Constitution of the substance. The following gases have no smell:—hydrogen, oxygen, nitrogen, water gas, marsh gas, olefiant gas, carbon monoxide, hydrochloric acid, formic acid vapour, nitrous oxide and ammonia. (It is necessary, of course, to distinguish between the sensation of smell and the irritant action of such a gas as ammonia.) The gases exciting smell are chlorine, bromine, iodine, the compounds of the first two with oxygen and water, nitric peroxide, vapours of phosphorus and sulphur, arsenic, antimony, sulphurous acid, carbonic acid, almost all the volatile compounds of carbon except those already mentioned, some compounds of selenium and tellurium, the compounds of chlorine, bromine and iodine with the above- named elements, and some metals. Chlorine, bromine, iodine, sulphur, selenium and tellurium, which are volatile and give off vapour at ordinary temperatures, have each a characteristic smell. Ramsay points out that as a general rule substances having a low molecular weight have either no smell or simply cause irritation of the nostrils. He also shows that in the carbon compounds increase of specific gravity as a gas is associated to a certain point with a sensation of smell. Take the marsh gas or methane series commonly called the paraffins. The first two have no smell; ethane (fifteen times as heavy as hydrogen) has a faint smell; and it is not till butane (thirty times heavier than hydrogen) that a distinct sensation of smell is noticed. Again, a similar relation exists among the alcohols. Methyl alcohol has no smell. Ethyl, or ordinary alcohol free from ethers and water, has a faint smell; “ and the odour rapidly becomes more marked as we rise in the series, till the limit of volatility is reached, and we arrive at solids with such a low vapour tension that they give off no appreciable amount of vapour at the ordinary temperature.” Acids gain in odour with increase in density in the form of gas. Thus formic acid is devoid of smell; acetic acid has a characteristic smell; and the higher acids of the series—propionic, butyric, valerianic—increase in odour. It would appear also that "the character of a smell is a property of the element or group which enters into the body producing the smell, and tends to make it generic.” Many compounds of chlorine, hydrogen, compounds of sulphur, selenium and tellurium, the paraffins, the alcohols, the acids, the nitrites, the amines, the pyridine series, the benzene group, have each a characteristic odour. To produce the sensation of smell a sub­stance must have a molecular weight at least fifteen times that of hydrogen. For instance, the specific gravity of marsh gas is eight (no smell), of ethane fifteen (faint smell), of propane twenty-two (distinct smell). Again prussic acid has a specific gravity of fifteen, and many persons fail to detect its odour. There is a relation between the molecular weight of a gas and the presence or absence of odour. Gases of less than a certain molecular weight are odourless, and it is significant that to some persons hydrocyanic acid, which has a low molecular weight, gives rise to no sensation of smell. It has also been pointed out by J. B. Haycraft that chemical compounds of elements belonging to the same group, according to the well-known periodic law of Mendéleeff, have sometimes odours of a similar character (see article "Smell,” Schafer’s *Physiology,* vol. ii. p. 1254). T. Graham pointed out that odorous substances are in general readily oxidized. J. Tyndall showed that many odorous vapours have a considerable power of absorbing heat. Taking the absorptive capacity of the air as unity, the following absorptions were observed in the respective cases:—

|  |  |  |  |
| --- | --- | --- | --- |
| Name of Perfume. | Absorption per 100. | Name of Perfume. | Absorption per 100. |
| Patchouli | 30 | Lavender.. | 60 |
| Sandal-wood . | 32 | Lemon | 65 |
| Geranium | 33 | Portugal . | 67 |
| Oil of cloves . | 33∙5 | Thyme | 68 |
| Otto of roses . | 36∙5 | Rosemary . | 74 |
| Bergamot . | 44 | Oil of laurel . | 80 |
| Neroli .... | 47 | Cassia .... | 109 |

In comparison with the air introduced in the experiments the weight of the odours must be almost infinitely small. "Still we find that the least energetic in the list produces thirty times the

effect of the air, whilst the most energetic produces 109 times the same effect.” @@1

