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lack of any references. The author mentioned that the material had been carefully abstracted from many printed articles rather than relying upon published textbooks and general reference works so as to avoid perpetuation of errors. This is particularly regretful since the material was referred to as a compendium for research and clinical use. It would seem that researchers working in a particular area would desire primary reference sources. Unlike *Comparative Guide of Veterinary and Human Pharmaceuticals* and *Remington's Pharmaceutical Sciences*, this text does not give the dosage form and strength of drugs supplied by the respective manufacturers. This type of information would have been useful for the clinician. The reader should also be aware of the fact that there are some differences between recommended dosages found in this book and in *Remington's*.

This work would be of limited value at best in most pharmacy curriculums. It should be included in all college of pharmacy libraries and could be used as a reference for a course in veterinary pharmacy. The book would be essential or desirable for inclusion in a pharmacist's library as an additional reference for supplying drug information to veterinarians where there is a close working relationship.

Edward D. Sumner
Medical University of South Carolina

Jack Cooper

Plastic Containers for Pharmaceuticals: Testing and Control

Geneva, Switzerland: World Health Organization (available USA: Q Corporation, 49 Sheridan Ave., Albany NY 12210), 1974. 204 pp., 10 figs., 37 tbls., 24 "attachments." Approx. \$10.80 (paper)

The objective of the book, prepared at the request of the World Health Organization, is to survey the present state of testing and control of plastics for use in contact with pharmaceuticals. The book consists of two parts.

The first part contains 26 pages and deals with a number of subjects. The general properties of plastics, especially polyethylene, polypropylene, polyvinyl chloride and the cellulose esters are briefly summarized. Though useful, this section is much too brief. Descriptions of potential problems are given, including sorption, permeation, degradation and modification — again somewhat useful but much too brief. A short survey is given of the relationships between plastic containers and dosage forms. Some discussion of regulatory requirements is given representing seven countries. Limited standards issued by the standards institutions of four different countries are presented. Finally, some recommendations are made for international standards for plastic containers.

The second part and the bulk of the book consists of 24 "Attachments" or appendices. The appropriate sections on plastic containers are given from the pharmacopoeias of the United States, Switzerland, France, Norway, German Democratic Republic, Sweden, United Kingdom, and Japan. Seven standard tests on plastics from the American Society for Testing and Materials (ASTM) are reprinted. Three of the appendices consist of summary tables of all physicochemical, *in vitro* biological, and *in vivo* biological tests which have been officially proposed or utilized for plastics or plastic containers. Brief tabulations of references are also given.

The second part of the book is a good source for nearly all of the available tests and standards employed for plastic materials with pharmaceutical applications. This material is often difficult to obtain. Therefore, the book is an excellent reference and should be available in all pharmacy and medical libraries as well as on the shelves of all professionals who claim involvement in the area of plastics in pharmacy and/or medicine.

The first 26 pages of the book are useful as text material in any course dealing with pharmaceutical container materials. However,

this material is much too brief and limited, and would have to be supplemented.

The subject matter of the book is largely ignored or unknown in most pharmacy schools. This reviewer hopes that Cooper's book will alert the pharmacy community to this important subject and stimulate further work and interest in this area. Cooper's book is a good introduction and beginning.

J. D. Andrade
University of Utah

N. Irving Sax, Editor

Dangerous Properties of Industrial Materials, 4th Edition

New York NY: Van Nostrand Reinhold Co., 1975. viii + 1,258 pp., 83 figs., 80 tbls. \$42.50

Even though in the last number of years a surge of interest has been generated in the broad area of toxicology, the number of resource publications on toxic aspects of chemicals is still meager. For the health professional practitioner, *Clinical Toxicology of Commercial Products* (Williams & Wilkins Co.) is still the bible for information on the toxicity of drugs, chemicals and household products. This same reference text is also of value to those in industrial hygiene, but a far more useful reference resource to toxicologists working in the industrial scene is Dr. Newton I. Sax's *Dangerous Properties of Industrial Materials*. Originally published in 1951 under the title of *Handbook of Dangerous Materials*, it has been periodically revised and expanded. The fourth and latest edition was published in 1975.

The 1,258-page volume may seem quite bulky, but the editor and his assistants have been able to condense the information into a normal-size text which is quite easy to use. Only the *Toxic Substances List* issued by the National Institute for Occupation Safety and Health contains a greater number of chemical agents with toxicity data or references to data. The latter serves a very good purpose but does not have the utilitarian value of Sax's reference.

Those familiar with past editions of Dr. Sax's book will find the new version similar to the last edition with, however, a number of new sections and chapters. The first 344 pages are divided into sections or chapters and include the following topics: The Historical Perspective; Industrial Air Contaminant Control; Industrial Noise — Effects and Control; The Effects of the Air Environment in Industrial and Residential Facilities; Radiation Hazards; Large Radiological Sources and Safeguards; Hazards of Solid-Waste Treatment; Industrial Fire Protection; Industrial Cancer Risks; Toxicology; Food Additives; and Labelling and Identification of Hazardous Materials. Fortunately, in the first section a complete listing of threshold-limit values as compiled by The American Conference of Government Industrial Hygienists is reproduced with proposed changes in these values.

The remaining portion of the book contains approximately 13,000 chemicals with concise, up-to-date information, including a description of the item, chemical formula, physical constants, and a section entitled "Hazard Analysis." This latter section includes a Toxic Hazard Rating which is numbered from 0 (none) to 3 (high) with the additional rating of U (unknown). These ratings are given for acute and chronic toxicity of the specific chemical. Hazards due to fires, explosions, radiation and floods are also included where appropriate. Finally, "Countermeasure" is included to diminish the hazardous aspects of the chemical.

With the pharmacist becoming more involved in toxicology and in community and environmental health problems, Sax's excellent reference should be considered for each pharmacy. For pharmacists in hospitals, poison control centers, drug information centers and industrial toxicology laboratories, the book, if not already in use, should be a requirement.

John Autian
University of Tennessee

W. Kemp

Organic Spectroscopy

New York NY: Halsted Press (Div. of John Wiley & Sons), 1975. xvi + 248 pp., 107 figs., 19 tpls. \$16.95

The author notes in the preface to this textbook that it is an introduction to spectroscopic techniques widely used in organic chemistry. As such it is geared to students with little prior training.

The text is divided into chapters on infrared, nuclear magnetic resonance, ultraviolet, visible, and mass spectroscopy. An introductory chapter entitled "Energy and the Electromagnetic Spectrum" describes wave properties and explains the units of measurement. The final chapter is a compilation of problems on the four techniques, some of which combine all four methods for structure determination.

The entire book is presented in a style that is a pleasure to read. Since the author freely recognizes that convention results in ambiguous units being used to describe absorption peaks, the reader is not distracted by the difference. The group assignments in all spectroscopic methods are discussed in concise terminology without laborious detail to the exception.

Contributing to the usefulness of this book is the fact that little attention is paid to the electronics and optics of the various instruments while the sampling techniques are described in detail. Most organic chemists are concerned with spectroscopic methods as tools in structure determination and proof — these needs are recognized in the author's presentation.

In addition to a complete discussion of the common techniques, modern methods also are discussed. For example, infrared reflectance methods, Raman spectroscopy, double resonance nmr techniques, the Nuclear Overhauser effect, pulsed nmr and Fourier transforms, ^{13}C , ^{19}F , and ^{31}P nmr, esr, ord, cd, electron spectroscopy, chemical ionization, and isotope substitution in mass spectroscopy, while not discussed in detail, are introduced in a manner that entices the reader to further study of the particular method.

This book is recommended as a textbook for introducing undergraduate and graduate students to spectroscopic methods. Furthermore, it should be useful for faculty and industrial chemists for review of the older methods and as an introduction to new methods of spectroscopy.

M. P. Mertes
University of Kansas

Armin C. Braun

The Biology of Cancer

Reading MA: Addison Wesley Publishing Co., 1974. xiv + 169 pp., 10 figs. \$9.50, \$4.50 (paper)

This rather small book consists of a brief overview of the field of cancer and emphasizes the biological causes and approaches to its control. It is decidedly not a clinical approach to oncology and will be of little value to the clinically-oriented reader, especially those in the health professions. It approaches the problem of cancer in both plants and animals as a biological problem, which it is. An attempt is made to relate the etiology of various types of cancer to problems in autonomy of the various involved cells in the plant and animal king-

doms, especially as these changes concern cell division. Tumor characteristics are mentioned, briefly, but clinical examples are sparse.

