

Introduction

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The problems mostly discussed in this volume pertain to the relationship between 1D and 3D structural data in proteins and DNA. This theme began in the last decades of the XX century, and is still the focus of numerous biophysical discussions. For years, the main question of how linear genome sequences predetermine the spatial structure of biopolymer remained very intriguing. The recent genome sequence analysis has provided new tools for studying DNA and proteins.

These problems lead, besides new biological questions, to an interesting mathematics, which is very natural to topology and more precisely to knot theory. Most of the chapters presented in this volume are concerned with these topics.

The book begins with a chapter by S.D. Levene, which might be considered as an introduction to the topological aspects of DNA structures. In the next chapter “Monte Carlo simulation of DNA Topological properties” Vologodskii studies the problem of calculating the main quantity writhing. In the chapter “Dynamics of DNA supercoiling”. Gabibov et al. are concerned with the very interesting and recently studied dynamics of supercoiled DNA, with topological constraints. The authors analyse not only theoretical aspects of the problem but also the experimental situation.

The following two chapters of Kauffman and Lambropoulou “From Tangle Fractions to DNA” and Cerf and Stasiak “Linear behavior of the writhe versus the number of crossings in rational knots and links” are devoted to interesting topological problems related with recombination properties of DNA. We point out that it is a rare case where biological questions lead to new mathematical notions such as the theory of tangle equations.

The next section commences with the chapter of Kister et al. The authors provide the combinatorial analysis of the above-mentioned problem: how one-dimensional genomic sequences determine three-dimensional protein structure. One more special problem is the structure of collagen, which is a protein with periodic structure. Rivier and Sadoc study the assembly of collagen molecules, the so-called fibrils, long, periodic bundle of finite collagen

molecules. The appearance of three-dimensional periodic structures leads to very interesting geometrical questions similar to the problems of classification textures and defects in liquid crystals (smectics and discotics), lattices of defects in superconductors, defects in liquid membranes, dense packing of spheres and so on.

The book ends with a large mathematical supplement. A short course on topology is included, assuming that some knowledge of topology presented in a comprehensive form will be useful for physicists and biologists. The basic notions in topology already used in biology as a reader can be found in the biological chapters of the book and some background is given. We guess it will be useful in future investigations.

The lectures of Buchstaber and Monastyrsky can also be found in this compendium. The points raised in the lecture of Millionschikov based on the recent new developments of topology, the theory of multivalued functionals, have already been applied in physics. It seems that such a good technique will be useful in future applications in biology. I follow the thought-provoking motto of John von Neumann: "Modern mathematics can be applied after all. It is not clear a priori, is it, that could be so".

The last chapter written by Brooks is based on his colloquium lecture in the MPIPKS, Dresden, and also on his talk in the Institute d'Henri Poincare, Paris. He considered some relations between graph theory and spectral properties of Laplacians on Riemann surfaces.

We publish his lecture for two purposes. First of all it is a very good mathematic study concerning with two fundamental topics (graph theory and Riemann surfaces) with very promising applications in biology. The second one is to acquaint a more general audience with the work of Robert Brooks, the very deep and original mathematician. He participated very actively in our seminar. Unfortunately he passed away soon after the end of our program. We dedicate this volume to his memory.

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