ORDER: THE LAST RESORT ?

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In their natural habitats, unicellular systems such as bacteria and yeast are continuously confronted by enviromnental assaults against which a rapid response must be initiated in order to allow survival. Indeed, bacteria have developed a variety of pathways that act to negate detrimental factors and to repair the dal-naged cellular components. Bacterial life-cycle is, however, characterized by long periods of severe nutritional deprivation during which the ability to mount a fast response through the induction of prote'n synthes's is seriously compromised. Quite surprisingly, starved bacteria are capable of enduring harsh enviromnental assaults much better than 'well fe&, actively growing cells. What are the n-techailisms that mediate such an enhanced starvation-dependent general resistance?

The research conducted in our laboratory is motivated by the notion that under severe stress and starvation, defense mechanisms that rely solely on biochemical pathways might not be fast and extensive enough. Since survival critically depends upon the ability of cellular systems to preserve the integrity of their DNA complement, we have initiated a comprehensive study on the factors that modulate DNA organization and the effects of such modulations upon DNA stability. Preliminary results indicate that under stress conditions bacterial DNA undergoes a structural transition, leading to a highly condensed and ordered liquid-crystalline assembly. Within tlils assembly, the DNA is effectively protected against irradiation, drugs and oxidative agents. We have further shown that such a global DNA reorganization is induced, regulated and finely tuned by DNA-binding proteins which facilitate the formation of highly ordered DNA assemblies, thus substantially enhancing DNA stability.

DNA molecules are not the only macromolecules that form ordered assemblies; neither are such organizations a unique feature of bacteria. Crystalline arrays of ribosomes have been detected in cells of animals during winter
hibernation as well as in brain cells of humans inflicted by various pathological conditions such as sclerosis or Parkinson dementia. Our research is aimed to obtain deeper insights into the notion that macromolecular order represents a very general mode of protection that is effected under severe stress conditions.