Chemistry in the Garden

By *James R. Hanson*. Royal Society of Chemistry, Cambridge 2007. 148 pp., hardcover £ 14.95.—ISBN 978-0-85404-897-7

Most people enjoy being in a garden, admiring the variety of colors, enjoying the scents of flowers and leaves, and watching vegetables grow into appetizing food. With the enjoyment of these various sensory experiences comes a sense of awe at nature's ability to produce this myriad of hues, odors, textures, and forms. Of course, all of these are the results of chemistry in the plants, insects, fungi, bacteria, and soil of which the garden is composed. For the natural products chemist, both the pleasure and the awe are increased by understanding the details of this chemistry and the amazing complexity of living organisms. Even a common blade of grass is a remarkable chemical factory using chlorophyll (a magnesium-containing compound with a porphyrin core and a diterpenoid tail) as a catalyst to convert carbon dioxide into sugars, a conversion that chemists would dearly love to be able to reproduce, especially with the current concerns about the greenhouse effect.

James Hanson has been a recognized authority on natural products chemistry for many years, and in this book he seeks to pass on not just his knowledge of the subject but also the excitement of seeing chemistry in action in an environment that too many of us take for granted. He also illustrates the intricate chemical balances in the biosphere and the use of chemicals for construction, energy provision, defense, and communication. It is clearly a book for chemists, as non-chemists would struggle with the level of chemical detail, and for them the author's assumption that his readers have a basic competence in chemistry would be a serious obstacle. For example, the illustrations are all in the form of structural formulas and schemes rather than pretty photographs of plants and insects. The potential breadth of the subject to be covered is vast, verging on infinite, and therefore, although the book is packed full of intriguing information, the author has had to be somewhat selective in the specific subjects he has chosen to discuss in more detail. It must be said that the cases he has chosen are all interesting, as the examples of strawberries and rhododendrons should serve to illustrate.

If you have ever wondered why strawberries are red, or why it is difficult to make jam from them, then this book will enlighten you. Even if you had already known or correctly guessed the answers to those questions (anthocyanins, and a low pectin and acid content, respectively), the explanation as to why consumption of strawberries makes some prescription drugs more effective might still prove elusive without this book. Similarly, the fact that some of the troops serving under the Greek general and author Xenophon were poisoned after eating honey might seem strange, until one learns something of the chemistry of the rhododendron flowers from which the bees had collected the honey.

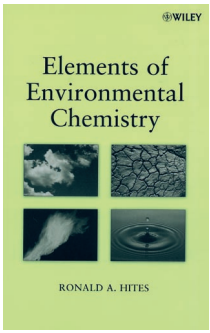
The chemical explanations behind some useful gardening tips are also fascinating. For example, there are chemical reasons why carrots should not be planted too closely together, and why bonfires might help germination.

Anyone suffering from the delusion that "natural" equates with "safe" should read Chapter 6 on bioactive materials from ornamental plants, and the accounts in Chapter 8 of the chemical warfare that is continuously raging between plants, bacteria, and fungi. Of course, many of the toxic substances produced as chemical weapons by plants and microorganisms constitute the active principles in herbal remedies and have formed the starting points for many modern medicines.

There is a very good general introduction to the subject of biosynthesis for those unfamiliar with it, and some more detail on selected aspects, which will interest the natural products chemist. There is a chapter on the chemistry of soil, a topic that I knew less about, and I was delighted to find the answer to a question that has always puzzled me: how is it possible that water-soluble minerals are not washed away but are retained and made available to plants? There is a glossary of botanical terms, which will prove very useful for chemists reading the book. It also has a good list of suggested further reading and, very importantly, a comprehensive index.

Charles Sell
Research Givaudan, Ashford (UK)

Elements of Environmental Chemistry



By *Ronald A. Hites*. John Wiley & Sons, Chichester 2007. 204 pp., softcover € 34.90.—ISBN 978-0-471-9815-X

The author of this book is a well-known environmental chemist and mass-spectroscopist, with a special interest in the area of bromine- and chlorine-containing trace pollutants. The latter compounds are not the main focus of the book, which instead concentrates on important quantitative relationships in environmental chemistry. It has been written primarily for graduate students in the USA, and begins with a well-written introduction to the use of Euro-

pean and US-American units of measurement and conversion between the two, the fundamentals of stoichiometry, mass balance relationships, and kinetic models.

In the following five chapters, the author deals with different aspects of modern environmental chemistry. Under the heading of mass balance relationships, he describes the use of the concepts of flow rates, pollutant burdens, residence times, and fluxes for water and the atmosphere. The student learns about methods for determining the sequence of steps in the breakdown of pollutants, and how quantitative data about the breakdown process can be determined comparatively easily by using the Microsoft Excel program. The following chapter deals with some fundamental principles of atmospheric chemistry. The three important catalytic cycles that lead to the breakdown of ozone are described. By applying the four Chapman equations of reaction kinetics to the formation and breakdown of ozone, the student can calculate the ozone concentration up to an altitude of 30 km. This chapter describes the quantitative relationships involved in smog formation and in the greenhouse effect. A separate chapter is devoted to the formation of acid rain through the action of carbon dioxide and sulfur dioxide. Using data from many examples on the mass balance for these two oxides and the reverse reactions with chalk or lime, one can calculate the resulting pH values of rainwater and surface waters. The chapter "Fates of Organic Compounds" briefly describes the most important physical properties that are involved in the enrichment of pollutants in water, such as vapor pressure, water solubility, the Henry's Law constant, the K_{ow} value, and bioaccumulation effects, and explains calculations based on these data. The short (too short) final chapter, "Toxic Environmental Compounds", discusses the most important classes of pesticides and metals such as mercury and lead. Students of organic chemistry will learn here about the structures of the organic molecules.

The work is very suitable for use as a textbook of environmental chemistry, and references to books for wider reading are given in the footnotes. The main strength of the book lies in the explanations of the calculation of quantitative relationships. Each chapter includes a detailed worked example. That is followed by 15–20 problems that are carefully chosen from a didactic standpoint, for which the reader can find solutions at the end. Therefore the book, which is relatively free of errors, can be recommended to university lecturers for teaching beginners in environmental chemistry. European users of the book should not allow the occasional USA-specific content (such as "how many people work at McDonalds worldwide", or "this question was designed in honor of Vice-President Dick Cheney") to put them off.

Dieter Lenoir
Institut für Ökologische Chemie
Helmholtz Centrum München
Neuherberg (Germany)

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