The "Hands-On" Approach

Experimental Organic Chemistry. By *Daniel R. Palleros.*. John Wiley and Sons Inc., New York 2000. xxiv+833 pp., hardcover £ 58.95.—ISBN 0-471-28250-2

Organic chemistry occupies a considerable proportion of any study of chemistry. In order to gain some familiarity with the enormous variety of compounds and reactions in organic chemistry, it is essential to accumulate some practical experience in the laboratory. It is only there that one acquires the necessary knowledge of materials and a feel for organic chemistry. There are already many textbooks on practical laboratory work. So what are the qualities that make this work by D. R. Palleros an interesting textbook? The author has succeeded in writing an easily understandable, practically oriented, textbook on preparative organic chemistry, which will be useful to a wide readership.

The book is divided into three sections. Section 1 ("The Basics") contains three units: Unit 1, "Laboratory Safety; Unit 2, "Basic Concepts"; and Unit 3, "Basic Operations". As preparative work in the laboratory is an essential part of the study of organic chemistry, it is important to observe certain safety procedures and rules from the start. In Unit 1 the reader learns about basic safety guidelines, so as to know the answers to questions such as: "What clothing should one wear in the laboratory?", "How should chemicals and glass apparatus be handled?", "What should one do in a dangerous situation or emergency (e.g., fire, fire alarm, spillages or splashing onto skin)?", "How should chemicals be labeled and stored?", or "How should one dispose of chemicals and laboratory wastes?". The author also mentions some particular chemicals with which one needs to be familiar, such as peroxides, peroxide-forming compounds, and cyanides, and describes safe procedures for handling them. Unit 1 ends with a list of useful literature references and Internet addresses on laboratory safety and the toxicity of chemicals.

Unit 2 ("Basic Concepts") discusses some important fundamental principles of a sort that every chemist should be able to recite while asleep, and which are used frequently in the experimental part of the book. These include the calculation of yields, descriptions and classification of organic solvents, polarity and hydrogen bonding, calculating the concentration of acids, advice on keeping a laboratory notebook and writing reports, and searching the literature, with some information about important journals, catalogs, textbooks, and works of reference. Cross-references to this unit occur throughout the rest of the book.

Unit 2 begins with an initial survey of working procedures and basic laboratory operations needed for carrying out organic reactions. The chapters that follow deal with topics such as handling liquids, filtration, working under reflux or in a vacuum, and centrifuging. The numerous diagrams (e.g., construction of a rotating evaporator, apparatus for vacuum filtration) help to make the operations easily understandable.

The second and longest section of the book (Units 4–9, 608 pp.) contains the experiments. These are designed to give an understanding of the synthesis of organic compounds, and of methods for isolating, separating, purifying, and identifying compounds. Each unit consists of two parts: first some background information, then the actual experiment. The first part gives an overview of the subject concerned. A short introduction is followed by the theoretical fundamentals, the mechanism of the reaction, a description of the apparatus, and instructions for how to use and maintain it. Additional information is given in a box highlighted by a double border. This typically includes the historical background of the chemistry and operations involved (e.g., a short history of distillation), and interesting connections between chemistry and everyday life (e.g., the use of ethylene for preserving fruit, the origin of colors, the formation of the ozone hole). These short digressions enhance the pleasure of reading the book and generate an enthusiasm for research. The theoretical part is accompanied by exercise problems, and answers to the less straightforward ones can be found at the end of the book. These problems help the reader to prepare for the experiments that follow, and to test his or her understanding of the subject.

Each experiment begins with an overview and a short description of the experimental set-up. Usually each unit contains two experiments, or one experiment with two independent parts. Clearly set out boxes in the margin give important information such as safety precautions, recommended workup procedures, and advice on handling the apparatus. Other useful information given includes the approximate duration of the experiment, and there are units containing relevant background material. "Pre-lab" and "in-lab" questions at the end of each unit help the user to be well prepared before the experiment and to write down a protocol. From Experiment 11 onward, the reader is also provided with ^{1}H NMR, ^{13}C NMR, infrared, and mass spectra, which can be used to evaluate the results and to compare with the user's experimental spectra if available. These data also provide some experience for students who do not have

the facilities to record spectra. The experiments in Units 4–11 and 14 introduce the main techniques of organic chemistry, including recrystallization, distillation, extraction, chromatography (GC, DC, SC, and HPLC), refractometry, and polarimetry. The individual techniques are described in detail. The presentation of theoretical background information and practical advice on working methods and apparatus in these units is excellent. For example, column chromatography is described very thoroughly, including many important practical aspects such as column packing, sample introduction, elution, and work with microcolumns.

