Engraved in the Mind:

The Significance of Smell

Jane Levi

The London Consortium

11 May 2012

"The sense of smell is well known for its ability to detect odorants at levels far below that of the most sensitive instruments, to discriminate between thousands of single odorants, and to engrave into memory recollections of scents that stretch far back into early childhood. In short, the capacity of the sense to detect, discriminate, and imprint odors is unmatched by man-made chemo-sensory devices." (Doty 1995, p.283)

The human sense of smell has tended to be placed on a low rung within the hierarchy of senses, being valued well below sight and hearing which, from the Enlightenment onwards, were prioritised over all the others. Yet smell was not always so lowly. Earlier human civilisations privileged odour as an intangible yet powerful means of communication with the gods; and professions associated with eating and drinking have always recognised the necessity and value of aroma in refining and appreciating flavour. Even in ages that have not considered odour such a crucial element within their culture – or which have emphasised the reduction or at least the management of smells above all other considerations – its power over memory and emotion has continued to be recognised, as testified to by its employment in literature. Medical professionals, cooks and firemen actively work with this sense every day. Even Kant, who described smell as the least grateful sense, admitted it had capabilities for every human that no other had (Candau 2000, p.9). Since the 1960s, developments in neuro-scientific enquiry have begun to demonstrate how and why this sense is so powerful, giving us tangible evidence of the way that a record of smells is written within each individual and how this personal odour map can determine our actions, emotions and – most particularly - tastes. It is now generally acknowledged that most of what humans perceive as being the output of our sense of taste is actually the result of our sense of smell.

Smell is the only sense we can't switch off: we can close our eyes, stop our ears, keep our hands to ourselves, refuse to take food or drink into our mouths; but we can't plug our noses for more than a very short period of time, and only by suffering from a disease can we prevent our body from picking up the signals that the odours in the air around us send. In fact, although the human sense of smell has been considered to be less developed than that of other animals (including other mammals), detection of odours has been shown to be the purpose of one percent of our genetic material, "making this the largest gene family thus far identified in mammals. The enormous amount of genetic information devoted to smell perhaps reflects the significance of this sensory system for the survival and reproduction of most mammalian species." (Anderson 2005, p.72) Smell is certainly one of our key distance receptors, as well as one of our most effective danger warning systems. In the brains of lower animals the rhinencephalon or 'smell brain' appears to be dominant; in man the equivalent mass seems to have become an organ of arousal, which may explain why our sense of smell is often so closely tied to sometimes powerful emotions (Gorman 1964, p.24). Even though our obvious 'smell brain' seems smaller, and humans are frequently said to have a far less keen sense of smell than other animals, this is not actually the case. Humans do respond with great sensitivity to odour – we simply operate differently to other animals. Deer or rabbits in their resting state are consistently registering 100 cycles per second of activity in the brain, constantly on the alert for any potential danger that could be identified through its smell. Once they are actively sniffing a specific object, this cycling reduces to between 30 and 60 cycles. Humans register the same levels when stimulated (in relation to the concentration of the odorant) but with a resting rate close to zero (Gorman 1964, p.27). Thus when stimulated by an odour, most land animals seem to operate at similar levels.

When we smell, molecules are taken in through the nose to olfactory receptors located in the upper rear of the nasal cavity, on the septum and the superior concha. These receptors are bipolar nerve cells with free nerve endings, which link to the human

