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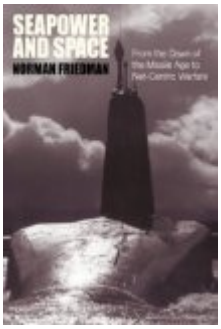
Norman Friedman. *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare.* Annapolis: Naval Institute Press, 2000. 284 pp. $42.50 (cloth), ISBN 978-1-55750-897-3.



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The Changing Nature of Naval Warfare Since 1970

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The Changing Nature of Naval Warfare Since 1970

If the reader wishes to be informed about the history of space-based naval warfare concepts, political developments, military strategies and tactics, and missile and computer hardware, this scholarly book is essential to that goal. This is the first study to move beyond the usual descriptions of space-based communication and navigational systems to describe in detail surveillance and targeting systems and tactics – both offensive and defensive – as they developed in the U.S. Navy and those of the former Soviet Union. As the reader will find, access to space-based systems has dramatically altered naval warfare during the past three decades. Because of the declassification of information in both the United States and Russia, and because of the collapse of the former Soviet Union, a great deal of information about naval sea and space systems has recently become available. The author assesses this information and its impact on American policies during the past several decades and examines the direction of future developments, including the impact of new civilian and commercial imaging satellites, the impetus to shift from military to civilian-owned communications systems, and developments in anti-satellite systems.

Every paragraph – nay every sentence – is packed with information that is instructive, enlightening and sobering. I have not read a book quite like this since Herman Khan's *On Thermonuclear Warfare* (Princeton, NJ: Princeton University Press, 1960; 2nd ed., New York: Free Press, 1969). There is a great deal to contemplate about the recent past and the impending future. Friedman has prepared a compelling, highly detailed, and well-documented evaluation of where the United States and the Soviet Union (and some of the allies of both powers) have been during the missile age and where we are headed in terms of "net-centric" warfare. This is not a volume for the casual reader or the fainthearted; there are dozens of acronyms, a healthy dose of statistical information, and detailed syntheses. His book is a complex, explicit, and provocative account that is well worth the reader's undivided attention.

Friedman is an internationally known strategist and specialist in the fields of weapons design and development and has written a number of respected design histories of warships of the United States Navy (carriers, battleships, cruisers, destroyers, submarines, and small attack craft). As a defense analyst, he has also authored volumes on naval radar, weapons, carrier aviation, maritime strategy, and a comprehensive series on world weapons systems. Among his recent salient works are an analysis of the 1990-1991 campaign against Iraq and a major analysis of the Cold War entitled *The Fifty Year War* . He also writes a monthly column for the *United States Naval Institute Proceedings* and is a valued commentator on television. Friedman has the gift of writing clearly and succinctly, explaining complex terms and leading the reader

into the wonderment of satellite technology, navigation, communications, electronic and image reconnaissance, and targeting. This current analysis he points out is derived from accounts of reconnaissance satellites taken from unclassified and unofficial sources (p. 12).

Friedman's meticulous yet highly readable book, rendered in British English, is composed of 14 chapters, 29 plates (placed between pp. 192-193), 49 pages of double column endnotes (423 total notes), a bibliography of 73 items (including two web sites and 18 Russian-languages sources), a glossary of 75 items (AMB, Anti-Ballistic Missile, through VLF, Very Low Frequency [3-30 kHz]), and a 12-page index of, in the main, proper noun terms and names. The endnotes are in 8-point font while the rest of the volume is printed in 12-point. The two web sites mentioned are those of the Federation of American Scientists (FAS) and James Wade's *Spacepedia* but the URLs are not listed. The FAS web site is located at `http://www.fas.org` but I have been unable to find *Spacepedia* using a variety of search engines. I shall comment briefly on the substance of each chapter prior to an assessment of the overall volume.

