Appendix A4

Preface to the proceedings of the **"5th international conference on biological physics"** held at Gothenburg University and Chalmers University of Technology, Gothenburg, 23-27 August 2004.

Without the tools of modern physics the structure of DNA would not have been discovered in 1953. The knowledge of the DNA structure in turn initiated the rapid development in molecular biology that we have seen during the last 50 years. It lead to the present detailed but from modeling aspects still qualitative understanding of phenomena, such as, gene regulation, DNA replication and division of cells, to mention just some. A quantitative understanding, for instance, of the dynamics of native DNA and its replication, however, requires the use of methods developed within condensed matter theory because, obviously, a living cell and its DNA consist of condensed matter although perhaps more complex than inanimate matter. In both living and inanimate condensed matter many identical molecules can do things together that the single molecule cannot. Thus, instead of asking what life actually is we could ask what molecules can do together in living matter that they cannot do together in inanimate matter. This may also give information about the origin of life and if there is a genuine difference between the living and nonliving states that could be ascribed to matter as such.

Perhaps life is just an illusion, a romantic concept that we fill with dreams and all sorts of imaginations, avoiding the core problem, the fact that living condensed matter usually defines chemically open, non-equilibrium, lyotropic systems. The dynamics and biological functions of living systems may therefore depend on reactant concentrations. Unfortunately, our present knowledge in physics is mainly about thermotropic systems, in which the interpolation between harmonic and displacive modes of interaction is driven by temperature variations. We have learned to handle non-equilibrium reactions such as those occurring in pattern formation experiments. However, such structures are not sufficiently robust to simulate biological systems. Single molecule experiments have shown that DNA already without the initiator proteins and histones is itself a rather rigid structure. We must therefore also learn to handle non-equilibrium reactions in dynamical systems restricted by correlations between steadily increasing or decreasing numbers of molecules. Apart from extending our physical knowledge beyond the Boltzmann type statistical mechanics, insights in this problem area could perhaps provide a clue to the definition of life. Knowing the dynamics of native DNA, and how to describe DNA replication in normal cells, we could then also have a chance to better understand proliferation of cancer cells.

This special issue of the *Journal of Biological Physics* contains papers presented at the 5th International Conference on Biological Physics. In the first paper Adrian Parsegian and I make an attempt to summarize some of all interesting material presented at this conference and give a short background. We also present data showing that it was a successful meeting. Thus, for instance, the large majority of some 500 participants, more than 400 of which were from non-host countries, stayed the whole week out.

The planning of the conference was a collaborative effort of a local organizing committee and I want to thank all colleagues who were active in that part of the process. Advice was also taken from the IUPAP commission on biological physics and an international program committee. The committees are listed here below. However, without the economic generosity extended to us by sponsors this meeting could not have taken place. I therefore would like to thank the Royal Swedish Academy of Sciences for

generous support given through its Nobel Insititue for Physics, and its Nobel Institute for Chemistry. I am also grateful for economic support from the Swedish Research Council, Göteborg University, and the International Union of Pure and Applied Physics (IUPAP). Finally I would like to cordially thank all participators for the extensive scientific contribution of high quality and for creating a constructive and warm atmosphere during the conference.

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Guest Editor and
Secretary General