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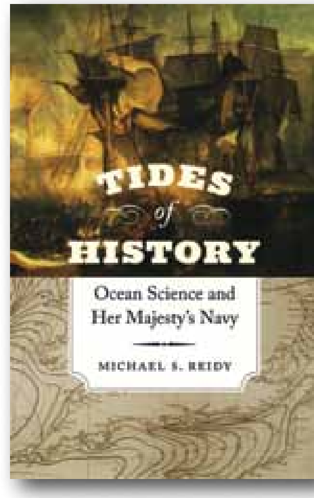
Tides of History: Ocean Science and Her Majesty's Navy



By Michael S. Reidy, University of Chicago Press, 2008, 392 pages, ISBN 0-226-70932-1, Softcover, $40 US

REVIEWED BY HELEN ROZWADOWSKI

Oceanographers today are more aware than ever of the importance of ocean science, particularly for understanding global issues such as climate change and the repercussions of fishing on ecosystems. Now, historian Michael Reidy offers a book that argues for the importance of ocean science historically on an equally global scale. Improved navigation is certainly part of his story. More strikingly, ocean science was an integral part of both the process of European expansion and the emergence of the modern scientist.

The book's focus is, of course, tidal science. It begins with the establishment of the Royal Society, covers developments through Newton's general theory of tides, then follows tidal theory to the Continent, especially to France. But the focus is not restricted to theoretical study of tides, and thus the story does not stop with Laplace's essentially correct hydrodynamic approach to tides because it did not lead to successful prediction of actual tides. From the end of the seventeenth century through the early nineteenth, although individual tide table makers worked to refine their products, no systematic study of tides was undertaken. By the mid nineteenth century, scientists could accurately predict tides in British ports and colonial possessions overseas. This book tells how governments, scientists, tide table makers, calculators, surveyors, dockyard officials, Admiralty leaders, and others contributed to the emerging science of tideology in the first half of the nineteenth century.

For readers interested in environmental history, the book's most striking contribution is its second chapter, which describes changes to the Thames and its banks that altered the river's tides dramatically. Construction of bridges, wharves, and embankments, along with dredging and straightening efforts, radically transformed the river and created the practical problem of prediction under new tidal regimes. Because most shipwrecks occurred near shore, ship owners, insurers, and underwriters pressed for study of tides. Reidy's work emphasizes the role that humans and their activities played in what we think of as a natural environment; changes to the river caused by people altered the tides and, as a result, produced interest in tidal science.

Readers accustomed to thinking about terrestrial history might rightly identify industrialization as an important theme for the early nineteenth century, but might be skeptical about the importance of tides. Yet industrialization depended entirely on coastal and overseas shipping, so England's strength in shipping was a cause and consequence of the industrial revolution. Since the sixteenth century, world power depended on sea power but, with industrialism, Britain required—and fiercely promoted—freedom of the seas to ensure free trade. Under freedom of the seas, what mattered for the extension of power was knowledge. Increased understanding of tides led to the ability to predict them; prediction provided an unprecedented degree of control over sea lanes, ports, and estuaries where safe entry and departure of British ships enabled the extension of empire. It comes as little surprise, then, that study of tides represents an early instance of government support of science.

Although the general public may still think of science as work done by lone geniuses, today's environmental scientists recognize the combined efforts of an array of people and funding sources and, therefore, may be interested to see how this kind of modern science came to be. In Reidy's account, tidal science was collaborative, requiring theoreticians to seek out expert calculators. Men of science, such as the banker William Lubbock and his former Cambridge professor William Whewell, who was drawn into tidal studies by Lubbock, depended utterly on the calculator Joseph Dessiou and other "associate laborers," to use Reidy's term for the small army of people who took tidal measurements, invented tide gauges, created tables, and carried out other related tasks. Whewell called such helpers "subordinate labourers" because he envisioned science as a hierarchical endeavor led by theoreticians. Reidy's thorough study documents clearly, however, that calculators and others contributed substantively to the development of tidal science in ways not acknowledged by the theorists. Calculators such as Dessiou tested theories, advanced methods, and suggested new avenues of research. The same was true for other Whewell collaborators such as Thomas Bywater, the Liverpool tide table maker; Thomas Gamlen Bunt, who was paid by grants from the young British Association for the Advancement of Science; and Daniel Ross, a calculator employed at the

Hydrographic Office.