The initial essay, the "Introduction" (pp. 7-12, 1 endnote), provides an essential background for his assessment of the premise that the advent of space systems has transformed naval warfare for those navies that had access to such systems. In the main, these are the United States and Soviet Union/Russia, but also the United Kingdom, Canada, People's Republic of China, among others. Friedman points out that many of the systems were developed as sources of intelligence rather than as operational sensors, and are rarely discussed in the literature. This transformation from traditional warfare capabilities toward information-oriented warfare is what is termed "net-centric warfare." Classic examples dating to 1998 are the launching of Tomahawk missiles from surface vessels in the Indian Ocean against targets in Afghanistan and in the Sudan, and firing hundreds of Tomahawks at Iraqi air defense targets later that same year. He also remarks how early-warning and communications satellites located in very high orbits were safer from attack than naval targeting satellites which operated in very low orbits. During the past two decades there has been a remarkable shift from the exploration of space for military purposes to commercial applications, particularly communications and navigation. This change from military to civilian applications had brought other issues to the forefront and suggests the ultimate need for a unified space command.

In Chapter 2, "Satellites and their Mechanics" (pp. 13-19, 8 endnotes), Friedman considers the "basics" about satellites, including gravity, elliptical orbiting, laws of physics, laws governing satellite motion, perigee versus apogee, geosynchronous orbits, transfer orbits, solar panels and decay lifetime. He also discusses threats to orbiting satellites, particularly electromagnetic pulses and space debris. The third chapter, "Getting into Space: Boosters" (pp. 20-45, 33 endnotes), is a summary of liquid-fuelled versus solid-fuelled rockets and boosters, oxidizers, and storable liquid propellants. In particular he reviews U.S. space boosters (ICBMs, IRBMs, Atlas, Titan, Thor, Agena, Castor, and the Delta series) as well as the reusable Space Shuttle, the maintenance of launch rates, the loss of the *Challenger* , Expendable Launch Vehicles and Evolved Expendable Launch Vehicles, and Alternative Launchers such as Notsnik and Spiral. Friedman also presents a very clear and detailed analysis of Soviet space boosters (R-7, Vostok, Voskod, Soyuz, and Energiya), the Soviet "bouquet" (clustered boosters), *Buran* (the Soviet designed space shuttle), and Uragan program. In addition, be reviews information on Chinese space boosters such as the Chang Zheng ("Long March") boosters and the accusation that the Loral and the Hughes corporations aided the Chinese in developing missile accuracy. Until the 1980s, he concludes, both U.S. and Soviet space booster development was driven by military requirements, but civilian space activities then began to take a more central role.

Friedman's Chapter 4, "Polaris and Precise Navigation" (pp. 46-53, 14 endnotes), begins with a review of the Polaris and Regulus systems, electronic navigational alternatives (Lorenz, Loran, and REDUX), transit satellite systems, and the absolute necessity to understand the shape and variations in the Earth's gravitational field. He also considers Ship Inertial Navigation Systems (SINS) which is vulnerable to atmospherics, and the development of the self-consistent gridlock process. With the fifth chapter, "Passing the Word: Reliable Communications" (pp. 54-86, 60 endnotes), the reader is informed of the Kennedy administration's thinking during the Cuban Missile Crisis. Friedman contends that this thinking is encapsulated in Barbara Tuchman's *The Guns of August* (1962), which explained the outbreak of the First World War largely on the basis of unthinking moves by the combatants (p. 55). A mix of theory and perceived reality, dense message traffic and the slowness of information transfer are also related. The loss of the intelligence ship USS *Pueblo* and seizure of the merchant ship *Mayaguez* are recalled. Friedman then returns to the early years

of communications beginning with HF (High-Frequency) radio developed in the 1920s and how HF radio helped to transform naval warfare (Convoy PQ17 versus U-boat Wolfpacks in 1942 is the example). Early 1950s experiments with satellite relays, transponder satellites, up-link transmitters, jamming, and information capacity as related to bandwidth is reviewed. U.S. programs such as Syncom 2 and the DSCA (Defense Satellite Communication System) and its variants DSC I (1966), II (1968), III (1975 – still in use), and the new DSCS SLEP (2000) are reported. The British Skynet system and its four variants are referenced. As an historical note, Skynet 2B launched in November 1974 was the first satellite system built outside of the United States and the Soviet Union. Lastly, Friedman recounts the four generations of NATO systems (NATO- 4 is a modified British Skynet-4) and systems developed by France, Spain, Japan, Australia, and Brazil.