The relevance of changes in the genetic make-up of cells to genesis of tumors is discussed and many specific examples are provided. In terms of the biological approaches to the control of tumors, a few selected examples serve to illustrate the theory that the immune system is intimately involved in the development of tumors. The use of BCG vaccine, interferons and chalones in controlling tumor growth are discussed. The use of antineoplastic drugs is not mentioned. The book should be part of most general libraries, but will be of limited use to those concerned with the health professions because of the lack of emphasis on clinical problems.

Charles O. Ward
Huntingdon Research Center
(formerly with St. John's University)

I. S. Rossoff

Handbook of Veterinary Drugs

New York NY: Springer Publishing Co., 1974. xxii + 730 pp. \$42.50

This book is intended to be used as a compendium for research and clinical use. The author received his DVM from Cornell University and has been active in clinical practice for 30 years. As pointed out in the foreword, this handbook covers some 1,800 old and new drugs, including their physiological action and dosage tables for many types of animals.

Along with the usual foreword and preface, directions for using the book and a list of abbreviations are included. Drugs are listed alphabetically in the text by their generic, USAN, chemical, and common local-use names. As an aid to the user, additional trade and chemical names for drugs are given in the index at the end of the book. Because the index was computer-generated, *alpha* drugs were grouped together in the A's rather than by the first letter of the drug name. For example, α -hypophamine is alphabetized within the *alpha* group in the A's rather than in the H's.

The format used to describe the alphabetical listing of drugs includes: names, equivalent names (including trade names), pharmacological classification, use, warning, and dosage. The dosages are given for specific species of animals and are shown in boldface type. The animals are grouped in the order of: large domesticated animals, poultry, miscellaneous, cats and dogs. As stated in the section, "How to Use This Book," the dosage is oral unless otherwise stated; many of them are still only guidelines. One will find drug dosages for numerous exotic, zoo and experimental animals, e.g. chinchillas, foxes, giraffes, mink, porpoises, tigers, etc.

There are four appendixes included at the end of the book. Appendix I gives the approximate equivalents useful for mixing pharmaceuticals in feed. Appendix II contains the equivalents of weights and measures (Metric, Avoirdupois, and apothecary). Miscellaneous fluid equivalents (United States and Imperial systems) and a simple formula for diluting solutions are included in Appendixes III and IV.

This reviewer is in agreement with a comment made in the foreword that one of the strongest features of the book are the dosage tables. For this reason alone, the book is a valuable reference addition. In general, the format is well done so that information can be retrieved quickly and easily. One significant deficiency in the book is

Donald H. Ford and Doris H. Clouet,
Editors

Tissue Responses to Addictive Drugs

New York NY: Spectrum Publications Inc. (distributed by Halsted Press), 1976. xx + 704 pp., 206 figs., 120 tpls. \$50.00

This book is the proceedings of a workshop of the International Society for Neuroendocrinology held at the Downstate Medical Center, State University of New York, June 1975. The book is comprised of 42 manuscripts which were contributed by 93 authors. Most of the research groups from the United States which have major involvement in the study of the mechanisms of opiate action, tolerance, and addiction are represented. There is a minimum of contributions from foreign researchers. The manuscripts are each well referenced and the book contains a complete and useful index.

The subject matter of the book is a multidisciplinary coverage of the effects of the opiates on brain and other tissues. The first five manuscripts deal with the disposition of opiates within the brain. A number of the contributions survey the evidence for the existence of specific receptors in nervous tissue for opiates. The methods of studying opiate receptors which are discussed include stereospecific receptor binding, photoaffinity labeling, and pharmacological discrimination.

The roles of various brain amines, the cyclic nucleotides, the prostaglandins, and protein synthesis in opiate action and addiction are discussed in a number of the manuscripts. Other major portions of the book deal with the effects of the opiates on neonates and on peptide hormonal release from the pituitary gland.

Most of the manuscripts are well written and serve as useful introductions and/or overviews into many of the currently active areas of opiate research. The pace at which research in this field has advanced is demonstrated by the fact that only one manuscript referred to the enkephalins, and the endorphins were not reported. Thus, this book does not represent the current state of opiate research; but, the book does discuss much of the science and experimental technique that have made possible the rapid advancement in this area.

The book will be useful for the student or new researcher who is attempting to become familiar with the many aspects of opiate research. The cost of the book makes it prohibitive for inclusion in most personal libraries; however, the subject matter and quality of the volume are sufficient to warrant inclusion in institutional libraries which provide services to researchers in the health sciences.

David S. Fries
University of the Pacific

Joseph D. Andrade, *Editor*

Hydrogels for Medical and Related Applications (ACS Symposium Series: 31)

Washington DC: American Chemical Society, 1976. xiv + 359 pp., 127 figs., 56 tpls. \$21.75

Hydrogels have many attractive features for a number of biomedical applications including the design of drug delivery systems. These are polymeric materials which are insoluble in water but which retain a significant amount of water in their network structures. Their interfacial free energies tend to be low. A combination of a 'wet' internal surface, low interfacial free energy, and the occasional presence of surface charges makes them much more compatible with biological fluids than most insoluble materials which can be used for coating purposes or for the construction of devices of various kinds and implants. Hydrogels also have useful permeability characteristics which can be modified by structural alteration.

The present symposium volume has been edited with care by Joseph D. Andrade and appears to be the first of its kind. It contains 24 articles. After a lucid, introductory chapter, the book is divided into two parts. The first part contains 13 chapters and is concerned primarily with bulk properties of synthetic hydrogels, particularly methacrylate derivatives. The topics covered include swelling pressures and their relations to water activity, effect of water on the osmotic and viscoelastic behavior of gels, permeability characteristics of hydrogels and diffusion through gel membranes, chemical and analytical aspects of hydrogels, and their thermal behavior. One chapter deals with some connective tissue components.

The second part of the book has 10 chapters on interfacial properties of hydrogels, and includes discussions on their wettability, surface electrical properties, water sorption, co-graft polymerization induced by radiation, and the formation of fibrous capsules. Some blood compatibility studies are also reported. I found this emphasis on interfacial properties refreshing. Throughout the book, the applications of many different theoretical and experimental techniques are illustrated.

As might be expected of the proceedings of a symposium, all the chapters are not of uniform quality. I found all of them of some interest, however, and some highly thought provoking. Many of the authors are reputable scholars in the field. Occasionally some overly enthusiastic claims are made regarding the resemblance of hydrogels to biological tissues and their biocompatibility, but these do not detract much from the overall quality of the book. I recommend it highly as a review of the many different kinds of experimental and theoretical approaches currently being used to understand and characterize hydrogels and to adapt them for biomedical applications.

Pasupati Mukerjee
University of Wisconsin-Madison

A. DeBruin

Biochemical Toxicology of Environmental Agents

Amsterdam, The Netherlands: Elsevier/North-Holland Biomedical Press (distributed by Elsevier/North-Holland Inc., New York NY), 1976. x + 1,544 pp., 123 figs., 57 tpls. \$130.75

Biochemical Toxicology of Environmental Agents is a difficult book to review. At first, one is almost overwhelmed that one individual could organize and write a 1,500-page book consisting of 42 chapters and about 13,000 literature citations from 1,100 journals. The author, himself, commented on having to correct, insert, and rewrite chapters as new publications appeared. Any single-author work of this size requires very good organization on the part of the author. Dr. De Bruin has done this admirably. The material is well presented including a balanced use of tables.

Is this book a textbook, a definitive reference work, or a review? It is partially a textbook, but because of the wide scope of topics that are covered, it is more of a comprehensive review of the current status of biochemical toxicology of agents encountered in the environment. The literature is covered through 1975.

