

OCEANOGRAPHY

From the Beach to the Sea Floor

Alistair Sponsel

Just 200 years ago the nature of the deep sea and the location of the ocean floor—if indeed there was one—were not merely unknown but largely unimagined. As Helen Rozwadowski points out in *Fathoming the Ocean*, at the end of the 18th century even explorers viewed the sea as a void: the purpose of setting sail was to reach land again as soon as possible. In this illuminating study, she argues that the deep ocean was only “discovered” as an object of scientific study in the middle of the 19th century, when Western attitudes about the ocean shifted away from understanding it “as an expansive divide, a watery highway, or an unfathomable barrier between places,” toward “a cultural redefinition of the sea as a destination and a location.”

Rozwadowski, a historian of science at the University of Connecticut at Avery Point who has previously written on the international politics of ocean science and management, now delves into the 19th-century origins of oceanography. She observes that cultural recognition and scientific study of the deep ocean emerged rapidly together between 1840 and 1880, when the sea became a more familiar part of everyday life in Britain and the United States through the rise of commercial transatlantic shipping, the flourishing of maritime literature, and the Victorian beachcombing and aquarium crazes. However, as she notes, the most important factor prompting the mid-century discovery of the deep ocean was the immense government and private investment in efforts during the 1850s and 1860s to lay a submarine telegraph cable across the Atlantic. Cable surveys produced a wealth of new knowledge of the ocean floor, and telegraph boosters used the resulting sounding data and bottom samples to usher away old perceptions of the deep sea as a forbidding wilderness. They urged the public to envision, in Rozwadowski’s words, “a cable resting safely and peacefully in a previously unimaginable place.”

One of the most impressive elements of the book is the author’s depiction of the equipment and techniques that, beginning in the

late 1840s, British and American hydrographers used to sound unprecedented depths. Mariners, and even naval surveyors, were previously concerned primarily with ensuring

that the sea was deep enough for navigation, a purpose served adequately by “no bottom” measurements. Rozwadowski shows that pioneering efforts to sound to the deep ocean floor required immense physical effort and were often more valuable as experiments in the development of sounding practices and equipment than as sources of reliable data. Hauling in 1000 fathoms of line required (by one account) the

work of 100 men for an hour and 20 minutes. One sounding from the 1850 voyage of the U.S. Coast Survey’s schooner *Taney* played out 5700 fathoms of line. Keeping the line “dead up and down” and determining when, if ever, the sounding lead had reached the sea floor were the greatest technical challenges of early blue-water hydrography. The *Taney*’s record sounding was among many early results that were discredited in the next decade, notably by measurements made using John Brooke’s 1853 sounding device that released its sinker upon striking the bottom.

Naturalists were the second group that “brought [the sea] into focus as an object of scientific inquiry,” although their conception of “deep water” lagged well behind the hydrographers’ until the 1860s. Like hydrographers, they “began close to shore, probing blindly... into ever deeper water.” Marine naturalists adapted the dredge from fisheries, and many dredging enthusiasts became “cruising yachtsmen” in the pursuit of zoological novelties. Although dredging flourished in local natural history societies on both sides of the Atlantic, several prominent British naturalist-dredgers moved to London around 1860 seeking the application of metropolitan resources to the study of life in the deepest parts of the ocean. When the Royal Society successfully petitioned the Admiralty to make navy vessels available for study of the ocean floor, the captains of H.M.S. *Lightning* and H.M.S.