Within the history and philosophy of science, Reidy's book makes the valuable contribution of fleshing out the central figure of William Whewell. Long acknowledged for his multi-volume *History of the Inductive Sciences* (1837) and his *Philosophy of Inductive Sciences* (1840), Whewell's own research had not been recognized by scholars. Yet, as he wrote his books, Whewell was engaged in a 20-year study of tides. He coined the term "scientist" in 1833 and used his tidal studies to reflect on the appropriate social and intellectual role for scientists. Reidy convincingly demonstrates that the challenges of studying the ocean, including its global extent, influenced Whewell's articulation of what it meant to do science and to be a modern scientist.

A powerful artifact linked knowledge of the ocean to power and, thereby, made scientists the arbiters of knowledge about the sea. The product of systematic ocean investigation under Whewell was the iso-tidal map of the world. Charts with co-tidal lines represented knowledge visually in a way that could pass easily between men of science and mariners. Similarly, in the same period, other geophysical sciences recorded meteorological data and measurements of magnetic variation on equally practical charts. The co-evolution of modern science, state funding, and political and economic uses of knowledge of the ocean is emphasized in a small section of the book examining the United States. Systematic study of tides by the Coast Survey was underway by the 1850s; in the same decade, there were two independent American coinages of the term "scientist." As in Britain, elite men of science in the United States successfully organized their work, linked it with the government, and created knowledge that conferred power on their nation.

Reidy's writing brings his actors, their story, and this time period to life. The volume itself is beautifully made, with over 60 figures that do much more than illustrate. Photographs and drawings of imperiled and wrecked ships remind modern readers of the overarching importance of tides to a sea-borne economy and society. Tide tables and self-registering tide-gauge tracings help explain the origins and power of co-tidal maps. The press is to be commended for the high-quality illustrations, the brief but helpful glossary, and the useful bibliography.

Near the end of the book, Reidy reminds us that Whewell's tidal theory was not correct; tide prediction is more local than global. Yet this fact only adds heft to his argument that the modern conception of the scientist was forged by studying the global ocean and, thereby, was inextricably linked to imperialism and worldwide trade.

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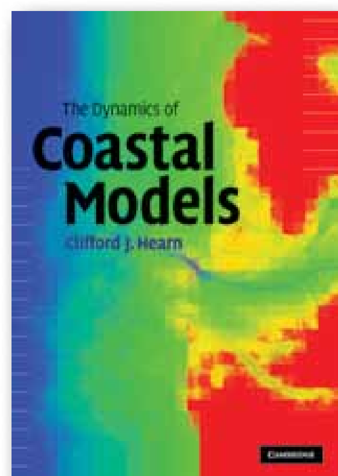
The Dynamics of Coastal Models



By Clifford J. Hearn, Cambridge University Press, 2008, 488 pages, ISBN 978-0-521-80740-1, Hardcover, $100 US

REVIEWED BY YU-HENG TSENG

Everything should be made as simple as possible, but not simpler.

—Albert Einstein

The basic governing equations of coastal dynamics have been known for decades, but how can these equations be formulated to improve our understanding of coastal basins? *The Dynamics of Coastal Models* by Clifford Hearn does a great job of explaining and illustrating fundamental coastal dynamics and equations through the use of simple analytical and numerical models. It motivates readers to further explore model physics using simple Microsoft Excel or Matlab examples from which basic ideas can be easily extracted (numerical codes are also tabulated). These examples are so simple that interested readers who have a basic math and science background can gain useful physical and mathematical insights into coastal dynamics through the simple models presented (which are never higher than two-dimensional). These models are very powerful tools, enabling clear demonstration and easy understanding of basic principles.

This book, aimed at the introductory level, lays out the fundamental scientific principles of coastal models. It could serve as the first advanced textbook for graduate students who are interested in modeling coastal dynamics. Hearn's perspective is