Elements of General, Organic, and Biological Chemistry, Ninth Edition

John R. Holum. Wiley: New York, NY, 1995. xvi + 605 pp. Figs., tables, and photos. 21.3 × 26.3 cm. $64.95.

The ninth edition of Holum's textbook continues to be a shortened version of his *Fundamentals of General, Organic, and Biological Chemistry, Fifth edition* (1994). It incorporates the changes and improvements made in that text. The audience for this text includes students in the health sciences (other than physicians) and nonscience students with an interest in the molecular nature of matter. The text can be used for a one-term course and does not have any chemistry prerequisites. The author has striven to create the most up-to-date kind of text possible particularly in environmental studies and the molecular basis of life.

Chapters are organized, as in the past editions, into general chemistry topics (1–8), the organic chemistry essential for biochemistry (9–13), and biochemistry (14–21). Radioactivity and nuclear chemistry are the topics of the final chapter. Changes made in this edition include a revision of the presentation of accuracy, error, uncertainty, and precision and a more cohesive treatment of acids and bases based on Bronsted concepts. The organic chemistry chapters have been enriched with special topics such as "Organic Fuels", "Ethyl Alcohol and Alcoholism", and others. The author has done considerable updating and some reorganization of the chapters on biochemistry. The chapter "Extracellular Fluids of the Body", the most important chapter in the text according to the author, remains about the same. It continues to provide important and relevant concepts and understanding both to science-oriented students and the liberal arts students alike.

Some topics, for example molarity, are introduced in abbreviated form early in the text to facilitate meaningful laboratory work but then are given detailed treatments later. The author continues to employ numerous learning aids such as highlighting of key terms, section "headlines" stating the major point of the section, chapter summaries, the factor-label method for calculations, a problem-solving methodology, and numerous practice exercises (most of which are new) with answers in an appendix. Icons are used to draw attention to skills or topics about health and the environment. The text is as colorful and as amply illustrated as the larger version. Computer-generated molecular models, both space-filling and ball-and-stick, are presented throughout the text.

Holum's text continues to provide a lucid and interesting survey of chemistry along with the stimulations for learning chemistry. It should be appealing to the intended audience and deserves consideration in the process of choosing a textbook.

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The Second Law: Energy, Chaos, and Form, Revised Edition

P. W. Atkins. Scientific American Library (W. H. Freeman & Co.): New York, NY, 1994. ix + 216 pp. Photos and illus. 21.7 × 23.5 cm. $19.95 PB.

As the title aptly states this book deals with the magnificent second law of thermodynamics, to wit: an experimentally accessible quantity, entropy is a measure of chaos, and characterizes by its increase the direction of spontaneous physical and chemical change. Atkins states in his opening sentence, "No other part of science has contributed as much to the liberation of the human spirit as the second law of thermodynamics." The law is universal, admits of no macroscopically observable exceptions, and is of overwhelming importance in the understanding of nature and technology. Famously recondite and inherently mathematical, here the second law and entropy are luminously explicated through combined use of the written word and many extraordinarily effective images.

As the author intends, "any persistent reader, however science unprepared," will indeed be capable of mastering the book, but the greatest benefits will go to those readers professionally interested in the concept of entropy. Here one includes students of thermodynamics, from any of the relevant disciplines, e.g., physics, chemistry, biology, medicine, and engineering. The author apologizes to the scientifically informed for the "slowness of pace" used to develop the concept of entropy and its consequences, but such rhetorical politeness is unnecessary. The better informed the reader, the more this book will be appreciated for its coherent explanations and illustrations of such a vast subject. Professors teaching the concept of entropy will find themselves using the book's examples and graphical illustrations to buttress their own lectures. The book's reasonable price suits it well as assigned supplementary reading for enhanced appreciation of entropy.

A good historical account is given of how an analysis of the steam engine gave rise to a statement of the second law. Sadi Carnot "took the view that the operation of a steam engine was akin to the operation of a water mill, that caloric ran from the boiler to the condenser, and drove the shafts of industry as it ran, exactly as water runs and drives a mill." Subsequently an interpretation of entropy from a microscopic viewpoint was obtained. The famous equation of Boltzmann–one of the few in the book–defining entropy as $S = k \log W$, relates it to W, the probability of a microscopic configuration. (The constant of proportionality, k, is Boltzmann's constant). A Carnot cycle analysis of an internal combustion engine is given, with particular emphasis upon types named after Sterling and Diesel. It is shown that any engine converting heat into work is limited to less than 100% efficiency, the exact efficiency being fixed by a quantity depending upon the temperature difference between heat reservoirs used for supplying heat to and expelling heat from an engine. A major advance in understanding followed from the work of Willard Gibbs, who showed how nature's tendency toward an overall increase in chaos provides a criterion to predict the natural direction of flow of all chemical reactions. The chemical reactions that underlie and sustain biological life also conform to the second law.

A most interesting discussion illustrates how the drive toward increased chaos leads paradoxically to local structures in space and time of great complexity and stability, including those characteristic of life. In this regard Atkins says:

> Thus, we see that the tendency to chaos builds both the quaternary and the tertiary structures of proteins, for the ordered helices bend and buckle, and the surroundings become more disorganized. It also builds their secondary structures, for it is through the consequences for entropy that the hydrogen bonds, on which the structure depends, are locked into stability, and wind the ordered helix from the random chain of links. But what of the primary structure, the ordering of the amino acids themselves into the original chain? . . . can this essential primary step also emerge as a consequence of chaos?

Yes.

Atkins has a deep understanding of the second law and imparts that to his reader. In another of his many excellent books, *Physical Chemistry*, he gives an equally good exposition of the second law, but there as is standard in such a textbook, the treatment is mathematical. The wonder of this book, *The Second Law* is the highly successful manner in which entropy and its consequences are conveyed, without the scaffolding of mathematics. In a deeply satisfying way, using sophisticated graphical representations and lucid companion explanations, Atkins succeeds in imparting a qualitative and intuitive appreciation of entropy. For those already familiar with the quantitative and mathematical development, the book has the effect of expanding and rounding one's appreciation of the subject. Thus, a great strength of the book is the beauty of exposition brought to such an important subject as entropy for the benefit, at many levels, of a wide-ranging audience.

A brief five-page appendix gives a nice summary of thermodynamics and of entropy developed from a mathematical point of view. In two pages are given a critique of and suggestions for further reading on the subject of the book.

For the sake of completeness, one may point out that a small number of technical errors have occurred in producing the book. For example, on page 203, the units of k are given as [M0l^{-1}], instead of the intended [J °K^{-1}].

Finally, one mentions in passing, the author may be unnecessarily pessimistic, where he seems to conclude there is a lack of mean-