TORPEDOES AND THE GUN CLUB

The U.S. Navy Bureau of Ordnance in World War II

by

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(ABSTRACT)

This thesis examines the shift of torpedo production responsibilities from military to civilian manufacturers as a case study in the use of civilian resources during World War II. The existing structure of the U.S. Navy Bureau of Ordnance failed to produce adequate torpedoes for the first two years of American wartime activity. The Bureau therefore abandoned the existing structure and shifted production to civilian contractors. This change occurred within the broader context of civilian scientific and technical involvement in military matters during World War II. The torpedo story illustrates one organization's unintentional participation in this process.

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Introduction

The U.S.S. *Trout*, a submarine commanded by Lawson "Red" Ramage (later to win the Congressional Medal of Honor), departed from Fremantle, Australia in December 1942 on her seventh war patrol. Within days, *Trout* intercepted a Japanese tanker off Borneo. Ramage fired four torpedoes; two successfully hit the tanker, but one exploded prematurely and the other failed to explode at all. Ramage fired three torpedoes several days later at a destroyer in Cam Ranh Bay, Indochina. All three failed to explode. *Trout* later attacked a freighter, again off Borneo, with two torpedoes. One hit and the other failed to explode; the *Trout* had to sink the ship with gunfire. Of the fourteen torpedoes fired by *Trout* on this patrol, one detonated prematurely and five were duds. Nearly half of the torpedoes had not functioned properly.[1]

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[1] Clay Blair, Jr., ***Silent Victory*** (Philadelphia: J.B. Lippincott, 1975), 328-329.

Ramage's experience typified one of World War II's best-known weapon scandals, the failure of Navy torpedoes during the first two years of American involvement in the war. Theodore Roscoe's semi-official history of submarine operations describes the torpedo story as a "tragically expensive muddle."[2] Submariners directed most of their frustration at the Navy's Bureau of Ordnance, responsible for naval weapon design and production. The Bureau, known in Navy circles as the "Gun Club," had a conservative, clannish reputation that reinforced such operating force suspicion.

The Bureau failed more in organization than in attitude, however. Its officers at the Newport Naval Torpedo Station had no desire to sabotage the war effort, although some frustrated submariners almost believed that to be the case. Its fault lay in clinging to an outmoded organization, incapable of handling complex wartime demands. The torpedo's special characteristics exacerbated the situation. The weapon required both careful construction and high production rates. In a sense it represented the Navy's first "smart" weapon: a high-technology expendable piece of ammunition. The Bureau's failure in producing such a weapon opened the door for outside contractors, shifting complex weapon production from the Navy to civilian manufacturers. This shift

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[2] Theodore Roscoe, ***United States Submarine Operations in World War II*** (Annapolis: U.S. Naval Institute, 1949), 263.

echoed the growing utilization of civilian scientific and technical resources during World War II. Civilian contractors, already building ships and aircraft, assumed design and production responsibilities for component systems as well. The torpedo story illustrates one organization's unintentional participation in this process.

Chapters I and II examine the Navy's experiences with the Mark XIV and XVIII torpedoes, respectively, to show the Bureau of Ordnance's response to specific technological challenges. Chapter III outlines the Bureau of Ordnance's responses to crises in production, communication and coordination. These functional challenges influenced the Bureau's activities described in Chapters I and II. The Conclusion evaluates the Bureau's organizational response to the torpedo challenge in the broader context of industrial mobilization and historical organizational change.

Chapter One - The Mark XIV Torpedo

The U.S. Navy entered World War II with the Mark XIV as the standard submarine torpedo. The Newport, RI and Alexandria, VA Naval Torpedo Stations had assembled every torpedo in service at that time. Built around a secret magnetic exploder, the Newport-designed Mark XIV promised to be "one of the most lethal weapons in the history of naval warfare."[3] Combat soon exposed three serious defects in the torpedo, however: it ran too deep; the magnetic exploder failed in various unpredictable ways; and the back-up contact exploder failed in a right-angle impact. The Bureau of Ordnance's reluctance to incorporate operational suggestions, or in some cases even to acknowledge the existence of a defect, split the Mark XIV's producer and consumer. The operational forces eventually discovered and corrected each defect, but the

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[3] Blair, xvii.

exasperated submariners in the meantime lost confidence in the Bureau and its torpedo.

