

ball splintering from her most notable battle), and a 300-year old skeletal cardboard pop-up model of a pair of ships (1720 and 1723) in launch-day livery. Two other chapters of especial interest (28 & 29) feature the detail of figureheads: the first is of an unfinished carving, demonstrating a work-in-progress; the second is a comparison of the figureheads of three different models of the same ship (*Queen Charlotte*, c. 1784), illustrating the evolution of the design of the figurehead.

Interestingly (shocking, to a naval architect!) the exquisite actual draughts of ships were not as popular, and King George, when offered one, rejected it in favour of a perspective painting of ships represented in the distinctive Admiralty Board configuration (open frames below the main wale to emphasize the shape). Chapter 31 includes a number of examples of these (as well as what may have been the rejected draught). The Kriegstein collection (and this book) also includes a number of van de Velde paintings and drawings (characterized as the ‘photo-journalism’ of the day). Of course, the heart and soul (raison d’être!) of any such book is the pictures, and the photographs (mostly taken by the authors themselves) are stunning. This comment applies throughout, but most particularly to the pictures of figureheads and other details, illustrating the truly exceptional artistry and craftsmanship of the model builders and carvers. Of the ships, it is hard to pick a favourite, but the pictures of the *Diamond*, a 4th rate of 1708, stand out as an epitome of the type, featuring a largely unpainted pear-wood construction that has aged the characteristic honey-gold colour, with exquisite carvings around the stern gallery.

Overall, this is a marvellous volume. It is not an alternative to Ball & Stephens’ more thorough and scholarly work (*Navy Board Ship Models*, 2018, reviewed in this journal (Issue No. 2, Summer 2019, p. 159) but is rather, a perfect complement to it, being the labour of love describing what those authors acknowledge is “by far the largest collection (of Navy Board models) in private hands.” The only criticism would be of the binding which, as per the review of a previous, similarly weighty, Seaforth publication, is definitely not up to repeated handling.

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**Don Leggett. *Shaping the Royal Navy—Technology, Authority and Naval Architecture, c. 1830-1906*. Manchester University Press, [www.manchesteruniversitypress.co.uk](http://www.manchesteruniversitypress.co.uk), 2015, xi+300 pp., illustrations, notes, bibliography, index. UK £80.00, hardback; ISBN 978-0-7190-9028-8.**

In his foreword to *Warrior to Dreadnought*, the first of his volumes on the evolution of British warship design, the accomplished naval constructor and

author D.K. Brown notes that ship design is a team sport and conjugates the irregular verb “To Design” as follows:

*I create,  
 You interfere,  
 He gets in the way,  
 We cooperate,  
 You obstruct,  
 They conspire.*

*Shaping the Royal Navy* tells the story of the most significant period in the evolution of ship design in the Royal Navy, and of naval architecture as a discipline, and features all of the grammatical persons suggested above. It is a tale that, while inseparable from technological developments, is not about these developments per se, but rather about how they influenced changes in the understanding of the ship design process and of the various roles, authorities, and responsibilities within it.

The broad trajectory of technological development through the era is well-known: sail to steam, paddle to screw, wood to iron construction, broadside armament to turrets, armour, coal-fired reciprocating steam to oil-fired turbines, man-powered ship operations to machine-powered, etc. For those interested in the topic and the period, the list of dramatis personae is also reasonably familiar: Seppings, Symonds, Coles, Reed, Russell, Froude, Thomson/Kelvin, Barnaby, White, Watts, and Fisher, to name but a few. What this book adds significantly to the literature is the mapping of how the interaction of these personalities – with each other and with the technological opportunities – redefined the very nature and concept of the warship design process.

The book is an outcropping of the author’s PhD dissertation but is not as dryly academic as one might expect of that provenance. Rather it is a lively narrative with plenty of colour-commentary provided by ample and well-chosen quotations from contemporary writings. They convey with immediacy the opposed viewpoints, anxieties, and social/cultural prejudices of the period. Indeed, the tenor of the discussions put this reviewer in mind of what was by some termed the naval-officer debating style: vigorous exchange of strongly-held opinions, followed by robust personal invective.

The academic focus of the work is the “role of human actors in technological change,” the “wider contexts which shaped technological change,” and “technologies in the making, which involve networks of actors negotiating risk, speculation, anxiety, fragile credibility, and competing interest groups.” This approach is contrasted with technological determinism which sees technology more as an independent galvanic force. The aim of the actor-driven approach to the history of technology is not to question the importance of any particular new technology, but “to reveal the contingencies

on which their success or failure depended” (4-6). Thus, in many ways, this is as much social history as technological history, and the social/class dimension looms large in the underlying question of who should exercise authority, based on what source of informed judgement, and how acquired. Through the arc of this eighty years, this manifested as a contest between the relative credibility of experience versus science. The lack of distinction between authority (as knowledge) in technical matters and authority (as executive license) to make decisions led one member of the Board of Admiralty (1859-1866) to confide in his journal the need for a First Lord who would “abstain from that which appears hereditary with first lords, namely, the vanity of supposing, after they have been a few years, or even months at the Admiralty, that they can build and arm a ship” (16).

