

BOOK REVIEWS

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:

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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*.

The Mathematical Modeling of Metabolic and Endocrine Systems. By E.R. Carson, C. Cobelli and L. Finkelstein, Wiley, New York, 1983.

In the last decade or so, mathematical modeling of biological systems has become respectable, largely due to Rashevsky's pioneering and wide-ranging studies during the 1950s and to Arthur Guyton's large and successful circulatory model of the late 1960s. A steady stream of solid books came onto the market, beginning with Riggs (1963) and Milsum (1966) and continuing through Atkins (1969), Jacquez (1974), Savageau (1976) and others (including the present authors) on up to the present day. With hindsight, some of these earlier works seem simplistic or incomplete. At the time, however, they plowed new ground as many researchers strove to apply the power of systems analysis and mathematical modeling to seemingly intractable problems in biomedicine. These efforts bore much fruit: the use today of computers as decision aids, of automatically controlled infusion pumps and of time release drug capsules is as much a result of understanding gained through physiological systems modeling as through strictly medical advances.

Ewart Carson, Claudio Cobelli and Ludwik Finkelstein are well-known physiological modelers. This book captures the results of their studies and those of other researchers on models of dynamic metabolic and endocrine systems and places these results in a comprehensive framework, taking the reader essentially through early 1982.

The book is logically organized and well laid out. The first three chapters (about 10% of the book) discuss some of the purposes of modeling and give a cursory overview of metabolic and endocrine systems. The book concentrates on the formulation, identification and validation of models. The authors continually remind the reader of the necessity for models to be grounded in reality, a viewpoint this reviewer wholeheartedly applauds. Thus, the authors discuss identifiability of models, parameter estimation, experimental design and validation of models. An underlying theme is that all models are of limited value, with the value closely correlated to the questions being addressed by the model, i.e. the purpose.

This is a "cautious" book, not in the sense of pedestrian, but rather in the sense that the authors continually remind the reader of the real world and of the questions being asked of the model. They quite clearly state that there exist no general models for metabolic or endocrine systems which cover the full range of questions which might be asked. Validity, purpose, theory and experiment are tightly interconnected.

The strength of the book is the presentation of a large number of models from several different viewpoints. Unfortunately, the authors do not lead the reader step-by-step to the solution of any of the models. Instead, a solution is simply presented or the results of several models are compared, with the reader given no basis on which to make a judgment about the authors' care in using data to validate the models. Indeed, this book requires a high degree of trust that the authors have handled the data and models correctly, for essentially none of their calculations are presented in any detail which can be checked.

This reviewer was initially enthusiastic about the catholic coverage of the book, but the enthusiasm waned when the realization sunk in that one can read the entire book without once applying (or being able to verify or validate) the authors' models or parameter estimation techniques.

While the book is aimed primarily towards researchers "concerned with quantitative dynamic studies in endocrinology and metabolism," it can serve as a useful reference for researchers thoroughly familiar with modeling techniques. It can serve as a reminder of the range of models, identifiability and validation schemes which can be used in physiological systems. It is definitely not a book from which to learn *ab initio*.

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Product Comparison System, Hospital and Product Comparison System, Diagnostic Imaging and Radiology. ECRI/McGraw Hill Healthcare Information Services Division (no author), New York, NY. Approximately \$500.00 for each service.

Each of these publications is a three-volume, looseleaf bound set which provides extensive information on commercially available medical hardware along with an ongoing update and newsletter service. The Hospital set (at the time of this review) provided detailed comparisons on over 100 specific products ranging—alphabetically—from Anesthesia Units to Wheelchairs. The Diagnostic Imaging and Radiology set included comparisons of over 40 products divided into 9 sections (CT, NMR and digital radiology; film and processing; general radiology and fluoroscopy; nuclear medicine; radiation therapy; special procedures and angiography; supplies and accessories;

