7 x 100).

We have found that comparison of two materials relative impact values gives a good starting point for the creation of an *accord*. An *accord* being a mixture where each material's odour within the mixture of two or more materials is at an equilibrium with each of the other materials so that no one odour dominates.

Step 4 : Odour life

It is not long before the student notices that a materials 'relative impact' changes over time, almost invariably becoming weaker. Now the student applies another quantification in the form of the odour life of the material.

Odour life is determined on the smelling strip (thinner chromatography 'paper' gives more consistent results) to the point at which the material becomes weak and uncharacteristic of itself. Understandably the results of this type of examination are very dependent on the amount dipped, ambient temperature, humidity, air-flow and testers' differences and experience. Despite this even in poorly controlled conditions the student is able to produce a set of comparative values that are worthwhile measures of raw materials relative blotter lives.

A material can further be evaluated by the 'volume' of odour that it produces over its evaporation. Odour 'volume' could be defined as a sample's impact multiplied by its blotter life.

Impact x hours life on the smelling strip.

Material	Impact	Life	Volume
Linalool	100	18	1800
PEA	15	22	330
Rose Oxide	550	1	550
Sandela	30	400	12000

Step 5 - Synaesthesia - the blending of the senses

There is a theory that at birth our senses are inter-linked. As babies when we heard sounds we saw colours or patterns, when we touched we experienced smells. As we developed, the theory goes, we learnt to differentiate the sensual experiences and compartmentalise each one into a definite single sensation. There are a handful of people, however, who have maintained some of these links between apparently 'disparate' senses into adulthood. This helps to explain Edmund Roudnitska's odour : shape analogies and the oft talked links between odour and colour. A study of aromachology would seem to support the still present links of synaesthesia. Odour also without question evokes memories and emotions.

The next step in training is to try to reactivate some of these long lost links, albeit in a forced exercise. Students are asked to evaluate each new material's 'sensual and emotional facets'. The game, "If this smell was a colour what colour would it be?", is introduced. For those dominantly left-brain oriented readers this might be likened to how a cartoonist transforms a famous person into an animal character. The students then expand the analogy into sounds, shapes, textures and feelings or any other impression that they received during smelling. Examples of results obtained are : Citral is yellow, a knife blade, the sound of breaking glass. Vetivert is, brown, a log and the sound of a large drum, etc. This is designed to activate some of the right brain activity necessary for creative activities later in the program and developing a colour code system. Some of the responses are clearly learned associations but it is an exercise that increases the depth of the experience of smelling. The table, below indicates some of the responses listed by classification, although individual materials within each classification often have quite different results.