A closely related discussion, Chapter 6, "Finding Targets: Reconnaissance" (pp. 87-128, 48 endnotes) begins with the American U-2 aircraft seeking intelligence on Soviet targets and the Soviet strategies of deception. Friedman reviews the origins of the U.S. Reconnaissance System since 1946, including Rand Corporation research, Project Corona, SAMOS, and photoreconnaissance satellites which mapped the USSR for Polaris targeting (1960-1970). Of interest is the discussion of the 11 KH (Key Hole) satellites, notably KH-11 (Key Hole 11) and Lacrosse radar satellite, the longer operational lives for satellites, changes in resolution and area coverage parameters, and side-imaging radar. The impact of imaging satellites has been particularly useful in the identification of naval construction and activities at naval bases. Friedman also considers ELINT (Electronic Intelligence), such as the Navy's "Ferret" program and Operation Tattletale; SIGINT (Signals Intelligence), such as tapping Soviet undersea cables, NSA's Spook Bird satellite, the Chalet or Vortex system, and a fifth generation system called Intruder, scheduled for 2000. One observation is that for the Soviets, national and tactical systems were undifferentiated, and that both the KGB and GRU (the latter specializing on ELINT satellites) controlled Soviet space assets. American satellite weather observation (TIROS and NAVWEPS) systems are also reviewed. Soviet ASATs (Anti-satellite Systems), especially the IS satellite interceptor which used infrared optics; Soviet imaging satellites such as Zenit and Yantar; and Soviet ELINT (three Tslina series satellites) capabilities are recounted. Friedman also discusses the U.S. ASAT programs (the U.S. Air Force SAINT and the Navy's Hi-Ho) terminated in 1975, three subsequent alternatives to space surveillance (the Army DOPLOC, Air Force SPACE TRAK, and Navy SPASUR), and the success of the Navy's program for over 40 years.

In Chapter 7, "A New Kind of Naval Warfare" (pp. 129-172, 73 endnotes), Soviet capabilities are assessed and the beginning of missile warfare in the Soviet Fleet traced since 1944 from modified German V-2 rockets and surface ship launchings. Friedman considers how German missile research scientists and actual missiles were captured and exploited, how the Soviets expanded this research, and how the KS series of air-to-surface missiles were developed during the 1950s and 1960s. The second-generation missiles, including the P-5 submarine-launched missile and KSShch shipboard missile, which could reach over-the-horizon targets, necessitated enhanced command centers. The Komets-10 (K-10), a strategic air-launched missile, was also developed and deployed. Notably, the submarines, ships, and bombers armed with the new long-range weapons had to be cued to fire them but the real limitation on the range of the Soviet anti-ship system was its ability to collect precise information. Thus, the Soviets developed long-range sea-search radars (Kobalt and Rubin). Friedman also discusses the Tu-22 "Blinder" aircraft (a supersonic "Badger") and the problems with the Kh-22 missile leading to the creation of the lighter weight KSR-5 missile. The Soviets had major difficulties with adequate sensors for surface shooters but were more successful with space-based sea reconnaissance (their US-A, active radar, and US-P, passive radar – called RORSAT and EORSTAT in the West), Cosmos 1735 and 1737 low altitude satellites, the improved Tsiklon-M series, Kristal-K, the Molniya series, and the Raduga/Potok military geosynchronous satellite system in service in the early 1990s. In a section "Weapons Directed from Space," Friedman examines two generations of long-range anti-ship missiles, Bazalt and Granit, beginning in 1963; the Kh-35 missile; and the Tu-22M "Backfire" bomber with its Molniya missiles and airframe modifications. In considering command control, he notes that the Soviets realized that "centralized control was unlikely to be effective" (p. 172).

The subsequent chapter, "Dealing with an Emerging Soviet Threat" (pp. 173-208, 56 endnotes), begins with an assessment of the capabilities of the U.S. OSIS (Ocean Surveillance System) begun in 1969 with the sea-based Bullseye system adapted from the German Kurier prototype (the Soviet Krug system was also based on Kurier). The subsequent American White Cloud program (to track Soviet surface ships) and the OTH (Over-the-Horizon)

