

HUBER THE NOSE.

Interesting facts in our field.



Les mystères, Germaine Knecht 1976

PASSION FOR SCENTS

Scientific facts about the Nose

Introduction

In certain animals, the capacity to smell has become enormously specialized during evolution. Fish such as salmon, e.g., swim thousands of miles along gradients of certain lead substances to find their breeding grounds. Wildcats track their mating partner over long distances by their smell. And in the insect kingdom pheromones play a vital role in courting rituals and basic survival.

The human sense of smell¹ is located in the nose. As a sense it is often considered inferior to the sense of hearing, touch or vision. At a closer look, however, we find that the sense of smell rivals the others in complexity and enriches our lives substantially: We eat and drink with the nose², we judge our environment and our partners with it and are led by it in many other circumstances. In fact, the sense of smell still plays a key role in the search and control of food and is an important factor in human relationships, choice of partners and social behavior³.

Biological and Biochemical Facts

Fragrance, or the perfume⁴ is not easy to define. As an ethanolic⁵ solution of essential oils, plant extracts, natural and synthetic compounds it assumes visible - almost graspable - characteristics. The perception of a fragrance, however, is the result of many complex interactions between the individual components of the fragrance and "smell antennas" (called cilia) in the nose, more precisely in the nasal mucous membrane⁶ while we are breathing.

The sense of olfaction is a chemical sense⁷: The biochemical interaction between the single smelling molecules in the air and the receptor proteins on the cilia stimulates the olfactory nerve cell^{8,9} which triggers further reaction.

Olfactory Transmission

The human nose has about ten million olfactory nerve cells and one thousand different receptor protein types^{10,11}. Thus there are about ten thousand copies of each receptor type spread over the nasal mucous membrane more or less evenly.

Through the process of breathing, drinking or eating, smelling molecules pass through the nasal chamber and are exposed to the cilia in the nasal mucous membrane. As they drift by they are matched with their corresponding receptor proteins, thereby stimulating the nerve cell associated with the particular receptor type. An electrical impulse is generated and travels from the peripheral nasal end to the brain¹², more precisely to the olfactory bulbs¹³. Equal receptors lead to one and the same site in the olfactory bulb, the so-called "glomeruli". Thus, the olfactory bulbs in the brain is home of one thousand specific glomeruli which are the specific target areas corresponding to the thousand different nerve cell receptor types in the retronasal mucuous membrane.

One could visualize a fragrance impression as a three-dimensional map generated in the olfactory bulbs. Two dimensions would relate to the receptor types stimulated (quality). A third dimension would correspond to the intensity of the stimulation (quantity; amount of stimulated receptors of the same type). Such a "fragrance character map" could be compared to a sky at night with one thousand fixed stars with distinct brilliance each. This fragrance character map in the olfactory bulbs is like a unique fingerprint which is then transferred¹⁴ to the limbic system in the brain where it evokes sensations, recollections and emotions¹⁵.

[More accurately, a fragrance should be represented as a one thousand - dimensional vector where the numerical magnitude represents the intensity (0 - 100%) and the thousand dimensions correspond to the one thousand receptor types].

Chemically, a fragrance is a mixture of odiferous molecules. Its impact on the brain may be described as the sum of the qualitative and quantitative influences of its individual smelling components on the receptors of the cilia in the nasal mucous membrane. The electrical impulse generated by this action creates a fragrance character map in the olfactory bulbs which is transmitted to the limbic system of the brain where it generates specific feelings, emotions and evokes corresponding behavior.

Raw Materials

Today a perfumer has a choice of over four thousand smelling raw materials of natural origin, from natural sources, chemical synthesis or biochemical pathways. However, many of those are somewhat exotic in character. They may be scarce, or their supply may not be guaranteed. Sometimes insufficient toxicological or dermatological data are available. In many cases their olfactory character is similar to competitive products. Therefore, only about one thousand different odiferous raw materials are used on a regular basis by most perfumers.

