Statistical Mechanics of Molecular and Cellular Biological Systems

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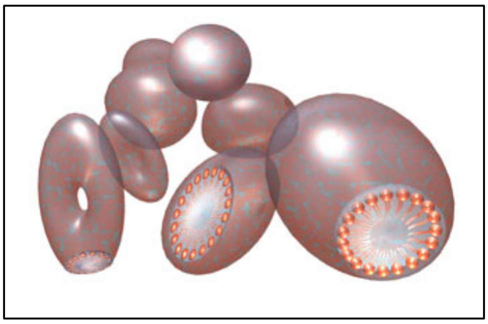
We are currently witnessing a remarkable period of renewed collaboration between physicists, mathematicians and biology. Not for the first time are there very good reasons for synergy – the beginnings of molecular biology itself emerged from a previous period in which techniques from physics, and mathematical analysis, demonstrated huge potential to answer biological questions. Famous examples are the application of radio-labelling in Copenhagen in the 1930s, and of course the determination of the structure of the "Double Helix" of DNA in Cambridge and London in the 1950s.

This programme arises from the very promising creative tension between the "randomness" of statistical physics, and the "specialness" of biology. Biological molecules, such as the protein to the left, have to work in a molecular soup of random motion – the consequences of heat. But they learn to work *with* it rather than against it – so that , for example, the miniature molecular motors that work our muscles rely on this "Brownian Motion" to work! Recent mathematical theories have begun to shed light on how nature exploits physics in these special molecules.

Similarly, the delicate membranes of each cell in animals and plants bodies are build from much smaller molecules, lipids, that assemble naturally into the closed structures that protect the insides and outside environments of cells (see figure on right). We are only just beginning to understand the patterning of structures within the cell walls – which brings into play the mathematics of self-organisation, diffusion, flow and signal-processing.



The programme will bring together theoreticians for long terms, but retain a constant stream of experimental biologists and physicists on shorter visits to stimulate, and we hope be stimulated by, the work.