targeting system are detailed. The history of the Fleet Satellite and its command system (FLTSATCOM) are reviewed from their beginnings in 1971 through 1999, and communication problems with submerged submarines (sending and receiving data and communications) are documented. Friedman's assessment of the Fleet Command Center (FCC) and the Task Force Command Center (TFCC) is essential reading; and he notes that the Royal Navy began to build its own FCC in 1974. He also considers the successors to Fleet Satellites during the past decade, pointing out a major limitation (geosynchronous satellites cannot reach users in the Arctic), and he reports specific means that the U.S. Navy developed to counter Soviet tactics, including the development and distribution of nuclear Tomahawks, and the use of deception and ASAT. A new generation of satellites, Milstar, which treat uplinked signals as digital information, creates a new digital signals that it can transfer to another satellite or send down to a ground station, leaves no traces of the original uplinked signal. But, as of 1999 he observed that only two Milstars are in orbit. Lastly, Friedman documents satellite ASW (Anti-submarine Warfare) and we learn what evidence can be employed to track Soviet submarines– acoustic, non-acoustic, thermal, chemical, etc.

In Chapter 9, "Enter Tomahawk: OTH Targeting" (pp. 209-229, 28 endnotes), Friedman begin his historical account in 1964 with a discussion of countermeasures, the *Los Angeles* class of submarines, and antiquated carrier-centered naval battle group formation that would give way to 4-W (widely dispersed pseudo-random formations). TENCAP (Tactical Exploitation of National Capabilities), developed at the U.S. Naval War College, was formalized by Congressional directive in 1978 but would be compromised by the Walker spy ring. The background of an NSA ELINT development, BRIGAND (Bistatic Radar Intelligence Generation and Analysis, New Development), the development of TFCC (Task Force Command Centers), and JOTS/JMCIS (Joint Operational Tactical System/Joint Command Information System) are detailed. JOTS is sometimes referred to as Jerry O'Tuttle System, recognizing the role of that Rear-Admiral in promoting the system. Friedman also considers the NATO Command and Control Information System variant. The combination of the Soviet surface shooter threat and the advent of anti-ship Tomahawk missiles caused major changes in the U.S. Navy's consideration of warfare, resulting in the creation of an ocean surveillance system and enhanced TFCC. The role of the OTH Targeting system during the Gulf Embargo is, likewise, assessed. We learn that with the incoming Reagan administration and Secretary of the Navy John Lehman in 1981, U.S. naval strategy that had been devised by Admiral Elmo Zumwalt, Jr. in the 1970s changed dramatically with the adoption of a new Maritime Strategy. This modification is documented in Chapter 10, "Defending the Fleet: The Outer Air Battle" (pp. 230-248, 27 endnotes). Friedman explains the emerging threat of the Tu-22M "Backfire," a naval missile bomber, and the shift toward planning for non-nuclear warfare as the key to U.S. Maritime Strategy. The U.S. Navy's term for a long-range attack on attacking Soviet forces was "The Outer Air Battle" which necessitated tracking the bombers immediately after take off. Pat of the plan called for finite sensors, Relocatable Over-the-Horizon Radar (ROTHR), and the deployment of the LORAINE ballistic missile and use of F-14 aircraft. Associated with this plan was the Slow Walker ground station that became operational in 1992. Friedman relates how the plans "worked" during the Gulf War when American Patriot missiles were pitted against Iraqi Scud missiles. And he tells how the current Defense Support Program (DSP), an infra-red warning system, is being replaced by a two-tier system, Space-Based Wide Area Surveillance (SBIRS) which supports a planned U.S. National Missile Defense (18 to 24 satellites in geosynchronous orbit to be launched in 2004). J-STARS (Joint Surveillance Targeting Attack Radar System), an airborne system which detects moving ground targets, is to be replaced by the Discoverer II/Starlite satellite system.