The volume is structured in nine parts: an introduction, seven chapters, and a conclusion. Each of the core chapters treats a specific issue and contemporary controversy, generally associated with a particular protagonist and exemplified by a particular vessel. The tale stretches from the “sailor-designer” Captain William Symonds and his HMS *Vernon*, through Baldwin Walker and the introduction of steam and screw; John Scott Russell and the introduction of iron; Captain Cowper Coles and the HMS *Captain* disaster; Sir Nathaniel Barnaby and William Froude addressing concerns with the seaworthiness of HMS *Devastation*; William White’s management of the design of HMS *Inflexible/Royal Sovereign* and the issue of balance in ship design; and finally Admiral Sir John Fisher and HMS *Dreadnought*, with the commitment to steam turbines.

The discussion and contemporary debates through these chapters tack back and forth between a number of key recurring themes: the role of experience versus expertise, or as it emerges, the clash between cultures of judgement and of observation; the nature and role of science in design; and the required qualities and background of individuals exercising authority.

Captain William Symonds’ tenure as surveyor represented the epitome of the culture of judgement, igniting debates on what skills a ship designer should have, and how the merits of ship design should be judged. Symonds was neither a shipbuilder, graduate of the School of Naval Architecture (1811-32), nor a member of the Naval Board. On the incoming Whig government’s abolition of the Tory-controlled Naval Board in 1830, however, he was appointed to oversee many of its duties. His claim to expertise was rooted in his repute as a naval officer and yacht designer (well connected with the Royal Yacht Club (RYC)) and his appointment was defended based on the prevailing notion that “institutionalized study was not necessary for advancement within a technical profession” (46). Interestingly, Symonds was presented as a “scientific man” and the qualities of his ships were demonstrated through “experimental

cruises.” Even at the time there was criticism of Symonds’ “guess and test” approach, “a form of empirical art rather than of science,” mobilizing “often aged Admirals’ to command squadrons of under-manned ships, and conducted in a ‘spirit of rivalry’, even to extent of recruiting ‘good jockeys.’” It was noted that there was little repeatability of results and no systemic analysis of contributing design factors. More critically, as these were effectively yacht races conducted in the relatively benign summer months, experimental cruises were not properly indicative of the range of performance qualities a warship should have. As an example, the sharp-formed Symondite hulls were notorious for rolling in a seaway with lower gunports awash.

The advent of steam was the subject of much polemic in the popular and technical press. As the author notes, the introduction of steam may be more productively examined as a history of steam advocates. Resistance was stiff – the RYC threatened to expel any members using steam. There was push-back also in this period on the experimental cruises, a critique of the time (1845) noting that the poor performance of many ships on their first trials “only affords lamentable proof of want of a governing principle” (76). The succession of Baldwin Walker following Symonds featured a restructuring of the surveyor’s office, with the actual design out of the surveyor’s hands and with his technical staff, and the surveyor’s role limited to directing and managing the work of the Royal Dockyards, ensuring the proper application of the navy estimates. This period also saw the second of several attempts to establish a professional development scheme, with the Central School of Mathematics and Naval Construction short-lived (1848-1853) because “the state did not perceive a significant advantage from giving a small group of the dockyard workforce a specialized education” (83). This period also saw the creation of a Committee of Reference (later Council of Science) to advise independently on questions of design.

The debate on design management intensified through the era of introduction of iron in shipbuilding. The homogeneity of French ships as a result of the French government’s “meritocratic bureaucracy” was contrasted with the disorder in British shipbuilding as a symptom of aristocratic patronage. Questions were raised of how best to effectively manage the Navy’s shipbuilding programme: what ships, by whom designed, by whom executed. John Scott Russell emphasized the need for naval architects who used experiments to generate new knowledge (105), noting that there was “no surer way to become unpopular than to insist on having right things done for right reasons” (113) and that “what must govern the ship is the object, aim, and purpose” (118). This period saw yet another re-organization of the surveyor’s office, taking the style of controller. It also saw a number of steps of progress in professionalization with the creation of the Institution of Naval Architects