Odiferous raw materials may be natural essential oils and extracts of flowers, fruits, leaves, stems, barks or whole plants, or synthetics of the fine chemicals industry¹⁶. Today, animal products like amber, musk and civet are not used anymore for reasons of respect and protection of the animals. Frequent adulteration, irregular supply and exorbitant prices also played an important part in the disappearance of animal products in fragrances.

Today modern analytical methods have revealed most of the secrets of these "magic" products and many of their characteristic components can be manufactured synthetically. At the same time nature-identical blends can replace the animal products efficiently and economically.

The Perfumer

A perfumer's main occupation consists in the creation of fragrance oils¹⁷. By blending the various components in the right proportions, he is able to evoke specific emotions or sensations in the person that smells it. He is capable of varying the character of a theme in finest nuances. The only limit for his creations is his own fantasy and the fragrance cost per unit the customer may impose.

Creativity

Three attributes are essential for a perfumer:

- . a good nose as basic tool for his work with fragrances¹⁸
- . a good memory of odors characteristics of odiferous raw materials as an important tool for the translation of a fragrance idea¹⁹ and for the translation of emotions and feelings into a fragrance composition
- . a high creativity as the powerful source of ideas for existing and future projects

“Hard work and exertion, toughness of thought and integrity of judgement, persistence in the pursuit of ideas and an open mind towards new experiences are prerequisites for creative or even ingenious achievement”²⁰.

Functional Products

Perfumes^{4,21}, Eau de Perfume, Eau de Toilette or Eau de Cologne are pure fragrance products. Their only function and purpose exists in making the consumer smell good.

Besides perfumes there exists an overwhelming variety of so-called “functional” products manufactured by the cosmetics and toiletries, detergents and soaps, pharmaceutical and technical industries. These products have been developed for special applications (e.g. to clean hair and make it soft and shiny, to humidify dry skin, etc.). They contain only small dosages of a concentrated fragrance oil.

The purpose of using a fragrance in functional products is:

- . a pleasant perception of the product (cream, shampoo, etc.) during the application
- . masking the otherwise sometimes disagreeable odor of the product
- . to underline the efficacy of the product by emotionally convincing the consumer of its value (“smoothes” the skin, “decreases itching”, makes hair “more shiny and brilliant”, etc.).

Technical Knowledge and Expertise

The reaction of fragrance raw materials and their mixtures in various media (alcoholic, water-based, emulsions, shampoos, soaps, detergents, etc.) or in technical products (room sprays, cleaners, etc.) is very complex. Physico-chemical parameters (partial vapor pressures, partition coefficients, etc.) play an important role. Aging processes like e.g. maceration or oxidation and other chemical reactions between the fragrance raw materials or the product ingredients may take place. This will influence the characteristics of the fragrance, i.e. its intensity, head space composition, etc. quite considerably, and over time. An experienced perfumer knows about these phenomena and uses his expertise to fulfill the requirements of the finished product.

A harmonious interaction of the fragrance and the product base are the prerequisites for successfully marketing and selling of the product. The olfactory impression and function of the product must perfectly match, as well as the color, the packaging, the product name, etc.

References:

Endnotes:

