Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600–1800 by Larrie D. Ferreiro

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In the interest of full disclosure, I should mention that I once sent the author of this book a copy of my Master's thesis, entitled 'Ships and Science'. In it I focused on the use of plan drawings in British naval architecture between 1580 and 1715, briefly arguing that scientific theory was of little use in early shipbuilding because it could not be used to make changes to the design drawings. I developed this argument more fully in my subsequent work having to do with stability theory in the 19th century, which I also made available to the author.

It was, therefore, with considerable interest that I noted the title of this book. It was with considerable surprise that I read the preface, in which the author defines naval architecture as the application of scientific theory to ship design. This view is logically, historically, and historiographically mistaken.

According to the dictionary, the term 'naval architecture' refers to both the design of ships and the superintendence of their construction. To equate naval architecture with theory alone is to confuse a small part with the whole. As for history, the phrase 'naval architecture' came into use in the late 16th century to describe a new approach to the design and construction of warships, organized around the use of measured, three-view, architectural-style drawings. Naval architecture was, in other words, already 'born' before this book begins. Originally, it had no connection to scientific theory whatsoever.

[1] Ed.: For a response to this review, see L. D. Ferreiro, *Aestimatio* 4 (2007) 8–12.

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Historians might recognize the methodological error. It is the common one of trying to impose modern categories on a historical subject instead of trying to understand how the historical actors understood the matter. But here the attempted imposition leads to a rather serious problem. The author is eventually forced to admit that 18th-century theories relating to the behavior of ships were, indeed, quite useless and rarely, if ever, applied to actual ship design—and that means that there was no 'birth of naval architecture' in the period 1600–1800 according to the author's *own* definition.

To put it more bluntly, the title of this book is misleading because naval architecture was not born in the period 1600–1800. Further, it is not surprising that, since there is no carefully chosen, logically defined, historical subject, there is no clear, logical order to the book's contents. On the contrary, there is a constant mismatch between what the reader expects and what the author provides. For example, given the author's equation of naval architecture with scientific theory, readers might reasonably assume that the subject of the book would be the work of a group of European savants who sought to understand the physical laws governing the behavior of ships at sea. Many famous scientists of the 18th century were involved to one degree or another, including Newton, several Bernoullis, Euler, Condorcet, D'Alembert, and a host of lesser lights. The results of their work came to be known in England as 'naval science'.

Again, assuming this to be a book about naval science, readers might reasonably expect the prologue (following the preface) to address the relevant scientific and technical issues. Instead, it contains a detailed account of the life of French savant Pierre Bouguer up to 1744, when Bouguer is described as 'ready to bring the laws of naval architecture down from the mountain' [22]. This leads the reader to expect an intellectual biography of Bouguer, detailing his theoretical contributions to naval science. No such biography ensues until the epilogue. Instead, what follows is an introductory chapter (following the preface and prologue) entitled 'Mere Carpenters'. From this one might expect to read about the problems of ship design that naval science was supposed to solve according to the rhetorical attacks of savants on actual shipbuilders. At the very least, having gone to the trouble of equating naval architecture with theory, one would expect the author to provide an introductory discussion of theory here, at last. Instead, this chapter contains a hodge-podge of

oddly-interpreted information concerning the number of ships in various navies, the use of cannon, the line of battle, ship models, a few words about the use of plans, a few words about early treatises on naval architecture and so on. It is not that the material is completely irrelevant. It is rather that, in the absence of a clearly defined subject, readers are left to wonder why they are reading this particular material at this particular time.

Naval science is, in fact, the focus of the book's three main chapters. The first, chapter 2, deals with the maneuver and masting of ships, neither of which are normally considered part of naval science, or naval architecture. Their inclusion does, however, draw attention to conceptual relationships between maneuver and masting and the more traditional topics of ship stability and resistance. The chapter is marred, however, by a strange organization leading to the inclusion of a great deal extraneous material. One might think, for example, that a chapter on maneuver should start with a discussion of maneuver. It starts instead with a history of the Jesuits, moves on to a history of European academies, printing, book publishing, and more.

