errors involved in relaxation-time measurements and (ii), with their expected differences in motional behavior, a considerable change of relaxation mechanisms could well take place in the series.

The relaxation data were determined using the progressive saturation method[4] with our Brukerian DFS-60[5] at a resonance frequency of 15.09 MHz. The solutions (50% w/w in $CDCl_3$) were degassed by three freeze–thaw cycles and were contained in special bulbs which matched the geometry of the rf signal coil in order to avoid diffusion effects within the liquid sample and the effect of gas–liquid exchange. The probe temperature was 30°. A spectral width of 200 Hz was used giving 2050 data points (acquisition time, 5 sec) to monitor the free-induction decay. An 8 K Fourier transform provided a resolution of 0.05 Hz/point, which seemed desirable for accurate integration. Of the various methods commonly tried to evaluate peak integrals, the most convenient method proved to be the application of a very small exponential weighting factor to the free-induction decay which produced broad symmetrical peaks with intensities directly proportional to their integrals.[6]

Nuclear Overhauser enhancement (NOE) measurements were made using a gating technique. During a delay time in the order of five times T_1, the proton decoupling frequency synthesizer was electronically switched to a position far from resonance. The ^{13}C T_1 data obtained are given in Table I. For factorization into the spin rotation and dipole–dipole contribution to the overall relaxation mechanism, the usual equations were used,[2] assuming the absence of other relaxation mechanisms for these compounds.

The major systematic error, using the progressive saturation method, proved to be the accuracy of determining the flip angle.[4] Because the common, small data-processing computers allow changes in the pulse width only in integer steps of microseconds, the method can hardly be more accurate than 10%, especially on a single-coil instrument with a typical 90° pulse within the order of 12 μsec. The random error of our measurements was close to 5%. To our knowledge, the only other reported data on cycloalkanes is that of Alger and Grant[7] who reported a T_1 for cyclohexane of 17.5 ± 2 sec, well in agreement with our results.

Table I. Relaxation Times, Nuclear Overhauser Enhancements for ^{13}C in Cycloalkanes $(CH_2)_n$

n	T_1, sec	NOE	T_{1D},[a] sec	T_{1SR},[b] sec
3	36.7	2.0	72.2	74.6
4	35.7	2.4	50.7	121
5	29.2	2.52	38.2	124
6	19.6	2.9	20.5	447
7	16.2	2.96	16.4	>1000
8	10.3	3.0	10.3	>1000
10	4.7	3.0	4.7	>1000

[a] Contribution to the overall T_1 of dipolar relaxation. [b] Contribution to the overall T_1 of spin-rotation relaxation.

The data in Table I clearly show that for the larger molecules (cyclohexane to cyclodecane) the dipolar mechanism is the only effective relaxation mechanism whereas, for the smaller molecules, spin rotation is competitive. In cyclopropane, both mechanisms are equally important. Preliminary results in this laboratory showed that there is no significant concentration dependence of the relaxation time of cyclohexane. The macroscopic viscosities of 50% solutions of cyclopentane to cyclooctane show a surprisingly good correlation to the measured relaxation time. However, the physical significance of this is not wholly clear at this point. We are currently investigating the temperature dependence of the relaxation times of these molecules and will report later studies with substituted cycloalkanes and bridged cycloaliphatic compounds.

Acknowledgment. We wish to thank Professor D. M. Grant of the University of Utah for many helpful discussions.

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(5) D. Leibfritz and J. D. Roberts, *J. Amer. Chem. Soc.*, **95**, 4996 (1973).
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(7) T. D. Alger and D. M. Grant, *J. Phys. Chem.*, **75**, 2538 (1971).
(8) (a) Postdoctoral Research Fellow, Deutsche Forschungsgemeinschaft, 1973–1974; (b) Postdoctoral Research Fellow, Deutscher Akademischer Austauschdienst, 1973–1974.

