Pure Appl. Geophys. 170 (2013), 725

DOI 10.1007/s00024-012-0596-z

Pure and Applied Geophysics

Book Review

"Physics of Continuous Matter: Exotic and Everyday Phenomena in the Macroscopic World", by B. Lautrup, Second Edition, CRC Press/Taylor and Francis Group, 2011; ISBN-13: 978-14200-7700-1, USD 75.95

Sujit S. Datta[1]

Despite its relevance to our everyday lives, physics is commonly viewed as being the esoteric study of subatomic particles and exotic quantum phenomena. This is misleading: the "classical", continuous world around us also abounds with deep physical problems that demand our attention. These range from developing the atmospheric models that pilots use to plan flights, to enhancing the mechanical stability of ships, to understanding seemingly more mundane phenomena like the formation of a vortex as you drain your bathtub or the dripping of a water faucet as you turn it off. Probing these problems can lead to surprising and important scientific developments; for example, insights into the physics underlying dripping have led to a recent explosion in microfluidics research, with crucial applications in biological and chemical engineering.

An improved understanding of such problems requires ideas from diverse fields, such as solid mechanics, fluid mechanics, and thermodynamics. While many excellent textbooks treat each field separately, there is a paucity of textbooks that integrate these ideas. This second edition of *Physics of Continuous Matter*, by theoretical physicist Benny Lautrup, fulfills this need in a remarkably clear and engaging manner.

After a concise introduction to the continuum description of matter, Lautrup dives right into its study, covering fluid and solid mechanics, fluid dynamics, thermodynamics, and a range of special topics, including wave phenomena, boundary layers, and turbulence. Each section is beautifully written, treating the material thoroughly without making it seem dry. Lautrup does this by focusing on the key physics; he eschews laborious derivations for simple estimates of physical quantities, and connects them to interesting, real-world situations whenever possible. For example, Lautrup illustrates the mechanical stability of pressurized shells by discussing the limits of deep-sea submersibles, such as the bathyscaphe Trieste that reached nearly 11 km underwater in 1960—the deepest manned descent to date. Or, for example, Lautrup explores the physics of Newton's third law using a fascinating case study of the turbines used to generate electrical energy at China's Three Gorges Dam project. Many of the references and examples are also at the forefront of research: for example, Lautrup illustrates vortices in fluids using his own recent work studying the remarkably fast flows that occur at the core of a steady bathtub vortex. Numerous other fascinating and diverse examples abound in this book.

Physics of Continuous Matter is aimed at third year undergraduate students, and would certainly be an excellent textbook for a year-long course. Each section has a wide selection of homework problems; half of these come with solutions, making the text ideal for self-study, as well. This book is also appropriate for researchers, either as a reference for key results, or simply to gain a broader perspective on a particular topic. With its elegant presentation and comprehensive treatment of the subject, *Physics of Continuous Matter* does a fantastic job of illustrating how the physics of the classical world around us is profound, beautiful, and often counter-intuitive.

[1] Department of Physics, Harvard University, Cambridge, MA, USA. E-mail: ssdatta@fas.harvard.edu