(INA, 1860), and the (3<sup>rd</sup>) School of Naval Architecture at South Kensington (1864), later moving to RNC Greenwich (1872) as the Royal School of Naval Architecture. Debate on the ship design and ship science question was lively at gatherings of the British Association for the Advancement of Science (BAAS), the INA, and Royal United Service Institution (RUSI). Between the latter two in particular there was polarization on the issue of qualifications for exercising authority on design matters. Design was not yet considered a matter of the application of science, but rather a contest of “science and mathematics” versus “common sense and empiricism.” The author notes that “parliamentary debates reveal the deep tensions between MPs about whether science added anything to the craft practice of ship design” (120). The apogee of confident ignorance is represented by a Hansard debate as late as 1874 in which Henry Watkin, MP and railway speculator, denied the requirement for specialized skills and knowledge to become a naval architect, noting (on the basis of childhood acquaintance with toy boats) that “in one sense we have all been naval architects” and concluding his contribution by urging that the Commons legislate on where the centre of gravity (CG) of a ship should be placed (186).

It is particularly striking that this opinion was rendered after the HMS *Captain* disaster of September 1870 in which a new turret ship capsized in the Bay of Biscay with the loss of 509 lives. In a reprise of Symonds’ route to ship design authority, *Captain* had been designed and built under the direction of Captain Cowper Coles, a well-connected Royal Navy gunnery expert who had distinguished himself innovating with gunnery rafts in the Crimean War. The ship was designed and built against the objections of the Admiralty naval architects and was delivered with both lower freeboard and higher CG than as designed (and already of concern). Captain Coles had derived his authority from arguments for turret ships that “rested on the perception that US Civil War engagements portended the future of naval warfare” (144). In the aftermath, debates began to acknowledge that, in the earlier words of Chief Constructor Sir Edward Reed “the form of her battery, however important, is but one of many features of a warship...” (152). Reed argued that only naval architects could bring the various components and tensions within ship design into balance. Meanwhile, Russell weighed in with the acidic comment “is it patriotism or want of patriotism that makes English citizens elevated to the rank of legislators dabble most earnestly and pertinaciously in those matters of public safety of which they understand least” (160), while an anonymous article of 1875 saw the inception of the *Captain* disaster in “the vain idea of a man who did not know a single iota of mathematics, and who endeavoured to link the possible to the impossible, by building a ship which at the same time should prove an efficient cruiser and a floating battery of unrivalled power.” The same source also noted that an officer in the senior ranks of the service

was heard to voice the sentiment “thank God he did not know what the curve of stability meant.” While this loss fed the debate about the role of science, it also inspired a parallel debate on balance and fitness for purpose in ship design, the strategic role of ships (control of the oceans vs defence of coastal regions), and whether such ships should have the full top-hamper of the previous sail era.

In the debates and writings throughout this transition era, one can appreciate the sense almost of cultural anguish and visceral reaction to the transformation of ships from a beloved animate object into a machine of war, with the cognitive dissonance of encountering a monstrosity, presenting “as if she were a ship, instead of being a sort of infernal machine, created by some tremendous engineering mind, when in a state of nightmare” (167). The discussion in chapter 5, entitled “A Scientific Problem of the Highest Order,” deals with the deep unease regarding seaworthiness of such creations. As the author notes, much of the debate concerning HMS *Devastation* really concerned strategic thinking, although it manifested as a technical debate with questions of trust in professional groups. The successful resolution of this unease was the joint work of two successive Chief Constructors/Directors of Naval Construction, Sir Nathaniel Barnaby and Sir William White, and the engineer/scientist William Froude. The author notes that the first two had a different approach than their predecessor, Sir Edward Reed, a conciliatory approach aimed at establishing legitimacy rather than Reed’s more antagonistic approach seeking recognition.

This project of generating trust in scientific and engineering expertise was also supported by Froude’s work establishing the utility of model experiments, validated by full-scale trials. In discussing the interactions between specialists and non-specialists (generalists) in ship design, the author makes an important point regarding the recognition of Froude’s personal and scientific credibility: that effective engineering required the patronage of authority that rested within institutions (and whose gift was often highly political) even as the Admiralty required the support of scientists and engineers in restoring public faith in safety of warships following concerns regarding HMS *Devastation*. Thus, this debate redrew the map of authority whereby science became analogous with efficiency, safety, and power (274).

The last two chapters (“The Politics of Management and Design” and “Re-engineering Naval Power”) cover two significant steps in ship design in terms of the artifact itself: White’s design for *Royal Sovereign* switched the design emphasis from defensive strength to seakeeping “speed and fighting power at sea” (225), while Philip Watts’ *Dreadnought* featured a commitment to steam turbines (as well as, of course, the all big-gun armament). The period featured a lively public interest in naval debate, fanned by Stead & Brassey, and tension between quantitative and qualitative measures of warship merit.