equivalent of 'smell brain': the olfactory bulb. The olfactory bulb contains synapses, sending neurone signals straight to the forebrain, "a directness which far transcends that of any other sensory system." (Gorman 1964, pp.29-31) Furthermore, the wider cognitive processing power of the brain is brought to bear on the task of olfaction, with activity in the temporal and frontal lobes. "Rather than being restricted to a tiny part of the brain, olfactory processing of complex smells, such as those produced in human cuisines, draws on the enlarged processing capacity of the human brain." (Shepherd 2004) In fact, the olfactory receptors are the only naked nerve endings in the body that directly link the brain and the external environment." (Gorman 1964, p.31) All our senses respond to external stimuli, but smell is unique in its directness, and in its physical relationship with the outside. In order to function it "requires incorporation of a particle of the external environment into the organism." (Gorman 1964, p.24) In other words, as we take molecules into our bodies in a physical sense, part of the external world enters us, and as we respond to these molecules they leave their mark. The involuntary and internalised nature of smelling is part of what renders it intangible: a scent is 'written' in memory in a form that can only be 'read' instinctively when encountered again.

People working in medicine are familiar with the specific scents of certain diseases, and this has become an important aspect of diagnosis and decisions on treatment. Diseases like acidosis and uremia give off a recognisable odour; leukaemia patents can have a smell that "resembles that of a "freshly opened corpse"."; whilst the sweat of chronic schizophrenic patients was identified as having a 'sweetish' smell in contrast to non-schizophrenic patients (Gorman 1964, p.27). Besides smells emitted, patients' own perception of smells may be affected by their illness and thus provide clues to their condition. Many neurological patients have problems with their sense of smell, and this sensitivity (or lack of it) can be used in much more specific diagnosis (Doty 1995, p.191). Dysfunction in the sense of smell can be caused by nasal or sinus disease, upper respiratory infection, head trauma, exposure to toxins, and aging; or it may come about as a secondary effect of other diseases such as endocrine or neurological conditions, Parkinson's disease, nutritional deficiencies, cranial tumours and dementia and related diseases (Doty 1995, pp.348-358). It is acknowledged that schizophrenics, neurasthenics and autistic children often have a terribly heightened sense of smell, which may cause extreme distress (Faivre 2001, p.168). By contrast, olfactory function is lost (along with so much else) in early Alzheimer's (Doty 1995, p.197). Some people suffer from anosmia, a complete loss of the sense of smell. The sense may also be lost by degrees as in hyposmia, or decreased sensitivity to some or all odorants. In dyosmia, the perception of the smell may be distorted in various ways, including phantosmia, the perception of an unpleasant smell where there isn't one (Doty 1995, p.346). Our state of health is recorded and revealed both in the odours we emit and in our perception of odours external to ourselves.

Smell brings together the mind and the body: a physical stimulus leaves a sensory impression which in turn becomes a component of a physiological or psychological reaction (Gorman 1964, p.vii). Freud established its role in psychological disturbance, especially repression and neurosis, in his 'Rat Man' and 'Lucy R' cases, both of whom had developed traumatic associations with odours (Freud and Breuer 1991 (1893-1895), pp.179). Freud also claimed that the development of erect posture was the re-defining moment of the human relationship with smell: our noses moved further away from our genitals making sexuality a core element of much subsequent neurosis (Freud 1991 (1909), pp. 126-127). Tenuous though some of Freud's more general remarks on smell might seem, he does establish a strong link to emotional development.

In *Emile*, Rousseau assesses the importance of all the senses in the formation of the adult and its attitudes to the world. He was keen not to develop too-sophisticated tastes in the

young Emile, as they would reduce his strength and adaptability. Recognising the strong anticipatory and imaginative power of the sense of smell, he wished to control the use and interpretation of these signals: "Smells by themselves are weak sensations. They move the imagination more than the sense and affect us not so much by fulfilment as by expectation. On this assumption, the tastes of some, having become so different from the tastes of others because of their ways of life, must cause them to make contrary judgements about tastes and consequently about the smells that announce them. A Tartar must catch the scent of a stinking quarter of a dead horse with as much pleasure as one of our hunters catches the scent of a half-rotten partridge." (Rousseau 2010, p.86)

Recent experiments have shown that our noses are essential to tell us, for example, if food is off or edible: even though we often perceive them as being clearer, visual clues alone are insufficient, and they stimulate a different part of the brain (Grigor, Van Tolller et al. 1999, pp.138-143). Chefs recognise the importance of the two senses working in harmony, and interestingly often prioritise both sight and smell over taste: "The sense of smell is the second sense of the professional cook, affirmed one of the great chefs of the region of Nice, the first being sight."[1] (Candau 2000, p.51) In the case of *Emile*, the smells described by Rousseau are linked to the future promise of food held in the scent of the raw ingredient, which besides having a quite different appeal to each individual - depending on what previous experience has been written into their smell-brain - will of course smell quite different once it's being cooked.