Units 12–17 and 19–22 are concerned with the chemistry of functional groups, which are treated in the sequence usually found in textbooks. However, the theoretical treatment of the different types of reactions is too brief. Many of the experiments have a biological background or are related to medical applications, and those in Units 24 onward are of special interest to food chemists, biologists, and medical students. The chemistry of proteins, carbohydrates, fats, enzymes, and nucleotides is described and illustrated by experiments (e.g., an investigation of the constitution of milk, and the isolation of casein and lactose). The unit on bioorganic chemistry includes an elementary introduction to stereochemistry. Section 2 also contains a unit on polymers and one on the chemistry of dyes and pigments. Here the experiments have been well chosen for their practical relevance (for example, after preparing dyes by various methods, the student tests their color fastness by experiments on dyeing cotton).

Section 3, the last one, is concerned with the broad subject of spectroscopy. Infrared, UV/Vis, and NMR spectroscopies are treated in detail, as also is mass spectrometry. The physical and mathematical background of each method is explained (e.g., Fourier transformation), followed by the construction of the instruments and much advice about how to interpret spectra. Here too exercise problems are provided to give a deeper insight.

To summarize, *Experimental Organic Chemistry* introduces the reader step-by-step to the language of the organic chemist. Fundamental concepts are explained in detail, and the many figures and sketches help in understanding the material. Because of the broad scope of the experiments, the users for whom this book can be recommended are not limited to chemistry students. It will also be useful to students of food chemistry and of related disciplines such as biology and medicine, to chemistry teachers, and to high school students. Many of the experiments could also be used in basic organic chemistry practical courses.

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Practical Process Research and Development. By *Neal G. Anderson.* Academic Press, San Diego 2000. 354 pp., hardcover $ 89.95.—ISBN 0-12-059475-7

Several books on industrial process research and development were published recently. This trend is probably connected to the growing pressure on pharmaceutical companies to develop more projects in a faster way in order to bring more new products to the market. Therefore, to find the best method for manufacturing a new compound quickly becomes crucial. On the other hand, process chemists become more and more aware that they should let other colleagues from the scientific community benefit from their wealth of chemical experience. This was probably one of the drivers for Neal G. Anderson in writing *Practical Process Research and Development*. Being a very experienced process chemist who has worked for over 20 years in chemical process R & D in the pharmaceutical industry, he states in the preface that his goal in writing this book was to provide a comprehensive, step-by-step, hands-on approach to organic process research and development for the preparation of small molecules.

The book is divided into 16 chapters in which chemical and technological problems from the author's own experience, as well as from the literature, are discussed. The first chapter ("Approaches to Process Development") provides an introduction to the theme. The author emphasizes the importance of simplicity in scale-up operations, as simple processes usually save time in the pilot and manufacturing plants and therefore also money. Furthermore, he shows that development of successful processes can only be achieved by a team of specialists from different disciplines. Especially useful for newcomers is the classification of operations into those that can and can not readily be used on a manufacturing scale. Another valuable feature throughout the book are the "TIPs", which are specially marked pieces of advice from the author's great experience. They are also very useful for quick readers, as they often summarize the essentials of the different topics. The information content of these tips ranges from very important advice of interest even to experienced process chemists to more or less self-evident issues. However, this is not to say that the majority of these hints are not very useful.

In the second chapter different aspects of "Route Selection" are discussed. The definition of the best route usually changes during the development of a process, as in the beginning of a new project it might be acceptable to scale-up expedient research routes in order to secure a quick supply of the drug substance for the other development functions. When a project moves on, other issues such as technical feasibility and availability of suitable equipment in the manufacturing plant, as well as long-term availability of bulk amounts of inexpensive starting materials and reagents, become more and more important. The goal of each optimization is to find the most cost-effective route to a new chemical entity, e.g., by minimizing the number of steps and protecting-group manipulations, taking advantage of a convergent synthesis, and minimizing environmental impacts. This chapter ends with a good example of a cost estimation spreadsheet for the assessment of an ultimate route, which can also be used to compare the efficiency of different routes.

