The book is divided into sections that deal with fluvial, aeolian, and chemical sediments and with remote sensing of desert sediments. The fluvial section contains papers on modern and Quaternary alluvial sequences in Israel and Oman and on Triassic ephemeral streams in Denmark. Frostick and Reid contribute an excellent paper on sedimentation in rift valleys, in which they draw on new data on the structure of the East African rift. Concepts of alluvial fan development have been formed primarily by studies in the American West, which often emphasize tectonic effects, so it is refreshing to see a paper by Harvey that indicates that in Spain variations in sediment supply play a major role in fan development.

The aeolian section is divided into groups of papers on dust, ancient and modern dunes, and grain-size analyses of aeolian sands. They include an intriguing experimental study by Whalley and his co-workers on aeolian abrasion of quartz particles. There is an excellent review by Pye and Tsoar of dust transport and deposition in deserts, which provides a background for papers on dust accretion and soil development in the Negev and West Africa. The group of papers on dunes is dominated by those on ancient dune sandstones of Devonian to Permo-Triassic age in Scotland, Australia, and Ireland. These papers demonstrate that the increasing recognition of the complex nature of ancient aeolian sandstones is largely a product of studies of modern dunes and sand seas. The three papers on grain-size studies show that, despite the use of sophisticated statistical methods to describe grain-size distributions and to discriminate between depositional settings, the use of textural parameters to discriminate between depositional environments is limited by the high degree of spatial and possibly seasonal variability on the scale of individual dunes, as indicated by Livingstone's intensive study of a Namib linear dune.

Chemical sediments are represented by studies of silica and calcium carbonate replacement of plant roots in Indian coastal dunes and of spring mounds in Tunisia. Such studies are important for understanding the diagenesis of desert sediments and for interpreting paleoenvironments in desert regions.

The volume ends with three papers that consider the "big picture" of desert environments by using remote-sensing data to study sand sheets in the eastern Sahara, surface sediments in Qatar, and sediment transfers on playas in Tunisia. A combination of approaches that include detailed field studies to calibrate and constrain the regional view offered by remote-sensing data appears to offer great promise for future studies of desert sediments and surfical processes.

The editors have done an excellent job in putting together a group of papers that illustrate the diverse nature of sediments in desert regions. The book is well produced, with a useful index. It fills a major gap in the literature on desert sediments and processes and should be on the shelves of all earth-science libraries and in the possession of researchers studying desert sediments, both ancient and modern.

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## Biomolecular Processes

**Dynamics of Proteins and Nucleic Acids**. J. ANDREW MCCAMMON AND STEPHEN C. HARVEY. Cambridge University Press, New York, 1987. xii, 234 pp., illus. $39.50.

Since the first simulation of the molecular dynamics of a small globular protein was reported 12 years ago, there has been explosive growth in the field. This is the result of the increasingly fruitful interchange between theory and experiment that is now taking place. On the one hand, computer simulations of biological macromolecules, which were initially limited to extremely short times (picoseconds), can now be carried out on much longer time scales because of the vastly increased speed of today's computers. On the other, new chemical techniques (2D NMR, ultrafast laser spectroscopy, cryogenic and time-resolved crystallography) are providing experimental information that can be used to validate the simulations. *Dynamics of Proteins and Nucleic Acids* provides a comprehensive introduction to the theoretical methods that are currently being used to probe the dynamics of biomolecules.

The intense interest in computer simulations of biomolecular dynamics derives in part from the potential applicability of these methods to the design of new molecules of biological importance. The powerful recombinant DNA techniques of molecular biology have made it possible to produce designer proteins, yet we lack a set of theoretical tools to make the design process something more than a hit-or-miss affair. This situation is changing, however, as "free energy simulation" techniques are developed and applied to molecular design problems. Included in the book is an introduction to this rapidly developing technology as well as a review of the theoretical tools required for such simulations.