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*Book Reviews**

Annual Review of Materials Science. Volume 3. Edited by R. A. Huggins, R. H. Bube, and R. W. Roberts. Annual Reviews Inc., Palo Alto, Calif. 1973. 483 pp. Price ?

This volume is a compilation of fifteen reviews in the general area of physics and physical chemistry of solid materials, from elements, such as carbon, to complex mixtures such as concrete. More general topics, such as crystallization, mass transport in solids, liquid crystals, etc., constitute other chapters. The reviews appear to be comprehensive, with substantial bibliographies, but unfortunately it is not made clear up to what date the literature was surveyed. Substantial author and subject indexes are a welcome feature.

Bibliography of Column Chromatography 1967–1970. Supplementary Volume No. 3 of the Journal of Chromatography. Edited by Z. Dayl, J. Rosmus, M. Juricova, and J. Kopecky. Elsevier, New York, N. Y. 1973. xix + 1067 pp. $68.50.

This fat and expensive paperback consists of a carefully organized bibliography which gives full titles of all citations (translated into English where necessary). The Table of Contents is a detailed guide of thirteen pages to the many subdivisions. There is also a 160-page author index and a 137-page list of compounds chromatographed. This work is obviously indispensable to libraries

* Unsigned book reviews are by the Book Review Editor.

catering to specialists in chromatographic analysis, but it is hard to visualize the possibility of private purchase.

General Chemistry. Readings from *Scientific American*. Introductions by J. B. Ifft and J. E. Hearst. W. H. Freeman and Co., San Francisco, Calif. 1974. 434 pp. $12.00 (cloth); $6.50 (paper).

This is another in the successful series of collected papers; they start with a 1950 article entitled "Chemistry" by Linus Pauling, and end with an epilogue written by him in 1973, in which he reviews his earlier predictions and makes some new ones. The other papers cover a wide range and embrace subjects to which the title "General Chemistry" gives little clue, such as instrumental methods of analysis and the chemistry of life. As usual in this series the illustrations are profuse and excellent.

Thermodynamique Structurale des Alliages. By Jack Manenc. Presses Universitaires de France, Paris. 1972. 198 pp. 20F.

This small paperback is concerned with phase equilibria in alloys. The references cited, ten in number, are all secondary (*i.e.*, books).

Rodd's Chemistry of Carbon Compounds. Second Edition. Volume IV. Part A. Three-, Four-, and Five-Membered Mono-heterocyclic Compounds. Edited by S. Coffey. Elsevier, New York, N. Y. 1973. xix + 650 pp. $69.50.

Other volumes of the Second Edition of this important reference work have been reviewed as they appeared, and it should suffice here to comment only on this volume. There has been much reorganizing of the material of the First Edition, in addition to bringing the subject up to date. The entire effort is credited to Dr. R. Livingstone, who has surely worked very hard. There are six chapters, supplemented by a 24-page Appendix, setting out the nomenclature of heterocyclic systems according to the recommendations of the IUPAC Commission. Three- and four-membered heterocyclic rings containing but one heteroatom are covered in the first chapter, whereas five-membered systems fill the other five, the last of which is devoted largely to the increasingly important phosphorus- and silicon-containing five-membered rings. The subjects are treated concisely yet with thoroughness, and there are many tables listing compounds with their melting or boiling points and references. The viewpoint is classically descriptive, and there is very little concern with spectroscopic properties.

References are interspersed in the text, which is distracting for the reader, and incidentally makes it difficult to scan the references to see how up to date the coverage of the literature is. Inasmuch as there is no statement on this subject in the preface or the text, this is especially unfortunate. A rather casual survey disclosed no references later than 1970. With so much effort expended in producing this generally commendable work, it is a shame to see it flawed by lack of a clear statement of its period of coverage. The index is quite comprehensive and enhances the usefulness of the volume.