support equipment; and ultrasound). Each of these comparisons contains a brief but very useful technical discussion of the generic product, its stage of development, reported problems, references to standards and citations from ECRI's "Health Devices Alerts" and "Health Devices," as well as other publications. This information is followed by a list of manufacturers, including addresses and phone numbers and comprehensive charts on the specifications and features of specific hardware derived from the manufacturer's literature. Some data is listed as not specified with occasionally annoying frequency, perhaps reflecting that the publisher is not supplementing the manufacturer's literature with independently obtained information. Unlike "Health Devices," product testing and value judgments are not included here, but as noted above, where there has been such an evaluation, it is referenced. These product comparisons are potentially a very valuable resource to the medical device shopper and would also be of great value in the academic environment with respect to quick overviews of hardware concepts, features and availability. The comparisons are also to be periodically updated for continuing subscribers which would serve to keep this kind of information current.

Volume I in the Hospital set also includes material on the availability of custom evaluations, ECRI User Experience Network forms (but not FDA/USP Device Experience Network forms) and space to file the monthly Product News newsletters which are part of each service. These newsletters typically contain a brief discussion of a particular medical technology along with industry news and related information.

The Diagnostic Imaging and Radiology set includes similar information as well as the Diagnostic, Imaging and Radiology edition of "Health Devices Alerts" and material on technology management. The product comparisons here also include incident reports for each product as reported to the FDA. This latter information would also be valuable in the Hospital set and it is curious that there are a few disparities such as this between the two sets which are otherwise quite similar and are worthwhile companions to each other.

One aspect of these volumes, and the system membership they provide, is that they duplicate material that is available at least in part from other resources. For example, lists of manufacturers of specific devices are available in various sourcebooks, recalls are widely reported, numerous industry news and notes newsletters are published, and one might already subscribe to the various publications of ECRI. Where such duplication exists the option to reduce reliance on and the expense of other resources could be considered and in this sense these volumes could be used to provide a consolidation.

As noted above, these volumes would be of considerable value to anyone involved in extensive purchasing and/or specification of medical hardware. They also can provide a ready reference resource to existing medical devices with a useful overview of their respective technologies. From the perspective of a book, or even a set of books, these volumes are expensive, yet from the perspective of buying an ongoing membership and service, perhaps not out of line. If an employer or library could be convinced of their value, this resource should be most welcome to anyone who is medical hardware oriented. However, for many, the cost of personal ownership of the service would probably be prohibitive.

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Corrosion and Degradation of Implant Materials. Edited by Anna C. Fraker and Charles D. Griffin, American Society for Testing and Materials, Philadelphia, PA. 1985. (STP 859). \$62.00 (\$49.60 ASTM members).

This volume contains 30 papers from a symposium of the same title which was held in Louisville, Kentucky in May 1983. It is the second such symposium sponsored by ASTM and follows by five years the 1978 symposium which also resulted in a published volume of exactly the same title (STP 684). While symposium volumes run the risk of highly variable subject matter, scope and quality, this volume is an extraordinary exception in that the individual papers are of very high quality and clearly could have been published as journal articles. It is fortunate they were not, because their collection here provides a most valuable resource in the subject matter. Along with the quality of the individual papers, the relevancy of the individual contributions to the theme is a tribute to both the numerous authors and the fine work of the editors.

The papers are grouped together in topical sections focusing on the behavior of metallic, polymeric and ceramic materials and devices *in vitro* and *in vivo*. These 26 papers are followed by two reports on the total joint component retrieval analysis programs at the University of Missouri-Kansas City School of Medicine and the Hospital for Special Surgery (New York), respectively. The final two papers on "Performance Standards: Flexible Tool or Straight Jacket?" and "Pluralistic Medical Device Risk Management: Standards, Regulation, and Litigation" are short and more-or-less nontechnical, yet they provide a worthwhile overview of some of the issues connecting the relevant scientific and engineering questions with the "real world" of clinical implant use.