Synaesthesia responses to odour

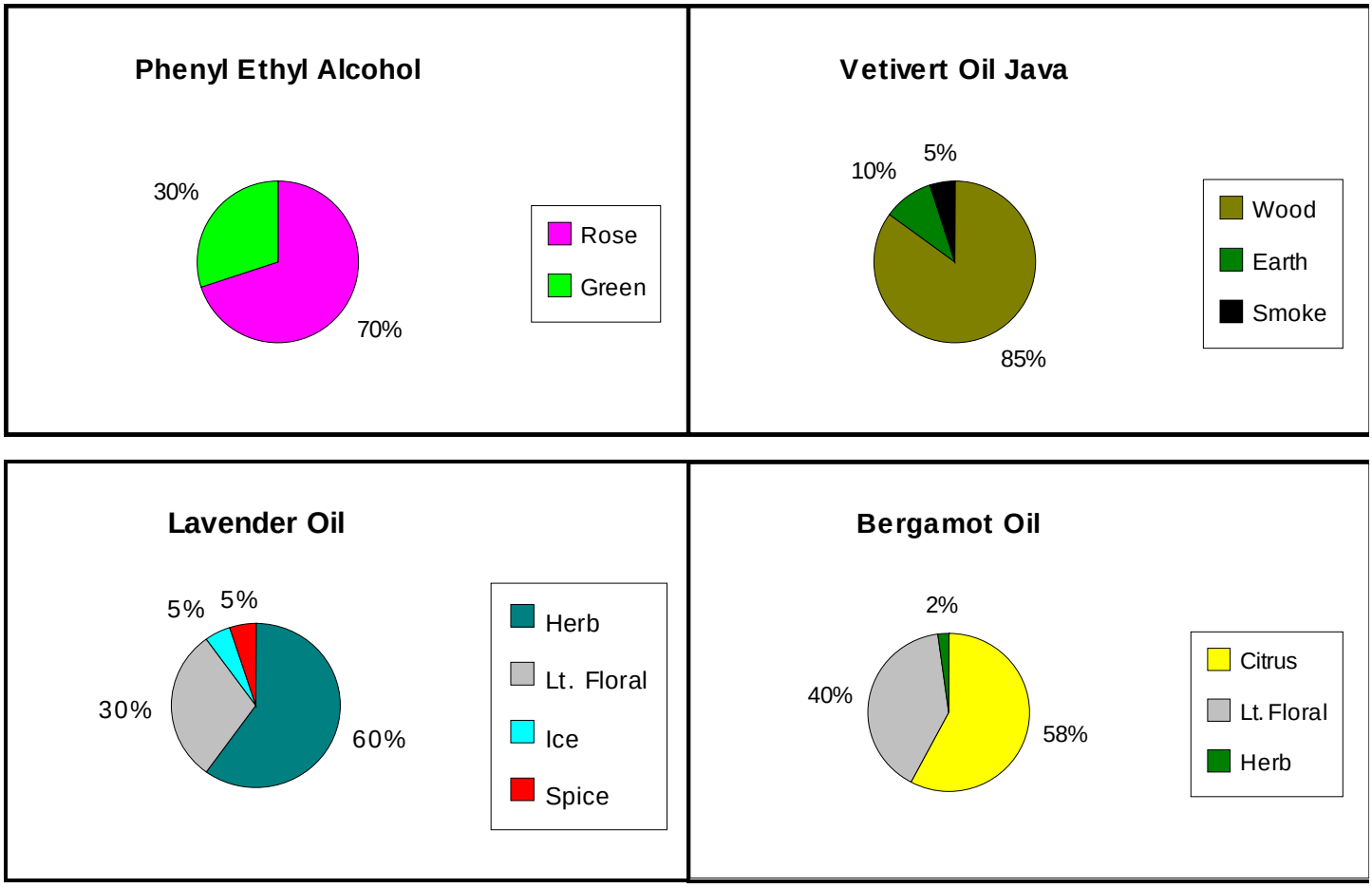
A-Z	Classification	Colour	Synaesthesia response
A	**ALI-FAT-IC**	Silver-White	running-water, neutral, lead-guitar, bird-song-cloud
B	**Berg - ICEBERG**	Frosty-White	cube, cooler, bell, drum, clear
C	**CITRUS**	Orange Yellow	small bell, flute, sour, 'zzz.....', sunshine
D	**DAIRY**	Cream	sticky, oily, creamy, smooth
E	**EDIBLE**	Yellow-Brown	rumble, rain-falling, almond-shape
F	**FRUIT**	Bright Red	Kenny-G, middle 'C', elliptical
G	**GREEN**	Bright Green	sharp, leaves, mower, chalk-on-blackboard
H	**HERB (Cool)**	Dark green	romantic, traditional, ice-skating, relaxing
I	**IRIS**	Purple	sad, old-house, creaky-wood, dull, serious
J	**JASMIN**	Yellowish-White	garland, classic, jazz, jolly, smooth
K	**KONIFER**	Light Khaki-green	bells, xmas, wind-blowing, velvet, mountain
L	**LIGHT Chemical Floral**	Pastel Yellow	slow-music, happy, lovely, piano, harsh
M	**MUGUET**	Pale Green	light-music, garden, tender, soft-wind-blowing
N	**NARCOTIC**	Dk Yellow/Brown	cigarette, headache, deep-sleep, train, bites nose
O	**ORCHID**	Purple	elegant, blues, jazz, a-fine-day
P	**PHENOL**	Dark Gray	toxic, "pok..pok", fizzy, Indian-dance, fabric
Q	**Queen of the ORIENT**	Deep Orange	Indian-song, buzzing, beauty, rough
R	**ROSE**	Pink	love, water-fall, jazz-violin, classic-song
S	**SPICE (Hot)**	Red/Orange	big-bell, marching, exciting, shaking
T	**TAR SMOKE**	Black	b-b-q, smoke, big-drum, misty, John-Denver
U	**Urine-Faecal ANIMAL**	Dirty Yell./Brown	dirty, zoo, sniffing-sound, hairy, can't-see, sour
V	**VANILLA**	Light Brown	laughing-children, baby-chatter, cake, bees-buzzing
W	**WOOD**	Brown	bark, log, drum, hard, water-fall
X	**X-rated MUSK**	Gray-White	forest-sounds, running-deer, cuckoo, earth, heavy
Y	**EARTHY MOSSY**	Green-Black	budding, moss, peace-in-the-forest, moist
Z	**ZOLVENTS**	Colourless	water, water-fall, clear, harsh, tum..tum

Let's picture the smell

The results of the colour - smell relationships are then applied to drawing a graphical representation of a fragrance's odour:

So instead of displaying a description of an odour in a written from it can be displayed for very quick understanding in the form of a pie graph. (Colours represented here may not be optimum due to restrictions of printing or graphics capabilities)

For the examples above:



Step 6 : 'Cracking' formulas with the system

The A-Z classification is then applied to simple florals and complexes as they are introduced and later developed to 'crack the code' in lists of chemicals and naturals found in formulas and GC data output to produce odour descriptions of the compounds.

To demonstrate the power of the system spend a few minutes looking at the formula below and try to create an impression of the odour type. Experienced perfumers will be familiar with this type of exercise but it is by no means easy and the outcome is usually more of a guess.