Before examining the Mark XIV story it is useful to outline the organization responsible for the torpedo. The Navy's bureau system began before the Civil War when the existing Navy Board of Commissioners, established in 1815, proved incapable of meeting the Navy's growing administrative demands. Acting on Secretary of the Navy Abel Upshur's recommendation, Congress in 1842 replaced the Board with five bureaus: Yards and Docks, Construction and Repair, Medicine and Surgery, Provisions and Clothing, and Ordnance and Hydrography. Each bureau assumed responsibility for a particular technical sphere, while the civilian Secretary retained coordination and policy functions. The Navy boasted seven bureaus by 1940: Ships, Ordnance, Naval Personnel, Yards and Docks, Supplies and Accounts, Medicine and Surgery, and Aeronautics. The structure changed little during that century of reshuffling and renaming. Each bureau chief reigned over his own empire, with minimal supervision from the Secretary and none from operational commanders.[4]

The Bureau of Ordnance (BuOrd) was responsible for the design and production of naval armament. BuOrd's cognizance therefore covered such diverse equipment as armor plating, anti-aircraft gun mounts and sixteen-inch projectiles. Until 1940 the Bureau contained sections for each major weapon

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[4] Robert G. Albion and Robert H. Connery, ***Forrestal and the Navy*** (New York: Columbia University Press, 1962), 42-44.

type.[5] Torpedoes naturally fell under Ordnance cognizance, and the Bureau's Newport (RI) Naval Torpedo Station assumed production and design duties upon its completion in 1907.[6]

Two philosophical concepts permeated the bureau system: technicism and independence. Samuel Huntington describes technicism as the identification of technical expertise with military expertise. Since the government dictated naval strategy, officers specialized in fleet construction and supply as "military" spheres of influence. "Technical" success became tantamount to "military" success; the bureaus thus wielded immense power within the Navy and jealously guarded their areas of "cognizance." The maritime tradition of independence reinforced this system. Navies relied on independent, assertive commanders, and the decentralized bureau system fit nicely into this heritage.[7]

Torpedo Design and Doctrine

Basic torpedo design remained largely unchanged over the decades: a cylindrical, self-propelled projectile set to run at a pre-selected depth, course and speed to deliver a warhead against a ship's hull. Torpedo warheads normally utilized a contact exploder mechanism. Upon striking the target's hull a firing pin set off a small booster charge, which in turn detonated the main warhead.

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[5] See Chapter III for further discussion of BuOrd's organization.

[6] Buford Rowland and William Boyd, ***U.S. Navy Bureau of Ordnance in World War II*** (Washington, D.C.: U.S. Government Printing Office, 1963), 1, 90.

[7] Samuel Huntington, ***The Soldier and the State*** (Cambridge: Belknap Press, 1957), 195-203.

Most world navies recognized the torpedo's utility after the German submarine successes of World War I. Navies differed in their opinion of the torpedo's proper role, however. Germany ably demonstrated one role, that of submarine-launched commerce killer. The Japanese made torpedoes an integral part of their surface-ship doctrine. The battleship-dominated U.S. Navy preferred another role: submarine-launched warship killer.[8]

This anti-warship role forced changes in exploder design. Although simple and generally reliable, the contact exploder suffered from post-World War I advances in warship design. New warships sported armor belts below the waterline, secondary hulls or "blisters" designed to absorb torpedo impacts, and increased compartmenting for buoyancy in the event of hull damage. Submariners using contact exploders thus faced two unappealing alternatives: larger warheads that could produce larger holes but required larger torpedoes, or more small torpedoes for each target. In either case, given the limited storage space available, individual submarines could attack fewer targets.[9]

For the U.S. Navy, the magnetic exploder seemed to resolve this dilemma. It detected variations in the earth's magnetic field caused by a large mass of metal (such as a ship's hull) and, when these variations reached a certain level, detonated the warhead. Since this exploder operated through influence rather than impact, the torpedo had to run *under* the target ship, lest the torpedo

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[8] Roscoe, 250-251; Blair, 5, 10-11.

[9] Blair, 40.

explode before reaching the target. This method solved the tactical problems posed by ship design advances. Designers of warship torpedo protection assumed torpedo impact, and thus localized such protection on ship hull sides. The bottom of the hull remained relatively vulnerable -- precisely the area most affected by a magnetically-exploded torpedo. Such torpedoes could therefore use smaller warheads; each submarine could carry more torpedoes, and since fewer impacts were necessary for inflicting serious damage, each submarine represented a large number of potential victories.[10]

BuOrd began development of the magnetic exploder in 1922. Captain Ralph Christie at the Newport station directed the design effort, known as Project G-53. The earliest models were based on captured German World War I experimental exploders, but Christie's team soon moved into more sophisticated designs. Newport first tested the device, ultimately designated the Mark VI, in May 1926. In addition to the magnetic feature, the final design incorporated a back-up contact exploder. As the Mark VI development continued the Bureau initiated work on a companion torpedo. The resultant Mark XIV torpedo, specifically designed for use with the magnetic exploder, carried only a 500-pound warhead, less than other models. By 1941, most U.S. submarines carried Mark XIVs as standard armament, but without the accompanying Mark VI exploders.[11]

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[10] *Ibid.*, 33-34; Roscoe, 252-254.