Olfaction applied to raw, cooking or cooked ingredients is a critical skill for chefs and other cooks; the smells of ingredients and dishes at different stages of preparation are described in a series of chef interviews as the musical notes in the orchestral score that makes up the dish (Candau 2000, p.51). Food aromas come from volatile chemicals within the foods, which are so small and light that they evaporate into the air and rise with our breath to the nose (McGee 2004, p.387). Each ingredient may contain many of them – for example a breakdown of the chemicals in the odour of gewürztraminer wine lists more than 40 different individual components (Kaiser 2006, pp.280-295). We do not necessarily perceive all of them: "Usually just a handful create the dominant element of an aroma, while the others supply the background, supporting, enriching notes." (McGee 2004, p.272) Thus the aroma of each food is both specific and complex, helping to explain why certain foods seem to be natural partners, or to echo one another: it's our recognition of the aroma molecules that leads to this comprehension of what will ultimately taste good (McGee 2004, p.272).

In fact, much of what we perceive as taste is in fact smell; flavour is a composite of the sensations perceived by the tastebuds in our mouths and the aromas reaching our olfactory bulb. "There are only a handful of different tastes – sweet, sour, salty, bitter, and savoury or umami, while there are many thousands of different odors. It's odor molecules that make an apple "taste" like an apple, not like a pear or radish." (McGee 2004, p.387) Herbs and spices heighten flavour by adding their characteristic aroma molecules, whilst the more pungent herbs and spices (like chilli) also stimulate and irritate nerves in the mouth and nose (McGee 2004, p.387) (Anderson 2005, p.77). This third set of sensations is described as our chemical sense, which comprises sensations like stinging, astringency, acridity and burning perceived in all our mucosal membranes, and producing reflex actions like sneezing and salivation. The chemical sense is said to be a vestigial trace of "the skin sense of our aquatic ancestors." (Gorman 1964, p.23)[2]

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[1] My translation: "L'odorat est la deuxième sensation du métier de cuisinier, affirme un grand chef de la région niçoise, la première étant la vue."

[2] The aquatic skin sense may more accurately be called a sense of smell. Experiments have shown that although salmon (known for their extraordinary homing skills) locate the general area of their birth and

Although each of us naturally develops a map of aromas and their meanings, more detailed, conscious comprehension is a subtle skill to learn, not least because the lexicon of smell (and flavour) is extremely limited. Harold McGee describes the appreciation of food's aroma as "Daunting, because it involves many hundreds of different chemicals and sensations for which we don't have a good everyday vocabulary; fascinating because it helps us perceive more, and find more to enjoy, in the most familiar foods." (McGee 2004, p.272) According to Candau's interviewees, developing depth of skill with aroma is the route to becoming a good cook: "Smells are the life of cookery, declared one of the chefs, and for a cook, learning is learning to analyse the smells. Because the written language is rather limited, the [smell] terms used are often the same, which seems to help cooks to understand one another."[3] (Candau 2000, p.120)

