In lieu of an abstract, here is a brief excerpt of the content:

The Submarine in Naval Warfare, 1901-2001
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This article surveys the evolution of submarine technology, submarine capability, and strategy for the use of submarines. It traces change in the operational capabilities of submarines since their introduction, evaluates the past effectiveness of submarine forces in war, and suggests how their roles and capabilities are likely to develop in the future. It also addresses the current debate over the proper roles of submarines in naval strategy and discusses prevalent misconceptions about their past and present capabilities. Submarines are fundamentally different from other warships. Because they function in the underwater medium, submarines tend, unlike surface ships and aircraft, to operate best in isolation; they require unique combinations of weapons and sensors; and they require tactics based on stealth and surprise. They are most capable in the role of hunter in hit-and-run attacks, in attrition warfare, and as platforms for single-salvo strikes ashore. They are least capable in missions that require prolonged exposure and the capability for sustained defense, such as sea control, naval presence, and projection of force ashore in a manner that requires more than a single salvo. Submarines further differ from surface and naval air forces in being most effective when dispersed rather
Submarines have been in regular naval service only since 1901 and have been effective as warships only since about 1910. Yet during their relatively short history, developments in technology have given them the capabilities to perform six basic roles in naval warfare. By the outbreak of World War I, submarines were fully capable in three roles: coast defense, naval attrition, and commerce warfare. Their capacity to perform three additional missions—projection of power ashore, fleet engagement, and assured destruction—matured in the 1960s, after a long period of relative equilibrium in submarine technology that lasted well into World War II. All six remain the basic mission capabilities of submarines today. Current trends suggest three further developments in the near future: a new capability to perform strategic counterforce missions, a decline in the capacity to wage commerce warfare, and the possibility of a new capability in the form of decisive naval battle. The history of how these capabilities were developed and used in war suggests five principal conclusions about submarine warfare. First, submarines possess no general immunity against countermeasures. Although they are difficult to find and largely immune to attack while cruising submerged, they become vulnerable once they disclose their presence by attacking. In fact, when actively employed in most combat missions, submarines are usually more vulnerable than other types of warships. This reflects the conflicting requirements of lethality and survivability in submarines and is a basic problem of submarine operations. Second, navies have had difficulty solving the twin problems of...
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This article is drawn from research on long-range trends being conducted at the Los Alamos National Laboratory, which is operated by the University of California for the U.S. Department of Energy. The conclusions and opinions expressed herein are solely those of the author. I would like to thank Linda A. Ronan and Thomas G.Doswell for their helpfull comments and suggestions, as well as Niamh McManus for her assistance. Karl Laatschlagner is a Staff Scientist at the Los Alamos National Laboratory. He has been an Associate Research Scholar at the Harvard Divinity School and a Visiting Faculty Member at the Coral Sea Centre at the University of Sydney, and was a naval officer for five years with two combat deployments to the Persian Gulf.

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