[11] Blair, 34-35, 40-41. The only other torpedo in use at that time, the obsolete Mark X, saw only limited wartime service.

In contrast to the Mark XIV's open deployment the Navy shrouded the Mark VI exploder in secrecy. Submariners generally knew of the exploder's existence, since commanders trained to fire *beneath* a target ship needed to understand why they were doing so. The Navy, however, decided not to disseminate the Mark VI's technical details; because of the exploder's strategic importance the Navy limited full knowledge of the Mark VI design to several critical individuals. BuOrd only issued Mark VIs to the submarine forces in November 1941, barely one month prior to the Japanese attack on Pearl Harbor. Submarine commanders, therefore, were relying on a device about which they knew virtually nothing.[12]

Depth Problems

Problems with the Mark XIV developed almost immediately after the U.S. declaration of war on 8 December 1941. Submarine commanders returning from their first short war patrols in late December reported problems with the torpedo. The *Pompano,* out of Pearl Harbor, reported several duds and premature explosions.[13] Tyrell Jacobs, commanding the Asiatic Fleet sub *Sargo,* proved the

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[12] Samuel Eliot Morison, ***Coral Sea, Midway, and Submarine Actions: May 1942-August 1942,*** vol. iv, ***History of United States Naval Operations in World War II*** (Boston: Little, Brown, 1950), 231; Blair, 41, 63; Roscoe, 252.

[13] U.S. submarines on combat duty during World War II served under one of three operational commands. Submarines, Atlantic (SubLant) covered the Atlantic Ocean. Due to strategic circumstances, SubLant saw little active combat and played only a peripheral role in the torpedo episode. Submarines, Pacific (SubPac) operated out of Pearl Harbor, Hawaii, covering the Northern and Central Pacific regions. The third command operated initially out of the Philippines under the command of the Asiatic Fleet. Following the Japanese conquest of the Philippines in the spring of 1942, Asiatic Fleet submarines relocated first to Java and then to Australia, with the new designation Submarines, Southwest Pacific (SubSoWesPac). Each command operated independently from one another, and reported to the overall fleet commander for each region.

most vocal early critic of the torpedo. After several prematures, Jacobs turned off the Mark VI's magnetic feature, relying on the back-up contact exploder. He still failed to score any hits, and blamed deep-running torpedoes.[14]

Although some skippers suspected the Mark VI exploder, most commanders focused on the torpedo's depth-keeping capability, because of the problem's visible effects. The steam-powered Mark XIV left a wake of bubbles as it sped towards the target, and occasionally puffed smoke along with the bubbles. Both qualities mitigated the surprise nature of torpedo attacks but allowed submarine commanders to track torpedoes into the target. More and more skippers watched as their torpedo's bubble trail intersected the target vessel with no explosion, and listened as sonar detected the torpedo's engine humming into the distance. The inescapable conclusion seemed to be that the Mark XIV ran deeper than set.[15]

BuOrd recognized the possibility of deep-running even before the war began. Tests conducted in October 1941 confirmed that Mark XIVs ran on average four feet deeper than set, but the Bureau failed to notify the submarine commands of this conclusion for several months.[16] Once the war began the Bureau had access to submarine patrol reports, and received regular updates on

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[14] Blair, 92, 116-118; Morison, 221.

[15] Roscoe, 251-253.

[16] Alexandria Naval Torpedo Station (NTS) to William Blandy, 1 November 1941, in U.S. Navy Bureau of Ordnance, General Correspondence, File S75 (Mk XIV-2), Box 388, Record Group 74, Washington National Records Center Branch of National Archives, Washington, D.C. [Cited hereafter as ***BuOrd Corr.*** All records are located in Record Group 74.]

weapon performance from the field. BuOrd even sent a representative to Java in early 1942 to investigate Tyrell Jacob's torpedo problems. Although this investigator exhibited dubious technical skill (he installed a torpedo gyroscope backwards, before being corrected by the *Sargo's* executive officer), his report nonetheless charged the *Sargo* crew with improper maintenance of the suspect torpedoes.[17]

Operational discontent with the Mark XIV grew as combat intensified. Reports of torpedo problems flowed into Ordnance during early 1942. Admiral William H. P. Blandy, BuOrd's chief, notified Newport on 31 January 1942 that "experience in the Far East leads to the belief that Mark 14 ... torpedoes with warheads are running considerably deeper than the depths for which set." Blandy directed Newport to investigate this problem.[18] In another letter to Newport on 23 February Blandy stated: "It is believed there is a prevalent feeling in the service that if a torpedo is set for a certain depth it will run at *exactly* that depth."[19] This seems a reasonable expectation on the part of the submariners; clearly Blandy and BuOrd perceived increasing pressure from the operational forces. Newport conducted the requested depth tests during February and March 1942. These tests confirmed to BuOrd's satisfaction the earlier conclusion that the torpedo ran four feet deeper than set. Blandy notified Captain Thomas

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[17] Blair, 147-148.

