book treatments usually address the concerns of field theorists and emphasize such topics as relativistic invariance and covariance, Dirac spinors, and renormalization. Here different aspects are important, such as a non-relativistic treatment of atoms and their coupling to the quantized radiation field. Given that most books on quantum optics give short shrift to the fundamentals of electrodynamics and its quantization, I think there is a place for a book like this. It is addressed to both graduate students and researchers, and both can profit substantially from it.

The span of the book is considerable, and it contains a wealth of material not easily found elsewhere. It starts with a detailed review of classical electrodynamics, followed by its Lagrangian and Hamiltonian formulation in the Coulomb gauge and by a discussion of symmetries and functional derivatives. This makes up somewhat more than a third of the book. Then quantum electrodynamics in the Coulomb gauge is treated in depth, since this gauge—though not manifestly covariant—is mostly used in quantum optics because of its practicality. Also the coupling to non-relativistic charged particles is presented. Equivalent formulations, obtained either by a change of gauge or by general unitary transformations, are then discussed thoroughly. The presentation of the Power-Zienau-Woolley transformation, which eliminates the potentials from the Hamiltonian and expresses the interaction with the charged particles in terms of the electric and magnetic field, is clearer than I have seen in other books. The last part of the book deals with quantization in the covariant Lorentz gauge and the problems associated with an indefinite metric. The Dirac field is also introduced, but Feynman diagrams and renormalization theory are not discussed. The book then finishes with a special treat for the reader, a justification of the non-relativistic theory in the Coulomb gauge starting from relativistic manifestly covariant quantum electrodynamics.

The presentation is lucid. It is apparent that the authors have taught this subject repeatedly, and some of the more unconventional material—and there is a lot of it—may have been prompted by concern with students' questions. Intentionally there are practically no concrete applications to atomic physics and quantum optics. These are reserved for an accompanying volume entitled *Interaction Processes between Photons and Atoms*, soon also to appear in English translation. Therefore a course following this book probably would have to be selective, with applications drawn from the other volume. This is facilitated by its very structured form.

The book shows, in particular through enlightening comments, that the authors have gone beneath the surface of their subject and thoroughly understand what they write—which is more than one can say about many a book. I definitely enjoyed reading it.

GERHARD C. HEGERFELDT
Institut für Theoretische Physik, Universität Göttingen, Göttingen, Germany, and Institute for Advanced Study, Princeton, NJ 08540

Neuronal Carbohydrates

Neurobiology of Glycoconjugates. RICHARD U. MARGOLIS and RENÉE K. MARGOLIS, Eds. Plenum, New York, 1989. xviii, 453 pp., illus. $79.50.

For over a century it has been postulated that the assembly of the nervous system is mediated by cell-surface or extracellular molecules. Ramon y Cajal proposed the existence of chemical cues in the extracellular environment to explain his observations of the directed growth of axons, and Sperry further suggested that specific cell-surface molecules guided axon navigation and synapse formation. Biochemical analyses of the constituents of membranes and extracellular matrix have suggested that the most likely candidates for these critical functions are glycoconjugates—a family of carbohydrate-bearing species including glycosaminoglycans, proteoglycans, glycoproteins, gangliosides, and glycolipids.

Neurobiology of Glycoconjugates is an updated version of an earlier volume assembled by the same editors. Glycoconjugate biology and biochemistry have advanced considerably over the last 10 years, and the contributors and topics in the present volume reflect these advances. For scientists in the field, as well as for neophytes, the editors have made an interesting and useful selection of topics. Included are chapters on the identification and characterization of nervous system glycoconjugates as well as on the basic biochemistry of these molecules. Full chapters are devoted to the biosynthesis of glycoproteins, gangliosides and proteoglycans, topics that are given only passing attention in many review articles.

Most of the book, which contains 15 chapters by 23 authors, is well organized and well written. Some of the better chapters include not only reviews of work up to the present but also interesting discussions of controversial topics and insightful indications of future directions. Some chapters largely reiterate material covered in recently published reviews but are useful in rounding out the volume as an overview of the subject. Unfortunately, there is no general introduction describing the criteria by which a molecular species is considered a glycoconjugate and explaining why these molecules are of such great interest in neurobiology.

The detailed roles that glycoconjugates play in neural development and structure are still little understood. At present it seems clear that both carbohydrate and protein structures contribute importantly to intercellular interactions. Carbohydrates may function to target proteins to specific cellular domains and may also, as in the case of sialic acid, regulate intermolecular interactions. The presence of intracellular glycoconjugates suggests additional roles, which in the nervous system are currently unknown.

A volume such as this documents that the list of molecules that may play a role in cell recognition and adhesion grows rapidly. Despite the increase in the number of such molecules identified during the last decade, understanding of the precise molecular mechanisms that mediate specific cell-cell recognition and axon navigation remains elusive. With a few good candidate molecules and the powerful techniques of modern molecular biology, work over the next decade is likely to produce a third volume in this series that will contain answers to some of the remaining questions concerning the functions of neural glycoconjugates. Until that time, the present volume will serve as a much-needed reference in the field.

SUSAN HOCKFIELD
Section of Neuroanatomy, Yale University School of Medicine, New Haven, CT 06510

Books Received

The Adrenal and Hypertension. From Cloning to Clinic. F. Mantero *et al.*, Eds. Raven, New York, 1989. xvi, 480 pp., illus. $88. Serono Symposia Publications from Raven Press, vol. 57. From a symposium, Tokyo, Japan, July 1988.

Agroecology. C. Ronald Carroll, John H. Vandermeer, and Peter Rosset. McGraw-Hill, New York, 1989. xiv, 641 pp., illus. $89.95. Biological Resource Management.

Aircraft Noise. Michael J. T. Smith. Cambridge University Press, New York, 1989. xiv, 359 pp., illus. $70. Cambridge Aerospace Series.

Alternative Agriculture. National Research Council. National Academy Press, Washington, DC, 1989. xvi, 448 pp., illus., + plates. $29.95; paper, $19.95.

Analytical NMR. L. D. Field and S. Sternhell, Eds. Wiley, New York, 1989. viii, 250 pp., illus. $64.95.

Animal Patents. The Legal, Economic and Social Issues. William H. Lesser, Ed. Stockton, New York, 1989. xiv, 369 pp. $100.

The Animal Rights Controversy. Laurence Pringle. Harcourt Brace Jovanovich, New York, 1989. viii, 103 pp., illus. $16.95.

Antarctic Paleobiology. Its Role in the Reconstruction of Gondwana. Thomas N. Taylor and Edith L. Taylor, Eds. Springer-Verlag, New York, 1990. x, 261 pp., illus. $98. From a workshop, Columbus, OH, June 1988.

Antigenic Determinants and Immune Regulation. Eli Sercarz, Ed. Karger, Basel, 1989. xii, 189 pp., illus. $99.50. Chemical Immunology, vol. 46.