TOWARDS PROTO-CELLS : "PRIMITIVE" LIPID VESICLES ENCAPSULATING GIANT DNA AND ITS HISTONE COMPLEX

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A crucial step in the formation of proto-cells should be the encapsulation of macromolecules such as DNA, involving their separation from the external environment by "primitive" membranes. In this context of the origin of life, the encapsulation of DNA by lipid vesicles has been reported on by several authors. For example, Jay and Gilbert reported that small DNA (with 1,000 base pairs) incorporation into sonicated small vesicles was enhanced in the presence of a basic protein, lysozyme. However, vesicles of several tens of nanometers acrossare too small to incorporate a typical natural DNA containing 10^5 -10^9 base pairs.

We have previously shown that geranylgeranyl phosphate, which had been postulated as the most "primitive" membrane component, could spontaneously form giant vesicles [1]. We wondered if bacteriophage T4 DNA (166,000 base pairs) could be incorporated into these vesicles. This was indeed the case. We used a swelling method or a laser tweezer method for the encapsulation of T4 DNA into geranylgeranyl phosphate giant vesicles (5-10 • m). Using fluorescence and confocal microscopies, we could directly visualize the entrapment of the DNA and the DNA-Histone H1 complex into the giant vesicles, as well as their conformation and dynamics in real time [2].

Next, we could perform the transcription of T7 DNA within cell-sized giant vesicles that were formed by natural swelling of phospholipid films. Direct observation using fluorescence microscopy confirmed that the vesicles behave as a barrier which can prevent the attack of RNase [3]. Finally, we demonstrated that cell-sized vesicles were spontaneously formed from a "primitive" membrane lipid, geranylgeranyl phosphate, accompanied with the encapsulation of a gene expression system, leading to functional protein synthesis.

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