subject matter and which detract from the overall value of the text. The authors' use and definition of the terms monocistronic and polycistronic are incorrect and confusing, and the description of an ELISA assay is not the experimental design more commonly employed. The structure of the nonpeptidic HIV protease inhibitor U-96988 is in error, and the influenza M_2 ion channel is not accurately or overtly represented in the depiction of the virus, surprising given the focus of subsequent discussion on amantadine and the historical importance of this agent. The contention that integration of the HIV genome into the host cell chromosome is not essential for viral replication is clearly incorrect and seems to have been carried over from the description of HBV. In addition, ribavirin is not, as stated, a natural product.

Despite these shortcomings, *Antiviral Chemotherapy* is a useful text that is modestly priced and should appeal not only to its target audience but also to those individuals embarking on a career in the pharmaceutical industry.

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Introduction to Medicinal Chemistry: How Drugs Act and Why. Alex Gringauz. Wiley−VCH, Inc., New York. 1997. xiii + 721 pp. 18.5 × 26 cm. ISBN 0-471-18545-0. $89.95.

"This book is intended to be useful, indeed necessary, to students pursing a career in the health sciences...the pharmacy student...will find this book invaluable. * * * It is anticipated that this publication will also be used at the early graduate training level..." states Alex Gringauz in his preface to this volume, explaining that "(t)his book is not intended for the medicinal chemistry practitioner...". But in spite of this, the promotional material provided by the publisher on the back cover indicates "(i)t will be extremely useful...for research scientists entering the pharmaceutical industry."

The book consists of 15 chapters that discuss basic considerations and mechanisms of drug activity, drug metabolism, antineoplastics, analgesics, antimocrobials, cholinergic and adrenergic agonists and antagonists, cardiovascular drugs, CNS drugs, antiulcer drugs, local anesthetics, steroids, and new developments. These divisions result in some strange bedfellows: both thyromimetic drugs and insulin mimetics appear in the chapters devoted to cardiovascular drugs.

The exposition is at once subject to both the advantages and disadvantages of a single-author text. On the one hand, a single author can uniquely provide a unified treatment of an entire field. But on the other, it is extraordinarily difficult for a single author to be successful in the present case given that medicinal chemistry today is a broad, complex, and rapidly changing field. These difficulties become painfully apparent in the case of the references to the chapters, which tend to be quite old—for example, no later than 1989 in the chapter on anticancer drugs—or even nonexistent—for example, in the case of the chapter on drug metabolism. It is not only the references but also the text itself that are out of date in places. For example, the crucially important topic of G-protein-coupled receptors is absent altogether in the discussion of receptors in the chapter on the mechanism of drug action.

Except for a huge number of structural formulas, the volume is almost devoid of illustrations, and the few that are presented, for example, in the chapters on cholinergics and CNS drugs, are amatueurish line drawings. Most of the formulas have been (badly) drafted, rather than set in type. In my mind these are all serious defects in a book intended for students.

We live in a competitive world, and this book will have to compete against other texts, notably Foye's *Principles of Medicinal Chemistry* (4th edition, 1995), available at a similar price. Even though it is now 2 years old, Foye's is a far better book. It is written by a panel of experts, represents current knowledge, has large numbers of useful references, is beautifully illustrated, and is produced using clear, typeset formulas.

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Annual Reports in Combinatorial Chemistry and Molecule Diversity, Volume 1. Edited by Walter H. Moos, Michael R. Pavia, Andrew D. Ellington, and Brian K. Kay. ESCOM Publishers, Leiden, The Netherlands. 1997. xiii + 354 pp. 17 × 24.5 cm. ISBN 90-72199-23.5. $97.00.

This volume is the first of a new annual review series that will follow progress in the exploding field of combinatorial chemistry. The book has chapters written by 33 different authors who are experts in the fields surveyed. Combinatorial chemistry and molecular diversity are emerging disciplines, and this volume does an excellent job of bringing the reader up to date. The book is divided into three major sections: Combinatorial Chemistry, Combinatorial Biology and Evolution, and Informatics and Related Topics. All together, there are 1464 references in 20 different chapters. There is a fairly extensive subject index, but its coverage is not uniform. The keyword indexes for the biological topics seem to be thorough, whereas the indexes for the chemical topics are less so. There are, for example, no index terms for biphenyl scaffolds, the Mitsunobu reaction, or the Suzuki reaction, even though these topics are detailed in several chapters. In addition, some index terms are odd, such as Microsoft Windows and fuzzy. Overall, however the volume is packed with good information.