The following chapter on "Reagent Selection" emphasizes the importance of safety, toxicology, and cost considerations in choosing the right reagent for scale-up. With these criteria in mind several families of reagents are dis-

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cussed, e.g., organometallic and alkoxide bases, amine bases, oxidation and reduction reagents, as well as catalysts, polymeric reagents, and biocatalysts. As generations of chemists in universities and industry have developed thousands of reagents which can be useful to solve synthetic problems, this chapter of 27 pages is necessarily incomplete. Nevertheless, a good introduction and valuable tips are given. Interesting literature is cited, but the reader should also have been referred to more comprehensive works on reagents (e.g., "Fieser and Fieser" or *Encyclopedia of Reagents for Organic Synthesis*, Ed.: L. Paquette).

From our point of view the chapter on "Solvent Selection" is one of the best in the whole book, as it describes in a systematic manner how to select solvents to increase reaction rates and to ensure the desired quality and yield of products. Other important considerations include minimizing waste by efficient solvent recovery. Here too the author distinguishes between solvents that are useful for scale-up and those that are inappropriate. Especially valuable are the tables in which important physicochemical properties of the different solvents are collected from several sources, including, for example, their solubility in water and their ability to form azeotropes with water. He also gives caveats on the handling of solvents on a large scale, as they might be responsible for impurities in the final drug substance, either by directly reacting with the compound (e.g., alkylation of amines by methylene chloride during overnight storage of solutions) or due to high-boiling impurities in the solvent itself which will remain in the reaction product after stripping off the solvent.

The fourth chapter deals with "Running the Reaction". This chapter alerts the reader to a lot of important considerations when transfering a reaction from the laboratory to the plant scale. Assessing safe operating conditions is always first on the list, regardless of the planned reaction scale. In several sections it is emphasized that success in scale-up of a process depends greatly on the proper selection of the right reaction conditions (e.g., temperature, pressure, reaction time, mode of addition of reagents, stirring) as well as on the specific description of the experimental procedure. Phase-transfer catalysis is also mentioned briefly as a helpful technique in large-scale reactions. However, given the importance of this methodology a separate chapter on this subject would have been desirable.

"Effects of Water" are discussed in Chapter 6, as water may play a decisive role in a reaction as solvent, as a beneficial additive, or as a source of side products. Although the right water content is very important for many reactions, it is questionable whether this chapter should not be a part of Chapter 4 ("Solvent Selection"), as some aspects are already described there.

"In-Process Controls" (Chapter 7) are used to verify that all stages of processing have been completed as expected, and such controls (IPCs) are therefore crucial to every process development. Moreover, IPCs are very important in another respect, as they must be included in the DMF (Drug Master File) section of a New Drug Application filed with the United States FDA. These regulatory requirements are discussed briefly within this and other chapters, but as these issues are becoming more and more important for the daily work of process chemists in the pharmaceutical industry, a separate chapter on regulatory issues would be a valuable addition for a second edition of this book.

In Chapter 8 the author gives advice on how to optimize a reaction by minimizing impurities, as the presence of impurities often complicates purification and reduces yields. Many different parameters, such as temperature, reagents and solvents, reaction concentrations, stirring, and reaction times, can influence the outcome of a reaction. How reactions can be optimized by properly adjusting these parameters is explained using examples of successful large-scale syntheses from the literature. Unfortunately many processes are complex, and therefore the classical approach of modifying one variable at a time may fail. A more organized approach to interdependent variables is employing statistical design of experiments (DOE). The introduction to this powerful optimization tool at the end of this chapter is far too short, and the theoretical background, as well as more examples of DOE, should have been discussed more thoroughly. In particular the combination of DOE with robotics and automated process optimization systems is a new and efficient tool. This now extremely rapidly growing field of automation in chemical process research and development is only mentioned very briefly (two sentences!) at the end of the chapter, and the literature citation is far from comprehensive. New developments such as the use of microreactors in chemical development and production are not mentioned at all. This last section seems to have been added by the author in a hurry, and this aspect should get much more space in a second edition of this book.