For most of us, though, one of the main difficulties in discussing and assessing both smell and taste is this very lack of specific taste or smell-related words in the English language (and, I'd suggest, most other European languages). Combining sight and language we can broadly agree on what 'red' is, and that it has numerous specific, colour-related terms of reference - crimson, vermillion, the various pinks. When it comes to smell we might be able to agree that gas smells like gas, or a rose like a rose, but where are the particular words for those scents? (Gorman 1964, p.59) "Smells envelope [sic] us, enter our bodies, and emanate from us. Yet when we try to describe smells, olfactory epithets do not quite provide accurate descriptions. …smells are more often than not described based on cause or effect." (Low 2009, p.4) Objects are simply said to smell more or less like themselves; or perhaps like a combination of other objects. We can refer to an entire encyclopaedia of smell experiences inside our brain; but have no common externalised dictionary of terms to specifically describe them in the outside world. A website describing itself as a perfumer's lexicon is typical of the kind of circular references we make when describing a smell: ambergris is sweet and woody; civet adds depth and warmth; vetiver is moist earth with woody undertones.[4] Wine lexicons are similar in that almost none of the words employed are specific to wine; they are existing terms that take on a particular nuance when associated with wine.[5] Whilst experts in both fields have developed their own highly specific language, there are few, if any, specific words that describe the sense of a particular combination of smell, taste and mouthfeel. By contrast, the Samburu of Northern Kenya possess a complex series of words to describe one of their staple foods, milk; there are words that describe specific states of sweetness, saltiness, bitterness, smoothness and combinations thereof that are not applied to anything else, even when they might display similar qualities (Rubel, Levi et al. 2011). Edward Sapir describes the development of vocabulary associated with taste as being "a very sensitive index of the culture of a people" (Sapir 1985, p.27). If a taste or a smell is sufficiently culturally important, then a means of differentiating it precisely through language will be found.

Anthony Synnott posits that it is the lack of an agreed classification of smells that accounts for its historically low status amongst the senses (Low 2009, p.5), but classification has been attempted. Linnaeus proposed seven classes of odour in 1752: fragrant; aromatic; ambrosial (or musky); alliaceous (or garlicky/oniony); hircine (or goaty); repulsive; nauseous (Low 2009, p.4). The Dutch psychologist Hendrik Zwaardemaker updated it to nine with additional subclasses - ethereal (fruits, resins, ethers) and floral and balsamic (flowers, violet, vanilla). In 1916, Han Henning came up

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reproduction using sight and visual clues, the precise final location work is done through their sense of smell (see Ueda et al).

[3] My translation: "Les odeurs, c'est la vie de la cuisine, déclare un des chefs, et apprendre pour un cuisinier, c'est apprendre à analyser les odeurs. Parce que le régistre léxical est plutôt réstreint, les termes utilisés sont souvent les mêmes, ce qui paraît faciliter l'intércomprehension entre cuisiniers."

[4] For example, http://www.nstperfume.com/perfume-glossary/. Accessed 20/07/2011.

[5] For example, http://www.lovewine.org/. Accessed 2/07/2011.

with six: fragrant; ethereal; resinous; spicy; putrid; burned (Smith 1989). More recently, McGee classified them as: Green (cucumber/melon); Fruity; Terpene (flowery/citrusy/piney/hernaceous); Phenolic (spicy, warming, pungent); Sulphur (McGee 2004, p.273). Surely the failure of the systems to catch on (at least outside certain very specific groups of people) is reflective of the limitations of the use of simile to describe experience, particularly across different cultural contexts. We feel that we know what McGee means by 'green', but still it seems inadequate and imprecise, open to too much interpretation. And just what is Zwaardemaker's 'ethereal' smell? Could your notion of that possibly be the same as mine? Given that "foul smells can be good, fragrant smells can be bad, and all smells can be metaphors," it is difficult to communicate effectively what each one might mean (Brant 2004, p.463). Shepherd likens this problem to our difficulty in describing a human face effectively, even though we can perceive it acutely with our sense of sight (Shepherd 2004). The knowledge of what these things actually are and what they mean remains written deep inside us, and our attempts to distinguish them in language a constant struggle.

