On the sensitivity of natural sensor systems

Ille C. Gebeshuber
Institut für Allgemeine Physik, Vienna University of Technology,
Wiedner Hauptstraße 8-10/134, A-1040 Wien, Austria
ille@iap.tuwien.ac.at

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Natural sensor systems exhibit extraordinary sensitivity. The nose is a single molecule detector, the eye a single photon observer. And the coding efficiency of inner ear receptor cells allows for a hearing threshold one order of magnitude below the thermal motion of their receptive organelles [1].

Yet, it is not only their sensitivity, which makes living systems highly interesting in terms of technological applicability. They exhibit further intrinsic properties, refined in millions of years of evolution, which are worth being understood:

Organisms excel at building smart materials from very basic building blocks. As an example, I will introduce adhesive production by nanostructured glass building microalgae [2,3].

Organisms construct highly efficient natural nanomachines. My example here will be a single biomolecule acting as a protein repair station, occurring throughout species, from bacteria to men, working in every single cell, every single second [4].

Many of the more interesting properties of living systems are emergent phenomena, found only in complete organisms or communities of those organisms, not in their isolated components. The traditional boundaries between scientific disciplines can no longer be upheld, if one is to understand nature. Today, physics has made further inroads into the organic domain, in its emphasis on nonlinear phenomena far from thermal equilibrium, on coherence and cooperativity which are some of the hallmarks of living systems [5]. I think that Alfred North Whitehead, the English philosopher who wrote Principia Mathematica with Bertrand Russel, was not too far off when he stated in 1925 that “physics has to be explained in terms of a general theory of the organism” [6] !

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