SELF – ASSEMBLY OF PROTEIN CLUSTER FILMS AND LAYERS OF BIOLOGICAL CELLS

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At present, a consistent theory of the origin of biological cells hardly is available. The question why the cells are structural units of protein layers (films) in any living organism also does not seem to be consistently answered. At the same time, the modem embryology describes the rise and first division of an egg as some densification of the protein surface layer and stress enhancement in a cytoplasmatic disk, so that a defect appears in the protein film, giving rise to appearing two cells, etc. (Bedemer, 1971).

It is possible that some recent new data may give rise to pushing forward some model of the cell origin. The data concern protein cluster films in vitro at non-equilibrium conditions. The behavior of such a film in some aspects agrees with the "embryological" model of division of a homogeneous protein structure in "cells" due to structural defects (Fig. 1). This may be associated with a rapid enough evaporation in an open protein-water system and the related protein condensation, without crystallization typical of equilibrium conditions (Rapis, 1997). For the latter, a reasonable model was earlier presented (Rebinder et al, 1975) and then developed (e.g., Aggel et al, 1997), based on free-energy minimization processes.

A hypothesis is here suggested that protein condensation at non-equilibrium conditions gives rise to a topologically connected system of self-assembled cluster films, of which subsystems are "cells" and "cell" layers (Fig. 1a). The process is assumed to be associated with non-linear, chaotic dynamics and related aggregation of protein molecules in films. This process may give rise to dissipative nanostructures and fractals and to defects cutting the film in "cells" containing "nuclei" as most equilibrium elastic regions.

Supporting the hypothesis appear to be:

1. Experimental data, revealing non-linear, chaotic dynamics of self-assembly of protein cluster films (Rapis, 1995-1997).
2. Well-known morphologic data on the important property of cells to form layers and films (Albert et al, 1989) and on occurrence of elastic filaments.
3. Accordance of morphologic and experimental data with some theories of non-equilibrium colloidal suspensions (Poulin et al, 1997), nematic unisotropic liquid crystals (Joanning, 1997) and elastic films (Burton, Taylor, 1997). The experimental and morphologic data noted do not appear to agree with the existence of crystalline protein structures in functioning biological structures.

Of course, a cell of a living organism is not equivalent to the "cell" of a protein film in vitro. Despite of similarities in their frameworks, the difference was in the multitude of links with other vitally important substances, which proteins acquired during the evolution processes

However, as experiments reveal, the protein films and the related cells" still retained the autonomic activity in self-assembly processes.

Certainly, the hypothesis suggested needs for a quantitative, mathematical, analysis and support. However, one may assume that the hypothesis may acquire a considerable importance for biology and medicine, making possible to present the protein thin films as the basic structure in protein folding. It is worthy of note that the modem physics of thin films (Lange, 1996) plays a special role in advanced communication technologies. At the same time, their role in biology and medicine is still rather unclear.