In Chapter 11, "Copernicus" (pp. 249-265, 18 endnotes), we are informed about multiplexing hardware and the need to meet increased demands for tactical and logistical information. In 1986 the Copernicus Project was envisaged as a new Global Command and Control System (GCCS) and the project office opened in 1990. But, as Friedman documents, Copernicus could not be adapted to a growing vision of "jointness" and enhanced cooperation among the armed services. A new Defense Department GCCS (Global Command and Control System) replaced the WWMCCS (World-Wide Military Command and Control System) and is in current use. However, the Navy's communications needs continued to outpace military satellite capacity, so that IT-21 (Information Technology for the 21st Century) and INMARSAT (International Maritime Satellite Organization, which includes 63 countries) came to provide most navies with their satellite communications service. Therefore, e-mail and chat room capabilities exist among all ships of a battle group, allowing officers from lesser units to discuss policies with their peers and superiors throughout the

group. One commercial advancement which had U.S. Defense Department backing was the 66 satellite Iridium system which offered unparalleled telephone service over the Earth's land and coastal areas but was limited in sea and polar areas. However, the civilian market failed to materialize and the system went bankrupt in 1999, although Globalstar with 36 satellites in place is yet viable. Friedman also discusses the advent of follow-on satellite capability beginning in 1995 and the use of Intel 8-series satellites to provide fleet television service. One relatively inexpensive way to increase communications capability is to add more less-costly satellites (Lightsats), but satellite launches failed.

In the next chapter, "The Global Positioning System" (pp. 266-281, 26 endnotes), Friedman describes briefly the need for and nature of GPS and relates the Tomahawk guidance system, TERCOM (Terrain Comparison) and DSMAC (Digital Scene-Marching Correlation), and the complexities of targeting a ballistic missile. Using examples from the Gulf War, the story of how flight plans are compiled, how the missiles are guided, and accuracy rates makes excellent reading. He also reviews GPS Missile Guidance, the U.S. Navy Precision Strike concept, aircraft guidance, mine countermeasures and amphibious warfare, and Ship to Objective Maneuver (STOM) used by Marines. Likewise, SABER (Situational Awareness Beacon and Response) first used in 1995 is discussed, and the vulnerability of GPS to jamming is assessed. With Chapter 13, "The Navy and the Battle Ashore" (pp. 282-300, 23 endnotes), Friedman examines the post-Cold War era and the changes that the Navy has been making from blue water warfare to littoral (shoreline) actions. Again, employing examples from the Persian Gulf and adding experiences from Kosovo, he considers the ATO (Air Tasking Order), difficulties in dealing with mobile Iraqi Scud missile transporter-erector-launchers (TELs), the development of Contingency Theater Automated Planning System (CTAPS) and Tactical Aircraft MISSION Planning System (TAMPS) with TOPSCENE consul enabling each pilot rapid real-time targeting in the cockpit (RTIC – Real Time in the Cockpit or Rapid Targeting in the Cockpit). Friedman's clear explanations of these sensor arrays and data enhancements give the reader pause to recall science fiction spacecraft battles – episodes of "Star Wars" and "Battlestar Galactica" particularly come to mind. Communication, targeting, and air planning require vast amounts of detailed, largely graphic information about the target area and the area over which the aircraft or missile would fly. Hence, "getting more bandwidth" is a significant problem, more so for submarines than for surface ships airborne craft. One development has been the creation of the Global Broadcasting System (GBS) developed by the Defense Department and which is modeled on existing direct television broadcasting technology (100+ channels using a 18-inch diameter satellite dish). Friedman also considers the current status and projected development of OTH (Over-the-Horizon) fire support, mine countermeasures, and Theatre Ballistic Missile Defense.

In the final chapter, "A New Kind of War? " (pp. 301-317, 8 endnotes), we understand that at the end of the Cold War the United States faced new realities, particularly that the world was becoming far less predictable, that far less money would be available for defense, and a few precisely delivered non-nuclear weapons would have to suffice. Military and political crises in widely separated locales have characterized the past decade. To deal with these new realities, the U.S. Joint Chiefs of Staff created a new military doctrine, "Joint Vision 2010." This concept requires, among other components, that the United States attack an enemy's "center of gravity," shield U.S. forces from the enemy's reconnaissance, and make naval forces stealthier. Therefore, satellites, and information technology dominate this new kind of warfare. Friedman then considers the transformation of surface combatants (aircraft carriers, for example), the new roles of intelligence agencies, the need to swiftly acquire and assess complex data (witness the error in targeting the Chinese Embassy in Belgrade during the Kosovo war), and the impact of the OODA (Observation, Orientation, Decision, and Action) cycle. OODA was proposed initially in the 1970s by U.S. Air Force Colonel John Boyd to explain the incredible success of F-86 Sabres in the Korean War. By accelerating the cycle one gains a tremendous advantage over an opponent. Friedman relates how the Soviets viewed with alarm American rearmament in the 1980s when computer-oriented weapons systems were deployed to NATO – the Soviets thought that Boyd was right and that Soviet land forces would "lose the OODA battle and collapse in combat" (pp. 305-306). This perception by Marshal Ogarkov, chief of the Soviet General Staff, "that the OODA battle was crucial was also deadly to the Soviet system. By this time the Soviet economy had been almost completely militarised; it had very little slack which could have been taken up in the creation of a Western-style computer industry," Friedman contends (p. 306).