Each major section is launched with excellent overviews, following which chapters continue with more focused topics. The first chapter in Section I, by Kiely (Houghten Pharmaceuticals), describes techniques for

mixture synthesis, emphasizing non-peptide approaches. Many of the methods discussed in this chapter have their roots at the beginning of combinatorial chemistry, such as Houghten's tea-bags, Geyson's pins, or Furka's split-mix method. Kiely maintains that deconvolution of mixtures "remains a robust and highly useful" method, and he provides three answers to the question, "Why mixtures?" First, current robotic synthesis of single compounds can not keep up with high-throughput screening. Second, the use of mixtures to find individual pure active compounds is well-precedented (cf. natural products). Finally, sometimes the biological target is in short supply, and it is desirable to minimize the number of assays. The second chapter, by Sarshar and Mjalli (Ontogen Corp.), reviews various techniques for synthesis of individual pure compounds—"singles." The next chapter, by Hall (Sphinx Pharmaceuticals), provides an overview of advances in solid-phase synthesis. He describes the state of the art and mentions the fact that most reactions are carried out on only two solid supports—cross-linked polystyrene (Merrifield resin) or Tentagel (a PEG-modified polystyrene). He discusses the use of linkers and describes solid-phase variants of many well-known name reactions. The chapter by Sucholeiki (Sphinx) details selection of commercially available solid supports and provides much useful data on physical properties of resin materials, including swelling and loading. Next, Coe and Storer (Glaxo) discuss solution-phase synthesis of compounds such as methods that employ soluble polymeric supports, dendrimeric solution-phase arrays, and other techniques. Mention is also made of the latest novel method—flourous-phase synthesis. The next chapter, by Fitch (Affymax), reports on analytical chemistry of combinatorial library synthesis. While product cleavage and off-bead analysis are widely used, measurement of yields by gravimetric methods is recommended by Fitch, based on experience at Affymax. The chapter also reports examples of on-bead spectroscopic methods such as IR, NMR, and ^{13}C NMR. A survey of the great advances in LC/MS techniques leads to a warning: "...there is no excuse for not fully characterizing compounds made by parallel synthesis". The assumption in this statement by Fitch is that mass spectrometry actually provides full compound characterization. It is widely known that this is not the case. In the next chapter, Dewitt (Diversomer Technologies) surveys the field of automated synthesis. Finally, the chapter by Patel (Versicor) discusses actual applications of combinatorial chemistry in drug discovery. Patel surveys both synthesis and screening and leaves the impression that diverse chemistry provides promising biological results.

The second major section is titled Combinatorial Biology and Evolution. The five chapters in this section provide an interesting collection of reviews on the more biological approaches to combinatorial chemistry. The first chapter, by Levitan (Santa Fe Institute), discusses both biological strategies for molecular diversity and information theory, as well as concepts underlying the application of such techniques to discovery. This is followed by a chapter by Schuster (Universitat Wien and Santa Fe Institute) that reviews the principles of evolutionary biotechnology. The following chapter by Ellington (Indiana University) continues with an excellent description of biological approaches to molecular evolution. The concept of "fitness landscape" for evolution and in vitro selection is very nicely described. The relationship of genetic diversity (random synthesis of DNA) and methods for the selection of compounds are examined; molecules that bind suitably to a receptor are allowed to "breed", for example, by PCR, which can amplify by a factor of 1 000 000 the desired molecule in a single generation. The next chapter, by Lam (Selectide), describes the solid-phase synthesis of peptide libraries by split-mix techniques. This topic examines a subject which truly is the roots of combinatorial chemistry. Lam makes a good case that the future for synthetic peptides is still bright, since many natural ligands are peptides. The final chapter in this section is an excellent review of phage display. Collins (Braunschweig) describes phage display in the context of the concepts of molecular diversity. He clearly presents the technique in comparison to organic chemistry methods. Collins describes the presentation of millions of ligands on the surface of a bacteriophage, the use of affinity selection techniques (called "panning") to concentrate the best specific binding clones, and finally sequencing of the consensus motifs and even model building to provide insights on the final structure. This chapter is long (52 pages with 255 references) and is quite comprehensive.

The final section, Informatics and Related Topics, is a collection of seven diverse topics: databases, high-throughput screening, deconvolution methods, combinatorial patent strategies, combinatorial business alliances, the promise of combinatorial chemistry, and a compendium of 643 solid-phase synthesis references. While these sections are not as detailed or comprehensive as those of parts I and II, they are filled with interesting tidbits. The penultimate chapter of the section is called Combinatorial Chemistry—Promise Fulfilled? This chapter is a teaser for the next volume of this series. The author claims: "The future versions of this section will provide the answer to this question."

In conclusion, this review volume is very worthwhile for all practitioners of molecular diversity: chemists, biologists, theoreticians, and even business types. One's first impression is that Volume 1 may be the best of the series. It will be interesting to see if the editors can continue to maintain such a meaty series. It may be largely determined by the efforts of scientists around the world who are discovering, developing, and publishing new advances in the fields of combinatorial chemistry and molecular diversity. In conclusion, I recommend this book to everyone with an interest in combinatorial chemistry and molecular diversity.

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Purinergic Approaches in Experimental Therapeutics. Edited by Kenneth A. Jacobson and Michael F. Jarvis. Wiley-Liss, New York. 1997. xiv + 581 pp. 16 × 24 cm. ISBN 0-47114071-6. $89.95.