An interesting feature of the publication format used is the inclusion of a discussion section for each paper in which written questions are responded to by the paper's authors. Although necessarily brief, these discussions provide a flavor of the interchanges that must have taken place at the symposium. A further detail of the format is an eight-page editors' summary which provides a useful guide to the papers. The papers are also noteworthy for the extensive details given on material specifications and experimental techniques, including copious references to ASTM standards and test methods. This is of course most appropriate for an ASTM symposium/publication, but can be annoyingly absent in publications from less stringent sources. In almost all cases the papers include numerous references and are, in addition, well illustrated with tables, charts and photographs.

Returning to the two papers on implant retrieval, an issue which was, in my opinion, somewhat glossed over is the legal and ethical considerations of explant ownership, authority for disposition and the potential importance of these devices with respect to litigation involving both professional and product liability.

The potential knowledge to be gained from explant analysis is clear. However, implying that this can be done without due appreciation of the broader implications may lead the investigator into an unanticipated morass of considerable depth.

In summary this volume can serve as a unique resource and guide to the literature on the effects of the internal environment (or its analogs) on materials and certain devices, and to a lesser degree, on the effects of biomaterials on living cells and tissues. While clearly not a text book as such, it can also serve as a reader for a nar-

rowly drawn course on biomaterial degradation, or through more selective use of the individual papers, as reference material for a biomaterials overview.

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Skiing Trauma and Safety. Edited by Robert J. Johnson and C. Daniel Mote, Jr., ASTM Special Technical Publication 860, 1916 Race St., Philadelphia, PA, 1985. ISBN 0-8031-0429-4. 501 pages. \$62.00.

This volume presents a collection of 42 individual articles presented in the Fifth International Symposium on Skiing Trauma, and it is divided into eight major sections: Organizations Working to Improve Skiing Safety, Biomechanics Related to Skiing, Ski Boots, Bindings, Epidemiology of Alpine Skiing Injuries, Treatment of Injuries, Cross-Country Skiing Injuries and First Aid and Cold Injuries.

The first section on Organizations Working to Improve Skiing Safety includes five invited papers highlighting the work of several standards organizations around the world. The first paper summarizes the history of ASTM involvement in skiing safety and the procedures by which voluntary standards are developed through ASTM. The following two papers provide the reader with an understanding of the work of the International Arbeitskreis Sicherheit beim Skilauf (IAS) and the Technischer Uberwachungs-Verein (TUV) Bayern and their relationship to the German Institute for Standards (DIN). The last two papers review the organization of skiing accident prevention in Switzerland and standards writing bodies in United States and Europe.

The second section on the broad topic of biomechanics in skiing includes seven articles. The first paper presents a statistical analysis for estimation of the tibia cross-section diameter from the weight and height of a person and also from the tibia head dimensions as measured with calipers and computed tomography (CT) methods. The next three papers deal with the experimental measurement and prediction of the bending and torsional loads transmitted to the lower limb while skiing. Pain caused by the ski boot to the foot and leg is the focus on the next paper. The following paper presents the first research published on the optimal ski design for the "curved" skiing turn. This study models the turning process and presents a criterion for comparing the carving efficiency of ski designs. Finally, the last paper reviews injuries at the knee over the last two decades in Spain.

Five articles dealing with ski boot design are presented in the third section. The first paper investigates application of a mathematical model for evaluation of boot/foot interaction incorporating muscle effects. The following paper presents the evaluative results of pressure distribution on the shaft of the tibia for various representative ski boots and their strong dependency upon the boot-shaft design. The next two papers investigate the optimal boot design for prevention of boot-top fractures, based on failure criteria for bending of the tibia. Development and application of a device for measuring the pressure distribution on the tibia during skiing is presented in the last paper.

Featured in the fourth section are six articles concerned with the ski release bindings. The first four papers mainly deal with the test results, personnel training, and release torque recommendations and specifications by various international skiing organizations. The last two papers review the development of electronic bindings and report on field testing of a microcomputer-controlled ski release binding.

The fifth section on the Epidemiology of Alpine Skiing Injuries includes eleven articles. Generally, they all report on the analysis of statistical data relating to various types of injuries while skiing. The comprehensive analyses of the data collected from various sites in the United States and Europe, are of significant value for the promotion and development of safety procedures.

