Book Reviews

Advances in Chemical Physics Vol. XCI. Edited by I. Prigogine (University of Brussels) and Stuart A. Rice (University of Chicago). Wiley: New York. 1995. ix + 600 pp. $165.00 ISBN 0-471-12002-2.

This volume continues the tradition of this series on high-quality, authoritative chapters in a wide range of chemical physics topics. It contains seven chapters covering properties and phenomena of molecules and materials that can be described in terms of their atomic structure and dynamics. The first chapter, by Goh, gives a useful review of experimental aspects of imaging processes and applications of force microscopy to polymers, and it deals with atomic force spectroscopy of mesoscopic scales. It emphasizes instrumental details and the interpretation of patterns. The folllowing chapter, by Douglas and Garboczi, focuses on transport properties of inhomogeneous materials, with a numerical and analytical approach. It considers mixtures including complex shaped particles in the limit of dilute mixtures and reviews results on viscosities and polarizabilities. Theoretical developments are given in appendixes, with the main text dedicated to aspects of interest in applied chemical physics. The third chapter, by Wajnryb, Altenberger, and Dahler, gives an elegant extension of global thermodynamics (in the style of Callen's approach) to nonuniform systems, with a minimum of additional postulates. It assumes nonlocality of macroscopic properties and uses functional differentiation in a general treatment. Statistical mechanics is introduced to complement the formalism and give a microscopic interpretation.

The fourth chapter is a long (140 pages!) and thorough one by Dejardin and Debiais, detailing a phenomenological theory of nonlinear dielectrics and dielectric relaxation. It expands on the Smoluchowski and Kramer equations and presents results by the authors on organic liquids, with comparisons to experiments. The next chapter by Anderson is an accessible review of many applications of the approach which combines transition state theory and molecular dynamics to cover many subjects, ranging from simple gas phase reactions to ligand scape from myoglobin, including reactions in liquids. A long table of applications with references until 1995 makes this a valuable literature source. The fifth chapter, by Henriksen, is a didactic presentation of the formalism of photodissociation, emphasizing the time-dependent wave packet formulation. It considers a three-state model, branching into two sets of products, and optical control schemes. The semiclassical short-time dynamics of nuclei is presented mostly with Gaussian packets. The formalism is adapted to diatomic dissociation and to simple triatomic models. Selected references are given until 1994. The final chapter, by C. and J. Nicolis, presents a very interesting treatment of the relation between nonlinear dynamics, including chaos, and atmospheric phenomena. It addresses fundamental questions on prediction of weather and on global climate changes. It starts from the equations of fluid dynamics, and their simplification, focusing on the Lorenz atmosphere circulation model. It concludes by reiterating that forecasting has intrinsic limitations arising from sensitivity to initial conditions.

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Biology of the Sialic Acids. Edited by Abraham Rosenberg (University of California, Los Angeles). Plenum Press: New York. 1995. xv + 378 pp. $95.00. ISBN 0-306-44974-9.

This 11-chapter book edited by Abraham Rosenberg gives the history, chemistry, and biology of the sialic acids. Most chapters highlight the chemistry first and then summarize the more biological aspects. The references are complete through 1993 and include a few from 1994 and 1995. It cites review articles for earlier work. Most chapters are consistent in the use of abbreviations, with a few exceptions.

The sialic acids are a class of carboxylic acids based on the nine-carbon sugar, neuraminic acid. Sialoglycoconjugates contain sialic acids bound to proteins (as sialoglycoproteins), lipids (as gangliosides), or other sialic acids (as polysialic acids linked to other glycoconjugates). Chapter 2 gives a table of 36 naturally occurring sialic acids. This includes many *N*-acetyl and *N*-glycolyl derivatives and one deaminated form called Kdn (for ketodeoxynonulosonic acid).

Various enzyme systems influence sialic acid's synthesis, chemical modification, covalent linkage to other sugars, cleavage, and transport. Some cloned enzymes include many sialidases (that cleave sialic acids, in Chapter 8), sialyltransferases (that link sialic acid to other sugars, in Chapter 3), and GD3 synthase (that forms ganglioside GD3, in Chapter 6). The gene for the O-glycosylated mucin, leukosialin (CD43), contains a tandem repeat of amino acids. Some proteins like the Thy-1 antigen from brain and thymus express both N- and O-glycosylated forms on the same polypeptide chain.

Sugars of glycoproteins are added post-translationally. Therefore, the exact structure of the resulting oligosaccharide depends on the enzymes present, the concentration of substrates, the conformation of the polypeptide, and the Golgi transporters for activated sugar nucleotides. Chapters 3−5 describe some of these events and examine how alterations in the sialoglycoproteins and gangliosides are manifested in malignancy and metastasis.

Three chapters describe various aspects of the developmentally important gangliosides. A table (in Chapter 6) outlines the six general classes of gangliosides, with two accompanying tables of the structures from vertebrates and invertebrates. Chapter 7 reviews the evidence that the ganglioside GM3 and two of its catabolites modulate transmembrane signaling, involving inhibition or activation of the protein kinase system. Recent work in Rosenberg's laboratory (in Chapter 11) shows that chick brain cortical neurons cultured in the presence of ethanol exhibit undersialylation of the gangliosides. This leads to loss of neurites. This may explain fetal alcohol syndrome.

Not surprisingly, the greatest details on structures of proteins that recognize sialic acids are from ortho- and paramyxoviruses (Chapter 9). For example, influenza viruses A and B have a hemagglutinin that recognizes sialic acid and is responsible for the fusion activity. The X-ray determined structure shows a protein trimer. Each monomer contains a membrane stem and a globular domain containing the binding site for silaic acid. Influenza A and B viruses have a separate protein with a sialidase activity. Influenza C virus has three activities expressed in one glycoprotein, HEF: receptor-binding (hemagglutination), receptor inactivation (esterase activity for Neu5,9Ac2), and fusion.

Chapter 10 describes several genetic disorders in sialic acid metabolism and their biochemical associated pathology. For instance, free sialic acid concentration, which is normally very low, increases greatly in Salla disease patients. This is due to a defect in the transport of sialic acid across the lysosomal membrane, presumably from the loss of the lysosomal transporter. Also gangliosidoses are disorders that are caused by the lack of enzymes that remove either galactase or *N*-acetylgalactosamine from gangliosides GM1 or GM2, respectively. The latter defect causes the familiar Tay-Sachs disease. The disorders all exhibit moderate to severe neurological manifestations.

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