The book begins with an overview of the different types of motion that are exhibited by biopolymers and the huge time range these motions encompass (for example, small-amplitude vibrations occur on a time scale of $10^{-13}$ second whereas large-scale allosteric transitions occur on a time scale of $10^{-3}$ to 10 seconds). This large dynamic range poses difficulties for the theoretical study of these processes. An excellent review of the many techniques that have been developed to handle these multiple time scales is presented. The perspective throughout is that of the physical chemist. Simplified pictures are used to help the reader organize the tremendous wealth of experimental and theoretical data on the dynamics of proteins and nucleic acids. In the overview of the dynamics of proteins, the similarities to other dense materials are clearly brought out, with their atomic motions over shorter time intervals likened to those of liquid and their longer-term motions to those of solids. Similarities and differences between the dynamic behavior of proteins and nucleic acids are illustrated with numerous examples. It is suggested that the extended shape and large net charge of nucleic acids account for the fundamental differences between the kinds of motions observed in globular proteins and nucleic acids.

The chapter on theoretical methods provides the most comprehensive review of the methodology currently available. Starting with a description of the potential functions used for macromolecular simulations, the authors clearly describe the techniques that are used to simulate motions on this surface, from adiabatic mapping, which is essentially an energy minimization technique, to molecular dynamics and brownian dynamics simulations. The various computational strategies for carrying out free energy simulations are reviewed, and the strengths and weaknesses of each of the methods are explained. The thermodynamic cycle perturbation method first applied to the simulation of enzyme-substrate binding by McCammon's group is particularly powerful in that it is computationally efficient and it focuses on the quantities that are of greatest experimental interest, the relative free energy of binding of different substrates, rather than the absolute values, which are much more difficult to calculate. The historical roots of this field in computational statistical mechanics of liquids are made apparent.

In the early development of this field a few molecular systems have served as paradigms for the study of biopolymer dynamics: trypsin inhibitor and cytochrome c for proteins and tRNA for nucleic acids. Many of the studies of these molecules described in the book were carried out in the authors' laboratories. The results, as well as those of many other studies, are presented in three chapters organized according to the time and length scales of the motions involved. The chapter on short-time dynamics considers motions during time intervals of less than 100 picoseconds. The treatment of these very fast motions provides the framework for the discussion of activated processes that are intrinsically fast but occur infrequently. Activated dynamics simulations are now being used to study the mechanism of such biologically important processes as electron transfer reactions. The book provides the background required to read the current literature on this subject.

As mentioned in the preface to the book, detailed computer simulations of proteins and nucleic acids involve a fusion of three "high technology" areas: molecular biology, chemical physics, and scientific computing. *Dynamics of Proteins and Nucleic Acids* explains how and why these fields coalesce in the study of biopolymer dynamics and shows how the foundation has been prepared for studies concerned with the interpretation and prediction of biological activity based on the physical properties of these macromolecules. The book serves as a valuable resource for graduate students wishing to enter the field as well as for working scientists in diverse areas of biophysical chemistry who wish to develop an understanding of the macroscopic properties of proteins and nucleic acids by studying their underlying structure and dynamics.

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## Neurophysiology

**Long-Term Potentiation.** From Biophysics to Behavior. PHILIP W. LANDFIELD and SAM A. DEADWYLER, Eds. Liss, New York, 1987. xiv, 548 pp., illus. $140. Neurology and Neurobiology, vol. 35.

In invertebrate animals the inquiry into the physical basis of learning and memory has proceeded from the systematic observation of learned behaviors to the study of nervous-system structures and processes. In mammals the complexity of the central nervous system has hindered straightforward progress. The present volume focuses on an electrophysiologically defined phenomenon, long-term potentiation (LTP), that fulfills many of the criteria expected, a priori, of neural mechanisms of learning and memory and has therefore come under intensive investigation.

The fundamental demonstration of LTP is simple and compelling. A brief train of electrical stimuli delivered to certain fiber bundles in the brain causes a great increase ("potentiation") in the size of subsequent single evoked responses. Most remarkably, the potentiation produced by a stimulus train lasting only a fraction of a second can endure for hours or days depending on the exact experimental conditions.