Most chapters follow the same general format. There is an introduction of the topic and, where necessary, biochemical pathways are shown. The remainder, and usually the majority, of the chapter covers specific topics. Thus halogenated hydrocarbons, alcohols, ketones, aldehydes, nitro compounds, aromatic compounds, organo-metallic compounds, and ionizing radiation will be discussed in terms of the biochemical topic being covered in a particular chapter. In other words, don't look for a complete chapter on pesticides. Instead, pesticides will be mentioned in nearly every chapter.

The 42 chapters are grouped together by broad biochemical topics. Chapters 1-8 cover the metabolism of foreign compounds. These chapters are complete and detailed. There are separate chapters on occupational agents, pesticides, chemical carcinogens, hepatic microsomal enzymes, and synergism and antagonism between com-

guage), should be added. Also, the language that the citation was published in has been omitted. Some references are in journals that small libraries may not carry. By giving more information on the contents of the paper, for instance, over what pressure-temperature-composition range liquid-vapor equilibrium was measured, and by including a complete reference, the reader would be able to assess if it is worth requesting the paper through interlibrary loan.

Donald L. Hall, Virginia Polytechnic Institute

Enamines: Synthesis, Structure, and Reactions. Edited by A. Gilbert Cook (Valparaiso University). Marcel Dekker: New York. 1988. vii + 717 pp. \$149.75. ISBN 0-8247-7764-6.

This book, an update on the 1st edition published in 1968, serves as a comprehensive secondary source for those needing information on the chemistry of enamines. In nine chapters with a total of about 2500 references, essentially all important aspects of enamine chemistry are covered. Although not explicitly stated by the editor, it appears that citations run through 1986 (at least in some chapters). The book contains relatively few typographical errors. In several chapters structures were clearly not computer generated but are nevertheless satisfactory.

Chapter one covers the structure and physical and spectral properties of enamines. It is written in a manner that makes it accessible even to those not well versed in physical organic terminology. Chapter two deals with the preparation of enamines. Thoroughly surveyed are not only the standard carbonyl/amine condensation processes but also a wide range of other useful and/or esoteric methodologies. Chapter three is a short, detailed look into the process of enamine hydrolysis. Chapters four and seven cover electrophilic substitutions and additions and cycloaddition reactions of enamines, respectively. Treatment extends from classic reactions to the use of organometallic electrophiles and intramolecular 6 + 2 cycloadditions. Metalloenamines are not covered. Chapter 5 deals with the oxidation and reduction of enamines. Chapter 6 covers the important area of iminium ions, accessible from electrophilic reactions of enamines and by other means. Unfortunately, the discussion is limited to "simple" iminium salts and no data or references concerning such species as acyl iminium ions are given. The point is made, however, that such entities are beyond the scope of the review. Chapter eight deals with heterocyclic enamines. Interestingly, of the 440 citations associated with this section of the book, only 18 are more recent than 1980; it thus provides a rather historical perspective on this area of enamine chemistry. Chapter nine is on the use of enamines in natural product synthesis and contains only 1 page of text. The remainder of the chapter diagrammatically presents portions of synthetic procedures in which enamines play an important role, either as intermediates or final products. The reaction diagrams are clear and easy to follow. Enamides and vinylogous amides are heavily but not exclusively covered.

To serve the book's apparent purpose of presenting a wealth of information in a relatively small space, the authors are frequently very succinct in their commentary on certain subjects. This is acceptable in a work which amounts to a doorway to a vast amount of primary literature.

Enamines in their broadest context can be quite useful in organic synthesis and this book serves as a good introduction to and review of all aspects of their chemistry. However, considering the amount of data available in this work, I found the index a bit light. It is certainly worth having in a chemistry library.

Michael Harmata, University of Missouri—Columbia

Deterministic Chaos. By Heinz Georg Schuster (Institut für Theoretische Physik und Sternwarte der Universität, Kiel). VCH Publishers: New York. 1988. xxiii + 270 pp. \$59.95. ISBN 0-89573-611-X.

This book presents the concept of deterministic chaos in a manner that will seem well-rounded to the connoisseur of the stochastic aspects of physical phenomena and is also accessible to those who spend most of their chemical lives along the straight and narrow of "well-behaved" physical phenomena. The introduction focuses on the history of the concept of chaos, providing a good general summary of the issues that underlie the term, but without defining it. The definition is left to the first chapter. The first chapter is the first of six on deterministic chaos in dissipative systems. This chapter contains numerous examples of deterministic chaos, which represent the range of physical and chemical systems that are capable of showing such behavior. The "definition" is then an operational one. The examples are used to characterize the essentials of deterministic chaos. This first chapter includes as examples Rayleigh-Bénard convection and the Belusov-Zhabotinski reaction. This chapter concludes with a discussion of measures that can be used to determine the existence of and the character of the chaos. The first chapter and the introduction make an excellent summary of deterministic chaos for the nonspecialist.

In Chapters 2 through 6, a detailed discussion is undertaken that

explores the possible processes that can lead to deterministic chaos. This mathematically detailed section uses a set of idealized, but mathematically tractable, systems to show how chaos can be constructed. The concepts dealt with include Liapunov exponents, Feigenbaum numbers, deterministic diffusion, quadratic maps, period doubling, noise, fractals, power spectrums, intermittency, renormalization, strange attractors, Kolomogorov entropy, quasiperiodicity, turbulence, and mode locking. Each chapter ends with a section on physical systems which lend evidence for the existence of the behaviors seen in the mathematically simple systems.

Chapters 7 and 8 deal with conservative systems. In Chapter 7 the ergodic hypothesis and the classical mechanics of Hamiltonian systems is studied and relationships are drawn with chaotic systems. Chapter 8 deals with the question of the existence of quantum chaos.

Although this book is not for everyone, it should be taken notice of by those who delve into the unusual and esoteric. As the author clearly states, and as I agree, the majority of everyday situations that are naturally occurring are dominated by the complexity of apparently disordered phenomena that are governed by apparently simple processes.

Michael D. Hatlee, University of Missouri—Kansas City,
and Brian Cliff College

Advances in Polymer Science. Volume 79. Biopolymers/Non-Exclusion HPLC. By J. D. Andrade et al. Springer-Verlag: New York. 1986. 232 pp. \$82.00. ISBN 0-387-16422-7.

The subject of polymer characterization continues to be an important one at both the academic and industrial levels. This book, mainly written by scientists from Eastern Block countries, attempts to summarize current progress in this area. Over the whole, it succeeds in its goal; however, as the fields are moving rapidly, there is some out-of-dateness in the book. The most important chapter would appear to be that by Andrade and Hady dealing with protein adsorption: a tutorial. While parts of this chapter have appeared elsewhere, nevertheless, the chapter outlines an excellent summary of the current basis of protein adsorption at interfaces. The other chapter of general interest is the final one by Glockner dealing with polymer characterization by using HPLC methods other than size exclusion. This is an excellent summary of the status of this important field. Particularly noteworthy is the author's own work dealing with polymer characterization. The area of protein chromatography is also covered, but only to a limited extent. The other chapters deal with a variety of focused subjects that represent the general interest of the authors but unfortunately do not provide a coherence to the text as a whole. Overall, the book generally provides useful information for those interested in polymer characterization. However, the price is rather steep for a reader who may typically be interested in only one chapter. Nevertheless, the book should appear in scientific libraries.

B. L. Karner, Northeastern University

Organic Solid State Chemistry. Volume 52. Edited by G. S. Desiraju (University of Hyderabad). Elsevier Science Publishers: Amsterdam and New York. 1987. xx + 550 pp. \$175.50. ISBN 0-444-42844-5.

This volume is a collection of 14 chapters individually written by experts of their subdisciplines, thus giving the feeling of a volume of an "Advances in..." series with the usual advantages and drawbacks of such an admirable enterprise. The book constitutes a valuable collection of present day understanding and knowledge of large areas of the organic solid-state science. The fields covered include such diverse areas as structural trends and energetics of molecules in the solid state, solid-state reactivity and principles of topochemistry, the role of phonons in organic solid-state reactions, phase transitions of organic solids, and various special groups of compounds, such as clathrates, phenols, diolefins, etc. A geometrical approach dominates many chapters, which is based on the knowledge of the structures in the solid state as revealed primarily by X-ray crystallography. One large area, that of conducting organics, has been deliberately omitted, as there are several recent books available on those materials.

