Information from Molecules: A Pluridisciplinary Approach to the Sense of Smell

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Abstract: In animals the sense of smell is the most ancient and most essential of senses because it is involved in behaviours indispensable for survival such as finding and identifying food and mate. Nonetheless it has been for long the most neglected in scientific studies. Being the most primitive of senses, it was considered less interesting than the "noble" ones, hearing and seeing, on which conscious human communications are based. The situation changed in 1991 when Linda Buck and Richard Axel, who received the Nobel prize last year, discovered "a new gene family" whose function is to code for olfactory receptors. Wheras only a few tens of different receptor proteins were expected, they found a thousand ones, so 3% of genes serve to code for olfactory receptors only, a quite large proportion for a sense deemed of secondary importance. This discovery turned an obscure field of science into a promising one, attracting a host of researchers from various disciplines.

In this talk I will present the current status of our understanding of olfaction, the nature of odorants and the long chain of events involved in their perception. The molecular mechanisms by which volatile molecules are detected at extremely low concentrations, as well as the cerebral neural networks converting the raw signals into meaningful messages, will be described. The richness of information that can be retrieved from odor plumes and the principles by which olfactory information is coded and processed in the brain will be presented. Examples taken from both invertebrates and vertebrates will illustrate how qualitative, intensitive and temporal aspects of odour signals are discriminated, and actually utilized by animals in various behaviours. The psychological, evolutionary and technological significance of these advances will also be outlined to offer a concise but comprehensive introduction to information processing in olfactory systems.