Progress in Phytochemistry. Volume 3. Edited by L. Reinhold and Y. Liwschitz. Wiley-Interscience, London, New York, Sydney, and Toronto. 1972. xi + 375 pp. $26.50.

This is a book for the dedicated plant biochemist. It's a lot of biochemistry and a lot of specialized plant material. The volume includes six very comprehensive reviews, all interesting and full of information, but information mainly for the specialist.

The first review is by S. Brown and L. Wetter, "Methods for Investigation of Biosynthesis in Higher Plants." They point out how the study of biosynthetic blocks by mutation is not so easy with higher plants. DNA transformation is not so easy, either, although it has been achieved recently by Leddux; sequential time of appearance of compounds, one after another, is an old ploy, but not necessarily a very good one. The next section on use of isotopic tracers is long and probably unneeded. We all know about pool sizes, permeability problems, etc. The final section on how the best final way to go in enzymology, isolating every enzyme in the biosynthetic pathway, is an "obviosity" to all of us. It is the ultimate. This is, perhaps, a good chapter, not for the rank beginner if he is a student, but the rank beginner if he is an older person trying to change his goals and lifestyle to become a student of biosynthetic pathways.

The second review is "The Biosynthesis of Ergot Alkaloids" by R. Thomas and R. Bassett. Ergot alkaloids are produced not only by *Claviceps purpurea* but also, to my amazement, by fungi such as *Penicillium*, *Aspergillus*, and *Rhizopus*, and also by higher plants as *Ipomea*, *Rivea*, and *Argyreia*. This is a very thorough and interesting review of all ergot and related indole alkaloids. It contains both historical and chemical facts and is first-class.

"The Biosynthesis of Plant Sterols" is considered by L. Goad and T. Goodwin. We start out with a catalog of all known plant sterols and their distribution throughout the plant kingdom. We next consider the biosynthesis of plant sterols, starting with squalene, all possible pathways from the resulting tetracyclic sterol precursor, different plants, and different pathways; it is very complete but does not result in any emerging simplifying principles. I prefer the more coherent and understandable reviews of Heftmann.

Next the volume considers the amino acid sequencing of proteins in the service of higher plant evolution, by D. Boulter. Several proteins are much studied, such as cytochrome *c*, proteases, histones, and ferredoxins. First Boulter gives a general picture of evolution. He leaves out histone distribution studies. Such studies show that fungi must have branched off before the common ancestor of higher plants and animals and insects, etc. Such a new view by Boulter would require only a 2-mm shift of the branch point of the fungi in his Figure 1 on page 202. That the fungi branched off from higher creatures before the common ancestor of plants, animals, and insects is a concept reinforced by the data on cytochrome *c* on page 222. Anyway, Boulter's conclusion is that we cannot construct a phylogenetic tree without the use of data in addition to protein sequence studies. Many more sequences are needed before evolutionary conclusions can be drawn from such studies alone.

J. H. Hanson reviews the bicyclic diterpenes. He considers first nomenclature, the episodic distribution of the bicyclic diterpenes, their stereochemistry, and their chemical rearrangement. This review is mainly chemical, nonbiological; as a chemical review it is very thorough and good.

The final review in the volume is by K. Takeda on "The Steroidal Sapogenins of the Dioscoreaceae." The Dioscoreaceae are a family of the Liliales monocotyledonous plants. Most Dioscoreaceae make tubers or rhizomes. Many of these are full of steroidal sapogenins. About 30 years ago Russell E. Marker not only isolated the diosgenin of *Dioscorea* species, but also discovered that it can be chemically and simply converted to steroids important to humans. The rest is history (*cf.* the history of Syntex). This review is chemical and to some extent biosynthetic, in which context it is apparent that Ray Bennett and Erich Heftmann played a major role. Overall, the volume is for specialists; but if you are interested in any of these reviews, the volume is worth it.

