

captured Spanish gunboats reused by the American Navy, there is barely a mention of the 18 Flower class corvettes built in Canada during 1942-1943 and used by America as Tempress and Action class gunboats. More detail on these vessels, along with the Second World War Atlantic and Caribbean gunboat operations in general, would be a welcome addition.

US Navy Gunboats is a good introductory text into the gunboat, monitor, and armed yacht designs fielded by the United States from the Spanish-American War era through the Second World War. Herder is able to provide succinct summaries of the various design types and several of the key conflicts within the limited space afforded by Osprey's New Vanguard format, coupled with a good selection of period images and an excellent cross-sectional rendering of the most famous gunboat, the *Panay*. While Herder's Second World War coverage could doubtlessly be expanded upon with discussions of the Caribbean and Atlantic Theatres, or the *Flower* corvettes, he has provided a solid stepping stone for those seeking to learn of the different vessels employed in a gunboat role by the United States Navy in the days leading up to the Spanish-American War through the fall of the Asiatic Fleet in 1942.

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Vickie Jensen. *Deep Dark and Dangerous—The Story of British Columbia's World-Class Undersea Tech Industry*. Madeira Park, BC: Harbour Publishing Co. Ltd. www.harbourpublishing.com, 2021. 282 pp., illustrations, index. \$36.95 CDN, cloth; ISBN 978-1-55017-920-0. (E-book available.)

Although the Second World War propelled the Canadian economy from its reliance on resources into a world of technology-based industry and innovation, that change still does not seem to have imprinted itself in the minds of much of Canadian society. It does not mean that Canadians are not innovative or technically competent, but all too often, Canadian technology and ideas are submerged or bought out by outsiders. Often, "made in Canada" breakthrough concepts are exploited by other nations' industries while Canadian governments, industry, and consumers eagerly snap up their products. Either that, or Canadian success stories remain invisible, only to be recognized for what they are beyond Canada's borders.

Vickie Jensen's survey of British Columbia's undersea technology industry exposes one of these success stories: not only as a chronicle of surmounting the challenging engineering problems of designing equipment that works reliably and safely in the forbidding environment of the deep ocean, but also of making the product a commercial success. Indeed, her own motivation for

writing this book illustrates the issue of an industry “hiding its light under a barrel.” After moving from the US Midwest to British Columbia, Jensen got a job as editor of *Westcoast Mariner* magazine, which led to spending months at sea on various coastal craft to write about the province’s coastal marine industry. Not until a reader prompted her to do so, however, did it occur to her to investigate the underwater component of that provincial industrial base. Just as ocean waters cover a myriad of wonders, so it seems, did they obscure an emerging industry.

Jensen’s journalism background is evident in her largely personality-based approach to the story. Her narrative begins in the late 1950s with the demands by commercial diving to extend beyond the (then) usual depth limit of 100 feet. This part of the story is based on the experience and drive of two pioneering BC divers and the challenges involved in the business of underwater salvage, bridge construction and rescue. Overcoming such problems as working in icy waters, river currents, and rough weather, at depths on the edge of the limitations of hard-hat diving at the time, prompted them to develop new techniques, update technology, and develop improved diving tables.

Their customer base, in particular the emerging offshore oil industry, demanded deeper dives and work on heavier structures, driving these early innovators to developing a mini-submarine capability to provide longer dives and safer working conditions. Again, Jensen focusses on the “characters” who chased the dream of developing a unique undersea intervention capability in BC and the mix of invention, engineering, and business sense necessary to pull it off. The result was the establishment of the International Hydrodynamics Company (or HYCO) which not only lived up to its international name, but spawned numerous corporations focussed on underwater operations and equipment. Perhaps even more important, HYCO provided the initial training and experience for many individuals who eventually became key players in the development, engineering, and business aspects of underwater technology. HYCO’s signature product was the Pisces series of mini-sub, which extended diving operations to 2000 metres. This, in turn, expanded the nature of jobs that could be undertaken on behalf of offshore oil and gas exploration, research, torpedo recovery, and, in one instance, a very deep rescue operation. It also expanded BC’s reputation as the incubator for undersea technology development and its international customers (including to the Soviet Union, which even featured a Pisces craft on a postage stamp). Success brought its perils however. Expanding operations meant expanding capital requirements, which led to business partnerships and eventually, a public offering. The latter involved a new world of corporate management for which the founders were ill-suited and this, coupled with the ups and downs of its customer base, and competing advances in technology, saw the demise of HYCO in 1979.