Given the multitude of catalytic reactions currently available to the organic chemist, the short description of how to optimize catalytic reactions (Chapter 9) is incomplete, but nevertheless it is still valuable, because the author shares with the reader a lot of tips for general approaches to catalytic optimization problems. Here again, rapid determination of the best set of parameters by automated screening of reaction conditions can greatly accelerate the development and optimization of catalytic reactions, and therefore should be discussed in detail.

The chapter on "Work-up" is one of the most important in the book, as such a summary on this topic is not easily accessible elsewhere, and also the topic tends to be rather neglected in university teaching. The job of a process chemist is not complete when the reaction is done, because work-up of the reaction mixtures and isolation of the product in pure form is at least as important. Given its importance, it would be desirable to learn even more from the author's rich experience, and that would need more than 18 pages. In particular the section on solid-supported reagents is too short, if one takes into consideration the already important role of these reagents for environmentally benign processes.

In Chapter 11 "Tools for Purifying the Product" are discussed. Purification by traditional column chromatography and simulated moving bed chromatography is described, as well as crystallization and reslurrying. Especially important for the process chemist in the pharmaceutical industry is the ability to manufacture a given polymorphic form reproducibly, and to select the best salt form. The

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importance of selecting and preparing the best polymorphic form is also discussed in the following chapter on "Final Product Form and Impurities Considerations", together with other regulatory aspects concerning the quality of the final drug substance.

Chapter 13 ("Vessels and Mixing") is more technically orientated. The strong influence that mixing and vessel design can have on the scale-up of a reaction is described, and the characteristics of batch and continuous operations are compared. Some special reactor types such as photoreactors and electrochemical reactors are also described briefly. Alongside these interesting technical aspects, the section on immobilized catalysts does not seem to fit well into this chapter, and should be better placed in Chapter 9 (catalyst optimization).

"Preparing for and Implementing the Scale-up Run" is the theme of Chapter 14. The author describes a step-by-step approach to successfully scaling up a reaction from the laboratory to the pilot plant, taking potential pitfalls into consideration. An action checklist for the preparation for the scale-up run is a useful supplement at the end of the chapter.

After a process has been transfered to the plant, new problems can sometimes arise during further development and manufacturing. Such problems have to be solved very quickly, as there is usually increased pressure due to the financial impact of such difficulties. Therefore "Troubleshooting" (Chapter 15) is an important aspect of the daily work of a process chemist. Steps for analyzing and solving the problem are described in a thorough way.

The final chapter on "Chiral Syntheses" (14 pp.) is rather sketchy and not always consistent. For example, the resolution of racemates (Section II.B.2) does not belong to the category of molecules prepared by asymmetric synthesis (heading of Section II). To put this chapter at the end of the book is not really logical, as it would fit better into the more chemically orientated parts on reaction and catalyst preparation.

The layout of the book is of good quality and therefore it is easily readable. As mentioned above, the many tips and tables are extremely valuable for practical work. This is reinforced by over 550 literature citations which cover work published up to early 1999.

In summary, we believe that every newcomer to the exciting field of process research and development should read this book, but also experienced process chemists and even academics will find it very useful and stimulating. As the language of stock analysts and brokers is very popular today, we recommend *Practical Process Research and Development*, by Neal G. Anderson, as a "strong buy" because this investment will pay off very quickly.

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A Chemical History Tour. Picturing Chemistry from Alchemy to Modern Molecular Science. By *Arthur Greenberg*. John Wiley & Sons Inc. (Wiley-Interscience), New York 2000. xviii+312 pp., 164 figs., hardcover $ 38.95.—ISBN 0-471-35408-2

There is a tradition of antiquarian book collecting among practicing chemists. For instance, the late Franz Sondheimer owned a superb collection whose auction after his death was a major event. Over the years, Professor Greenberg, formerly chairman of the Department of Chemistry at the University of North Carolina in Charlotte, now Dean of Arts and Sciences at the University of New Hampshire, has also assembled a private collection. He is now sharing his bibliophilic interests with fellow chemists. Where one might have expected dry scholarship and historical information, seemingly remote from present concerns, Greenberg has turned out a delightful, easy to read, and highly entertaining book. Yes, the title is most accurate: the reader is taken on a tour of an ideal alchemical and chemical library, where he is let loose leafing through the printed volumes with Greenberg serving as a guide, relating each picture to present-day chemistry, putting it in its historical context, and offering tongue-in-cheek analogies.

