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Book reviews

Biological Process Engineering. An Analogical Approach to Fluid Flow, Heat Transfer, and Mass Transfer Applied to Biological Systems. Arthur T. Johnson, John Wiley and Sons, 1999, 732 pp., £58.50, hardback, ISBN O-471-24547-X

This is a book about transport phenomena and how they relate to biological processes. The breadth of the book is remarkable. Arthur Johnson has peppered his book with examples from sciences as diverse as biomedical, plant, soil, ecological, and food sciences. But equally striking is the way he has taken the analogy between fluid flow, heat transfer, and mass transfer one or two steps further. They are related in detail to electrical and mechanical phenomena, with an occasional aside on how the analogies can be further extended to optical, magnetic, and other phenomena. If a major branch of biological or physical sciences was left out, I did not notice. Such a book will especially appeal to the nimble mind.

The intended audience is primarily students in the emerging field of biological engineering. There is a particular need for texts in this area in the United States, where the traditional role of the agricultural engineering department is being broadened in its biological content. Use of examples such as the estimation of a convection coefficient for people in hot tubs and mass transfer through human skin lends a fresh, and often wry perspective to the subject matter. The food process examples tend towards the more conventional types found in other books, but help demonstrate the many facets of biological transport processes.

For myself, the most valuable contribution of Arthur Johnson's text is the use of many examples of transport processes applied to human physiology. This is shown nicely in his progression from resistance to flow in rigid pipes, where the realm of the chemical process engineer usually stops, to resistance to flow in elastic tubes. The latter case typifies the multitude of plumbing inside living organisms. Another is his description of the intestines and other organs as 'mass exchangers' analogous to the heat exchangers that process engineers know so well. The biomedical aspect of the text appears to be Johnson's forte. If the book had focused even more on that area, it would not have been diminished.

This leads to my main quibble about the book, regarding its pedagogical use. The book appears to be intended for use in a first course on transport processes; however, I fear the sprawling scope of the book would overwhelm many such students. An effective teaching book should build the students' confidence in their ability to solve problems independently. The author's unified presentation of transport processes is a plus in this regard. But a successful problem-solving technique requires an understanding of what simplifications can be made in order to obtain both a manageable equation and a useful result. A unified approach to doing this is beyond the reach of even this book. The diversity of examples, each often requiring some biological or other knowledge to competently simplify the equations, may ultimately undermine the students' confidence. Also, in his preface, Johnson suggests a desire to connect with those 'right-brain-dominant' students, that is students who are more creative but less mathematically oriented. This, I agree, is a valid concern; traditional engineering texts have ignored such individuals. But the right-brain-dominant students will struggle to get past chapter one of this book.

Nevertheless, teachers of biological transport processes should become acquainted with this book, and students should have access to this book as a reference. Johnson's examples and his frank remarks following each example make for interesting, accessible reading. The explication of the analogies between the various transport processes could be particularly effective for advanced students of transport processes. I will be recommending this book for use as an important reference in our educational program.

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Chemical Engineering Design and Analysis. An Introduction. T. Michael Duncan and Jeffrey A. Reiner, Cambridge University Press, 1998, 380 pp., hardback, US$90.00, £65.00, ISBN 0-521-63041, softback, US$39.95, £22.95, 0-521-63056-5

Chemical engineering is a fascinating but difficult profession. This book by Duncan and Reiner takes on a noble and useful task: persuade students with various backgrounds to