The very lack of tangibility within their constant presence is part of what makes smells mysterious, and even a route to manipulation. "The power of perfumes is in effect that of the restoration of our lost unity, our relationship with the world, and because of that they are powerful and therefore dangerous." [6] (Faivre 2001, p.184) Because it is powerfully linked to our mechanisms of response, and because some odour chemicals have specific effects, smell is recognised as something that will promote particular reactions and types of behaviour. Lavender is used in old people's homes to aid sleep; some Japanese companies use combinations of mint and lily-of-the-valley to promote energy and hard work (Faivre 2001, p.175). Ambient scents are used as marketing tools in supermarkets, shops, car showrooms, trade shows and casinos (Morrin and Ratneshwar 2003, p.23). In a study of people's responses to particular branded products, testers "generally find that product evaluations are more positive among subjects in scented environments. Furthermore, although subjects in the scented conditions did not actually spend significantly less or more time in the store than subjects in the unscented condition, they perceived themselves as having spent less time there." (Morrin and Ratneshwar 2003, pp.10-11) Shoppers are more attentive to and remember more about a product associated with a pleasant smell, and time passes more quickly. It is not even necessary for the smell to be congruent with the object: "the use of virtually any pleasant ambient scent should achieve this objective. Thus a firm selling beauty products and toiletries does not necessarily need to choose floral scents; a bakery need not limit itself to only vanilla, cinnamon, or other scents and spices typically used in baked goods." (Morrin and Ratneshwar 2003, p.23) Scent-induced emotion can unconsciously override logic or reason.

"But perfumes also permit us to heal the future, to restore the original unity, rediscovered through their first vocation – divination." [7] (Faivre 2001, p.184) The power of scent to influence behaviour was recognised by ancient religions, which used perfumed fire to communicate with the heavens. Indeed the word itself refers to this use, from the Latin *per fumum*, through smoke. "Unlike most of the objects that we sense around us, which we see or touch or hear, aromas are an invisible, intangible presence. To cultures that knew nothing of molecules and odor receptors, this ethereal, penetrating quality suggested a realm of invisible beings and powers."(McGee 2004, p.388) The rites of ancient Egyptians, Greeks, Persians and Jews involved lavish quantities of perfumes; the priest could only enter the inner sanctum carrying a censer,

[6] My translation: "Le pouvoir du parfum est en fait celui de la réstuaration de notre unité perdue, celui de nos rélations au monde et en cela ils sont puissants et donc dangereux."
[7] My translation: "Mais ils permèttent aussi de guérir du dévenir, de réstaurer l'unité originelle, rétrouvant par la leur vocation première de divinisation."

and sweet smelling substances like frankincense were added to sacrifices (Wilson 1895, pp.62-63). Not only a mark of dedication to the service of the gods, the clouds of incense were specifically read as emblems of prayer rising up to them.

In the Old Testament tradition, there is scented fire within the sacrifices or offerings made at every critical stage of the biblical version of the world, and the odour is a critical element in the communication with God. When he leaves the ark, Noah erects a pyre and makes a sacrifice, and it is when "The Lord smelled a sweet savour" of burning meat and incense that he agrees to the second covenant - he won't attempt to destroy human existence again (Wilson 1895, p.65 [ref.Gen.viii.21]). The Lord also enforces obedience through smell-related threats: "if you go against me, said God, "I will not smell the savour of your sweet odours."(Wilson 1895, p.65; p.82 [ref.Lev.xxvi.31]) For the ancient Egyptians, perfumes were a key element of the quotidian as well as the holy. The blue lotus of the Nile (*Nymphaea caerulea*) was prized for its beautifully sweet, aromatic, floral scent, as well as its narcotic qualities, which would both perfume the temple and induce a state of ecstasy among the priests. The Egyptian nobility would steep the flower heads in wine to produce a fragrant and hallucinogenic intoxicating drink (Kaiser 2006, p.115). Considering this, it is difficult not to read the numerous paintings of these flowers included in Egyptian tomb paintings as an attempt to inscribe the divine scent and mystic effect into the final resting place.