The volume does a good job in bringing the reader up to date on what is going on in several leading laboratories in the world of organic solids and it is recommended for specialists and graduate students alike.

Miklos Kertesz, Georgetown University

Supramolecular Photochemistry. Edited by Vincenzo Balzani (University of Bologna and Institute FRAE-CNR). D. Reidel Publishing Company: Dordrecht and Boston. 1987. xx + 469 pp. \$99.50. ISBN 90-277-2593-4.

This 214th volume of the NATO ASI, Series C, reports the proceedings of the Advanced Research Workshop of Photoinduced Charge Separation and Energy Migration in Supramolecular Species held in April 1987 in Anacapri, Italy.

A rapidly expanding branch of photochemistry concerns the studies

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Michael Harmata, University of Missouri—Columbia

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and Brian Cliff College

Advances in Polymer Science. Volume 79. Biopolymers/Non-Exclusion HPLC. By J. D. Andrade et al. Springer-Verlag: New York. 1986. 232 pp. \$82.00. ISBN 0-387-16422-7.

The subject of polymer characterization continues to be an important one at both the academic and industrial levels. This book, mainly written by scientists from Eastern Block countries, attempts to summarize current progress in this area. Over the whole, it succeeds in its goal; however, as the fields are moving rapidly, there is some out-of-dateness in the book. The most important chapter would appear to be that by Andrade and Hladky dealing with protein adsorption: a tutorial. While parts of this chapter have appeared elsewhere, nevertheless, the chapter outlines an excellent summary of the current basis of protein adsorption at interfaces. The other chapter of general interest is the final one by Glockner dealing with polymer characterization by using HPLC methods other than size exclusion. This is an excellent summary of the status of this important field. Particularly noteworthy is the author's own work dealing with polymer characterization. The area of protein chromatography is also covered, but only to a limited extent. The other chapters deal with a variety of focused subjects that represent the general interest of the authors but unfortunately do not provide a coherence to the text as a whole. Overall, the book generally provides useful information for those interested in polymer characterization. However, the price is rather steep for a reader who may typically be interested in only one chapter. Nevertheless, the book should appear in scientific libraries.

B. L. Karger, Northeastern University

Organic Solid State Chemistry. Volume 32. Edited by G. S. Desiraju (University of Hyderabad). Elsevier Science Publishers: Amsterdam and New York. 1987. xx + 550 pp. \$175.50. ISBN 0-444-42844-5.

This volume is a collection of 14 chapters individually written by experts of their subdisciplines, thus giving the feeling of a volume of an "Advances in..." series with the usual advantages and drawbacks of such an admirable enterprise. The book constitutes a valuable collection of present day understanding and knowledge of large areas of the organic solid-state science. The fields covered include such diverse areas as structural trends and energetics of molecules in the solid state, solid-state reactivity and principles of topochemistry, the role of phonons in organic solid-state reactions, phase transitions of organic solids, and various special groups of compounds, such as clathrates, phenols, diolefins, etc. A geometrical approach dominates many chapters, which is based on the knowledge of the structures in the solid state as revealed primarily by X-ray crystallography. One large area, that of conducting organics, has been deliberately omitted, as there are several recent books available on those materials.

The volume does a good job in bringing the reader up to date on what is going on in several leading laboratories in the world of organic solids and it is recommended for specialists and graduate students alike.

Miklos Kertesz, Georgetown University

Supramolecular Photochemistry. Edited by Vincenzo Balzani (University of Bologna and Institute FRAE-CNR). D. Reidel Publishing Company: Dordrecht and Boston. 1987. xx + 469 pp. \$99.50. ISBN 90-277-2593-4.

This 214th volume of the NATO ASI, Series C, reports the proceedings of the Advanced Research Workshop of Photoinduced Charge Separation and Energy Migration in Supramolecular Species held in April 1987 in Anacapri, Italy.

A rapidly expanding branch of photochemistry concerns the studies

Symposium on Artificial Organs, Biomedical Engineering and Transplantation, by D. B. Olsen, S. W. Kim, R. L. Stephen, J. J. Brophy, R. A. Normann, and D. E. Detmer. VCH Publishers, New York, 1987, 773 pages, \$79.95, ISBN 0-89573-335-8

Reviewed by Eli A. Friedman, Department of Medicine, SUNY Health Science Center at Brooklyn, New York 11203, USA

Successful application of mechanical devices to sustain life upon failure of a vital organ system began with Willem J. Kolff's design, fabrication, and testing of an artificial kidney. Laboring under the adversity imposed by the German occupation of Holland in 1943, Kolff built a rotating wooden drum on which sausage casing containing blood was exposed

to a saline and potassium containing solution (dialysate). Treatment for several hours permitted extraction of sufficient urea and other solutes to wake the patient from uremic coma, which if acute and reversible, meant recovery. Kolff emigrated to the United States at the end of World War II where his extraordinary drive and undaunted vision was the major force behind the establishment of departments devoted to artificial kidneys and hearts in the 1960s. Kolff's important observation that blood turned red during its passage through the artificial kidney was the spark that promoted the concept of a membrane artificial lung now used in cardiac bypass devices in every major surgery department. At the Cleveland Clinic and later the Artificial Organ Institute at the University of Utah, Kolff gathered a team devoted

to improvement in hemodialyzers (as the artificial kidney's membrane core came to be called), heart-lung machines, and completely bionic hearts.

Modified Kolff artificial kidneys served as the nidus for genesis of renal care departments in Boston, Cleveland, New York, Montreal, Lund, and Paris. During the Korean war, the artificial kidney permitted salvage of severely traumatized soldiers (as depicted in an episode of MASH). Once hemodialysis was shown to be able to permit recovery from acute renal failure, there followed: 1) the derivative development by Belding Scribner, at the University of Washington, of chronic (maintenance) intermittent hemodialysis, which now is applied to 250,000 patients worldwide, and 2) cadaver kidney transplantation for more than 8000

individuals annually. No factor was more responsible for the birth of Nephrology as a speciality than the growing success in keeping the ravages of chronic uremia at bay.

Rather than preside over a continuing celebration of past accomplishments, Kolff chose to force the future of what is now termed bionics. In Kolff's laboratory the first implantable artificial heart was developed and implanted. Kolff's associates are perfecting a completely implantable artificial heart. Other associates of Kolff strive to replace lost sight and hearing. The march toward a device to substitute for missing β cell function in diabetes is also based in part on experiments by workers supported by Kolff.

Artificial Organs recounts much but not all

of the Kolff Story. A sampling of chapters connected mainly by their authors' association with Kolff recount birth of artificial organs, present state of the artificial heart, studies of membrane plasmapheresis, and isolation of xenogeneic islets of Langerhans for human transplantation. Bionic eyes and ears are discussed in the context of substitution for disrupted neurons. The effect on ethical values of spare parts medicine is also considered.

As for Kolff's present writings, he proffers two marvelous chapters: "Obscure Projects," the recounting of things that might have been, and "The Future of Artificial Organs and of Us All," in which the growing risk of nuclear annihilation is weighed in the hope

that by speaking out those who have seen the ghost of Christmas future may, like Scrooge, be able to alter a not inevitable fatal outcome.

Everyone immersed in research in or use of bionic devices would benefit from reading *Artificial Organs*. Kolff is a giant whose contributions have changed medicine for the good. His friends, students, and disciples are in faculties from Asia to South America. This text is one of the last that can be written about organ substitution without constant reference to molecular events, recombinant DNA technology, and cellular modification. All that Kolff needed to make a dream come true were heparin, cellophane, salt, and hard work.

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In summary, this book is a reasonable compendium of artificial organ research and related physiological matters. The authors represent a wide range of applications and topics. Many of the papers can be understood by undergraduates and graduate students as well as physicians who are not technically proficient in design and analysis aspects. Each paper is well documented, well referenced and contains excellent figures, tables, graphs and photographs. However, the papers are of random length and are, for the most part, not technically detailed. The authors are not necessarily world leaders, although most are well known in their field of study. This book would be more useful to those who attended the conference, since many of the papers are obviously abstract versions of oral presentations made at the conference. The book would have been better served if the authors had been required to submit standard length papers subsequent to the conference for the printed version.

