Gautier and Owen, Pollack and Bodenheimer) and their attendant large satellites (chapter by Lunine and others). Here, we see tantalizing clues of the accumulation process for most of the planetary mass in our solar system, a process that we hope to understand better through the emerging, exciting field of extra–solar-system planetary detection.

DAVID J. STEVENSON
Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125

A Synaptic System

Plasticity of the Neuromuscular System. DAVID EVERED and JULIE WHELAN, Eds. Wiley-Interscience, New York, 1988. x, 273 pp., illus. $54.95. Ciba Foundation Symposium, vol. 138. From a symposium, London, U.K., Jan. 1988.

One of the central questions in neurobiology is how nerves regulate the properties of the target cells they innervate and how they are in turn regulated by their targets. To attempt to answer such questions in a system as complex as the mammalian central nervous system would be a Herculean task. Neuroscientists have therefore adopted reductionist approaches, exploring these interactions in the relatively simple nervous systems of invertebrates or in isolated synaptic systems. For this purpose, the neuromuscular system is nearly ideal; the neuromuscular junction is by far the most thoroughly studied and best-understood mammalian synapse. There is a vast body of knowledge about its structure, function, chemistry, and pharmacology, and it is readily accessible to experimental manipulation. Yet some of the apparently simplest questions about nerve-muscle interactions, which seemed on the brink of solution long ago, have not yet been fully resolved:

1) How do motor nerves form appropriate connections with muscles? Are the connections predetermined, or are they adjusted during development?

2) How do nerves establish a monogamous relationship with muscles (one branch to one muscle cell)?

3) How are the contractile and metabolic properties of muscle cells regulated? Are they preprogrammed or under neural control? How do nerves modify these properties?

4) How are acetylcholine receptors up-regulated at neuromuscular junctions (where they are densely concentrated) and down-regulated away from the junction (where they are sparse)?

5) How do muscle cells influence the life or death of nerve cells during development so as to assure the survival of just the right number of motor neurons? And how do muscle cells instruct nerves when to sprout?

These are some of the questions explored in the Ciba Foundation symposium that led to *Plasticity of the Neuromuscular System*.

Overall, many of the phenomena examined now appear to be far more complex than they once did, even in this relatively simple synaptic system. In almost all cases, multiple influences regulate each property of the muscle cell. One instructive example concerns "slow" and "fast" muscles. Nearly three decades ago, Arthur Buller (who chaired this meeting) suggested that motor nerves play the chief role in determining the contractile properties of the muscles they innervate, resulting in "slow" or "fast" muscles, characterized by their speed of contraction and related biochemical properties. Though this concept has been extremely useful, it is now evident that it was an oversimplification. There is actually a vast array of muscle types with a spectrum of contractile protein isotypes and varied patterns of metabolic enzymes. These patterns result from regulation of gene families and their products at multiple levels of transcription, translation, and assembly. Moreover, the final pattern is determined not only by neurally triggered activity but also by intrinsic genetic programs and hormonal influences.

The revelation of this and other complexities results from the methods of molecular biology now being applied to the phenomena of nerve-target interactions. These methods are likely to bring us closer to understanding the mechanisms of regulation. Thus, for example, much is currently being learned about the mechanisms that regulate acetylcholine receptors. The genes for all of its subunits have been cloned, probes have been made, and the regulatory regions outlined in this volume have recently been even more rigorously identified.

Less encouraging is the fact that some of the old semantic confusion still exists. "Activity," which plays an important role in regulation of many muscle properties, is still ill-defined. Does it mean mechanical contraction, electrical conduction, acetylcholine transmission, or all of those? Few of the contributors to the book make these crucial distinctions. Moreover, for this reviewer, it is disappointing that the important regulatory role of neurotransmission is not represented. Indeed, the book presents little if any new information about how the nerve transmits its regulatory influence to muscle. This important key to the cellular biology of nerve-target interactions almost seems to be on hold.

This small book offers a glimpse of the study of nerve-target interactions through the window of the neuromuscular system. Despite the notably uneven quality of the contributions and the terse style, which makes for slow going, there is much to be gleaned. The informal comments, particularly those of Nadal-Ginard, provide some illuminating insights. *Plasticity of the Neuromuscular System* marks a nodal point in the progress of the field when it has become obvious that molecular biology is being applied effectively and has enormous potential for answering many important questions.

DANIEL DRACHMAN
Department of Neurology, Johns Hopkins University, Baltimore, MD 21205

Laser-Molecule Interactions

Lasers, Molecules, and Methods. JOSEPH O. HIRSCHFELDER, ROBERT E. WYATT, and ROB D. COALSON, Eds. Wiley-Interscience, New York, 1989. xviii, 1022 pp., illus. $125. Advances in Chemical Physics, vol. 73. Based on a symposium, Los Alamos, NM, July 1986.

The theoretical and computational description of the interaction of electromagnetic fields with molecules is an enterprise that engages chemistry, physics, applied mathematics, and several branches of engineering. Despite the common focus, however, these disciplines have been only loosely coupled in their research on this topic. *Lasers, Molecules, and Methods* is a welcome attempt at breaking down the disciplinary boundaries by providing a broad survey of the methods used in describing laser-molecule interactions. This survey consists of 23 papers representing all the above-mentioned disciplines. Many of the papers give lengthy reviews of mathematical concepts and methods that have generally not appeared in the nonmathematical literature.

Perhaps the most important strength of this book lies in synergisms that are developed through the presence of a common set of themes. Matrix methods for determining transition amplitudes (the Lanczos algorithm, recursive residue generation) provide one such theme, showing up in applications to multiphoton excitation, spectra, relaxation dynamics, scattering, eigenvalues, and many other problems. Other recurrent themes include methods for solving the time-dependent Schrödinger and Liouville equations, high-intensity and short-duration laser pulses and their interaction with molecules, and the nonlinear dynamics of Hamiltonian and dissipative systems.

The focus in all of these discussions is on methods, but applications to laser-molecule (or, more generally, electromagnetic radiation-molecule) interactions appear throughout, providing an important connection with real physical systems that makes this book much more than just a compendium of mathematical methods. In addition there is a lengthy introductory paper by J. O. Hirschfelder that provides a general survey of the theoretical description of laser-molecule interactions. Although the book suffers from the heterogeneity of contributors, the treatment of common themes within an interdisciplinary framework makes it a valuable contribution.

GEORGE C. SCHATZ
*Department of Chemistry,
Northwestern University,
Evanston, IL 60208–3113*

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