

pursue. They weren't called "the Exploders" for nothing.

Hamilton's table listing every boat that had snorkel fitted, from U-92 to U-1308, including those with anti-radar covering and hull modification, provides a useful reference. HMCS *New Glasgow* paid the price in March 1945, at night off Londonderry, when their bridge watch sweeping the area before her group went out on escort duty, heard a thrumming noise. They presumed it was a patrolling aircraft, when in fact it was U-1003's new snorkel close alongside! Her commanding officer had misjudged his closing angle, and in fact hit *New Glasgow*, damaging both of them, to the extent the U-boat broke his snort and periscopes and had to be abandoned the next morning! Count it a dubious success for the RCN, since the ship had to return for major repairs, and a lesson too late for the *Kriegsmarine*.

Offering both detailed description of the trials, successes and engineering amendments, in text and illustrations, this is an important and well referenced book on Germany's late war efforts to regain an advantage. Meanwhile, as Roskill noted, the Allies were just "keeping up."

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Thomas Heinrich. *Warship Builders: An Industrial History of U.S. Naval Shipbuilders 1922-1945*. Annapolis, MD: Naval Institute Press, www.usni.org, 2020. xii+346 pp., illustrations, tables, charts, notes, bibliography, index. US \$ 39.95, cloth; ISBN 978-1-68247-537-9. (E-book available.)

Most of the US armada assembled in Tokyo Bay to accept the Japanese surrender in September 1945 had been commissioned since Pearl Harbor. Au-

thor Thomas Heinrich uses this diverse fleet of vessels, ranging from aircraft carriers to landing craft, as a vivid symbol of American wartime shipbuilding. This book is a comprehensive look at shipyards including their management and labour, the roles of the US Navy and government support programs, the impact of new technologies, and details of how certain building programs were achieved. The narrative shows how warship building differed from merchant ship construction and from the fabrication of other types of military equipment. Warships were, in fact, built in batches by skilled labour. Writers who have depicted US warship-building as analogous to the mass production of aircraft, tanks, or artillery or liberty ships, by recently-trained workers are incorrect. The book offers welcome comparisons in each chapter with practices in Britain, Germany, and Japan.

Thomas Heinrich is a German-American professor of business and naval history. His *Ships for the Seven Seas: Philadelphia Shipbuilding in the Age of Industrial Capitalism* (1997) examined the nexus of factors that produced a major shipbuilding conglomerate on the Delaware River. *Warship Builders* is the result of ten years of further research and thinking. The writing style is clear; the writer's painstaking efforts to explain (and illustrate with drawings) points like the nature of arc and electric welding, propulsion rotors and the construction of turbine rotors perhaps reflect his teaching background. Extensive endnotes comprise one fifth of the book; they are followed by a 35-page bibliography.

When Congress approved a 70 per cent expansion of naval tonnage under the *Two-Ocean Navy Act* in July 1940, America already had one of the world's largest warship-building indus-

tries (7). The reader is reminded that in 1906, the boilers for HMS *Dreadnought* had been supplied by the UK branch of Babcock-Wilcox, a firm that had grown from its origins in Rhode Island to an international concern. The warship-shipbuilding sector, having been largely fallow in the 1920s, was steadily strengthened by the Roosevelt administration from 1933 onwards. The President had been involved with wartime shipbuilding during his eight years as Undersecretary of the Navy in the Wilson administration. Under the New Deal's *National Recovery Act* of 1933, private and naval shipyards started receiving funds for facility improvements. The new administration also began approving larger warship-building programs, a trend that accelerated as the international climate, particularly in the Pacific, deteriorated. Heinrich notes that navy shipyards—whose workforce during the Second World War would represent one-third of warship-building labour—started receiving funds from Congress for facility improvements as early as 1928 (29). All four countries had developed the use of electric welding in warship construction in place of riveting. It was only in the United States and Germany, however, that large, overhead cranes enabled large modules, or in the case of U-boats, hull sections, to be first welded and moved into position on the hull.