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Received August 11, 1988*

Symposium on Artificial Organs, Biomedical Engineering and Transplantation, by D. B. Olsen, S. W. Kim, R. L. Stephen, J. J. Brophy, R. A. Normann, and D. E. Detmer. VCH Publishers, New York, 1987, 773 pages, \$79.95, ISBN 0-89573-335-8

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amphiphile chains. A value of 53.3 cal/g is inferred for ΔH_1 from the observed limiting value of $\Delta H_{f, \text{obsd}}$ at high oil contents. Extrapolation of the data to infinite dilution gives a value of 18 cal/g for ΔH_2 . This value is in accord, within the context of the assumptions used, with the entropy change upon melting of this "mixed" oil fraction being smaller than that of the isotropic fraction.

Values of p_2 were calculated by using eq 1 and are presented as a function of oil content at a fixed surfactant:water ratio (Figure 3). A comparison between these values derived from the thermal measurements can be made with those from previously observed⁴ quadrupolar splittings of the solubilize, i.e.

$$\Delta\nu_{\text{obsd}} = p_1\Delta\nu_1 + p_2\Delta\nu_2 \dots \quad (2)$$

where $\Delta\nu_1$ and $\Delta\nu_2$ refer to the quadrupolar splittings in the "mixed" and "unmixed" states, respectively (hence $\Delta\nu_2 = 0$). Good agreement between the two sets of values is seen in Figure 3, taking into account the fact that the NMR measurements were made⁴ at 298 K.

This preliminary study has demonstrated the utility of differential analysis to investigate the state of solubilized *n*-hexadecane directly. In this respect, this study reveals similarities to a recent study¹⁴ of microemulsions using differential scanning calorimetry that provided information about the degree of oil penetration in the associated surfactant structure. The results are consistent with the previously adopted simple two-state model for the solubilize system. A more disordered state than the pure *n*-hexadecane solid is indicated from the lower value of ΔH_2 for the oil component, which is mixed with the amphiphile as expected; i.e., there will be a smaller entropy difference between this state and the melted isotropic state. The upper limit to this portion of the solubilized oil appears to be at approximately 1 mol of oil to 5 mol of surfactant. This oil content also corresponds to that which gave the largest ordering effect in the bilayer as shown by the compositional dependence of the solubilize order parameters.

Registry No. C_{12}EO_4 , 5274-68-0; *n*-hexadecane, 544-76-3.

Book Reviews

Surface and Interfacial Aspects of Biomedical Polymers. Vol. 1: Surface Chemistry and Physics. Joseph D. Andrade, Editor. Plenum, New York, 1985.

As stated in the Preface, this book is intended to provide a fundamental basis for the study of interaction of polymers with living systems, biochemicals, and aqueous solutions. The editor has met his goals in a significant and in-depth fashion. Volume 1 of *Surface and Interfacial Aspects of Biomedical Polymers* contains chapters dealing with the fundamental aspects of surface chemistry and the physics of polymers, polymer surface dynamics, model polymers for probing surface and interfacial phenomena, polymer-oriented monolayers and multilayers as model surfaces, X-ray photoelectron spectroscopy (XPS), surface infrared spectroscopy, contact angle and interface energetics, interfacial electrochemistry of surfaces with biomedical relevance, interface acid-base/charge-transfer properties, graft copolymer and block copolymer surfaces, and interfacial tensions at amorphous-water interfaces: theory, surface Raman spectroscopy, and polymer surface analysis.

This volume provides useful information on the theory and techniques utilized in the characterization of polymer surfaces and interfaces. Specifically, the volume provides information on elemental surface composition, organic functional groups present, the variation in composition and molecular character with depth,

and to some extent, the lateral distribution of the elemental and molecular character of the surface. While comprehensive in its approach, this volume points out limitations of the various techniques utilized to characterize surfaces and interfaces. Moreover, gap areas in theories and experimental techniques are presented.

For the student, teacher, or scientist involved in the study of surfaces and their interfacial properties, this volume serves as both a useful textbook and a comprehensive reference. The editor and his contributors have gone to painstaking effort in constructing chapters which present their topic material in a clear, concise, and highly readable fashion. The use of tables and figures in the volume is excellent. Of special importance to potential users of this volume is the detailed and comprehensive list of references provided at the end of each chapter. These will be especially useful to those requiring the original presentation of theory, techniques, perspectives, and data and their interpretations.

Surface and Interfacial Aspects of Biomedical Polymers. Vol. 1: Surface Chemistry and Physics is recommended to individuals with a commitment to the study of polymer surfaces and interfaces. It will be useful as a textbook and a reference text. Its value is enhanced by the fact that Volume 2, *Protein Adsorption*, is also available. It is hoped that the editor, Dr. Joseph D. Andrade, will continue this excellent series.

James M. Anderson, Case Western Reserve University

Additions and Corrections

William D. Machin* and Peter D. Golding: Adsorption of *n*-Butane on Silica Gel. 1987, 3, 346-349.

The correct expression for eq 13 is

$$\alpha_p - \alpha_p^0 = \ln(A/A^0)/(T - 468.6)$$

The correction amounts to ca. a 0.5% increase in α_p and does not have a significant effect on the values of α_p plotted in Figure 3.

Book Review

The *Annals of Biomedical Engineering* has initiated a book review series under its newly formed section dedicated to Professional Technical Service. The book review section will bring timely and informative reviews of new books in biomedical engineering to our readers.

Additional book reviewers are needed to support this effort. If you would be willing to write an occasional review in exchange for a copy of the book, please send your name, address, phone number and areas of interest to:

Dr. William A. Hyman
Book Review Editor
Annals of Biomedical Engineering
Bioengineering Program
Texas A&M University
College Station, TX 77843

Contributions to the book review section are most welcome. You are urged to submit two copies of the review with your name, address (affiliation), phone number and area of interest to: Dr. William A. Hyman. You will be reimbursed for the book if your review is accepted for publication by the *Annals*.

Artificial Organs. Proceedings of the International Symposium on Artificial Organs, Biomedical Engineering, and Transplantation in Honor of the 75th Birthday of Willem J. Kolff. Edited by J.D. Andrade, VCH Publishers, 1987. \$79.00.

This book is a compendium of the proceedings of an international conference on artificial organs, biomedical engineering and transplantation held in Salt Lake City, Utah on January 20-23, 1986. The text is split into six sections: (1) a plenary session which is historical in perspective, (2) artificial hearts and transplantation, (3) artificial kidneys, blood plasma processing, and transplantation, (4) neuroprostheses, (5) drug delivery systems and biomaterials, and (6) socioeconomic aspects.

The first section describes plenary sessions on the birth and history of artificial organs and the role of Willem Kolff in this process of technical evolution. An introduction by Yukihiro Nose of the Cleveland Clinic is followed by a brief paper on various artificial organs by Dr. Kolff. The historical papers by Horst Klinkmann and Keith Reemtsma were no doubt interesting when presented in person. However, the printed version in these proceedings is less than three pages each, certainly not sufficient to meet the challenge of the title of these papers. This is a shortcoming of this text. One would have hoped that Dr. Nose, a leader in this field for decades, could have prepared such a paper and lengthier printed version.

The second section deals with artificial hearts and heart transplantation. The papers in this section are written so that a relative layman could understand the material. They are well documented and have numerous figures and photographs in support of the text. The papers present versions of artificial ventricles and ventricular assist devices from the Cleveland Clinic, Novacor Medical Corporation, the University of Utah, the University of Athens, Japan's Taketa Hospital, and the University of Tokyo. Each paper has sufficient length to inform the reader of the essentials of the research results without overburdening the reader with too much text. The authors represent a diverse international field. Although not necessarily world leaders in such research, these authors are well known in the field of artificial ventricle development and the papers are well presented.

Also included in this section is a discussion of *in vitro* studies of hemodynamic and mass transfer aspects of arterial disease by Brant and Borovitz at the University of Pittsburgh. Two papers dealing with the artificial ventricle as a bridge to transplantation are presented by researchers at the Pacific Presbyterian Medical Center in San Francisco and the University Medical Center in Tucson. Papers which deal with physiological concerns are presented next, including a discussion of artificially induced biological organs by Wildevuur and Van der Lei from the Netherlands, a paper on coronary venous outflow by Ratajczyk from Poland and a paper on anesthesia of the future by Stanley of the University of Utah. These last three papers concerning physiological matters seem somewhat out of place with the rest of the section. The paper on artificially induced biological organs would be of considerable interest, but is extremely brief, and leaves the reader to research the extensive reference list.