James Bonner, *California Institute of Technology*

Organic Selenium Compounds: Their Chemistry and Biology. By D. L. Klayman (Walter Reed Army Institute of Research) and W. H. H. Gunther (Xerox Corp.). Wiley-Interscience, New York, N. Y. 1973. xv + 1188 pp. $55.00.

This book is listed as part of the Wiley series of monographs on the Chemistry of Organometallic Compounds. It differs from the previous volumes in the series by being an edited collection of thirty-five different contributions grouped into seventeen chapters rather than being a work of one or two authors. Three brief introductory chapters are followed by nine chapters (containing fifteen contributions) on various types of organic selenium compounds. These constitute half the volume of the book. Two chapters (seven contributions) on the biological aspects of selenium, one chapter on selenium-containing polymers, and two chapters (nine contributions) on various instrumental and analytical techniques round out the book.

Certainly this collection represents the most complete compilation of work on organic selenium compounds now extant. It covers the literature through 1971 fairly completely, with a handful of 1972 and 1973 references. Unfortunately, its size and concomitant price will confine the sales primarily to libraries. The chapters on biological and related aspects of organic selenium compounds (to this reviewer the most interesting and valuable part of the book) might well have been published as a separate monograph. For workers in selenium chemistry who can afford the price, this volume will be a very useful addition to their reference libraries.

John S. Thayer, *University of Cincinnati*

Synthetic Procedures in Nucleic Acid Chemistry. Volume 2. Edited by W. Werner Zorbach (deceased) and Robert S. Tipson (National Bureau of Standards). Wiley-Interscience, New York, N. Y. 1973. x + 674 pp. $35.00.

Although the first volume of this series was, in fact, devoted to the synthesis of nucleic acid components, this one incorporates no synthetic procedures. It is instead a compilation of physical

characterization techniques used to identify the purines and pyrimidines and their nucleosides and nucleotides—and to determine their respective structures. The nine techniques discussed are ionization constants and ultraviolet spectra (A. Albert), gas phase chromatography (A. E. Pierce), mass spectrometry (D. C. DeJongh), optical rotatory dispersion (T. L. V. Ulbricht), infrared spectroscopy (M. Tsuboi and Y. Kyogoku), nuclear magnetic resonance (L. B. Townsend), X-ray crystallography (S. T. Rao and M. Sundaralingam), and liquid phase chromatography (S. Zadražil).

The chapters are rather variable—both in length and content. None can be considered an up-to-date survey of applications since all were written no later than 1970. This is particularly unfortunate in the case of the surveys of nmr and ORD. The recent extensive applications of ^{13}C nmr and of circular dichroism can only be intimated from the results of the early studies which have been included in these monographs.

The principal value of this text would appear to lie with the various spectra and tables of properties which have been accumulated and referenced as aids in identification. With the exception of the chapter on X-ray crystallography, the introductory descriptions of the fundamental principles of the techniques are extremely brief. The uninitiated worker would need more to achieve a working knowledge of the methods.

Photo-offset printing (after size reduction) of the typewritten manuscripts has been employed—presumably as an economy measure. It is difficult to reconcile this with the quoted price.

Max M. Marsh, *Lilly Research Laboratories*

The Alkaloids (Volume 3 of Specialist Periodical Reports). Senior Reporter, J. E. Saxton (University of Leeds). The Chemical Society, London. 1973. iv + 337 pp. £8.50.

From the beginning of this century dedicated fellows of the Chemical Society have summarized progress in chemistry on an annual basis. Even allowing for the biases of the reporters, the task of adequately citing major progress has become exponentially more difficult since 1960 owing to the phenomenal growth in scientific literature. Responding to this problem and endeavoring to meet the needs of the Fellows, the Chemical Society first split the Annual Reports into two sections and followed up several years later with "Specialist Periodical Reports" which now number thirty titles. This evolution has enabled the "Annual Reports" to preserve its character as well as providing timely reports, intermediate between the *Chemical Abstracts* and the traditional monograph which it may eventually replace. The Chemical Society could not have succeeded in these new endeavors without the willingness of the Senior Reporters to persuade first-class contributors to write against deadlines.

