

as one expects in view of the importance of these methods to the pharmaceutical industry. As can be seen from the literature references cited, many books and review articles dealing with aspects of virtual screening have appeared in the last few years. That is especially evident in Chapter 4, which is concerned with similarity searches. The authors have incorporated into this book most of the work that they have published in the primary literature.

Chapter 1 gives an introduction to high-throughput screening (HTS) and virtual screening. Although it contains a brief summary of the current state of the art in HTS, it fails to provide the reader with a comparison and evaluation of the various virtual screening methods used in the development of pharmaceutical agents. Chapter 3 deals with the subject of predicting physicochemical properties, the great importance of which is clearly emphasized in the opening sentences. Although an active agent may have a high affinity for binding to the receptor, that is of no use if it turns out to be ineffective in vivo because of insufficient solubility and bioavailability. This chapter is concerned with calculating lipophilicity, solubility, pK value, and protein-binding efficiency. Several references in this chapter give the impression that a paragraph is missing.

In Chapter 5 on the modeling of structure–activity correlations and in Chapter 12 on measurements of molecular diversity some mathematical formulas were unavoidable. In Chapter 5, for the benefit of readers with only limited mathematical knowledge, some statistical methods are explained in the appendix.

Chapter 7 describes the identification of pharmacophores in biologically active compounds and their use in virtual screening. The applications range from the screening of already existing data bases to the design of compound libraries. In the discussions much space is devoted to problems associated with the conformational flexibility of molecules. For identifying pharmacophores one can use various computer programs that are commercially available. Chapter 11 includes tables listing programs for dealing with docking and for de novo design of pharmaceutical agents, and discusses ligand–receptor interactions in the con-

text of predicting binding constants. As well as the question of the conformational flexibility of molecules, the chapter discusses problems of protein flexibility and the role of water molecules in the docking experiment. Several examples of interesting pharmaceutical projects are described.

If the crystal structure of the biological target is known, one can carry out docking or superposition experiments with the ligands to achieve a virtual screening with selection. In Chapter 10 a university-based research group explains this principle. The examples described illustrate its relevance to pharmaceutical development.

Who will benefit from this book? What group of readers is it intended for? For medical chemists involved in the synthesis of active agents the book provides an excellent survey of the methods that are currently available for virtual screening. A particular advantage of the book is that the various aspects of virtual screening (library filtering, drug-likeness, ADME, QSAR, etc.) are considered from different viewpoints by the authors of the individual chapters. In that way the reader with only a limited knowledge of the subject can appreciate the concepts from a variety of different standpoints. However, the book has a few weaknesses, some of which are mentioned above, and inevitably the chapters vary in quality.

To summarize, the book resembles a collection of short stories of varying interest rather than a coherent novel.

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Nuclear and Radiation Chemical Approaches to Fullerene Science. (Series: Developments in Fullerene Science, Vol. 1.) Edited by *Tibor Braun*. Kluwer Academic Publishers, Dordrecht 2000. 204 pp., hardcover £ 60.00.—ISBN 0-7923-6524-0

Fullerene research is clearly not at present a field that gets a mention every month in the popular press. Despite that, the enthusiasm of the scientist whose satisfaction comes from discovering new

types of carbon structures, thoroughly investigating their properties, and gaining new scientific insights remains undiminished, provided that he or she courageously and successfully resists the currently prevailing attitudes. Against that background it is to be welcomed that the well-known Hungarian scientist Tibor Braun has succeeded by his tenacity in persuading a major publishing house to begin a new series on fullerene research, and to courageously choose for the first volume a topic that does not promise sensational developments. Instead the book begins the series in a way that emphasizes the broad scope of fullerene research.

The subject *Nuclear and Radiation Chemical Approaches to Fullerene Science* is, of course, the editor's special area of interest, and thus he has been able to bring together a collection of articles reporting contributions to fullerene research that have not been given the recognition that they deserve in other review publications and conference volumes.

The articles by C. S. Sundar on positron annihilation and by E. J. Ansaldi on muon spectroscopy review the relatively small numbers of publications on their respective topics. Ansaldi emphasizes the advantages of the latter form of spectroscopy for determining surface states. However, for both these methods of characterization the scope for applications in fullerene research will remain narrowly defined. Klenscár and Vértés discuss the use of Mössbauer spectroscopy, and report the first studies on determining the structures of fullerene–metal complexes and metallofullerenes. Although only a small number of elements can be observed by Mössbauer spectroscopy, the method yields important information about the redox states and mobilities of the ions, and therefore it is to be hoped that its use in fullerene research will grow. In the following chapter Nakahar and Sueki describe the use of radionuclides and their decay processes in studies of metallofullerenes, with particular emphasis on the scandium group elements and the rare earth metals, which are especially important in work on endohedral fullerenes. After describing the preparation of endohedral fullerenes, the authors discuss methods for isolating them, and emphasize