From its title, one might infer that this book treats a single phenomenon, but this is true only in a general sense. A lot of circumstantial evidence suggests that more than one, perhaps many, superficially similar phenomena are designated "LTP." The subtitle, "From Biophysics to Behavior," should be understood in the same sense in which America is said to extend "from sea to shining sea"; that is, not much sea is included in the territory. Finally, the title does not mention "hippocampus," though nearly all of the work discussed was carried out on this structure for both historical and practical reasons: LTP was discovered in the hippocampus and is produced especially readily there. Structurally, the hippocampus offers a number of technical advantages for studying LTP, and a large base of hippocampal data exists. There is evidence that the hippocampus is involved in behavioral learning. Because of this bias, however, the non-hippocampologist will occasionally find the going a bit rough without a review of the relevant anatomy and physiology handy. Luckily, such reviews are readily available.

The book aims to provide a "highly comprehensive overview of LTP at all major levels of analysis" as well as a detailed discussion of specific research findings and controversies. This ambitious program is undertaken in 15 chapters written by investigators who, for the most part, work on hippocampal LTP. The chapters are a mix of reviews and shorter, more narrowly focused essays. In general, the objectives of the book are well met, and a number of the critical reviews are excellent. Ample coverage is given to the phenomenology of LTP, including stimulus parameters appropriate for its induction: "cooperativity" (there may be a minimal degree of excitation necessary to produce LTP) and "associativity" (coincident inputs from different fiber systems can interact to produce greater LTP than either could produce alone). The major types of analysis applied to LTP to date are thoroughly discussed: anatomical (changes in the size or number of synaptic contacts or in the shape of the dendritic spines on which most synapses are made); biochemical (changes in receptor number, the phosphorylation state of certain proteins, and the role of protein synthesis); and physiological (increases in synaptic potentials, the role of calcium and of the postsynaptic membrane potential in LTP induction). As is pointed out in the last sentence of the book, determining the behavioral relevance of LTP will require much further effort. The evidence available is presented in a balanced way.

The authors seem to have been given a free hand, the better to allow controversial points to surface. This often produces the desired effect, although occasionally at the cost of redundancy on points on which no disagreement is expressed. The most extreme case is the number of not very different renderings of the *N*-methyl-D-aspartate (NMDA) hypothesis. However, the book's open style allows the reader to draw his or her own conclusions. One finds, for instance, general agreement that different forms of LTP exist and that disinhibition enhances the probability of LTP induction. On the other hand, there is no consensus as to whether the important events of LTP occur presynaptically or postsynaptically. Both hypotheses are represented and defended. The phenomena of associativity and cooperativity and the excess potentiation of the action-potential generation all seem to call for a postsynaptic explanation. Measured increases in the release of glutamate, the presumed excitatory neurotransmitter at some synapses undergoing LTP, imply a presynaptic locus.

The NMDA hypothesis provides a modern rationale for an idea put forward in 1949 by D. O. Hebb that memory storage might involve participation of both presynaptic and postsynaptic elements. The emphasis on the state of the postsynaptic element was new. Much recent excitement centers on the NMDA subclass of the excitatory amino acid receptors since it is unique in requiring both the binding of a neurotransmitter to its receptor site and an appropriate level of depolarization for opening of the associated ion channel. Direct support for the NMDA hypothesis in LTP comes from the observation that NMDA antagonists block LTP at certain synapses. Since neurotransmitter release has its provenance in the presynaptic neuron, whereas the membrane potential sensed by the NMDA channel is determined on the postsynaptic side, the NMDA complex seems ideally suited to the requirements of a Hebbian synapse. Even more suitably, calcium, already implicated in the establishment of LTP, is quite permeable in the NMDA channel. Calcium influences are, of course, ubiquitous, and so the number of possibilities for its involvement is rather large. Hence the NMDA hypothesis is compatible with many disparate ideas and helps tie together much of the book, but other