"The Alkaloids," Volume 3, summarizes the period from July 1971 to June 1972 and for the first time includes steroidal alkaloids of the Solanum and Veratrum groups. The standard of reporting and writing is high, and enough detail is given to answer obvious questions which the reader might pose. There is an author but no subject index. Provision of the latter would make use of the volume much easier for nonexpert use.

The Senior Reporter in keeping with his attempt to compile a comprehensive, critical summary of the literature within three months of the end of the next period under review would appreciate reprints on alkaloid chemistry from minor and/or regional journals that are not found in every laboratory.

William I. Taylor,
International Flavors & Fragrances (IFF-R&D)

Chemical Kinetics: Homogeneous Reactions. Second Edition. By N. M. Emanuel and D. G. Knorre. Translated from Russian by R. Kondor. Edited by D. Slutzkin. Wiley-Halsted, New York, N. Y. 1973. xii + 447 pp. $18.95.

The authors present a broad review of macroscopic theories of homogeneous chemical reactions along with *numerous* examples of reactions to illustrate the theory. The development of any theoretical ideas is outlined, and just the main results are presented. Therefore, the student in the learning stage must look elsewhere. However, the authors present enough examples to make the book a useful *supplement* for understanding the theories. There is little mention of any recent microscopic theories of homogeneous reactions which have been developed to describe results from molecular beam and chemiluminescence experiments on simple chemical reactions.

The authors take the point of view that there have been no books published on chemical kinetics within the last five years. This is evidenced by their list of recommended reference books, where every book was written five or more years ago. This list ignores a host of books on chemical kinetics within the last several years. Part of the reason for this is twofold: the book has been translated from Russian to English, resulting in a time lag due to the translation, and there is not enough communication between the United States and the Soviet Union on research ideas, so that each country often works in a vacuum with respect to the other. A book such as this is useful in that it makes the American reader more aware of the Russian literature, but this awareness is most likely five years behind active research in the Soviet Union.

Thomas F. George, *The University of Rochester*

Stress Analysis of Polymers. By J. G. Williams (Imperial College). John Wiley & Sons, New York, N. Y. 1973. 275 pp. $16.95.

This is a very clear and readable description of strain–strain analysis for application to polymer materials. The author first develops the basic relationships between stress and deformation in elastic solids. He then incorporates plastic deformation and time dependence, and goes on to apply these results in a variety of situations, such as bending and buckling of beams and sheets, plastic failure, optimum design of composite (sandwich) structures, and crack propagation. The viewpoint throughout is that of continuum mechanics. The mechanical properties of the materials are assumed to be known from the outset, and the purpose is to predict behavior under various types of loading without regard for the detailed molecular origins of these properties.

What sets this book apart from most others on mechanics is the simplicity of the mathematics employed and the straightforward physical viewpoint which is maintained throughout. Many equations are presented, but they are developed by easy stages, with an eye to teaching the nonspecialist what he needs to know.

The author states that the book is intended for the materials engineer without formal training in polymers, who must increasingly design with polymeric materials, and for the chemist without previous training in mechanics who must solve technical service problems and foresee possible uses for new polymers. He succeeds admirably in filling the needs of both.

William W. Graessley, *Northwestern University*

Geochemistry of Germanium. Edited by Jon N. Weber (Pennsylvania State University). Dowden, Hutchinson and Rose, Inc., Stroudsburg, Pa. 1974. xiii + 466 pp. $23.00.

This work is a compilation of published reports on the geological chemistry of germanium and is one volume of a series entitled "Benchmark Papers in Geology." Such compilations are designed to provide geologists with important reference works which may not be readily available.

