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PREFACE TO THE SECOND EDITION

Fundamentals of Environmental Chemistry, 2nd edition, is written with two major objectives in mind. The first of these is to provide a reader having little or no background in chemistry with the fundamentals of chemistry needed for a trade, profession, or curriculum of study that requires a basic knowledge of these topics. The second objective of the book is to provide a basic coverage of modern environmental chemistry. This is done within a framework of industrial ecology and an emerging approach to chemistry that has come to be known as “green chemistry.”

Virtually everyone needs some knowledge of chemistry. Unfortunately, this vital, interesting discipline “turns off” many of the very people who need a rudimentary knowledge of it. There are many reasons that this is so. For example, “chemophobia,” an unreasoned fear of insidious contamination of food, water, and air with chemicals at undetectable levels that may cause cancer and other maladies is widespread among the general population. The language of chemistry is often made too complex so that those who try to learn it retreat from concepts such as moles, orbitals, electronic configurations, chemical bonds, and molecular structure before coming to realize that these ideas are comprehensible and even interesting and useful.

Fundamentals of Environmental Chemistry is designed to be simple and understandable, and it is the author’s hope that readers will find it interesting and applicable to their own lives. Without being overly simplistic or misleading, it seeks to present chemical principles in ways that even a reader with a minimal background in, or no particular aptitude for, science and mathematics can master the material in it and apply it to a trade, profession, or course of study.

One of the ways in which *Environmental Chemistry Fundamentals* presents chemistry in a “reader-friendly” manner is through a somewhat unique organizational structure. In the first few pages of Chapter 1, the reader is presented with a “mini-course” in chemistry that consists of the most basic concepts and terms needed to really begin to understand chemistry. To study chemistry, it is necessary to know a few essential things—what an atom is, what is meant by elements, chemical formulas, chemical bonds, molecular mass. With these terms defined in very basic

ways it is possible to go into more detail on chemical concepts without having to assume—as many introductory chemistry books do somewhat awkwardly—that the reader knows nothing of the meaning of these terms.

Chapter 2 discusses matter largely on the basis of its physical nature and behavior, introducing physical and chemical properties, states of matter, the mole as a quantity of matter, and other ideas required to visualize chemical substances as physical entities. Chapters 3–5 cover the core of chemical knowledge constructed as a language in which elements and the atoms of which they are composed (Chapter 3) are presented as letters of an alphabet, the compounds made up of elements (Chapter 4) are analogous to words, the reactions by which compounds are synthesized and changed (Chapter 5) are like sentences in the chemical language, and the mathematical aspects hold it all together quantitatively. Chapters 6–8 constitute the remainder of material that is usually regarded as essential material in general chemistry. Chapter 9 presents a basic coverage of organic chemistry. Although this topic is often ignored at the beginning chemistry level, those who deal with the real world of environmental pollution, hazardous wastes, agricultural science, and other applied areas quickly realize that a rudimentary understanding of organic chemistry is essential. Chapter 10 covers biological chemistry, an area essential to understanding later material dealing with environmental and toxicological chemistry.

Beyond Chapter 10, the book concentrates on environmental chemistry. Traditionally, discussion of environmental science has been devoted to the four traditional spheres—the hydrosphere, atmosphere, geosphere, and biosphere—that is, water, air, land, and life. It has usually been the case that, when mentioned at all in environmental science courses, human and industrial activities have been presented in terms of pollution and detrimental effects on the environment. *Fundamentals of Environmental Chemistry* goes beyond this narrow focus and addresses a fifth sphere of the environment, the anthrosphere, consisting of the things that humans make, use, and do. In taking this approach, it is recognized that humans have vast effects upon the environment and that they will use the other environmental spheres and the materials, energy, and life forms in them for perceived human needs. The challenge before humankind is to integrate the anthrosphere into the total environment and to direct human efforts toward the preservation and enhancement of the environment, rather than simply its exploitation. Environmental chemistry has a fundamental role in this endeavor, and this book is designed to assist the reader with the basic tools required to use environmental chemistry to enhance the environment upon which we all ultimately depend for our existence and well-being.

Chapters 11–13 address the environmental chemistry of the hydrosphere. Chapter 11 discusses the fundamental properties of water, water supply and distribution, properties of bodies of water, and basic aquatic chemistry, including acid-base behavior, phase interactions, oxidation-reduction, chelation, and the important influences of bacteria, algae, and other life forms on aquatic chemistry. Chapter 12 deals specifically with water pollution and Chapter 13 with water treatment.

Chapter 14 introduces the atmosphere and atmospheric chemistry, including the key concept of photochemistry. It discusses stratification of the atmosphere, Earth's crucial energy balance between incoming solar energy and outgoing infrared energy, and weather and climate as they are driven by redistribution of energy and water in

the atmosphere. Inorganic air pollutants, including nitrogen and sulfur oxides, carbon monoxide, and carbon dioxide (potentially a “pollutant” if excessive levels lead to detrimental greenhouse warming) are discussed in Chapter 14. Organic air pollutants and photochemical smog are the topics of Chapter 15.

The geosphere is addressed in Chapters 17 and 18. Chapter 17 is a discussion of the composition and characteristics of the geosphere. Chapter 18 deals with soil and agriculture and addresses topics such as conservation tillage and the promise and potential pitfalls of genetically modified crops and food.

Chapters 19–22 discuss anthropospheric aspects of environmental chemistry. Chapter 19 outlines industrial ecology as it relates to environmental chemistry. Chapter 20 covers the emerging area of “green chemistry,” defined as the sustainable exercise of chemical science and technology within the framework of good practice of industrial ecology so that the use and handling of hazardous substances are minimized and such substances are never released to the environment. Chapter 21 covers the nature, sources, and chemistry of hazardous substances. Chapter 22 addresses the reduction, treatment, and disposal of hazardous wastes within a framework of the practice of industrial ecology.

Aspects of the biosphere are covered in several parts of the book. Chapter 10 provides a basic understanding of biochemistry as it relates to environmental chemistry. The influence of organisms on the hydrosphere is discussed in Chapters 11–13. Chapter 23 deals specifically with toxicological chemistry.

Chapter 24 covers resources, both renewable and nonrenewable, as well as energy from fossil and renewable sources. The last two chapters outline analytical chemistry. Chapter 25 presents the major concepts and techniques of analytical chemistry. Chapter 26 discusses specific aspects of environmental chemical analysis, including water, air, and solid-waste analysis, as well as the analysis of xenobiotic species in biological systems.

The author welcomes comments and questions from readers. He can be reached by e-mail at manahans@missouri.edu.

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Professor Manahan is the author or coauthor of approximately 100 journal articles in environmental chemistry and related areas. In addition to *Fundamentals of Environmental Chemistry*, 2nd ed., he is the author of *Environmental Chemistry*, 7th ed. (2000, Lewis Publishers), which has been published continuously in various editions since, 1972. Other books that he has written are *Industrial Ecology: Environmental Chemistry and Hazardous Waste* (Lewis Publishers, 1999), *Environmental Science and Technology* (Lewis Publishers, 1997), *Toxicological Chemistry*, 2nd ed. (Lewis Publishers, 1992), *Hazardous Waste Chemistry, Toxicology and Treatment* (Lewis Publishers, 1992), *Quantitative Chemical Analysis*, Brooks/Cole, 1986), and *General Applied Chemistry*, 2nd ed. (Willard Grant Press, 1982).

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