The mysterious qualities of aroma are often used in literature. Proust's now clichéd madeleine is, for all its overuse, linked to a recognisable truth of human experience: memory is stored as scent, and scents call up memories and feelings that we may not have known were there, or may not have appreciated the power of. For Rousseau, "Smell is the sense of imagination; keying up the nerves, it must agitate the brain a good deal, that is why it revives the temperament for a moment and exhausts it in the long run. Its effects are known only too well in love. The sweet fragrance of a dressing room is not so weak a trap as is thought and who is the insensitive man who has never been made to quiver by the smell of the flowers on his beloved's bosom?"(Rousseau 2010, p.86) Baudelaire, too, evokes strong emotions through his references to the senses, and frequently cannot help privileging scent and its music when he talks of love, as in *The Temptation*: "My senses into one sense flow –
Her voice makes perfume when she speaks,
Her breath is music faint and low."(Baudelaire 1919, p.17)

Other authors use odour to convey ideas that are not necessarily fully accessible to the characters themselves – using the sociologists' notion that "Odour is many things: a boundary-marker, a status symbol, a distance-maintainer, an impression management technique, a schoolboy's joke or protest, and a danger-signal – but it is above all a statement of who one is," or perhaps the situation one is in (Synnott 1991, p.438). Oedipa Maas, in Thomas Pynchon's *The Crying of Lot 49*, explains her increasingly surreal experiences in terms of epilepsy, emphasising the parts played by smell and taste in the barely grasped realisation of her situation, both as she experiences it and as she considers what may be recalled: "She could, at this stage of things, recognize signals like that, as the epileptic is said to – an odour, colour, pure piercing grace note sounding his seizure. Afterwards it is only this signal, really dross, this secular announcement, and never what is revealed during the attack, that he remembers. … In the space of a sip of dandelion wine it came to her that she would never know how many times such a seizure may already have visited, or how to grasp it should it visit again."(Pynchon 1996 (1965), p.66)

In Don Dellillo's *Falling Man*, it is at the precise moment of recognition of her own smell that Lianne reaches some kind of personal resolution about her situation, and her ability to face the future: "she yanked a clean green T-shirt over her head and it wasn't sweat

she smelled or maybe just a faint trace but not the sour reek of the morning run. It was just her, her body through and through. It was the body and everything it carried, inside and out, identity and memory and human heat. It wasn't even something she smelled so much as knew. It was something she'd always known. The child was in it, the girl who wanted to be other people, and obscure things she could not name. It was a small moment, already passing, the kind of moment that is always only seconds from forgetting."(Delillo 2007, p.236) At the same time, her ex-husband Keith, who had been inside the twin towers on 9/11, is finally able to relate his experience inside the building that day, something withheld from the reader until the final pages. The challenge is to describe the indescribable; and a significant element of the chaos and carnage and disgust is conveyed through smell: "He smelled something dismal and understood it was him, things sticking to his skin, dust particles, smoke, some kind of oily grit on his face and hands mixing with the body slop, paste-like, with the blood and saliva and cold sweat, and it was himself he smelled, and Rumsey."(Delillo 2007, p.244)

Smell is basic and primal; but it is also transcendent, speaking to our deepest understanding of events and ourselves, conscious and unconscious. These notions are instinctively felt in the individual act of eating, conveyed in literature, described by psychoanalysis and used as evidence in various fields of medicine. Our lack of specific language to adequately describe smell and taste serves only to highlight the intangible yet all encompassing importance of smell in our lives. Within neuroscience, the science of olfaction is making a significant contribution to our current understanding of how the human brain works, including what it is about its operation that makes us distinctively human. This work demonstrates that what we have felt by instinct may indeed be fact: the chemical pathways inscribed in our brains through the simple act of smelling are an intrinsic part of the personal interior writing of all our recallable experience.

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