This volume includes 43 reprints and excerpts organized into nine chapters. Each chapter is prefaced by editorial comments which provide limited biographical information on the authors and helps familiarize the reader with each investigation. Topical areas include crystal chemistry and phase equilibria, isotopic distribution, occurrence and distribution in meteorite, tektite, lunar and terrestrial samples, ores and hydrothermal processes, and occurrence in natural waters and fossil fuels.

Several works have been drawn from rather obscure sources, and all entries appear to be of lasting value. Since the compilation does provide critical reference material, it is certainly a worthwhile contribution to the geochemistry of germanium.

J. M. Haschke, *University of Michigan*

Environmental Systems Engineering. By L. G. Rich (Clemson University). McGraw-Hill Book Co., New York, N. Y. 1973. xiii + 448 pp. $16.50.

Although this book was designed principally as a textbook for engineering students, it may also serve as an excellent introduction to relevant environmental systems for the applied chemist or chemical engineer. The water environment is stressed throughout the book; however, a few topics were also surveyed from the broad spectrum of environmental study areas which includes air pollution, solid wastes, and radiological health.

The author did a commendable job in logically developing a systems approach to the selected topics, ranging from environmental phenomena to engineered facilities used for controlling the environment. His approach is mathematically based with appropriate computer solutions. There is little in the way of descriptive modeling included. The subject matter is divided into four areas: phenomena that occur in environmental systems, natural environmental systems, engineered systems, and transport processes. It is unfortunate that the survey did not provide more references to

extend its usefulness to the inquisitive reader, who may wish to locate a review article or a book on a topic which was of interest. Because of the amount of material surveyed, few topics were developed to the point where the need for supplemental references was unnecessary.

During a time when many chemists and chemical engineers are developing an interest in the new and expanding field of environmental chemistry, this book should find its place in their libraries. For only when a quantitative picture of the chemical interactions of environmental significance is developed, will environmental scientists begin to solve many of the complex pollution problems that are currently receiving attention in the popular media.

Robert B. Pojasek, *QLM Laboratories, Inc.*

Molecular Structure by Diffraction Methods. Volume I. Senior Reporters: G. A. SIM (University of Glasgow) and L. E. SUTTON (University of Oxford). The Chemical Society, London. 1973. xvi + 824 pp. £15.00.

In keeping with the high quality standards adopted by The Chemical Society for the preparation of Specialist Periodical Reports, this volume provides a comprehensive survey of recent literature in the areas of electron diffraction, neutron diffraction, and X-ray diffraction. The reporters have done an excellent job of presenting the massive quantity of structural data in the format of a well-organized treatise by subdividing the literature into structurally related topics. This organization of material, in conjunction with a detailed table of contents and author index, provides rapid access to specific information of interest.

The volume, as intended, should provide the specialist with a time-saving bookshelf reference to the current structural literature. In addition, the beginning graduate student as well as the nonspecialist will find this volume beneficial in gaining an appreciation for the current state of structural chemistry.

Richard L. Hilderbrandt, *North Dakota State University*

Environmental Phosphorus Handbook. Edited by E. J. GRIFFITH (Monsanto), A. M. BEETON (University of Wisconsin), J. M. SPENCER (Baylor University), and D. T. MITCHELL (University of Arkansas). John Wiley and Sons, New York, N. Y. 1973. xvi + 718 pp. $34.95.

The handbook is a collection of 37 papers by over 40 authors covering a wide range of subjects concerning phosphorus in the biosphere. General topics include organic phosphorus compounds in aquatic systems, analytical techniques for phosphorus determination, geochemistry of phosphorus compounds, phosphorus cycles in lakes, and phosphorus in waste-water treatment. It is a basic reference work for anyone researching areas of phosphorus chemistry in the environment. Most papers are well referenced and there is a comprehensive index.

David Linden, *University of Michigan*

Antibiotica und ausgewählte Chemotherapeutica. By ROLAND REINER (F. Hoffman-LaRoche & Co., Ltd., Basle). Georg Thieme Verlag, Stuttgart. 1974. xi + 243 pp. 14.8 DM.