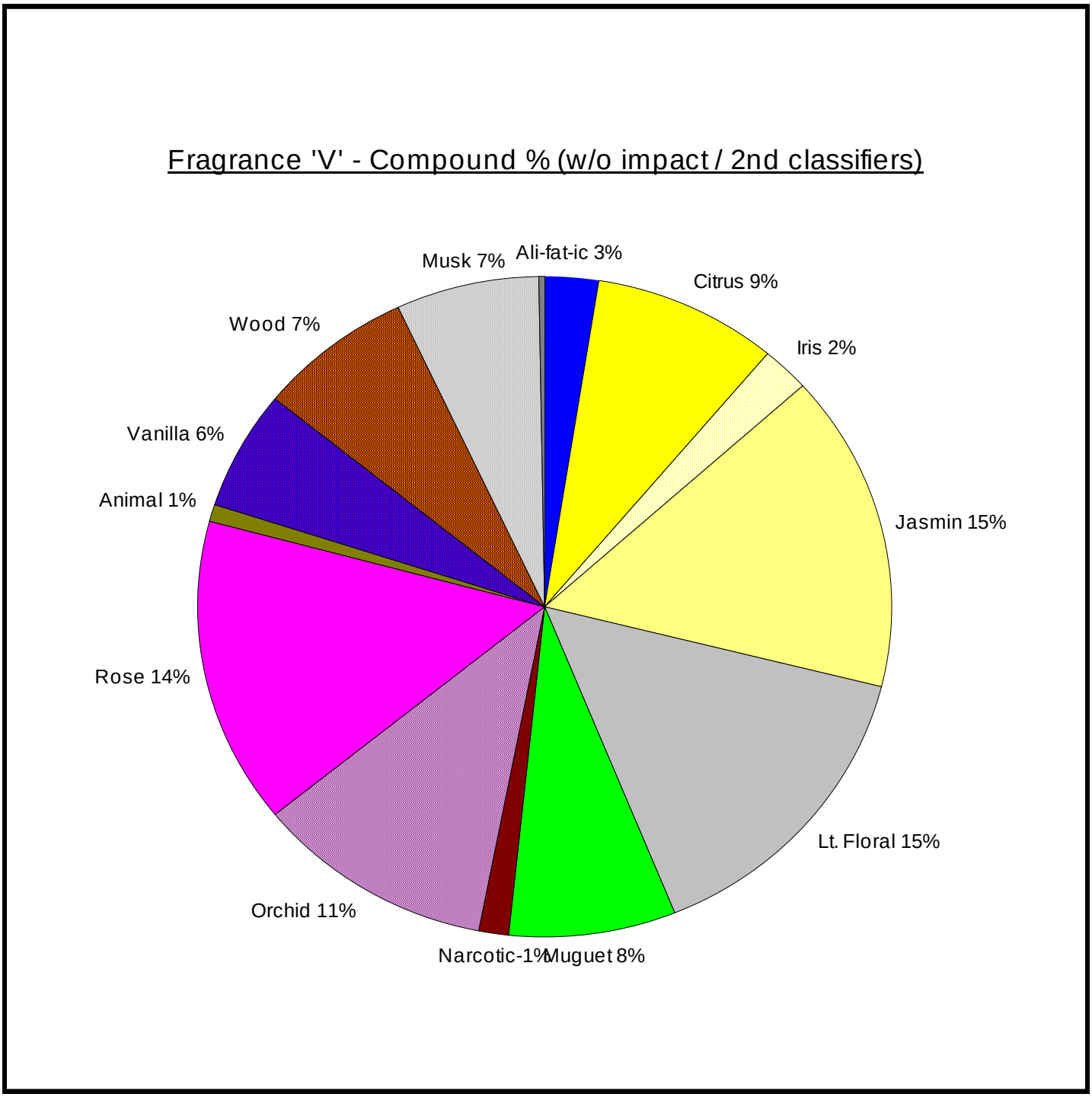
	Geranyl acetate	3.8
	ACA	6.8
	Benzyl acetate	3.5
	Benzyl butyrate	2.9
	Bergamot Oil	4.7
	Bisabolene	1.6
	Bourgeonal	2.1
	Bromstyrol, beta-	0.68
	Calone	0.19
	Cedroxyde	2.3
	Citral	0.22
	Citronellyl acetate	2.5
	Hydroxycitronellal	4.7
	Civettone	1.6
	Decanal	0.66
	Dihydro coumarin	1.3
	Dimetol	1.9
	Ethyl maltol	0.001
	Benzoin Siam Resinoid	3.5
	Geranyl butyrate	1
	HCA	1.6
	Indol/hydroxycitronellal Schiff base	0.28
	Ionone	1.8
	Isobutyl salicylate	0.83
	Isophytol	7.019
	Lauric Aldehyde	1.2
	Lilial	0.93
	Linalool	3.4
	Vanillin	4.6
	Musk xylol	3.8
	Nerol	1.9
	Indolarome	0.23
	Nerolidol	4.7
	Orivone	0.31
	PEA	4.7
	Phenyl ethyl methyl ether	2.6
	Phenyl ethyl salicylate	6
	Physeol	3.5
	Rose de Mai Absolute	0.43
	Tetrahydro-para-methylquinoline	0.28
	Undecanal	0.47
	Musk R-1	1.1
	Ylang Ylang Oil	1.3
	Hedione	0.79
	10-undecen-1-al	0.28

Now in the same formula the raw materials have the principal classification marked in the left hand column and the formula has been sorted A - Z. Try to repeat the exercise;

A	Lauric Aldehyde	1.2	
A	Undecanal	0.47	
A	Decanal	0.66	
A	10-undecen-1-al	0.28	A: 2.61
C	Bergamot Oil	4.7	
C	Citral	0.22	
C	Dimetol	1.9	
C	Nerol	1.9	C: 8.72
I	Ionone	1.8	
I	Orivone	0.31	I: 2.11
J	Benzyl acetate	3.5	
J	Benzyl butyrate	2.9	
J	ACA	6.8	
J	HCA	1.6	
J	Hedione	0.79	J: 15.59
L	Nerolidol	4.7	
L	Isophytol	7.019	
L	Linalool	3.4	L:15.119
M	Bourgeonal	2.1	
M	Lilial	0.93	
M	Hydroxycitronellal	4.7	M: 7.73
N	Ylang Ylang Oil	1.3	N: 1.3
O	Isobutyl salicylate	0.83	
O	Phenyl ethyl salicylate	6	
O	Bromstyrol, beta-	0.68	
O	Benzoin Siam Resinoid	3.5	O: 11.01
R	Geranyl butyrate	1	
R	Geranyl acetate	3.8	
R	PEA	4.7	
R	Phenyl ethyl methyl ether	2.6	
R	Citronellyl acetate	2.5	
R	Rose de Mai Absolute	0.43	R: 15.03
U	Indolarome	0.23	
U	Indol/hydroxycitronellal Schiff base	0.28	
U	Tetrahydro-para-methylquinoline	0.28	U: 0.79
V	Dihydro coumarin	1.3	
V	Ethyl maltol	0.001	
V	Vanillin	4.6	V: 5.901
W	Bisabolene	1.6	
W	Cedroxyde	2.3	
W	Physeol	3.5	W: 7.4
X	Civettone	1.6	
X	Musk R-1	1.1	
X	Musk xylol	3.8	X: 6.5
Y	Calone	0.19	Y: 0.19

Fragrance V - Did you 'crack' it yet ?