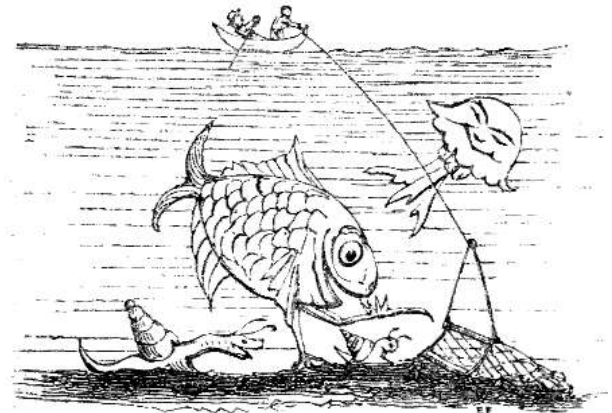
Porcupine modified tackle that had been recently developed for deep-sea sounding to allow dredging at depths approaching a thousand fathoms. Although Rozwadowski argues that it was “novel only in its huge scale,” the British *Challenger* expedition (1872–76) was the technological and organizational culmination of the new scientific fascination with the sea. Its circumnavigation of the globe resulted in a 50-volume report (published 1880–1895) renowned as the foundation of 20th-century research in ocean zoology, geology, chemistry, and physics.

Historians of science may read *Fathoming the Ocean* most enthusiastically as a contribution to the geography of scientific knowledge. A rapidly growing body of historical literature seeks to demonstrate the influence of physical locations (such as labs, museums, field sites, or specific institutions or nations) on the practices and prestige of scientists. Rozwadowski’s work is well poised to catch this historiographical wave, because the book addresses the importance of scientific

Fathoming the Ocean The Discovery and Exploration of the Deep Sea

by Helen M. Rozwadowski

Harvard University Press,
Cambridge, MA, 2005.
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“Odd fishes to entangle!” Edward Forbes’s enthusiasm for natural-history dredging led him to pen “The Dredging Song” (1840), in which this line appears, and this cartoon from his *Natural History of the European Seas* (John van Voorst, London, 1859).

“places” at a number of levels. Besides treating the distinct Anglo-American national contexts, Rozwadowski explains how physical and zoological studies of the ocean fit among other field sciences in a period that also saw the rise of professional geology and a surge of astronomical expeditions and polar explorations. She follows 19th-century marine scientists as they moved out from the shoreline on rowboats, pleasure craft, and finally working oceanographic vessels, enabled by a shift of patronage in the opposite direction, from local societies in coastal towns to elite metropolitan institutions. In doing so, she also provides a striking counterpoint to studies of lab-

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oratory life by demonstrating how the succession of specific shipboard working spaces shaped the social and material cultures of the emerging discipline of oceanography.

The book's considerable appeal is enhanced by the inclusion of several dozen outstanding illustrations, and Rozwadowski's prose conjures further images of early ocean

scientists' battles with hemp, brine, and benthic ooze. The narrative is occasionally repetitious as it jumps back and forth between Britain and the United States, and readers may also be left to wonder whether ocean science developed similarly in other countries. Nevertheless, *Fathoming the Ocean* will clearly be welcomed as a serious contribution

by historians of science, technology, and maritime culture. And in addition, as the foreword by marine biologist Sylvia Earle underscores, the story is also of immediate relevance to anyone who wonders when and how we came to understand—as we now urgently do—the ocean's importance to our blue planet.

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ENVIRONMENT

Too Wed to the Sea

Venice is a city whose strength and vulnerability have always depended on the sea. From a tiny settlement founded in the fifth century A.D., it grew to become the heart of a dominant maritime power by the 14th century—an ascendancy due in large part to its location within a lagoon on the edge of the Adriatic Sea. Venice's famous fleet of commercial ships could easily embark on their immensely profitable voyages, while the city remained protected from enemies by water too shallow for attack by sea and too deep for attack by land. It is ironic then that the very setting that allowed Venice to flourish is the one that puts it in such danger.

The magnitude of this threat became apparent on 4 November 1966, when the city was submerged by a disastrous storm surge that raised the local water level by nearly two meters, flooding more than 90% of the city.