HYCO may have collapsed but, as the author points out, it spawned a number of follow-on companies, both in the underwater intervention business itself and in support industries, as well as a new generation of entrepreneurs eager to get into the business. Can-Dive, Oceaneering, and Nuytco are major examples of BC enterprises that evolved from the late 1960s to the present day. Innovations in equipment and techniques came with an expanding international customer base and conditions that ranged from the Caribbean to the high Arctic. Oceaneering's successful development of an Atmospheric Diving Suit permitted deep-diving operations (300m) without compression and decompression operations, the use of regular gas, and a smaller surface support system. Projects undertaken using diving suits and manned mini subs also included support to the film industry, ecological research, underwater survey and even training astronauts in a simulated zero-G environment.

As the world of underwater intervention and exploration evolved, demanding even deeper operating depths, the future lay in eliminating the human element (on the ocean floor) altogether. This led to the development of the Remotely Operated Vehicle (ROV), leaving the human operator on the tender vessel above. Development of this technology generally favoured larger, well capitalized firms, but BC companies persevered with often surprising success. Ocean Works won a remotely-operated submarine rescue system contract (Pressurised Rescue Module System—PMRS) based on previous work done for the Australian navy. Subsequent projects by BC companies involved developing ROVs for pipeline route survey, semi-submersible remotely-operated vehicles for naval mine countermeasures, and one, the Remotely Operated Platform for Ocean Science (ROPOS) used in Canada and the US for research.

International Submarine Engineering (ISE) was a key player in these later developments, but the company realized that a major limitation of ROVs, namely the umbilical providing control, power and data communications to a surface tender, could be overcome. Tapping into emerging power, computer and sensor technology, they developed an Autonomous Underwater Vehicle (AUV) suitable for long-range operations free of any surface link. AUVs represented a major capability improvement for long-range and long-duration projects hydrographic surveys under ice, oceanographic research, and mine countermeasures and was a major step forward in underwater work. Another innovation, outlined in the book, is the development by the University of Victoria's Ocean Networks Canada of two instrumented undersea networks (VENUS and NEPPTUNE) off the BC coast, designed to provide open and continuous geophysical, oceanographic, and biological monitoring of the sea floor on the Juan de Fuca plate.

There were other applications for undersea technologies as well, and

Jensen's account includes sections on submarine tourism, underwater research, and even treasure hunting. She focusses on the people involved, providing bulleted career summaries of some of the key people in the various companies. The business background is also a key element of her account of the marriage of managing a growing business, a volatile customer demand and requirements, tight timelines with cutting edge technology, and innovation.

Depending on the reader's bent, one might wish for a bit more detail on the technology side. For instance, more discussion of the technique and capabilities of Atmospheric Diving Suit technology and comparison with other systems might have been useful. While the emphasis is the author's privilege, one wonders at times if Jensen had difficulty with some elements of it. For example, when discussing some early Pisces submersible employment, she describes work done recovering Mk 46 and Mk 48 torpedoes for the US Navy on the test range at Nanoose, BC. In describing the difficulty in extracting the larger Mk 48's buried in the mud it might have been useful to have mentioned that these submarine-launched heavyweight weapons were some seven times heavier than the air and ship launched Mk 46 anti-submarine torpedoes. A trivial point perhaps, but she compounds it later in the book when she states that a former submarine commander used the Mk 46 torpedo with a "21-in hull diameter" as the inspiration for an AUV. (The Mk 46 is a 12.75-in design not used by submarines and the submariner would have used the much larger Mk 48 and Mk37C weapons.)

While ostensibly an account of the trials and tribulations of developing technology in a challenging and dangerous environment, Jensen's book is really about the people involved and how they rose to meet those challenges. In fact, the final chapter largely focusses on advice on how to build a career in such a world with an explicit exhortation to women not to be afraid of getting involved in a technology-based career. The book, therefore, is well worth a read by career guidance counsellors at high schools and colleges. Similarly, its discussion of the difficulties of marrying the risk-taking and "get 'er done" attitude of the early technology pioneers with the practicalities of managing a growing business and expanding one into a publicly traded corporation. Indeed, the work would not be out of place in the case studies section of a business school library. Jensen states up front that she chose the title *Deep, Dark and Dangerous* to underline the risks involved in deep-diving operations. The reader comes away with the impression that perhaps the title more accurately reflects the business environment in Canada when trying to establish a technology-based enterprise here.

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