Roots of Modern Technology: An Elegant Survey of the Basic Mathematical and Scientific Concepts

by Siegfried Wendt

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REVIEWED BY FLORIN DIACU

Most engineers regard mathematics as a tool that can help them build roads, bridges, robots, or smart phones. They don't ask why a certain formula is true as long as it fits their purposes. There is nothing wrong with that. After all, few mathematicians know how the engines of their cars work. But some of us care to learn such details. Similarly, there are engineers who have a good and wide understanding of mathematics. Siegfried Wendt is one of them. Now an emeritus professor at the University of Potsdam in Germany, he took on the task of writing a book that gives mathematics and science their due for the technical achievements we enjoy today. His *Roots of Modern Technology* is, indeed, an elegant survey of the basic mathematical and scientific concepts that led to the remarkable progress made in engineering during the past two-and-a-half centuries. I was initially put off a bit by the word "elegant" in the subtitle, but in the end I had to admit that the word fully reflected the content of this volume. The smoothness of the prose and the clear rendering of some complex concepts from many branches of mathematics and science are, no doubt, the book's most valuable assets.

In the preface, Wendt already states clearly his position toward mathematics and mathematicians. He agrees with the Spanish philosopher Ortega y Gasset, who wrote, in the first half of the 20th century, that we exaggerate a bit the difficulty of our subject, and that the reason our field appears so incomprehensible is because we don't do enough to simplify our teaching. Nevertheless, Wendt claims that there is something special about dealing with mathematics. "It is not primarily a question of a good memory," he writes, "but it requires the motivation to struggle for understanding." I couldn't agree more with his view.

Most of the mathematical concepts this book presents don't go beyond the undergraduate level. Remarkable, however, is the original way they are introduced and the connections the author makes with the technological aspects where they apply. The book is filled with figures, diagrams, and tables, all of which allow the uninitiated reader to enter a world that is normally closed to him or her. For instance, the section *How Mr. Maxwell Transferred his Ideas from the Bath Tub to Free Space*, which spreads over more than ten pages, provides a

visual understanding of certain vector calculus concepts, such as gradient, divergence, flux, etc., in the context of fluid dynamics. No standard sophomore calculus textbook I happened to browse in the past few years renders these ideas so well. Moreover, the author shows how the concepts were derived and where they apply outside mathematics. These explanations are mixed with historical notes that make the reading pleasant rather than heavy, for the author never delves into murky details. He even remarks at some point that "omitting irrelevant aspects is an art." *Roots of Technology* shows that he has mastered it well.

The range of topics this book covers is wide, from counting-problems to linguistics, from quantum mechanics to general relativity, from molecular biology to digital systems. It is no easy feat to have such breadth of knowledge and to weave it skillfully into a single narration. But the chance to make mistakes grows with the distance from one's base. Although I found no mathematical blunders, there were statements I disagreed with, albeit not in my direct field of expertise, but in the realm of my general interests. For instance, on page 311 the author claims that "we are convinced that human individuals and bacteria both are living objects, although they don't have much in common except for their capability to reproduce and the inevitability of their death." In fact they do: both have similar genetic codes, in spite of exhibiting quite different genomes. A lot of mathematics research is done now in this direction, to help biochemists understand the connections that prove the evolution of life from simple to more complex forms. Other aspects of mathematical genetics are in fact presented in the pages that follow the aforementioned statement, which seems thus to be rather a slip of the tongue than a misunderstanding of molecular biology. Such inaccuracies, however, do not harm the general scope and beauty of this book. They are only another reminder that nobody is perfect.

For mathematicians, *The Roots of Technology* is an interesting read, filled with unexpected turns and fresh points of view about things we think we know well. We can all draw new knowledge from it, such as seeing concrete directions in which mathematics is useful, for most of us have only a general impression about the applicative power of our field. And those of our colleagues who are engrossed only in pure mathematics have a chance to take a first glimpse at, say, special and general relativity, without which the GPS would be useless, or at the more recent achievements of logic and computer science that gave us workstations, laptops, and iPads. I kept turning the pages with excitement while reading this book, curious about where it would take me next, and I was never disappointed. Therefore I warmly recommend *The Roots of Technology* to all the readers of *The Mathematical Intelligencer*.

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