activity enhances the uptake of small molecules. These are incorporated into a "marker," probably a protein, that is characteristic of that nerve cell and that, when released, causes the postsynaptic cell in some way to repress transmission from other terminals bearing different markers. What else effect will prove a key to understanding ouabain does, and whether the observed learning, remain to be seen.

Although this book is so compact that most of its arguments can be made only sketchily, it remains a valuable volume. It critically reviews the many diverse and often conflicting theories of learning. More important, it draws together many strands of evidence that the formation and regeneration of neural connections are highly specific and that, during maturation, these connections can be "enduringly modified" by experience. Mark's specific model may prove to be an overenthusiastic interpretation of findings that are still inadequately established or understood. Nevertheless, it is not a rash extrapolation to suggest that once the mechanisms involved in developmental plasticity are understood one can look for similar mechanisms of adult learning and memory.

ALAN D. GRINNELL
Department of Biology,
University of California,
Los Angeles

Outermost Components of Cells

Surface Carbohydrates of the Eukaryotic Cell. G. M. W. COOK and R. W. STODDART. Academic Press, New York, 1973. xiv, 346 pp., illus. $19.50.

It has been recognized for about a century that the plasma membrane acts as a permeability barrier. Historically, in the study of membranes, we have started with a presumed knowledge of the function and then proceeded in identifying the molecular structure. This sequence appears to have been reversed for the outer component of the membrane, the cell surface carbohydrates. At present one might call them structures in search of function. We have learned much about their localization and even their molecular composition without understanding why nearly all cells are covered with such material. Our knowledge about these carbohydrates developed, as if incidentally, from investigations apparently having little in common. Laboratories working on such diverse topics as plant lectins, blood group substances, cell-cell interaction, and cancer cells found that they all were studying interactions of cell surface carbohydrates. This book attempts to bring much of this diversified information to bear on that general topic. Its goals, as stated by the authors, are "to cover the basic tenets upon which the subject is founded . . . to draw attention to . . . points of growth for the future [and] to provide a comprehensive view of present knowledge of carbohydrates in cell surfaces."

The first chapter summarizes the structure of plasma membranes. The authors present a comprehensive and well-thought-out review of the steps that led to our present concepts of membrane structure. Naturally, as happens in any fast-moving field, there are some new concepts and ideas that are not included, but they can be easily found in more recent review articles such as that by S. J. Singer (*Annu. Rev. Biochem.* **43**, 805 [1974]).

The next chapter reviews the principal lines of evidence for the presence of carbohydrates on the surface of animal cells. Electrokinetic and microscopic studies are discussed in detail, as well as the evidence obtained by the use of lectins. The following two chapters, constituting a large portion of the text, are devoted to the structural characterization of glycolipids and glycoproteins of animal cell surfaces, fungal cell walls, and the carbohydrates of plant cells. Methods for the study of complex carbohydrates are discussed. Examples of glycopeptides from a variety of tissues are given. It might have been helpful, at least to a beginner in the field, to include some generalizations that can be drawn about the frequency and localization of carbohydrates within polysaccharide chains, the types of linkages between polysaccharide chains and peptides, and the behavior of the chains on hydrolysis. This kind of information was given by R. C. Hughes in a more recent review of the subject (*Prog. Biophys. Mol. Biol.* **26**, 191 [1973]). The problem of microheterogeneity also should have been discussed at this point. The large number of references, however, will allow the beginner to bring himself up to date on these subjects.

The mechanism by which the cell synthesizes a glycoprotein and incorporates it into membranes is a controversial subject. The authors present a well-rounded review of this topic with some critical evaluation, a difficult task because of the insufficiency of knowledge and experimentation in this area.

The final chapter of the book deals with the question, What is the biological role that these materials play in the cell membrane? While the authors restrict themselves to the evidence pertaining to the membrane alone, the question could be asked about the function of carbohydrates attached to proteins in general. One might then obtain additional clues from the work of investigators such as Ashwell and DeVries, which is not discussed in this book. The major topics included in this chapter are cell recognition, intercellular adhesion, the role of glycoproteins in cell growth regulation in animals, and the plasticity, permeability, and hydration of plant cell walls.

This book is welcome as a much-needed treatise on a current topic. It is well balanced and is enjoyable reading and deserves a warm recommendation.

ALEXANDER EICHHOLZ
Department of Physiology,
Rutgers Medical School,
New Brunswick, New Jersey

Surface Analysis

Characterization of Solid Surfaces. PHILIP F. KANE and GRAYDON B. LARRABEE, Eds. Plenum, New York, 1974. xviii, 670 pp., illus. $32.50.

The study of solid state surfaces is one of the most rapidly developing areas of physical science. In the past 10 years a multitude of techniques have become available that can be used to study the structure and composition and the physical chemistry of solid surfaces on a monolayer atomic scale. These techniques have found applications in research on catalysis, adhesion, and lubrication, as well as in the development of integrated circuitry and other solid state devices of high surface-to-volume ratio. As a result, our knowledge in solid state surface science is increasing explosively, and this area promises to be the birthplace of many new technologies.

This book is a timely contribution to the field. There are 23 chapters, each of which concentrates on either a new research technique or a whole field of surface analysis. The first seven chapters discuss techniques of physical structural characterization, including light and scanning electron microscopy and the x-ray diffraction methods that are useful in surface analysis. In later chapters,