For the experienced perfumers the mist has probably cleared. It can quickly be seen this is an aldehydic floral with a strong jasmin, rose, orchid and muguet heart and a sweet vanillic, animalic, musk background. Perhaps a modern interpretation of a Chanel style fragrance. This same data can be represented in Graph form for even easier appreciation. Please note that the graph is NOT adjusted for the impact of individual materials - an adjusted graph is shown at the end of the article.



Step 7 : Sub-Classifiers

The next step is to ascribe a sub-classifier to the materials odour. There are many thousands of odours but over-classification leads to a complexity that does not act as an aid but rather a hindrance. It is equally clear that 26 classifications is hardly sufficient to describe the thousands of odours that we use in perfumery. Cedarwood and Sandalwood may both be Woody but can hardly be said that they possess close odour profiles. For this reason a second letter is applied to indicate, for example, which type of woody note we are talking about. This gives us 26 (A-Z) x 26 (a-z) = 676 theoretical classifications. In practice we find that with the exception of F-Fruity notes usually only 5 or so sub-classes are necessary for each classification.

The sub-classification is used less rigidly. In the above formula sorting exercise the sub-classification, if added, would ensure that similar odour materials appear next to each other. For example, Vetivert is listed on adjacent lines to Vetiverol, Vertofix, Iso E Super and Kephalis or that Allyl Caproate is listed with Allyl Cyclo Hexyl Propionate and Allyl Amyl Glycollate. This may prove particularly useful for flavourists in adapting the system for their use. The sub-classifiers listed here are based primarily on the secondary odour note.

eg. Blackcurrant is a fruity(**F**) note with a minty(**b**) background so its classification becomes "**Fb**". This is always done to give the best sorting of materials and in some cases the rule is modified to acheive this.

	Main Classification	Sub Classifications (a - z, lower case)
A	**ALI-FAT-IC**	**Aa**-Aliphatic Alcohols, **Ac**-Aldehydes C8-10, **Ar**-Aldehydes C11-12
B	**Berg - ICEBERG**	**Bh**-Eucalytus, **Bw**-Camphor, **Bg**-Mint
C	**CITRUS**	**Ca**-Orange, **Cc**-Lemon, **Ck**-Lime, **Cl**-Bergamot, **Cn**-Mandarin, **Cj**-Neroli, **Cw**-Petitgrain
D	**DAIRY**	**Db**-Butter Milk, **Dd**-Lactone **Dv**-Coconut
E	**EDIBLE**	**Eg**-Sulphur, **Eh**-Vegetable, **Ep**-Coffee, **Et**-Meat, **Eu**-Fish, **Ew**-Nut
F	**FRUIT**	**Fa**-Apple, **Fb**-Blackcurrant, **Fd**-Peach, Apricot, **Fe**-Durian, **Fg**-Melon, **Fi**-Raspberry, **Fj**-Banana, **Fo**-Cherry, **Fn**-Grape, **Fp**-Pineapple, **Fv**-Strawberry
G	**GREEN**	**Gg**-Fresh-grassy, **Gh**-Galbanum, **Gn**-PhenylAcetAldehyde
H	**HERB (Cool)**	**Hl**-Lavender, **Hb**-Sage
I	**IRIS**	**If**-Ionone, **Iw**-Methylionone, **Ia**-Orris, **Ig**-Violet
J	**JASMIN**	**Jf**- Fruity-jasmin, **Jn**- Jasmin-absolute
K	**KONIFER**	**Kl**- Pine, **Kh**- Pineneedle
L	**LIGHT Chemical Floral**	**Lw**-Linalool, **Lb**-cool cyclic esters, **Lr**-DMBC, **Lw**-Vertenex
M	**MUGUET**	**Mg**-Green-fresh, **Ml**-Flowery
N	**NARCOTIC**	**Nj**-Ylang, **Nn**-Narcissus, **No**-Tuberose
O	**ORCHID**	**Oo**-Salicylates, **On**-Benzoates, **Oo**-Aromatic notes, **On**-Orchid
P	**PHENOL**	**Pp**-Medicinal, **Pv**-Honey
Q	**Queen of the ORIENT**	**Qv**-Balsam, **Qn**-Resin
R	**ROSE**	**Rl**-Otto, **Rr**-Absolute, **Rl**-Flowery
S	**SPICE (Hot)**	**Sb**-Anise, **Sp**-Clove, **So**-Cinnamon, **Sh**-Hot "Herbs"(Thyme)
T	**TAR**	**Tt**-Smoke
U	**Urine-Faecal ANIMAL**	**Uu**-Civet-Faecal, **Uw**-Ambergris, **Up**-Castoreum-Leather
V	**VANILLA**	**Vv**-Vanillin, **Vt**-Caramel/Furanones, **Vh**-Coumarin
W	**WOOD**	**Wb**-Patchouli, **Wq**-Sandal, **Ww**-Cedar, **Wy**-Vetiver
X	**X-rated MUSK**	**Xx**-Macro & Polycylcic Musks, **Xo**-Nitro
Y	**MOSSY, EARTHY**	**Yh**-Moss, **Yp**-Seaweed, **Yg**-Ozone, **Yy**-Mushroom
Z	**ZOLVENTS**	**Zz**-DEP, **Zo**-Benzyl benzoate