The sixth section on the treatment of injuries includes one article which discusses the treatment of shoulder dislocations reported by a medical society whose members practice in French ski resorts. The type of accident, reduction methods, therapy and recurrence are presented in this paper.

Three articles concerned with cross-country skiing are presented in the seventh section. The first paper reports on a controlled prospective study of the incidence of injuries in cross-country skiing carried out at various ski touring centers in Vermont. The following paper compares the types of injuries produced by cross-country and downhill skiing accidents. The final paper in this section presents the basic biomechanics of cross-country skiing techniques and their application in the future developments of cross-country skiing equipment.

The final section on first aid and cold injuries offers four articles. Infrared thermography in evaluation of clothing, ski boot insulation, and rescue are discussed and demonstrated in the first paper. The second paper stresses the need for skiers to have a working knowledge of heat production and conservation. Finally, the last two papers deal with hypothermia in the Austrian snow fields and the methods used by the ski patrol to treat hypothermia patients along with a comparative study of the relative effectiveness of four types of chemical heat packs used in Austria.

The articles presented in this volume summarize the state of research in skiing injuries. For the most part they are comprehensive, well-referenced and generally include empirical, experimental and/or analytical analyses of their respective fields. It is fair to say that the state of research in skiing injuries is at its early stages, and therefore this volume serves as an excellent foundation and knowledge base for future investigations. The editors have done a commendable job in selecting high-quality articles, providing the reader with an excellent selection and knowledge of the subject matter.

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Human Calorimeters. Volume 7, Endocrinology and Metabolism Series. By Paul Webb, M.D., Praeger Scientific Publishers, 1985. 166 pages, \$34.95.

This volume is a documentation of information on human calorimeters and gives the reader a historical perspective of their development. A human calorimeter is a device

for measuring the heat released by humans under various physical and environmental conditions.

It begins with a classification of the basic types of calorimeters in existence, their principle of operation and a discussion of their uses and areas of application. This is an introduction which should be useful to those who are not familiar with calorimeters and calorimetry. The reader is then taken through the historical development of calorimeters over the last two-hundred years, starting with the earliest ones which were designed for use with animals. The calorimeter of Lavoisier and Laplace, who around 1780 measured the heat released from a guinea pig by placing it in a wire cage surrounded by ice, is described. Other animal calorimeters and experimental work on animals during the 1800s are also described. Human calorimeters, from the turn of the century through the early 1980s, are traced with particular mention of W.O. Atwater's calorimeter, one of the first to be built.

The author explains the reasons and motives for building different calorimeters and offers his own rationale for it. The operational characteristics, advantages and deficiencies of each type are discussed with respect to the specific application of the calorimeter. This gives the reader information useful for selecting a particular type that is suitable for his needs. A chapter on Suit Calorimeters is quite detailed. It is perhaps the most useful part of the book. It talks about the components of Suit Calorimeters, their design features, their operation and some of their performance characteristics. This is valuable to those interested in the technical aspects of these devices and those who are already in the field of calorimetry.

The book includes a listing and cataloguing of almost all of the calorimeters that have been built – some described a little more than others. In all, 36 known human calorimeters are listed in a convenient tabular form giving the date they were built, location, type and information on their size and performance. There also is a table of some of the animal calorimeters that have been built. The book concludes with a review of what factors to consider when building a calorimeter – whether it be a calorimeter for energy balance studies, thermal studies, clinical studies or other purpose.

The writing style makes the material easy to read and understand. A strong case is made for the use and potential use of human calorimeters in several areas of research where they could be of value. The author's apparent enthusiasm about the subject encourages the reader to continue reading. The same enthusiasm also shows up in some repetitions and minor details. For example, a whole chapter is devoted exclusively to a description of the Atwater-Rosa calorimeter, which is interesting from a historical viewpoint only.

This is a good introductory volume for those interested in human calorimeters. It is recommended reading for those who are considering building a human calorimeter of their own and should be of interest to physiologists, medical doctors, engineers and other researchers.

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