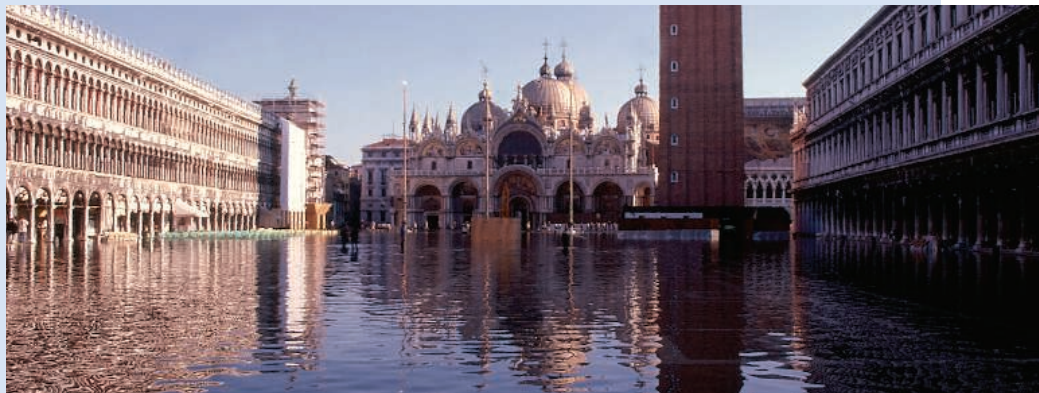
Since that time, the protection of the city from such floods has been the subject of vigorous investigation and debate. In *The Science of Saving Venice*, Caroline Fletcher and Jane da Mosto summarize what is known about the problem and some potential solutions. Their account is distilled from the efforts of the U.K.-based Venice in Peril Fund and its Venice partner, CORILA (the Consortium for the Coordination of Research Activities Concerning the Venice Lagoon System).

Venice has always had to endure floods, as the city's highest point rises only two meters above sea level. But the frequency and intensity of *acqua alta* (literally, "high water") events have increased dramatically over the past century. (In the early 20th century, St. Mark's Square flooded less than 10 times a year; now that number is more than 60.) The increases are due to a combination of factors including the natural subsidence of the region, a 50-year period of accelerated subsidence in the middle of the 20th century caused by excessive extraction of groundwater (which was stopped in the early 1970s), and a gradual deepening of the lagoon as a result of sediment starvation and removal by increasingly strong tides. Together these factors have made the city more prone to inundation by the water piled up in the northern Adriatic by storms, which sometimes overwhelms the natural and man-made barriers protecting Venice. If current trends continue, the city eventually will be all but uninhabitable and beyond restoration.

How, then, can Venice be saved? The consensus solution, a focus of the book, relies on erecting across the lagoon's three

inlets a series of mobile flood barriers that can be raised whenever large storm surges are expected. Construction has already begun on this project, the Modulo Sperimentale Elettromeccanico (called MOSE, like the biblical patriarch). The giant gates of these barriers are intended to protect Venice from the highest floods for at least the near future, but their longer-term success is threatened by both natural subsidence and the sea-level rise anticipated from global warming. As the authors recognize, the task of preventing Venice from flooding is not merely an engineering problem. Any solution (such as MOSE) that involves changing how water is exchanged between the lagoon and the Adriatic will necessarily also impact the lagoon's ecology and geometry, key elements that help to control the way storm surges propagate to the city.

The book does a good job of explaining why Venice floods, what remedies have been applied in the past, and which may be important in the future. It describes why the solution to the problem of flooding has to be more holistic than simply blocking storm surges from entering the lagoon. It is also stunningly illustrated, with numerous drawings and photographs that clearly illustrate the concepts discussed as well as the city's renowned beauty. Despite its title, *The Science of Saving Venice* is not at all scientific: beyond a few figures, a glossary, and a list of some relevant Web sites and organizations, it offers no technical information, no quantitative analysis, nor any references to published, peer-reviewed work. Readers interested in the science and engineering involved will have to track that down independently.



A frequent sight. St. Mark's Square is now inundated more than 60 times a year.

Such shortcomings do not, however, negate the book's principal values. The authors provide the lay reader with a broadly useful foundation for understanding the complexity of the situation Venice now faces and explain why saving the city for future generations depends largely on how well we achieve a good scientific understanding of its tremendously complex natural environment. In the spirit of the best field guides for travelers, the book offers an informative and engaging account of an issue related to one of the world's most precious cities—an account that can only help increase public awareness of Venice's plight and thereby contribute to its rescue.

—JESSE SMITH

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