Chapter 1 starts with the *Prima materia* of the alchemists, the four elements of Empedocles, the Pythagorean polyhedral geometries whose universality Kepler envisioned for nature, seeding of the Earth with metals, and the chemical symbolism of Moyse Charas (1678). It presents and describes 11 plates from Lazarus Ercker's *Aula Subterranea* (1574) to illustrate 16th century technologies of practical chemistry, mining, and metallurgy. Chapter 2 deals with alchemy. Rooting it in the Middle East, it relates the four colors of transmutation (black, white, citrine, and red) to the glazes of native earthenware in many cultures. It presents glassware and its symbolic equivalents. Showing the title pages of some of the key texts in spiritual alchemy, it also presents and explains some of the Keys of "Basil Valentine", one of the emblems from Michel Maier's *Atalanta fugiens* (1618) and six plates from *Mutus liber* (1677) by "Altus." Chapter 3, on Paracelsian iatrochemistry and spagyrical preparations, focuses also on the technique of distillation, documented from Conrad Gesner and with four plates out of John French's *Art of distillation* (1653). Chapter 4, on the emergence of chemistry as a science, is one of the most fascinating. Justifiably, Robert Boyle is a central figure, since as we now know he truly epitomizes the transition from alchemy to chemistry. The chapter closes with Geoffroy's affinity table (1718) and with three plates out of Stephen Hales's *Vegetable Staticks* (1731). Chapter 5 illustrates the birth of modern chemistry, from Priestley's and Lavoisier's work on the composition of air and water to Dalton's atomic theory. Chapter 6 deals mostly with agricultural and industrial applications during the first half of the 19th century, giving pride of place to electrochemistry (Davy and the Berzelian dualism) and analysis (Liebig). Chapter 7 does justice to the popularizers (Marcet, Faraday). It also features less well known but nevertheless imaginative writers such as Decremps and his 1823 *Diagrammes chimiques* and the 1854 *Chemical Atlas* by Youmans, both with admirably clear graphics. The final chapter closes on contemporary achievements such as STM imaging of atoms and Stang's self-

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assembled polyhedra, after going through the periodic table and the underlying atomic structure, Lewis formulas, and the DNA double helix—no less an icon of chemistry than Kekulé's benzene formula.

In summary, the book is thoroughly recommended, if anything for providing in a very convenient and nicely produced format a portfolio of most interesting pictures from major alchemical and chemical texts. The unpretentious approach and the lively style, with its witty asides (and puns), make for high readability. It will be a must on the shelves of the cultured chemist, no longer an endangered species on account of efforts such as this one.

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Modern Amination Methods. Edited by *Alfredo Ricci*. WILEY-VCH, Weinheim 2000. 285 pp., hardcover DM 228.00 (ca. 116 Euro).—ISBN 3-527-29976-9

Amines are of enormous importance in organic chemistry, pharmacology, plant protection, and medicine, and also in industrial processes as intermediates or products. Until fairly recently they were still commonly produced by methods developed in the 19th century in the early years of organic synthesis. However, the enormous amount of activity in organic synthesis during the last 25 years, including especially stereoselective methods, has led to the development of new amination reactions and methods for stereoselectively creating C–N bonds. This book is intended to present a comprehensive report on these developments. The preface cites a number of earlier review articles on selected areas of the subject.

