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Plenary Lectures

PL–1

INSIGHTS FROM OPTICAL IMAGING OF ARCHITECTURE AND FUNCTION IN THE LIVING BRAIN

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Purpose: To study the organization and the function of neuronal assemblies in the cortex.

Methods: Two optical imaging techniques shed more light on the development, organization and function of cortex. The first method is based on monitoring slow intrinsic signals. The second technique is based on voltage sensitive dyes responding in real time.

Results: The orientation domains are usually arranged in a pinwheel fashion around orientation centers. The meticulous relationships between various subsystems were determined and the rules underlying the connectivity among functional domains were clarified. Utilizing Real-time optical imaging we found that the amplitude of coherent on-going activity was often nearly as large as that of evoked activity.

Conclusions: There is a remarkable functional architecture in the visual cortex. Intrinsic on-going activity in neuronal assemblies plays an important role in shaping spatio-temporal patterns evoked by sensory stimuli.

PL–2

TOWARDS MOLECULAR RESOLUTION

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Purpose: The functioning of biological systems is ultimately determined by interactions of macromolecules. It is a demanding problem to develop detection methods that allow imaging of these molecules in undisturbed systems.

Methods: Molecular specificity may be derived from optical microspectroscopical methods like fluorescence and Raman. The spatial resolution of these techniques is not sufficient to resolve molecules. Combinations with AFM, NSOM, and light scattering are being tried for imaging of cells, chromosomes and single molecules.

Results: All methods are successful in resolving *part* of the problem. Raman allows probeless identification of molecules but has low sensitivity and needs high concentrations. AFM and NSOM are limited to surface studies of chromosomes, cells and surface-bound molecules. Light scattered by reporter beads coupled to single molecules yields nm resolution for molecular displacements of these molecules.

Conclusions: To localise and identify a single functioning molecule *on* or *in* a cell still is a challenging goal.

PL–3

GENERATION OF BIOLOGICAL INFORMATION

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A living entity can be described as a complex adaptive system which differs from any, however complex, chemical structure by its capability of functional selforganization based on processing of information. If one asks where does this information come from and what is its primary semantics the answer is: information generates itself in feedback loops via replication and selection, the objective being "to be or not to be". Experimental studies referring to different levels of molecular organization are described. They shed light on how genetic information originates. Although viruses, as we know them today, are presumably of a postbiotic origin, i.e. depending on the existence of proper hosts, the examples well demonstrate nature's strategies of generating information by molecular evolution. The experiments were carried out with the help of automated, computer-controlled bioreactors, called "evolution machines", that form the basis of a new "evolutionary biotechnology".

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PL–4

PERSPECTIVES IN SUPRAMOLECULAR CHEMISTRY: FROM MOLECULAR RECOGNITION TOWARDS SELF-ORGANISATION

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Molecular recognition is defined by the energy and the information involved in the binding and selection of a substrate by a given receptor molecule. It involves the molecular storage and the supramolecular processing of molecular information.

Supramolecular chemistry has relied on more or less preorganised molecular receptors for effecting molecular recognition, catalysis and transport processes. A step beyond consists in the design of systems undergoing *self-organisation*, i.e. systems capable of spontaneously generating a well-defined supramolecular architecture by *self-assembly* from their components in a given set of conditions. The molecular information necessary for the process to take place must be stored in the components and acts through selective molecular interactions. Thus, these *programmed supramolecular systems* operate via molecular recognition.

Self-assembly will be illustrated by the spontaneous formation of different types of supramolecular architectures from suitable organic ligands and metal ions, in particular double helical and triple helical complexes and other structural analogs of nucleic acids.