Large private warship builders operated as cartels in the thirties in both the US and UK. In the late twenties, the only three American yards capable of building large warships had secretly coordinated bids for constructing a class of heavy cruisers to ensure that each received at least one contract. Their profits were 25, 35, and 37 percent of the contract price (25). The results of these insider arrangements were ultimately beneficial in that yards came to spe-

cialize in building certain types of warships. Newport News won the contract for the first American carrier to be built as such from the keel up, USS *Ranger*, in 1930, after the two other yards had agreed to submit higher bids. In fact, Newport News made a 23 percent profit on this ship, and this was the start of the yard's specialization in carriers. It would build the three successful *Yorktown* class ships later in the thirties and then nine of the 24 powerful *Essex* class during the Second World War. The *Two Ocean Navy Act* instituted no-bid contracts negotiated between the navy and pre-selected builders. Wartime profits for private yards averaged 5 percent; the building of destroyers (9 percent for Bath Iron Works), submarines (8 percent) were more profitable than constructing heavy combatants (99). Seventy-five years later, both yards still specialize in building these warship types. The wartime profit figures do not factor in heavy investments by government in facility improvements that were written off after the war. Major British warship builders were more profitable than US and German yards in the 1930s (50); the yard on the Clyde that built the battleship *Anson* between 1937 and 1942 realized a 30 percent profit. Professor Heinrich provides a fascinating comparison of the costs in the late-thirties of battleship classes on page 51. The approximate cost per ton for a *Yamato* was \$780, as against \$790 for a *King George V*, \$1,100 for a *Bismarck*, and \$2,200 for a *North Carolina*.

Individual chapters discuss the role of navy yards, private shipyards, and internal reforms in the Navy Department. Heinrich cites the "unprecedented concentration of power" under Admiral King as Chief of Naval Operations and Commander in Chief of the US Fleet (113). All four of the Iowa-class battleships were built in navy yards on

the east coast. Their construction is described in detail in the chapter on navy yards. Apparently, warship plans produced in the Bureau of Ships were more detailed than those provided to builders in Britain by the Naval Construction Department (150). During the design stage, the Brooklyn Navy Yard carpenters built full-scale mock-ups that helped resolve the internal arrangement of individual spaces and issues such as the positioning of machinery and piping. This yard built two *Iowas* and acted as the lead yard once construction started when there were regular conferences between the three yards involved. In 1941, the President had pushed to complete nine Cleveland-class light cruisers under construction by a single yard, New York Shipbuilding, as Independence-class fast light carriers. Admiral King supported this innovative proposal. There is a fluid and comprehensive narrative about this project in the chapter about private shipyards. It highlights various aspects of their propulsion systems and the role of sub-contractors and extensive supply chains in producing a complex warship. The Independence-class joined the Pacific war at roughly the same time starting in late 1943 as the powerful Essex-class fast carriers. The author notes that the “Two Ocean Navy” plans in 1940 lacked provision for ocean-going escorts (92). Later he covers the massive programs that produced 563 destroyer escorts which started entering service late in 1943.

Warship Builders is rich in detail. The narrative describes the prodigious scale of US wartime naval construction and cites numerous dollar figures. There are, however, few attempts to relate these to a total figure in a category (e.g., assistance for facility improvements to private/navy yards or expenditures on aircraft or other weapon production).

The reader is not provided with a frame of reference to evaluate and compare various expenditures. An exception is a statistic on page 122 which shows that the total value of the 11 navy yards and industrial shore establishments in 1944 was \$12 billion, “comparable to the combined assets of General Motors, US Steel, and American Telephone and Telegraph.”

Warship Builders includes well-chosen photographs, excellent diagrams, and useful graphs. It has been produced to the usual high US Naval Institute standard with sturdy binding and clear typeface. The text is jargon-free and covers a wide span of topics in a clear manner. This is an admirable book that describes the scale of US naval shipbuilding, how it was achieved and how it compared to parallel efforts in Britain, Japan, and Germany.

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David Hobbs. *The British Carrier Strike Fleet after 1945*. Barnsley, S. Yorks: Seaforth Publishing, www.seaforthpublishing.com, 2020. xvii+622 pp., illustrations, glossary, notes, bibliography, index. UK £19.99, US \$39.95, paper; ISBN 978-1-5267-8544-2. (E-book available.)

At nearly 1,000 feet long and embarked with fifth generation F-35 aircraft, the HMS *Queen Elizabeth II* is the pride of the British Fleet. The aircrew of the F-35 is comprised of a joint and combined force of US Marine aviators and Royal Air Force (RAF) pilots flying beside Royal Navy (RN) aviators. This incredible feat of engineering and military might, however, almost did not happen. *The British Carrier Strike Fleet After 1945* covers the decline and atrophy of the British fleet after the