Chapter 1 (pp. 1–36), by Karl Anker Jørgensen, entitled "Modern Allylic Amination Methods", begins with nucleophilic aminations of functionalized alkenes such as allyl alcohols or allyl halides. The palladium(0)-catalyzed amination of halides is of special importance here; there are also enantioselective variants of this, and analogous methods using other transition metals. An interesting and very promising method for synthesizing allyl amines involves reacting olefins with nitrene complexes, which are prepared from PhI=NTs using a transition metal catalyst. It is also possible to aminate olefins by an ene-type reaction using compounds such as Ts–N=S=N–Ts or azo compounds. Allyl amines can also be synthesized by reacting olefins with Ph–NH–OH using a transition metal catalyst. This chapter gives the reader a good overview of the intensively researched topic of allylic amination methods, even though some of the methods described are not capable of giving really good results.

In Chapter 2 (pp. 37–63) Elena Fernandez and John M. Brown report on "Electrophilic Amination Routes from Alkenes". They begin with a method in which a boron compound prepared from an olefin is treated with an electrophilic aminating reagent such as H_2N-X, where X acts as a leaving group, giving a primary amine in high yield. It is also possible to prepare a boron compound by enantioselective hydroboration using a suitable reagent, thus affording a route to enantiomerically pure amines. However, Scheme 13 on page 44 is rather misleading, as it is not clear whether one is concerned here with diastereoselectivity or enantioselectivity: what reagent was used for the hydroboration?—and is it a *de* value or an *ee* value that is given? Secondary and tertiary amines can be synthesized by reactions analogous to that for primary amines. The direct amination of an alkene by reaction with an amine, in which the N–H bond reacts additively at the C=C bond, was discovered only three years ago. It can be carried out using a samarium catalyst, and can take either an intermolecular or an intramolecular form. Enantioselective variants of this synthesis have also been reported.

Chapter 3, by Jean-Pierre Genet, Christine Greck, and Damien Lavergne (pp. 65–102), deals with "Stereoselective Electrophilic Amination with Sulfonyloxycarbamates and Azodicarboxylates". After describing the preparation of the reagents, the authors discuss the stereoselective synthesis of α-aminocarboxylic acids and -phosphonic acids, followed by the reactions of sulfonyl oxycarbamates with chiral enamines and enol ethers. Next they report on the use of azodicarboxylates as efficient reagents providing electrophilic nitrogen atoms. They can be used to synthesize amines from silylketene acetals, ketoenolates, P-stabilized "anions", and other nucleophiles, in some cases enantioselectively. The chapter gives an excellent overview of this topic, which is important from a synthetic standpoint.

In Chapter 4 (pp. 103–128), Heiko Tietgen, Martin Schultz-Kukula, and Horst Kunz report on "Glycosylamines as Auxiliaries in Stereoselective Syntheses of Chiral Amino Compounds". They describe how amines derived from carbohydrates can be used for stereoselective syntheses of amino compounds, a development in which one of the authors (H.K.) has been closely involved. By treating the glycosylamine with an aldehyde one obtains an enantiomerically pure α-amino acid. Similarly, reaction with silylketenes yields the corresponding α-amino acids, while stereoselective multicomponent reactions (Passerini, Ugi) yield (stereoselectively) amides of α-amino acids. Glycosylimines can be used in a Diels–Alder reaction to synthesize cyclic amines stereoselectively. This survey shows that glycosylamines have now become very important reagents for stereoselective syntheses.

The subject of Chapter 5 (pp. 129–168), by Craig S. Tomooka, Hitoshi Ikura, and Erick M. Carreira, is "Syntheses of Transition Metal Nitride Complexes". The chapter is essentially concerned with metal nitride complexes in which a nitrogen atom is bonded to a transition metal atom in the ratio 1:1. First the authors summarize the various sources of nitrogen that can be used, then they treat in detail the amination of vanadium, chromium, molybdenum, tungsten, manganese, tellurium, rhenium, ruthenium, and osmium to give nitrides. Areas in which these compounds are potentially important include nitrogen fixation, the transfer of nitrogen atoms to a wide variety of acceptors, and new materials, and therefore the interest of the article is not confined to chemists engaged in organic synthesis.

In Chapter 6 (pp. 169–194), Satoshi Minakata and Mitsuo Komatsu take up the subject of the nitrides mentioned above, in their contribution "Asymmetric Nitrogen Transfer with Nitrido-

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manganese Complexes". After introducing the topic of the transfer of an RN group onto an olefin, they describe in detail the use of chiral nitridomanganese compounds for asymmetric syntheses, mainly of aziridines but also of aminoketones. The main significance of this amination reaction concerns its use for converting styrene or styrene derivatives into aziridines. Thus, at least at present, such processes are only of limited importance.