- 1 Generally, one speaks of five senses: Seeing, hearing, touching, tasting and smelling. Today, science tends to add more: the sense of warmth and cold, the sense of pain, the sense of equilibrium and the sense of positional and motional perception and awareness of the body and its parts. This adds up to nine senses altogether.
- 2 The sense of taste is located on the tongue and allows us to differentiate sour, salty, sweet, bitter and Umami sensations. Most other flavor characteristics, however, are perceived by the sense of smell in our nose.
- 3 It is known, that in addition to the olfactory organ in most mammals (and probably in men as well) there exists another organ sensitive to smelling substances. This so-called “vomero-nasal” organ is specifically stimulated by pheromones and known to control innate social and emotional behavior. It also communicates sexual messages like readiness for mating, etc. During evolution the vomero-nasal organ developed independently from the sense of smell. It is strictly separated from the olfactory organ.
- 4 Derived from “per-fumum” (latin), “through the smoke”.
- 5 More rarely, in other solvents like diethyl phthalate, for religious or other reasons. E.g. in muslim countries where (drinkable) ethyl alcohol is strictly forbidden, even in cosmetics.
- 6 The human nasal mucous membrane is an area of about 5 square centimeters in the upper back part of the nose.
- 7 Contrary to vision (optical) or touch (pressure) or hearing (waves/frequency), etc.
- 8 Olfactory nerve cells are primary cells, i.e. they lead directly to the brain without the help of other (secondary) nerve cells.
- 9 Olfactory nerve cells are constantly regenerated during a whole life time (about once a month). This is a very peculiar feature which may be due to the extreme exposure to extraneous matter. According to the present knowledge all other nerve cells are not regenerated, i.e. their number is constantly decreasing during a life time.
- 10 Dogs are mammals which are highly specialized in smelling. Their nasal mucous membrane contains more than one billion olfactory nerve cells. Therefore, even if a dog’s sight or hearing is not too good he can find his way around quite dependably with his nose. The quality of a dog’s nose is not so much the result of a bigger number of different receptor types, but much more a factor of the absolute number of nerve cells per specific receptor type. This is more than one million per type compared to ten thousand in men, i.e. more than one hundred fold.
- 11 The production of a specific receptor protein is originated by the corresponding gene. For one thousand receptor types one thousand respective genes are needed. The cell nucleus of mammals generally consists of a total of about 35’000 genes for the complete organic building plan. This means that about three percent of all the genes of mammals are reserved for olfactory response: a very astonishing fact which clearly demonstrates the very importance of the sense of smell in mammals.
- 12 The receptor for fragrance molecules is an integral part of the olfactory (primary) nerve cell which at the other end leads directly (without synaptic translation) into the brain (olfactory bulbs). The sense of touch has a similar scheme, whereas in vision, hearing and taste the receptors are highly specialized epithelial, non-neuronal cells which are connected to the corresponding nerve cell only in a second step (similar to synapses).

- 13 There are two symmetrical so-called "bulba olfactoria" in the brain, just across the mucuous membrane of the nose.
- 14 The transmission proceeds via synapses and secondary, tertiary, etc. nerve cells.
- 15 This probably involves associations with earlier similar or identical fragrance sensations. How the olfactory information is coded and decoded in different parts of the brain is amongst the most difficult and challenging unsolved questions of neurobiology.
- 16 The number and quantity of natural products compared to synthetic raw materials used in perfumery decreases constantly. This is due to increasing costs of the naturals (land and labor costs), quality fluctuations in composition from crop to crop, availability, weather dependability and also for safety reasons (toxicology, immunology, dermatology).
- 17 Fragrance oils are sometimes called "blend", or "fragrance composition".
- 18 Of course, sophisticated and expensive analytical hard and software systems support the work of the perfumer substantially. However, the human nose is still the better "instrument" as far as smelling is concerned.
- 19 An idea can only be converted into a fragrance if the link between the fragrance raw materials and their odiferous profile is mastered reliably. During the progress of his work a perfumer must be capable to judge which component is missing or overdosed, In this process knowledge about specific properties and reactions of the many different fragrance raw materials are very important.
- 20 "Fleiss und Anstrengung, Zaehigkeit des Denkens und Unbestechlichkeit der Urteilskraft, Beharrlichkeit im Verfolgen eingeschlagener Wege und Offenheit gegenueber neuen Erfahrungen sind entscheidende Voraussetzungen fuer das Hervorbringen von Werken, die wir als kreative oder gar geniale bewundern" (R.W. Weisberg, Kreativitaet und Begabung, Verlag SPEKTRUM, 12 (1989)).
- 21 Perfumes are, with few exceptions, high percentage (18 - 30%) solutions of concentrated fragrance oils in ethyl alcohol. Eau de Perfume and Eau de Toilette are a less concentrated (EdP 12 - 18%, EdT 5 - 12%). Sometimes the Eau de Perfumes or Eau de Toilettes differ from the perfume in their composition. The latter are mostly fresher, greener, less heavy than the high percentage perfume.

General literature:

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