The third section deals with artificial kidneys, blood plasma processing, and renal transplantation. Many of these papers describe long term clinical trials of various dialysis systems. Some of these are quite brief and are obviously abstract versions of lengthier presentations made during the conference. Even those papers dealing with mathematical analysis of dialysis systems, such as that by Shettiger *et al.* from Utah, are far too short for the reader who did not attend the conference. The largest paper in this section deals with a discussion of Medicare and the ESRD system. Although this is an interesting presentation, it seems strangely out of place with the remainder of the section.

Other papers dealing with technical discussions of the workings of cross flow dialysers and hemofiltration systems are presented such that a layman would be lost in the presentation. An expert in the field would have little trouble, as the material is well documented and referenced with ample figures and graphs. However, there appear to be no rules in the proceedings concerning length of paper or topic of discussion. A paper on transplantation of the pancreas is lengthy, written for the layman, and fits well into the flow of the proceedings, unlike others which are too brief and too technical.

The fourth section concerns neuroprostheses such as visual prostheses, auditory prostheses, speech systems, artificially induced motor and muscular action, and the interaction between microelectronics and neural systems. These papers are all very interesting, albeit too brief in many cases. They are written so that a layman might follow the material and are well documented and referenced with excellent figures. However, as with earlier sections, the papers are of exceedingly varying length, which is at times disconcerting to the reader.

BOOK REVIEWS

N.A. Peppas (Editor), *Hydrogels in Medicine and Pharmacy*, CRC Press, Boca Raton, FL, 1987: Vol. I, *Fundamentals*, 192 pages, \$94.00; Vol. II, *Polymers*, 184 pages, \$95.00; Vol. III, *Properties and Applications*, 208 pages, \$110.00.

N.A. Peppas, Professor of Chemical Engineering at Purdue, has performed a major service for the biomaterials and bioengineering community by editing and contributing to this three-volume treatise. *Hydrogels in Medicine and Pharmacy*, Volume I — *Fundamentals*, Volume II — *Polymers*, Volume III — *Properties and Applications*, constitutes the most comprehensive and complete source of information on hydrogels now available.

A particular strength of the book is Peppas and co-workers' own contributions, which provide a rigorous and complete polymer science and theoretical framework for the continued study and applications of gels in medicine and pharmacy.

Although the volumes are generally excellent and comprehensive, there are a number of omissions and criticisms. In general, many of the figures tend to be larger than they need to be. Considerable space could have been conserved with no loss of readability by reduction of some of the figures and reduction of some of the white space in the manuscript. One particular annoyance is that there are no chapter headings on the individual pages of the manuscript, making it difficult to turn to the beginning or end of any particular chapter. There is a fairly complete index for each volume, but unfortunately, there is no list of symbols, which would have been particularly useful in light of the theoretical discussions in many of the chapters.

Although Peppas recruited a very complete and outstanding list of contributors, it was disappointing to this reviewer that there were no

contributors from the Institute for Macromolecular Chemistry in Prague. Another major group that was not represented is that of the University of Uppsala and Pharmacia, whose developments with Sephadex and agarose gels have had such a major impact on chromatography, biochemistry, and biotechnology. Another significant omission in Volume I is the lack of theoretical treatments dealing with phase transitions or critical phenomena in gels.

Volume I, *Fundamentals*, consists of three chapters by Peppas and co-workers, one by Ratner titled *Hydrogel Surfaces*, which is unusually brief, one by Gombotz and Hoffman on *Immobilization of Biomolecules and Cells*, and one by Horbett on *Protein Adsorption*, which is quite comprehensive and complete.

Volume II, *Polymers*, includes contributions by Peppas and coworkers on *Polyvinyl Alcohol and PolyHEMA hydrogels*, one by Kim and coworkers on *Biomedical Applications of PolyHEMA*, one by Graham on *Polyethylene Oxide* and one by Doelker on *Water Swollen Cellulose Derivatives*. In general, all of these chapters are quite comprehensive and complete.

The final volume is titled *Properties and Applications*. It includes a chapter by Merrill and coworkers titled *Hydrogels for Blood Contact* and one by Sefton on *Heparinized Gels* — which is a particularly complete and a comprehensive review of the field. Chapter 3 is by Tighe — *Hydrogels as Contact Lens Materials*. Chapter 4 is by Migliaresi and coworkers on *Tendon Applications*. There are three chapters on *Gels for Controlled Release Applications*: Chapter 5 by Cost and Langer, Chapter 6 by Peppas and Korsmeyer, and Chapter 7 by Heller on *Bioerodible Gels*. Park, Cooper, and Robinson have a contribution on *Bioadhesive Hydrogels* which is quite comprehensive and helpful. The volume is concluded by Chapter 9, authored by Peppas, titled *Other Biomedical Applications*, in which those applications and topics not oth-

erwise covered in the treatise are briefly presented.

A number of areas not covered comprehensively or in specific chapters include a general discussion on sterilization problems with gels and the long-term stability of gels in tissue and/or blood environment — including such issues as tissue reaction and calcification. There is no chapter on cell adhesion to hydrogels, in spite of the fact that gels or gel-like surfaces are widely used as culture substrates and as supports for mass cell culture in biotechnology.

Although Peppas is quite familiar and knowledgeable with the theories and applications of Professor deGennes in Paris, it was disappointing to this reviewer that there appears to be no treatment in the three volumes of the deGennes model of gel-like surfaces, which is so important for rationalizing and understanding protein adsorption, cell adhesion, and the general compatibility properties of gels.

In spite of these omissions, however, this three-volume treatise is the best comprehensive source of information on hydrogels today. The three volumes are recommended to all workers involved in medical and pharmaceutical applications of hydrogels.

J. ANDRADE

Department of Bioengineering
University of Utah

B.D. Ratner (Ed.), Surface Characterization of Biomaterials, Elsevier, Amsterdam, 1988, 344 pages, Dfl. 230.00, \$121.05.

Controlled release research is moving away from the simple mixing of drug A with polymer B and measuring the release rate. Researchers are beginning to focus on basic mechanisms: for example, on interactions between drug and polymer or between delivery system and host animal or patient. These generally involve surfaces and interfaces. Those of us who have been conditioned by our experiences in the biomaterials field already know that characterization

of these surfaces is critical to understanding the phenomena we observe. The assumption that the surface is the same as the bulk is flawed even at the best of times. This book is useful as an introduction to the major surface analysis techniques for characterizing the surface composition (and to a lesser extent energetics) of biomaterials and, by extension, drug delivery systems.

This book consists of the proceedings of the Symposium on Surface Analysis of Biomaterials held in Ann Arbor, Michigan, June 21–24, 1987.

The Introductory Section (Perspectives) immediately focuses the reader's attention on the present atmosphere surrounding the understanding of mechanisms involved in biomaterial–host response. Kasema and Lausmaa express the need for sophisticated analytical tools along with the standardization of test procedures, if any real headway is to be made in untangling the implant–tissue interface. Ratner goes on to point out some of the present state-of-the-art techniques available to the biomaterial scientist. He indicates the advantage and limitations of each of these and suggests what directions might be taken.

Section II is for tutorial purposes. It performs this function well, making it a handy reference. The contributions on X-ray photoelectron spectroscopy (XPS) by R. Paynter and on secondary ion mass spectroscopy (SIMS) by D.G. Castner and B. Ratner are good introductions offering the basics involved in each technique. Unfortunately, the typeface used in the chapter on solid surface tension made this offering difficult to follow at times.

Section III offers a variety of methods for characterizing biomolecules at interfaces. The utility of some methods, however, was not immediately apparent to this reader. J.H. Abrams and H.F. Dylla in their contribution give the impression that electron-stimulated desorption (ESD) has a lot to offer to the biomaterials field; it is too early to tell.