the advantages of radionuclides compared with UV/Vis detection in HPLC. They also describe the separation of radionuclide-labeled metallofullerenes in laboratory rats, which is of interest for tomography studies. The authors consider the questions of how the fullerene cage accelerates the decay of the included ion, and describe how a new endohedral fullerene can be formed by β -decay. For example, the decay of ^{155}Sm can result in a europium-containing metallofullerene which is stable. It is interesting that the redox state of the included ion can be changed by radioactive decay; how this affects the chemical stability is not yet fully understood. However, it can be said that in general a change in the redox state of a fullerene leads to instability. Furthermore, metallofullerenes undergo changes as a result of neutron activation analysis, and their redox state is also altered. This chapter illustrates the great possibilities of using radioactive isotopes in fullerene research, but the methods are little used, for reasons that are not discussed here.

The second part of the book is concerned with the structures of fullerenes in solution. It is dominated by an article by Asmus and Guldi on irradiation studies of fullerenes, with the main emphasis on C_{60} . This is known to be an efficient free radical scavenger, and therefore the possibilities for electron-transfer studies are mainly limited to fullerenes in host-guest compounds, since otherwise the free-radical reactions predominate. A further complication in studying the chemistry of irradiated fullerenes is the formation of fullerene clusters. It is largely because of these difficulties that irradiation studies of fullerenes have not progressed very far, and are at present completely overshadowed by photochemical studies, a fact that the authors of the article have taken into account in their most recent work.

The third part is devoted to endohedral fullerenes, and begins with an article by Gadd on endohedral rare-gas fullerenes. The editor and his co-workers contribute an introductory discussion of the importance of this special field of research, and this is followed by a report on neutron activation studies of rare-gas fullerenes. The evidence for the endohedral nature of the rare gases is presented

carefully, but this is ultimately seen to be of an indirect kind, as it depends on an HPLC separation. Ohtsuki and Ohno then report isotopic labeling studies on endohedral fullerenes and heterofullerenes. These mainly involve C_{60} metallofullerenes, which were previously found difficult to isolate using other methods of preparation. The molecular dynamics models for the formation of endohedral fullerenes presented here are not very convincing, as they assume that penetrating metal atoms interact only weakly with the fullerene cage. Moreover, the discussion of metal-containing heterofullerenes that follows shows that much more work is still needed on elucidating the structures of fullerenes. Masumoto, Ohtsuki, and Shikano describe radioisotope labeling of fullerenes with ^{14}C and ^{15}N , which offers an interesting but expensive route to new fullerene structures, the evaluation of which is a matter for the future. The following chapter on fullerene radiopharmaceutical agents is only three pages long, and is thus too short to be usefully discussed.

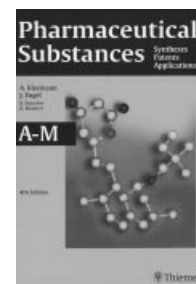
Lastly, in the fourth part of the book, Braun and Rausch describe the determination of trace impurities in fullerenes by neutron activation analysis. That is a difficult task when one considers the wide variety of impurities present in the graphite used as the starting material. One has to beware of making general statements about this, even though someone experienced in the preparation of fullerenes can, on the basis of the proportions of elements found in the fullerene samples, form conclusions about the manufacturers' (usually secret) processes.

The book, which has been produced with a high standard of typography, paper quality, and binding, is completed by a brief subject index. The work is an essential addition to the bookshelves of everyone who is engaged in research on fullerenes and wishes to be well informed.

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Pharmaceutical Substances. Syntheses, Patents, Applications. 4th Edition. Two volumes. By Axel Kleemann, Jürgen Engel, B. Kutscher, and D. Reichert. Georg Thieme Verlag, Stuttgart 2000. 2488 pp., hardcover DM 998.00.—ISBN 3-13-558404-6

A common problem encountered by the pharmaceutical chemist is that of coming across an unfamiliar International Nonproprietary Name (INN) and needing to know the chemical structure. The work reviewed here lists over 2000 INNs with their structures



and relevant information, and even the most knowledgeable pharmaceutical chemist cannot be expected to be familiar with all these. Asking a subordinate or colleague can be rather embarrassing for both parties, and often does not help. However, if one owns the Kleemann encyclopedia, one at least knows where the information is likely to be found, and can then usually answer the question easily and with confidence, without needing to worry about uncertain networking connections, the niceties of how someone must be approached, or rights of access. The alphabetical arrangement of the INNs gives rapid access to the required basic chemical and pharmaceutical information. Synthetic routes to the compound are also clearly described, which is an advantage compared with other reference sources. Thus, the encyclopedia is especially interesting and valuable for the organic chemist who needs to get a quick first impression about a compound.

In order to access the information quickly through the alphabetical list, it is essential to know the exact INN. If one needs to find a synonym one can refer to the "Alphabetical List of Drug Monographs". There is another index that allows one to search under trade names. The different types of names are kept strictly separate, a commendable system which contrasts with the rather loose practices typical of many publications, where original papers often give a trade