Resistance is the subject of chapter 3, entitled 'A Shock to the System'. It is never explained whether the cute title is supposed to refer to Newton's account of resistance in terms of the impact of particles on a ship's bow, or to the shock of savants working on theories of resistance in the Great Age of Newton when they discovered that the great man's theories were wrong. This chapter also includes a great deal of extraneous material, ranging from a completely unnecessary discussion of Cartesian vortices, never referred to again, to an analysis of a modern study of the relative number of ships captured by French and English navies during their many wars.

Stability theory is covered in chapter 4, where readers will again have to scratch their heads as to organization. The first two paragraphs of the chapter say that stability theory was not developed as a response to stability accidents. The very next section is entitled 'Stability Accidents'. This is followed by a lengthy discussion of tonnage calculations, displacement, then tonnage again; but it is not explained to the reader that the measurement of displacement is relevant to calculations of stability. The chapter ends with 20 more pages of marginally relevant information, including a tacked on account of rolling and pitching, which was very poorly understood in the 18th century and not very well explained here either.

Nowhere is the organizational oddity of the book more apparent than in the fifth chapter. It simply lists the tables of contents from what the author identifies as the 'Great Works' of naval architecture. If not wholly irrelevant, this material should surely have been integrated into the text, where the books in question are discussed more than once. A sixth chapter has the misleading title 'Genius and Engineering'. It contains potted accounts of the professionalization of naval architecture in various European countries. The book ends with a brief epilogue that concludes the biography of Bouguer abandoned in the prologue.

When all is said and done, it is clear the author has done a great deal of research. Alas, he does not seem to have been able to bring himself to leave any of it out, perhaps under the impression that masses of marginally related material constitutes 'context'. The unfortunate result is that not enough time or space is devoted to a careful consideration of the actual science. Recourse to the calculus is far too quick. Too little attention is paid to explaining the underlying concepts.

This is a great shame because naval science has not received much attention in the English speaking world since the excellent introduction to John Fincham's *History of the Naval Architecture* of 1852, and Edward Reed's wonderful *Treatise on Stability of Ships* of 1885 (if you want clear explanations of the theory of stability and its historical development, read this). But naval science is a subject that deserves study. Sailing ships, as frequently stated in the 18th century, were the most complicated machines of their time, composed of thousands of parts, operating in the most complicated physical environment known to man. Naval scientists were engaged in the reduction of the extremely complicated behavior of these machines to the consideration of a few abstractions, expressed in the new language of the calculus. According to stability theory, for example, the behavior of a ship could be interpreted in terms of the movements of the centers of gravity and center of buoyancy—two abstract points that do not really exist. How and why savants came to think about the behavior of whole ships in this way deserves a proper explanation. It eventually led to an engineering revolution.

There is, however, an even bigger mystery. As noted above, the naval science of the 18th century was basically useless. It would not

even begin to be applied in a meaningful way until 1870. Why then did so many famous scientists continue to work on more or less useless theories for more than a century and a half? The author invokes a few clichés about the interest of the state in 'rationalization' and 'standardization', but it is not at all clear how theories of admittedly little practical utility could 'rationalize' anything. The author spends almost no time analyzing what the naval scientists had to say about why they were doing what they were doing.

To sum up, the author of this book equates naval architecture with the application of scientific theory to ship design. Mistaken or not, the equation leads the reader to expect a history of that activity. One would expect such a history to begin with a historical description of the nature and process of ship design. One would expect it to include an assessment of the problems resulting from the design process. One would also expect it to include an explanation as to how theory was supposed to correct these problems. One would then expect a careful historical description of the theory itself, along with an explanation of the motives of those who worked on it, particularly given the limited utility of their work.

This book never clearly identifies or addresses these issues. The reason seems to be that there is no clearly defined subject from which the necessary order could be deduced. A book about a conceptual revolution needs a better conceptual foundation than that.