Examples of the use of each of the surface

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Tiny plants challenge greenhouse plan

Evidence from an algal graveyard has thrown a wrench into investigations of the perplexing climate changes of the last ice age. By extension, those same findings raise important questions about a controversial proposal to combat global warming by seeding the Antarctic Ocean with iron.

A decade ago, scientists discovered that carbon dioxide levels dropped by about 30 percent during the last ice age, thereby lowering Earth's greenhouse effect and helping to keep the planet locked in the deep freeze. To explain such atmospheric alterations, oceanographers suggested that microscopic algae in Antarctic waters proliferated during the ice age, drawing carbon dioxide out of the atmosphere and storing it in the deep sea.

Not so, say Richard A. Mortlock and his colleagues at Columbia University's Lamont-Doherty Geological Observatory in Palisades, N.Y. Using sediment cores from the Antarctic Ocean floor, they studied the glassy remains of ice-age algae called diatoms. Contrary to expectations, the scientists found that Antarctic diatoms fared poorly during the glacial age, they report in the May 16 *NATURE*.

These results are disconcerting be-

cause they all but demolish one potential regulatory mechanism for atmospheric CO₂, one which has been considered quite powerful by many geochemists and paleoceanographers," comments Wolfgang H. Berger of the Scripps Institution of Oceanography in La Jolla, Calif.

The seemingly esoteric topic of Antarctic algae took on headline status last year when an oceanographer suggested enlisting these tiny plants to slow global warming. John H. Martin of the Moss Landing (Calif.) Marine Laboratory proposed that adding extra iron to the Antarctic Ocean would stimulate algal growth, causing the plants to absorb millions of tons of carbon dioxide from the atmosphere each year (SN: 1/26/91, p.63). He reasoned that the same iron-supplement scenario occurred naturally during the last ice age.

The new data challenge Martin's theory about the ice age, but that doesn't necessarily scuttle the entire proposal, says Berger. Some laboratory evidence indicates that adding iron to seawater does stimulate the growth of algae, regardless of what happened in the past. Scientists are now considering an ocean experiment to test Martin's proposal.

— R. Monastersky

Altered enzyme reverses Gaucher's symptoms

Roscoe O. Brady first proposed enzyme-replacement therapy for Gaucher's disease 25 years ago. A tantalizing series of experimental ups and downs followed, but never quite produced the hoped-for cure. Now, Brady and his colleagues outline a new twist on the enzyme treatment, one that provides dramatic relief from the major symptoms of this debilitating and sometimes lethal disease.

People with Gaucher's disease inherit a defective enzyme that cannot break down a fatty substance called glucocerebroside. As a result, the fatty material builds up in scavenger cells of the immune system, called macrophages. The fat-engorged macrophages cluster in the liver and spleen, causing these organs to swell. Symptoms of the disease, which strikes about one in 40,000 people in the United States, include bone loss, excruciating bone pain, internal bleeding, and severe anemia involving a decrease in the oxygen-carrying hemoglobin within red blood cells.

Previous attempts to treat Gaucher's disease with injections of the fully functioning enzyme failed because scientists couldn't get enough of the lifesaving substance into the patients' macrophages. In the May 23 *NEW ENGLAND JOURNAL OF MEDICINE*, Brady and his colleagues report

that a modified enzyme therapy produced striking improvement in 12 adults and children with moderate to severe Gaucher's. The team used chemically treated enzyme that binds and enters macrophages.

Patients received intravenous injections of the modified enzyme once every two weeks in moderate cases and once a week in severe cases. After six months of treatment, five participants showed a 16 to 22 percent reduction in liver size and all 12 showed a significant reduction (averaging 33 percent) in spleen size. The most dramatic finding, however, was an increase in all patients' hemoglobin, which reached normal levels in seven individuals. Three people also showed signs of increased bone density, and Brady thinks others may follow suit after several more years of treatment.

All volunteers reported less fatigue and most experienced less pain, the researchers note. In two particularly severe cases, children who had been virtually crippled by the disease resumed normal activities, says Brady, of the National Institute of Neurological Disorders and Stroke in Bethesda, Md.

The new treatment "completely reverses the pathology of the disease," he told *SCIENCE NEWS*. — K.A. Fackelmann

Monolayers reveal protein preferences

The chemical complexity of proteins makes them seem quite fickle to bioengineers. On one hand, these molecules often stick to surfaces where they don't belong, fouling contact lenses or leading to clots in artificial blood vessels, implanted valves and other biomedical devices. On the other hand, they sometimes don't stick as well as researchers would like, as in procedures for purifying biotechnology's protein products.

Now, two scientists at Harvard University have developed a technique for figuring out just what makes one protein favor some surfaces over others. In the May 24 *SCIENCE*, chemist George M. Whitesides and graduate student Kevin L. Prime report developing organic films to test how well proteins stick to different materials.

To make the films, Prime and Whitesides add hydrocarbon molecules called alkanes to an alcohol solution containing a thin strip of gold. The alkanes self-assemble on the gold template and form a single, dense layer of molecules. For their experiments, the researchers used alkanes with methyl, sugar, hydroxyl and polyethylene glycol tails that stick up from the monolayer. This enabled them to create monolayers with known surface structure and composition. They then added various proteins to determine how much each monolayer film absorbed.

"Proteins are complex, so if you can minimize the complexity of the solid surface, then you have a chance to correlate the solid surface's properties with what [absorption] you see," notes bioengineer Joseph Andrade of the University of Utah in Salt Lake City, who also studies protein/surface interactions. "The self-assembled monolayer system provides a degree of control, reproducibility and reliability that is simply unavailable with all other systems."

Whitesides and Prime observed that the five proteins they studied stuck poorly to films containing lots of polyethylene glycol. This tail is so bulky that it forms a slick gel that proteins cannot penetrate. But the proteins seemed to take a fancy to the other films, which readily absorbed the added molecules.

"Now we can understand on a molecular level the interaction of proteins with man-made materials," Whitesides told *SCIENCE NEWS*. In the past, chemists have relied mostly on trial and error to identify "nonstick" surfaces that absorb less protein. But with the new data, researchers can develop "a prescription for how to modify these surfaces to improve them," Whitesides says. "We want to develop man-made materials that are as non-interactive as possible."

— E. Pennisi

BOOK REVIEW

Artificial Heart: The Development of Biomation in the 21st Century

Editor: Yukiyasu Sezai, M.D. FACS.

Published by W. B. Saunders Company, Harcourt Brace Jovanovich, Inc. Philadelphia.

Copyright by Nihon University, 1992. \$120.00

by Elaine Duncan

The attractive cover of this book beckons the die-hard artificial heart "groupie". "Buy Me!", it cries. A book this pretty must have the very latest information on artificial hearts, right? Well, not exactly.

"As part of the events marking the centenary of Nihon University, an international symposium was held on The Artificial Heart-Biomation in the 21st Century." This book is a compendium of the papers by the participants in the symposium. It strives to include a medical anthropological point of view and the role and contribution of the artificial heart to the humanity, as well as ethical aspects of the technological revolution of "biomation." This goal was intriguing and unique.

There are sixty-four chapters in the book, contributed by world-wide authors from universities, companies and consortiums from around the globe. For this reason alone it is shocking to see how many photographs in the book appear to be Jarvik-clones (such as the Thomas 60). Artificial heart "success" is repeatedly measured by survival times of animals in days.

(Continued from page 12)

Some of the chapters make interesting reading still today. One "find" was the article by Dr. Joseph D. Andrade et al. about the "lab on a chip", titled, "Immuno-Biosensors, The Clinical Chemistry and Coagulation Laboratory on a Chip." Clearly one of the most difficult challenges to the long-term maintenance of a patient on a permanent assist or replacement device is to adequately understand the biological fluctuations induced by the mechanical replacement. Responses to drug therapies may not be the same for an assisted-patient. The exact conditions of the patient and his or her response to device parameter changes and drugs must be appreciated almost simultaneously, but no current laboratory methods can provide that. The technology proposed in this article will also have merit independent of the success or failure of the artificial heart technology.

For \$120, this book could be an addition to a library or a nice "parting gift", but don't buy it for your personal collection unless you just like to collect handsome books.