Step 8 : Fuzzy logic shelf arrangement

The student now applies the system to his arrangement of his perfumery organ/work-bench. Raw Materials bottles are labeled with coloured labels to represent each classification group A-Z. The students perfumery-organ is arranged according to the alphabetical classification code. During the compounding process the student is encouraged to investigate the adjacent bottles as alternatives to the indicated material in the formulation.

This "Fuzzy logic"[vii] system helps to build a much wider knowledge of raw materials in a shorter time than if the materials are arranged according to their identity or trade name. Coloured labels assist in quick replacement of the material to it's correct position on the shelves. The student is advised to change the labels if necessary in light of additional experience but remembering to change this on his computer index as well so that both records correspond. This ensures that if the student is looking for a specific material, that he has forgotten the odour of, then he can find it's reference quickly.

Step 9 : Odour description and olfactory analysis - 'odour-prints' and odour profiles

As their competency increases the system is used for odour description and producing an 'odour-print'. I use the term 'odour-print' as it more accurately describes the process than a profile. It is based on the analogy of fingerprint analysis used by the police who use 16 points of reference (whorls, breaks and ends in lines, etc.) that appear to be unique for the pattern in question. They do not describe the pattern of the whole fingerprint only the 16 points of reference. In the fragrance odour-print then we go through a process of looking at the 26 attributes (A-Z) in the odour of a fragrance and quantify each attribute with a proportionate value. A true profile would require that we take both the main classification and the sub-classification, which is covered in the second stage of our analysis.

The student is supplied with a sample of the fragrance on a smelling strip and asked to systematically go through the 26 classifications, A to Z. The student determines if the fragrance has A - Ali-Fatic notes, if No then he moves on to B if Yes then he gives a proportionate value. Percentages can be calculated at the end of the process. The principle with this process that I stress with students is : it is often as useful to determine "what the fragrance is not" as it is as to "know what it is" . Frequently, when smelling a sample for the first time, particularly if we have no name or visual pointers then a student or perfumer's reaction can be "no idea what it smells of" or "I know it but it's on the tip of my tongue".

By systematically going through the A-Z then we can break this 'mental block' relatively easily. In addition to determining for example, that a specific fragrance is fruity and green, we also have eliminated the presence of ali-fat-ic or spice notes. Of course these determinations can be corrected at any stage in the process but we quickly obtain a starting point to move off from. We go on to build a fairly accurate description of a sample's odour systematically.

The process may go something like this for something like this for "Fragrance X" ; (a 'L'air du temps' style fragrance)

The odour-print of Fragrance 'X' ;

A-Z	Main Classification	Is this note present or not?	Estimate of proportion in smell (head-space)
A	Ali-fat-ic	No	-
B	Ice (IceBerg)	No	-
C	Citrus	Yes	5
D	Dairy	No	-
E	Edible	No	
F	Fruity	Yes	0.5
G	Green	Yes	0.5
H	Herbal	No	-
I	Iris	Yes	3
J	Jasmin	No	-
K	Konifer	No	-
L	Lt. Chem. Floral	Yes	15
M	Muguet	Yes	15
N	Narcotic	Yes	2
O	Orchid	Yes	10
P	Phenol	Yes	1
Q	Oriental (Queen of the Orient)	Yes	3
R	Rose	Yes	20
S	Spice	Yes	12
T	Smoke (Tar)	No	-
U	Animal (Urine-Faecal)	Yes	2
V	Vanilla	Yes	2
W	Woody	Yes	3
X	Musk	Yes	5
Y	Mossy (Earthy)	Yes	1
Z	Solvent	No	-

A second pass (A-Z) of the positive scores identifies specifically which sub-classification applies and supplies more detail to turn our odour-print into a description of the fragrance:

A-Z	What Sub-classification ?
C	Bergamot
F	Peach
G	Flowery Green
I	Methyl ionone
L	Bois de Rose/Bergamot
M	Light Floral Flowery
N	Ylang
O	Salicylates
P	Honey
Q	Benzoin
R	Rose de Mai type
S	Clove/Carnation
U	Civet, ambergris
V	Vanilla
W	Vetivert
X	Nitromusk
Y	Oakmoss

Combining data from the odour-print scores and the sub-classifications the following **description** is gleaned ;

"Fragrance X"

A heart (main) of Rose de Mai, Carnation, Light Floral Muguet with notes of Spice, Orchid
A top note of Bergamot and nuances(<1%) of Flowery Green and Peach notes
Blended with Bois de Rose, Musk, Iris, Ylang,
Fixed with Benzoin, Vanilla, Ambergris, Civet and Moss

Using the odour-print and description to produce a full odour profile

The student armed with this description then sits at his perfumery-organ/workbench and moves through the materials arranged A-Z. He chooses those that he thinks fit best into each classification of his proposed fragrance. He will probably choose for many of his classifications more than 1 material to acheive a better match to the target smell in the classification. In this event the student calculates the proportion of each material to make up that classification, without reference to its relative impact. In the example above 20% of the smell of Rose is required in the compound and the sub-classification determines that it should be a Rose de Mai type note. When the student sits at his perfumery organ he perhaps decides that the following three materials are necessary in these head-space proportions to achieve this particular note required.