Venturi, B. Prevost and Liégeois have studied the well- known movements of odoriferous particles, such as camphor, succinic acid, &c., when placed on the surface of water, and they have suggested that all odoriferous substances in a state of fine subdivision may move in a similar way on the moist surface of the olfactory membrane, and thus mechanically irritate the nerve­endings. This explanation is too coarse; but it is well known that the odours of flowers are most distinctly perceived in the morning, or after a shower, when the atmosphere contains a considerable amount of aqueous vapour. It would appear also that the odours of animal effluvia are of a higher specific gravity than the air, and do not readily diffuse—a fact which may account for the pointer and bloodhound keeping their noses to the ground. Such smells are very persistent and are apparently difficult to remove from any surface to which they have become attached. The smell of a corpse may haunt a living person for days, notwithstanding copious ablutions and change of clothes

*Special Physiology of Smell.—*It is necessary that the air containing the odour be driven forcibly against the membrane. Thus the nostrils may be filled with eau de Cologne in normal saline solution, or with air impregnated with sulphuretted hydrogen, and still no odour is experienced if the person does not breathe. When a sniff is made the air within the nasal passages is rarefied, and, as the air rushes in to equilibrate the pressure, it is forcibly propelled against the olfactory surface. When the air stream enters the nostrils, it passes vertically upwards, bends round and sweeps backwards and downwards at the level of the middle turbinated bones towards the posterior nares. There is a motion of the air over;· the olfactory surface. The olfactory surface must be moist; if it is dry, or is covered with too thick a layer of mucus (as in catarrh), the sense is much weakened or lost. The first moment of contact is the most acute and the sense quickly becomes blunted. The first scent of a flower is the strongest and sweetest; and after a few minutes’ ex­posure the intensity of even a foetid odour may not be perceived. This fact may be accounted for on the supposition that the olfactory membrane becomes quickly coated with a thin layer of matter, and that the most intense effect is produced when the odoriferous substances are applied to a clean surface. The intensity of smell depends on (1) the area of olfactory surface affected, and (2) the degree of concentration of the odoriferous matter. It is said that musk to the amount of the two-millionth of a milligram, and one part of sulphuretted hydrogen in 1,000,000 parts of, air, may be perceived. The smell of mercaptan has been experimentally de­tected when the dilution was I to 50,000,000,000, and it was cal­culated that the weight of mercaptan so detected in 50 cc. of air was 1/400,000,000 of a milligram (E. Fischer and Penzolalt). If the two nostrils are filled with different odorous substances, there is no mixture of the odours, but we smell sometimes the one and some­times the other. Morphia, mixed with sugar and taken as snuff, paralyses the olfactory apparatus, while strychnine makes it more sensitive (Lichtenfels and Frölich). There is no evidence that there are in the olfactory region different end organs or olfactory cells for different odours. The sense, however, may be fatigued by one odour so that other odours are not experienced. Thus camphor may so fatigue the sense that ether and eau de Cologne cannot excite smell.

As a rule, we experience odours by the simultaneous use of both nostrils. Stimulation of either nostril would give rise to the sensa­tion, while there is a fusion of sensations when both are affected. If, by means of a tube, an odour is conveyed into one nostril, while an odour of a different kind is directed into the other, there may be either a compound sensational effect, a sort of double-odour, or one odour may so predominate as entirely, to destroy the other. The fusion of odours is not complete, and it is similar to the effect of combining, say blue and re<l, in stereoscopic vision. When one odour destroys the other, the obliteration must take place in the cerebral centre. Certain odours are antagonistic, such as musk and oil of bitter almonds, volatile oils and iodoform, ammonia and acetic acid. It is not unlikely that when one odour predominates among many, this may be due not to any chemical action of one substance over another, but that the missing sensations may be accounted for by their failure to excite the olfactory region of the cerebrum in the presence of a stronger stimulus.

The delicacy of the sense is much greater in many of the lower animals. than in man, and it is highly probable that the dog or cat obtain information by means of this sense which a human being cannot get. Odours may excite in the minds of many animals vivid impressions, and they have probably a memory of smells which the human being does not possess. Even in man the sense may be greatly improved by exercising it. A boy, James Mitchell, was born

@@@1 Tyndall, *Contributions to Molecular Physics in Domain of Radiant Heat,* p. 99.