The chapter by the Pierce group at Pennsylvania State University presented their original work on the electrical heart assist device, but at the time of this book, only sketches of human implant locations could be provided. The steam artificial heart from Russia certainly seemed interesting, but the technical discussion was scanty.

This is a continuing difficulty with books generated by symposia. By the time the hard-cover is published, the information is dated. Worse, the papers cannot be adequately critiqued and so the authors may produce any information that they choose.

One of the most ironic statements in the book was the conclusion offered in "The Total Artificial Heart — A subjective view from Berlin", by Dr. Klaus Affeld. He stated, "After many years of development of the artificial heart, a light is finally visible at the end of the tunnel, the reasons for this is that the basics of heart replacement and heart assists are understood and that the tools for the design of these devices are developed." *Oh really?*

The book has merit, don't misunderstand. In fact, someone went to a great deal of work to get these authors to return their manuscripts and photographs. This book is a lasting tribute to the extremely hard work of all of these scientists and engineers. What seems amazing, reading through chapter after chapter is that with all of this work, worldwide, why is there yet no total artificial heart on the market in the U.S.?

Simple answers are hard to come by, but it seems that eventually one program will succeed. When it does, this book will have collector's value, as well as merit as a general reference text.

The least interesting chapters deal with the "clinical experience" of use of the hearts in different countries. The statistics are numbing and have little appeal to the technologist. There is little or no discussion of the biomaterials testing conducted for these various devices and there is only meager emphasis on design qualification. The promised ethical and anthropological assessment of the artificial heart was not delivered.

(Continued on page 17)

BOOK REVIEW*(continued from page 11)*

is known as to how the ECM is developed *in vivo* in the presence of biomaterials" but that "synthetic extracellular matrices may assist in the realization of the definition of biocompatibility".

"The Race for the Surface" chapter was an ironic but excellent choice in a book about implantation biology. We owe a great debt to Dr. Gristina and colleagues and other pioneers in this area of biomaterials research for having alerted us to the competition between bacteria and tissue (host) cells for the biomaterial surface. As one of the best chapters in this text with respect to adherence to the book's mission, this chapter alerts the reader to the concept of the immunoincompetent fibroinflammatory zone around implants.

The text provides an overview of the implanted biomaterials for cardiac and vascular surgery, plastic surgery, orthopaedic surgery, neurosurgery, urology and other applications in artificial organs. The chapter of most contemporary interest is tissue engineering, a "growing field" (yes, it's a pun). Alexis Carrel would be proud to know how far his dream of culturing replacement organs has advanced. The authors incorrectly characterize this as a "new field", but certainly they have provided the foundation for learning more about this emerging technology. This book is worthy of addition to any collection of biomaterials text and provides an excellent research resource on a variety of biomaterials applications.

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Medical and Biological Engineering in the Future of Health Care

Editor: J. D. Andrade; Published by University of Utah Press, Salt Lake City, Utah, 1994 \$24.95

submitted by Samuel F. Hulbert

The American Institute for Medical and Biological Engineering (AIMBE) was formed several years ago to provide a unified and coherent representation of the field and to deal with the problems that are important to all areas of medical and biological engineering and our affiliated societies.

A major purpose of AIMBE is to establish the scholarly and professional identity of medical and biological engineering and to speak for this discipline on issues of concern to the American people. In 1993 the delivery of health care — technology, economics and management — dominated the political agenda. Therefore, AIMBE's second annual event, held at the National Academy of Sciences on March 8-9 1993, was devoted to "The Future of Health: The Role of Medical and Biological Engineering."

A collection of papers presented at the Annual Meeting has been edited by J.D. Andrade. All twenty-four chapters were well written, informative, and provocative.

Several of the chapters are especially noteworthy for anyone interested in trying to understand the impact of technology on health care costs — Chapter 2; "Issues in the Development and Adoption of Technology in Medicine" by Kenneth Keller and Chapter 10; "Technologies, Incentives, and Health Care Costs: What is in Our Future?" by Burton Weisbrod.

Chapter 24; "The Future Role of Health: The Roles of Medical and Biological Engineers" by Dr. Andrade, is an excellent summary of the major points of the Conference. Chapter 23; "The Future of Bioengineering" by George Bugliarello is an eloquent call to action to the bioengineering community.

A number of the chapters deal with the future role of information and communication technologies in advancing health care and reducing costs. There are also five chapters devoted to innovation and new technologies for improved health care and reducing costs. Chapter 18, "Empowering Patient Decision Making" by John Wennberg was particularly thought-provoking.

The editor has selected several pertinent quotes from each chapter and put them at the beginning of each chapter. They provide an excellent summary of each author's main thesis. *Medical and Biological Engineering in the Future of Health Care* is recommended reading for the entire biomaterials research community.

(Book Reviews are continued on page 16)

BOOK REVIEW

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(Book Reviews are continued on page 16)

Industrial Biotechnological Polymers

edited by Charles G. Gebelein and Charles E. Carraher, Jr. Technomic Publishing, 1995. \$fr169.00 pbk (xiv + 408 pages) ISBN 1 56676 292 8

This volume is based on a symposium of the same name at the 207th National American Chemical Society meeting, held in March 1994 in San Diego. The book includes 25 chapters, organized in five parts.

Part 1, titled 'Industrial applications', consists of six papers that are largely brief reviews and overviews, focused on starch, cotton and other polysaccharides.

Part 2 on polysaccharides and lignins is perhaps the major strength of the book. The papers are quite comprehensive, particularly the Japanese contributions, which deal with hyaluronic acid applications,

macromolecular pro-drugs using chitin, applications of chitin and chitosin, and hyaluronate derivatives containing nucleic acid bases. The other two papers in this section, dealing with anti-bacterial and anti-yeast polymers, are unusually brief.

Part 3 deals with spider silk, and includes papers by three of the major groups in the area (Kaplan, Viney and Cappello, and their co-workers).

Part 4 is titled 'Protein-based systems' and includes a comprehensive contribution from Urry's group (Birmingham, AL, USA), which gives an update on their activities dealing with microbial biosynthesis of their elastin-based polypeptide systems. There is a comprehensive paper on structural approaches in collagen interactions, one on proteases for peptide synthesis, and a Japanese contribution dealing with biochemomechanical systems utilizing glucose oxidase.

The final part of the book is titled 'Miscellaneous biotechnological

polymers'. It includes papers dealing with melanins, triglyceride oils, clinical studies with a polyinosinic polycytidylic acid-polylysine complex, called PolyICLC, and polymeric calcium phosphate composites. These papers range from very brief and perhaps superficial surveys to very complete and comprehensive contributions.

There are major faults with this book: there is no index; there are no abstracts or summaries at the beginnings of the papers; authors' addresses are incomplete; and in at least one chapter the quality of the figures is terrible. Nevertheless, it is a useful and comprehensive compilation, and still relatively timely, and should be of interest to engineers and scientists working on applications of biopolymers based on polysaccharides and/or proteins.

J.D. Andrade

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**BIOENGINEER
JOE ANDRADE**

Antibiotics exist in the secretions of a frog or in the saliva of animals. Such is the wisdom contained in G. Benyus' *Biomimicry: Innovation Inspired by Nature*. U. of U. bioengineering professor Joe Andrade found this book, written for the general public, a fascinating read. Ecosensitivity and photosynthesis are further discussed, while interviews with groups of people who use



nature as a model in engineering applications are featured.

Mr. Andrade claims that all the books he reads are for pleasure and finds no point in reading something "unpleasurable." In Leonard Schlain's *Art and Physics: Parallel Visions in Space, Time and Light*, creativity in the arts is seen as a predecessor to scientific discovery, a unique idea. Author Schlain, a practicing physician, was stymied when his 12-year-old daughter asked about art. He spent 10 years studying art and, along the way, realized certain parallels in physics. Schlain claims that over the centuries, artists laid the cultural groundwork and scientists walked in their footsteps.

Schlain's second book, *The Alphabet Versus the Goddess*, heralds another unusual concept. This book points out that "misogyny and patriarchy rise and fall with the fortunes of the alphabetic written word." There are suggestions that ancient societies were maternally based and that paternalism took hold over the years as language and alphabet developed. Though he has not yet read this work, Mr. Andrade intends to indulge in the book soon. For pleasure, of course.