Rose de Mai type note (total 20) **:**

Phenyl Ethyl Alcohol	10
Rhodinol	9
Rose Absolute	1

An aside :

The proportions in the head-space of a compound are not the same as the formula proportions

At this stage it is good to emphasise that the student's description applies to the smell ("head-space") of the fragrance and not the percentage composition in the formula. The percentage of fragrance materials necessary in the formula to achieve this "head-space" are determined by factors of vapour pressure, attraction between the molecules within the fragrance itself and the substrate that is being evaluated on (e.g. smelling blotter).

The measure that we use in this system to replace these factors is the relative impact of the material (which takes in these aspects in a generalised form).

In essence the proportion necessary in a compound to produce lets say 10% of a low impact material in the head-space will need to be much higher than 10%.

In contrast a high impact material it would need to be considerably less than 10% in the compound.

The following simplified formula is offered to approximate the adjustment that is necessary for each material to ensure that the proportion in the compound is about right to give the target head-space proportion required.

Proportion in Compound% = Target Headspace% x (100 / Relative Impact)

e.g. 1)

I want to add 13% of Hydroxycitronellal to the "head-space". Relative Impact = 25

Proportion in Compound% = 13 x (100 / 25) = 52

To get 13% of the smell of Hydroxycitronellal in the "smell" I need to use 52% in the formula

e.g. 2)

I want to add 0.5% of Phenylacetaldehyde 50% to the "head-space". Relative Impact =230

Proportion in Compound% = 0.5 x (100 / 250) = 0.22

To get 0.5% of the smell of Phenyl acetaldehyde in the "smell" I need to use 0.22% in the formula

The reconstruction of Fragrance X :

A-Z	Head-Space	Sub-Class	Raw material choice at the students perfumery organ	RM. Prop	RM. Impact	RM. Prop x (100/Impact)	%
C	5	Bergamot	Bergamot Oil Sicilian	5	110	4.55	2.46
F	0.5	Peach	Aldehyde C14	0.5	400	0.13	0.07
G	0.5	Flowery Green	Phenyl Acet Aldehyde 50%	0.5	230	0.22	0.12
I	3	Methyl Ionone	Iso-a-Methyl Ionone	2.8	90	3.11	1.68
			Orris Concrete	0.2	40	0.5	0.27
L	15	Bois de Rose	Bois de Rose Artificial	15	100	15	8.10
M	15	Light Flowery	Hydroxycitronellal	13	25	52	28.07
			Cyclamen Aldehyde	2	90	2.22	1.20
N	2	Ylang	Ylang Ylang oil Extra	2	120	1.67	0.90
O	10	Salicylates	Benzyl Salicylate	8	25	32	17.28
			Phenyl Ethyl Salicylate	2	50	4	2.16
P	1	Honey	Phenyl Ethyl Phenyl Acetate	1	65	1.54	0.83
Q	3	Benzoin	Benzoin Siam Resinoid	3	60	5	2.70
R	20	Flowery type	Phenyl Ethyl Alcohol	10	60	16.67	9.00
			Rhodinol	9	100	9	4.86
			Rose Absolute	1	120	0.83	0.45
S	12	Clove	Clove Oil	6	200	3	1.62
		Carnation	Acetyl iso eugenol	6	90	6.67	3.60
U	2	Civet	Civet Artificial	1	500	0.2	0.11
		Ambergris	Ambergris Base	1	25	4	2.16
V	2	Vanilla	Heliotropin	2	100	2	1.08
W	3	Vetivert	Vetiveryl Acetate	3	80	3.75	2.02
X	5	NitroMusk	Musk Ketone	4	50	8	4.32
			Celestolide	1	15	6.67	3.60
Y	1	Oakmoss	Yugoslavian Oakmoss Abs.	1	40	2.5	1.35
			TOTALS			**185.23**	**100**

Head-Space = proportion in smell
RM = raw material
Prop = proportion

Step 10 : Creative use of the system

Is the system then only a tool for matching? No, while it has been easiest to demonstrate the principles against a specific sample smell that can be analysed equally by each student or observer, the true strength is in the opportunities that it opens for creative work.

What is important is that the student builds his inspiration for a fragrance into a concept that he can test his idea against. When one matches a fragrance the goal is defined clearly because the result can be tested by comparison of the original sample and the matched sample by any third party. It is all too easy in a creative project to say that the first sample made is 'nice' and use this as justification to conclude the project. This is why students are required to define their objectives for their creative fragrance project concretely, either visually, in the form of a phrase, diagram, picture or even musical score. The description must include in written form or by inference the emotional response expected from the fragrance at its completion. The point is not for the result to be judged by a critic but rather that the student does not alter the memory of his goal to fit the result he has obtained.

If we accept what we make as creative because we like the result, or our colleagues like the smell, then this reduces the act of creation to an act chance. How long will it take 1,000 perfumers on a 1,000 balances to reproduce "Chanel No.5" ? Rather if the act of creation is a discipline then we should be able to visualise the result that we require in such a manner that we can smell it, in our mind's eye, before the first material goes into the bottle.

The process of matching, I encourage, be viewed as a method of learning procedures, accords and techniques rather than an end in itself.

Surely, if we follow the leaders then we will always be behind them.