By the end of the 20th century the United States is facing a major problem – the need to replace aging satellite sensor systems and maintain ELINT. The future of

the "Sea Sanctuary" and the surface navy are a major political and military concern but ELINT will continue to be a prerequisite for any type of open-ocean surveillance. While the U.S. Navy is the single greatest user of American space systems, these are largely controlled by the U.S. Air Force which seeks full control under the U.S. Space Command, a lineal descendant of the U.S. Air Face Space Command (1982) and its predecessor NORAD (North American Air Defense Command). Friedman also considers other potential space powers, the Western European Union or European Union, and the Chinese (People's Republic of China). Lastly, there is another concern, the "Coalition Issue," notable in the Gulf War, in former Yugoslavia, and even in Haiti. Military cooperation requires the sharing of knowledge and technology but U.S. tactical style is not necessarily followed by other coalition allies.

Since Friedman prepared this assessment several events have occurred that expand and extend his treatise. Terrorist attacks continue, notably on the USS *Cole* DDG 67 in Yemen (12 October 2000), but Friedman only mentions Osama bin Laden (p. 304) and other terrorist groups in passing. Likewise, there has been some minor resolution to the Lockerbie/Pan Am Flight 103 terrorism (21 December 1988) and its Libyan connection. With the incoming Bush administration in January 2001, we are informed that Secretary of Defense Donald H. Rumsfeld has recently requested a defense analysis from a Defense Department analyst, Andrew W. Marshall, who is reported by the news media to be an "unconventional thinker" and may recommend dramatic changes in the Pentagon and in weapons systems. Marshall, who began as a nuclear strategist for the Rand Corporation in 1949, moved as a civilian to the Pentagon in 1973, and has seen the entire Cold War play out. Also joining the new team is Paul D. Wolfowitz, Deputy Secretary of Defense (designate), while Philip E. Coyle III, head of Pentagon weapons testing remain in this position as of this writing. Are there likely to be strategic and fiscal changes given the new political climate? Yes. The fate of the Marine Corps' Osprey, the Air Force's F-22, Army heavy tanks, and Navy aircraft carriers will come under renewed scrutiny. A likely geographical refocusing of military strategy will emphasize Asia, particularly the People's Republic of China, rather than Europe.

Norman Friedman has written a masterpiece. The reader is informed about satellite technologies for precision navigation and communications, electronic and image reconnaissance, and missile targeting. We learn how satellite-based precise navigation facilitated submarine-based ballistic missile deterrents. Friedman also documents how the Soviet satellite-cued, long-range antiship systems developed for submarines, surface ships, and aircraft, and the U.S. Navy's response to that effort, based on space technology, promulgated "net-centric" or information-based warfare. The means to detect submarines from space and OTH (Over-the-Horizon) missile targeting revolutionized the role of surface ships are also discussed. In addition, he elaborates how littoral and deep sea warfare systems developed for large-scale conflict during the Cold War have proven to be of great significance in the unstable international political environment that followed the break up of the former Soviet Union. And Friedman also explains how American and Soviet ASAT (Anti-satellite) programs introduced the potential for actual orbital warfare. It is clear that naval warfare has undergone dramatic changes even since the Gulf War and recent conflict in Kosovo. In sum, Friedman's compendium is a careful, fulsome, and well documented analysis of the linked revolution of long-range missiles and their space-based supporting systems which transformed the navies of the United States and the Soviet Union.

A minor error slipped by on p. 72: SSSMA should be SSMA; both spellings, defense and defence, are employed but relate to Friedman's original sources (American or British) and his own use of British English. These do not detract from this splendid synthesis.

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