Chapter 7 (pp. 195–262), in which John F. Hartwig reviews the "Palladium-Catalyzed Amination of Aryl Halides and Sulfonates", is a highlight of the book. During the 1990s the author, as well as S. L. Buchwald, have developed this reaction into a completely new method for preparing aromatic and heteroaromatic amines, the importance of which can hardly be overemphasized. Although several review articles on this topic have already been published, the rate at which further results have continued to appear has made a new survey necessary, and it is appropriate and pleasing that it has been written by J. F. Hartwig. The chapter is a high point of the book in every respect.

All the chapters together cover most of the currently important developments in the field. However, it could have been mentioned in one of the articles that the amination of DNA is a cause of the mutagenic and carcinogenic properties of aromatic amines and nitro compounds, through the formation of electrophilic aminating reagents, such as the corresponding *N*-acetoxy compounds, as intermediates. This emphasizes again that in vivo there have long existed reagents and reactions that are of current importance in the context of this book.

To summarize: *Modern Amination Methods* is an important contribution to the subject for everyone interested in the application of modern (including enantioselective) methods to the synthesis of amines. I am sure that the book will appear on the desks of all chemists concerned with the area. It is definitely a must for every chemical library.

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Crystal Engineering: From Molecules and Crystals to Materials. Edited by *Dario Braga, Fabrizia Grepiani* and *A. G. Orpen*. NATO Science Series, Ser. C: Mathematical and Physical Sciences, Vol. 538. Kluwer Academic Publishers, Dordrecht 1999. x + 500 pp., hardcover £ 137.00.—ISBN 0-7923-5898-8

This book contains 28 conference contributions to the "School of Crystal Engineering" which took place in 1999 in Erice, Italy. It deals with a topical area of solid-state chemistry and materials science. Due to the large number of articles, not all of the authors can be mentioned, nor can all their different topics, which are often only loosely related. The most numerous contributions are those related to organic compounds in the solid state. They are concerned with technical aspects of structural analysis, and some of its uses in materials science. The first type of contributions is represented by theoretical (crystal packing and energetics, data bases), technical (neutron and synchroton X-ray measurements, NMR spectroscopy) and applied topics (statistical analysis of hydrogen bonds, secondary interactions, and inclusion compounds). The crystal properties mentioned for applications in materials sciences include magnetic effects and organic superconductors, nonlinear optics, and thermochromism. Biomineralization also appears, of course, as a topic that is seldom absent nowadays.

Unfortunately, the purchase of this book can not be recommended. The reason is not the quality of the contributions—some of which are, in fact, quite stimulating (but whose contents may be found in many cases in similar articles elsewhere). Rather, it begins with the enormously high price which will make everybody feel uncertain about whether they can afford it or not. And, unfortunately, after closer inspection this does not remain the only reason. A successful conference cannot always be effectively transformed into a book. It is probably unavoidable that all the contributions from authors who used different fonts were just copied without any corrections. It is probably also still understandable that the contributions to a conference mainly deal with the authors' own research (up to 73% self-citations in this case). Unfortunately, however, the editors seem to have done no more than to contribute a 1½-page preface and to collect the articles together. There is not even a modest index. Although there are many cross-references, at least in the article by J. Perlstein (written: Persltein), they only refer to "this volume" without even chapter numbers, let alone page numbers. At least a table of contents is provided, so that the search becomes a little easier.

No guidelines for style or size of the articles appear to have been provided. Some of them restrict themselves to a basic or historical overview, others almost exclusively to the author's own research. G. R. Desiraju, appearing so often in the chemical literature, has condensed his article to 2½ pages, but at least adds nine pages of citations. Probably to reduce production costs for the publisher to an absolute minimum, all pictures could only be printed in black and white, and in some of them the details have become almost invisible (e.g., pp. 249, 250, 252, 325, 417, and 493).

To finally repeat it: unfortunately, I can not recommend the purchase of this book even to wealthy individuals or institutions with interests in the title area.

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