There are many methods (perhaps more than there are perfumers) to turning an inspiration into a formulation. Here I shall summarise one method that I have found students can quite quickly relate to. It uses the "Mind Map" system developed by Tony Buzan[viii].

Students choose a subject, which can be an occasion, a place, a person, a landscape, an event or any subject that can be visualised by that person in detail.

They draw a circle 10 cm's in diameter on a piece of paper, A3 or larger. In the circle they draw a picture that represents the essence of their subject. For example if they had chosen "an evening in the city of Paris" the central picture might be the Eiffel Tower. (See; "An evening in the city of Paris", below)

In the central circle the students draw as best and as colourfully as they can this essence of their subject. From the central image lines are drawn with keywords to represent the elements that make up the chosen subject. In the example "Paris" perhaps Evening, River Seine, Music, Fashion, Cafe and Romance become the trunks of trees of thought. Branches are added to further break down these elements into essential parts. Twigs are added to the branches, each twig bearing another word. This is different to brainstorming as the ideas are clumped into groups and tend to be hierarchic which is very useful for the next stage.

Students draw circles at the end of each elemental tree and using their experiences from the games "If this were a sound, colour, shape it would be a ....." They follow the same process backwards linking the emotional and synaesthesia responses to groups of smells and specific odours. In the circles they write their ideas on what smells they think would best convey the

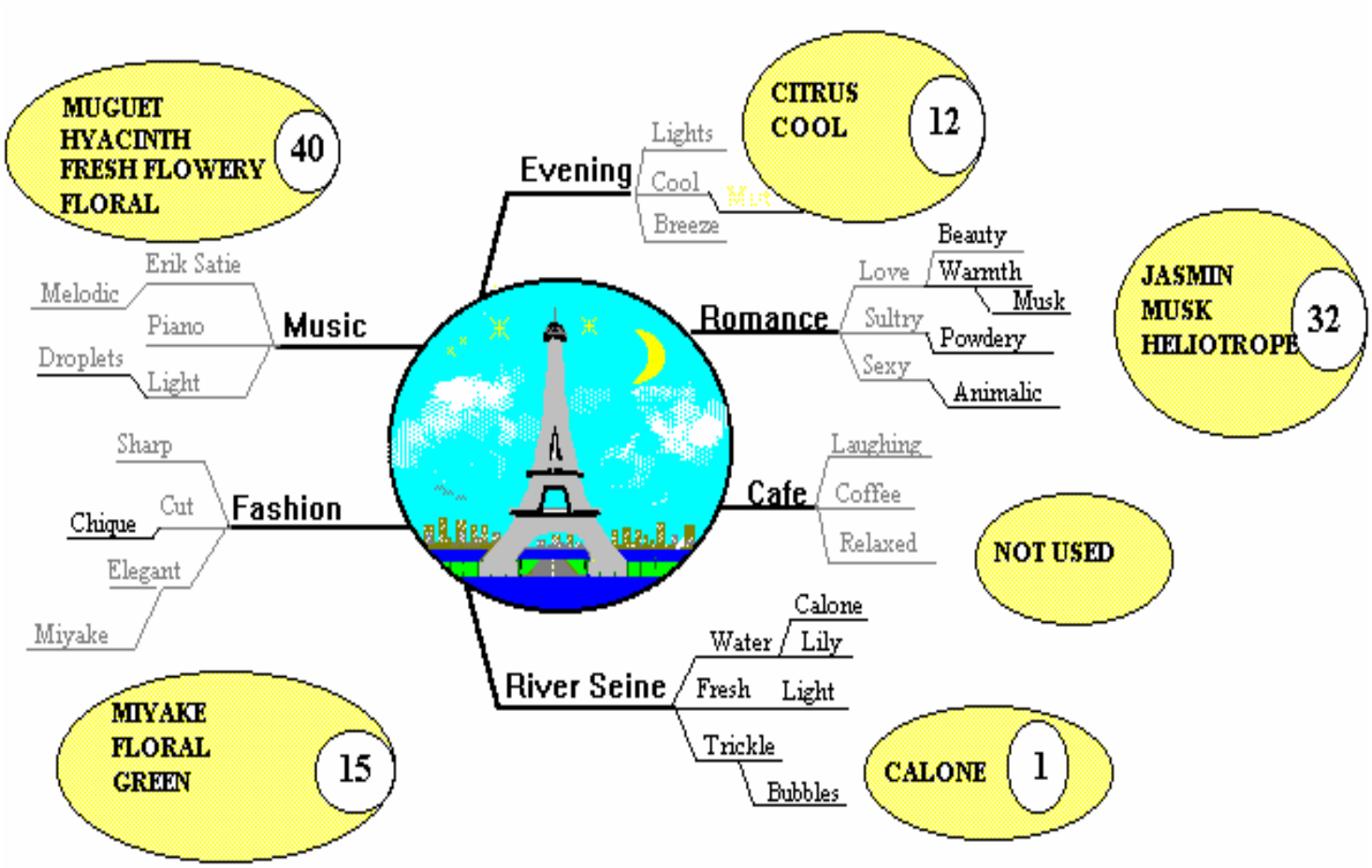
information about the subject and equally importantly the 'feel' or atmospheric attributes of the subject.

This point is often where students who had approached their training in perfumery as a scientific exercise suddenly see the artistic expression that is possible within perfumery. A 'crystallisation' of thought can occur and I have seen students become quite emotional at this point.

Students then give a proportionate value to each grouping that they have circled. Changes to any of the branches can be made as necessary if the student feels that the concept is moving too far away from his original intention.