As the author comments, consensus required “conscious thought about what a battleship’s qualities were and how it was to be used. The absence of such discussion, however, revealed a serious problem in the British techno-military sphere: very few naval officers thought about engineering and naval power in a connected sense” (221). Admiral Sir John Fisher did not lack for articulate opinions on the requirements hierarchy, observing that there was “very little connected discussion between the naval officer, naval architect, and administrator concerning how ship design affected tactics and vice versa” and that “[s]trategy should govern the types of ships to be designed. Ship design as dictated by strategy should govern tactics. Tactics should govern details of armaments” (251). While Dreadnought is often viewed as Fisher’s baby, it was rather the product of his establishment of a Committee on Designs (1905) with instructions for “naval officers to use their ‘experience’ to ‘propose the tactical and fighting requirements’ for the ship and civilian members to state ‘the limits within which these requirements are capable of being fulfilled’” (267).

But what these two chapters also narrate is the change in social attitudes toward participants and their roles in an increasingly technical endeavour. The Royal Dockyards were the largest state engineering enterprise of the time and there were arguments for naval officers to be in charge due to their social status and acknowledgement of superiority through possession of important qualities such as “common sense, sound judgement, and self command” (206). At the same time there was a shift from apprentices in a craft-oriented system to naval college graduates in a scientific-management scheme and a professionalization of the Royal Navy’s design cadre (the Royal Corps of Naval Constructors (RCNC) was established 23 August 1883). Fisher was intolerant of class prejudice impeding progress and instituted the Selbourne scheme to improve the acceptance and status of RN engineer officers, commenting caustically “the decline and fall of England will not ... be due to the upper classes leaving the Navy but it will be due to their effeteness in failing to recognize what a great ‘leveller’ is education...” (262).

This review has only scratched the surface of the many valuable insights in this excellent book. It is a fascinating tale of the evolution in the interaction of personalities in a highly complex technical field – an evolution that accomplished the techno-strategic (almost diplomatic) feat of establishing effective, mutually-beneficial spheres of influence between the operational and engineering/design realms, whereby the warriors stepped back from attempting to assert their experience in designing the ship, but rather applied it more strategically and effectively to “designing the requirement.” This is the story not so much of the technological changes in this period of transition from artisanal design to modern technical design, but rather of the evolution of roles and parsing of authority within the design enterprise. Thus, it is a very

important contribution to the history of warship design and is most highly recommended.

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**Jean-Denis G.G. Lepage. *Torpedo Bombers 1900-1950: An Illustrated History*. Barnsley, S. Yorks: Pen & Sword Books, [www.pen-and-sword.co.uk](http://www.pen-and-sword.co.uk) (distributed by Naval Institute Press), 2020. ix+394 pp., illustrations, bibliography, index. UK £30, US \$44.95, cloth; ISBN 978-1-52676-347-1. (E-book available.)**

After the first controlled heavier-than-air flight by the Wright brothers in 1903, navies slowly appreciated and embraced the possibilities for aircraft as a new technology in conducting naval warfare. Aircraft quickly evolved from flimsy prototypes with flyers perched precariously in the open air to more substantial, enclosed models used for reconnaissance, surveillance, gunnery spotting, and communication purposes. On 28 March 1910, the French inventor and manufacturer Jean-Henri Fabre flew the world's first floatplane, taking off from the water under its own power. The idea of matching up aircraft with torpedoes, another technology changing the nature of naval combat, was broached and taken more seriously after the start of the First World War. Britain proved the concept with successful air-launched torpedo attacks against Turkish ships in August 1915 by aircraft operating from a seaplane tender. Subsequent years and decades saw the development of new types of land-based and shipborne torpedo bombers dedicated to the specialized role of sinking ships in the maritime environment. The experimentation of the interwar period gave way to large-scale employment in combat during the Second World War and predominance of carrier aviation in the vast Pacific Ocean. The torpedo bomber's days, however, were numbered with improved anti-aircraft defences, the advent of missiles, and eventual introduction of the helicopter, another vertical air platform capable of carrying torpedoes and operating off ships. Jean-Denis Lepage, a Dutch-based author and illustrator, takes on the weighty task of documenting the evolution of the torpedo bomber up to the mid-twentieth century in its many varieties.

The book is divided into six chronologically structured parts, comprising forty distinct chapters focused on general developments and specific countries. Further headings within chapters places the focus squarely on the individual aircraft, with paragraphs of various lengths giving background and technical details and accompanied by illustrations. Though references are not provided, the entries are very detailed and comprehensive, drawing upon available secondary literature and trade sources. Lepage covers both torpedo bombers