Dr. Reiner has included in this small volume the structures, origins, and summaries of the pharmacology for many of the important antibiotic groups including all of those currently used clinically and most of those used in agriculture. The mechanisms of action, methods of isolation and detection of antibiotic producing organisms, and the biogenesis (where known) are also included. The relationships of structure to activity among the semisynthetic penicillins, cephalosporins, tetracyclines, and lincomycins are also mentioned. Chemical preparation of semisynthetic penicillins and cephalosporins is also discussed. Trade names and related matters are mentioned for the antibiotics currently used in Europe.

The index is very complete, and both the subject and author portions are quite free from errors; 435 papers are cited in the text and the latest references are to papers published in 1973.

This volume will be invaluable to chemists who are involved in screening programs for new antibiotics, for those who are teaching courses in the chemistry of antibiotics, and for students who want a ready reference to our knowledge on antibiotics.

D. Perlman, *University of Wisconsin-Madison*

Control Mechanisms and Protein Synthesis. By S. D. WAINWRIGHT (Dalhousie University). Columbia University Press, New York, N. Y. 1972. vii + 550 pp. $20.00.

This book was written with the aim of providing students interested in research in cellular development and differentiation with a summary of the advances that have been made in the biochemistry of protein synthesis and gene regulation. It is an excellent review of these subjects with an even emphasis on bacterial and eukaryotic systems. It thus gives a strong classical background for the problems of current interest.

In general, the various aspects of gene regulation are introduced with examples from prokaryotic systems. The first chapter is a review of the mechanism of protein synthesis—the system regulated as Wainwright terms it; and the third, fourth, and fifth chapters are on enzyme induction, enzyme repression, and gene transcription in prokaryotes. However, there is one subject that is introduced with examples mainly from eukaryotic systems; Chapter 2 is on the mechanism of controlling gene activity by changing the quantity and accessibility of genetic material itself. The subjects covered are nuclear and chromosome differentiation, gene amplification, and cell cycles. There is no discussion in this section (nor in the book) of the biochemistry of DNA replication nor of the regulation of replication in prokaryotic cells. Evidently, Wainwright felt that the control mechanisms involved with these processes are not suitable models for nuclear differentiation in higher organisms.

After the chapter on gene transcription in prokaryotes (Chapter 5), full attention is given to the specific differences and unique features of gene regulation in metazoan eukaryotes. The general aspects are covered in four separate chapters on gene transcription, regulation of gene transcription, extranuclear transmission of the transcripts, and regulation of protein synthesis; and some specific examples are presented in two chapters devoted to model systems of differentiation. By admission of the author, the examples used are ones that interest him particularly and, although they are not necessarily the most representative examples of molecular differentiation, they are suitable for his purpose of demonstrating specific principles. One of these chapters is devoted to the problem of antibody formation and the other is on three subjects, which are the replacement of histones by protamine in maturing trout spermatids, the synthesis of milk proteins by mouse mammary gland in organ culture, and the regulation of synthesis of embryonic hemoglobins in the chick blastodisc. These two chapters are more biologically oriented than the previous ones and serve to show how complex the specific problems of differentiation are and how little is known about the actual mechanisms of gene regulation involved in developmental changes. They thus indicate the challenge of the current research efforts in this field and make it clear that there is still a lot to be learned before an aspect of regulation in an eukaryotic cell will be understood as well as the regulation of the lactose operon in *E. coli* is understood today.

The strong point of this book is that it integrates very well our current understanding of gene regulation in bacteria with the more general aspects of RNA and protein synthesis in higher organisms. Wainwright has done a superb job of covering the basic material of these subjects. The book is well written and a pleasure to read, and the information presented is accurate, up-to-date at the time of publication, and very well documented with over 2500 references. In sum, it is an excellent review of the background information needed for doing research on the molecular basis of cellular development.

John P. Richardson, *Indiana University*