Using the circles' data as a guide, the student writes a concise sentence or short paragraph including the main features of the fragrance and it's emotional message that it should convey upon its completion.

An Evening in the City of Paris



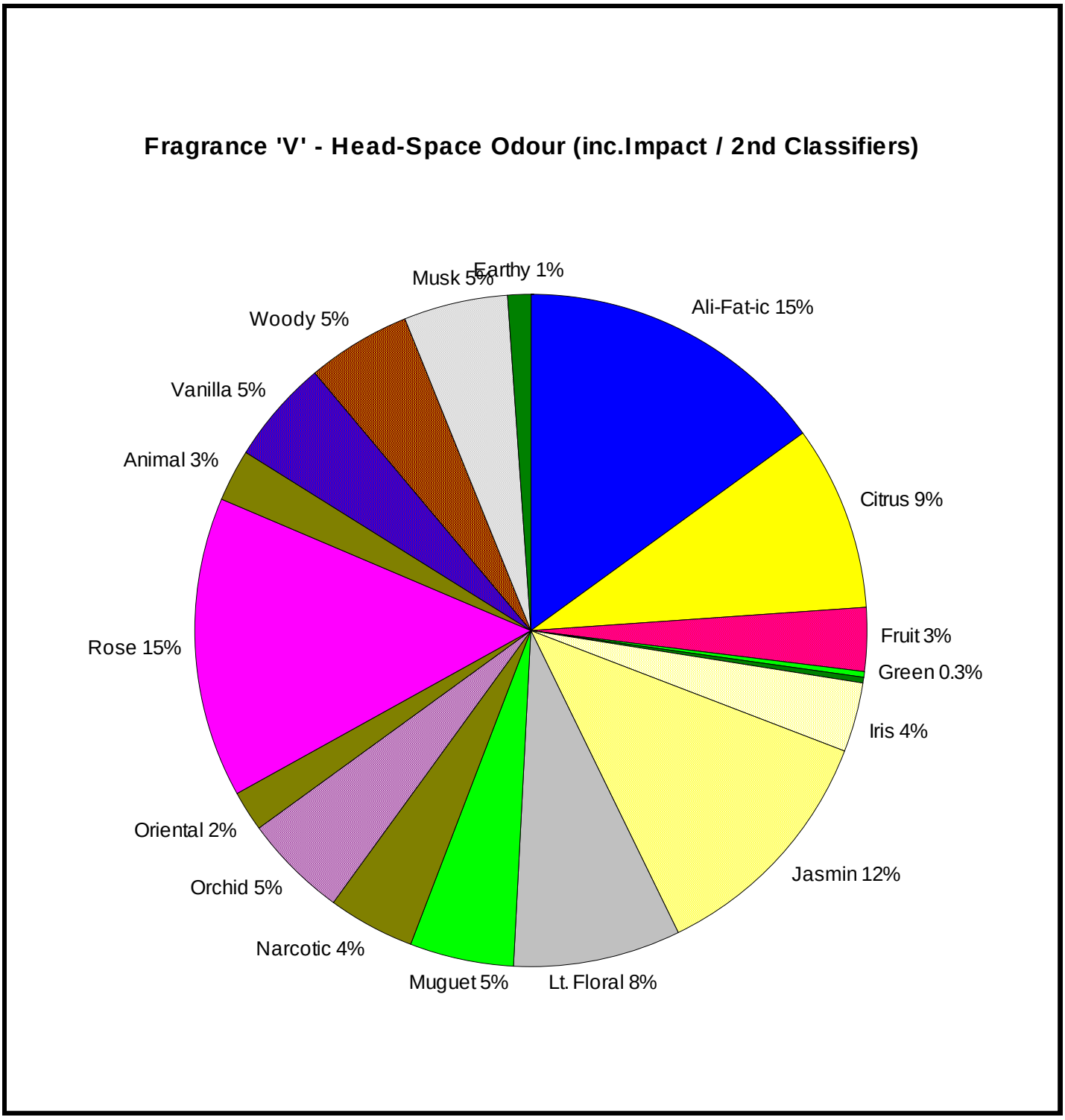
"A walk along the left bank of the River Seine in Paris, France, on a cool summers evening. Lily of the Valley (Muguet) and Hyacinth are dancing in the air like droplets of rain. There is a feeling of sensuality and romance in the air"

The student then applies the system A-Z as outlined from Step 9 and builds his first formulation.

Whilst the above example is intentioned to produce a 'fragrance of the heart', the method is easily adapted to commercial applications and can include concepts such as "cover the base smell", demographics's information, age, class, pricing, etc. Those interested in the subject are directed to Tony Buzan's work "The Mind Map Book", BBC 1993.

Graphic Odour Design

Adding the dimension of quantification to a system of classification allows the possibility to produce graphic odour-prints and full profiles of current formulations. Listing formulations in their groups A-Z then applying the factors of impact gives us the opportunity to predict the fragrance's odour and display it in graph form. Obvious oversights such as the inclusion of 1% Dimethyl Sulphide in the formulation quickly become apparent and the formulation can be corrected before compounding.



Also if the odour-print and profiling method can successfully predict a compound's odour consistently then it is theoretically possible from a precise enough description to produce a compound formula automatically, using the very same steps that the students have been following with the aid of computer algorithms - Graphic Odour Design.

Fragrance V, was a computer generated formula using the Graphic Odour Design Wizard in " The Perfumer's Workbook"[ix] from a formatted description. The formula was not modified (by humans) for the purpose of this presentation.

References:

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Windows based perfumer's raw material database and formulation management program. Free download at www.perfumersworld.com.