[18] Blandy to Newport NTS, 31 January 1942, in ***BuOrd Corr.,*** File S75 (Mk XIV), Box 111. BuOrd delegated primary responsibility for torpedo design, testing, and production to the Newport, RI Naval Torpedo Station. See Chapter III for further discussion.

[19] Blandy to Newport NTS, 23 February 1942, in ***BuOrd Corr.,*** File S75-1 (26), Box 112.

Withers, commanding Submarines, Pacific (ComSubPac), of this conclusion on 30 March 1942.[20]

Although Blandy's letter never mentioned the October 1941 tests Withers apparently discovered BuOrd's pre-war knowledge of the problem. He sent a blistering memo to Blandy on 16 April: "Failure of the Bureau of Ordnance to provide the forces afloat with timely information that Mark 14 ... torpedoes run 4 feet deeper with warhead installed may have been a contributing factor in failure to sink several enemy ships ... Such information is of the utmost importance."[21] Chastened, BuOrd distributed Circular Letter T-174 on 29 April, advising all torpedo users that the Mark XIV ran "as much as four feet deeper than set." The Bureau qualified this, however, by saying that "it may be possible to more precisely define this depth performance with more experimental firings." Still, for Ordnance the problem was now resolved.[22]

A new figure entered the operational scene in May 1942: Rear Admiral Charles Lockwood. He quickly developed into a major nuisance for BuOrd, and became the torpedo controversy's most important operational personality. He held a prominent place in the small close-knit U.S. submarine community. Well-liked and well-respected, Lockwood soon demonstrated two crucial qualities. First, he listened to his submarine commanders and believed their

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[20] Blandy to Withers, 30 March 1942, in ***BuOrd Corr.,*** File S75-1 (42), Box 113.

[21] Withers to Blandy, 16 April 1942, in ***BuOrd Corr.,*** File S75-1 (42), Box 137.

[22] BuOrd Circular Letter T-174, 29 April 1942, in ***BuOrd Corr.,*** File S75-1 (42), Box 250.

complaints. More important, he took action on behalf of those men regardless of potential command disapproval. The submarine force now possessed a clear and authoritative voice.

Lockwood assumed command of the Asiatic Fleet submarine force from Captain John Wilkes in April 1942. Wilkes' Asiatic sub force turned in a lackluster performance during the early months of 1942, contributing little to the doomed U.S. defense of the Philippines. Dissatisfied with this effort, Navy high command relieved Wilkes after the Asiatic force had resettled in Australia. Lockwood, now admiral and commander of the renamed Submarines, Southwest Pacific (SubSoWesPac), reviewed the force's recent activities in May 1942. Among numerous other problems, he found that torpedo performance had been erratic at best. In a 22 May letter to Admiral Ralph Edwards Lockwood commented that the sub skippers believed the Mark XIVs ran much more than four feet deep, in spite of BuOrd's Letter T-174. He wrote: "[I] have come to the conclusion that [the torpedoes] probably run 10 or 15 feet deeper [than set] ...."[23]

Lockwood resolved to correct the situation, thereby initiating the shift of torpedo testing from BuOrd to the operational force. He requested information from Ordnance regarding Mark XIV depth performance. The Bureau in reply referred him to Circular Letter T-174. This did nothing to allay Lockwood's suspicions, and he decided to run his own tests in Australia. A submerged

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[23] Lockwood to Edwards, 22 May 1942, in Charles Lockwood papers, Naval Historical Foundation Collection, Manuscript Division, Library of Congress, Washington, D.C. [Cited hereafter as ***Lockwood MSS***], Container 12; Blair, 249-250; Roscoe, 144.

submarine fired several torpedoes through fish nets strung in a remote Australian bay on 20 June 1942. Holes in the nets torn by the torpedoes' passage indicated that the Mark XIV ran an average of *eleven* feet deeper than set -- nearly three times deeper than BuOrd acknowledged.[24]

This operational involvement forced the Bureau into action after some initial hesitation. Lockwood advised BuOrd of his tests on 22 June. Ordnance replied a week later, stating that Lockwood's tests were inconclusive and standing by its own figure of four feet. A flurry of messages between Australia and Washington followed. Lockwood finally wrote a long, courteous letter to BuOrd's chief, William Blandy, on 11 July. Lockwood explained the operational evidence that pointed to deep-running and outlined the field tests conducted in Australia. He acknowledged the makeshift nature of those tests, but stated firmly that "the indications are that these torpedoes run about eleven feet deeper than the set depth." Further, Lockwood advised Blandy that SoWesPac subs were now firing torpedoes based on the eleven-foot depth, rather than Newport's four-foot depth.[25]

To insure Bureau action, that same day Lockwood also sent a letter to his friend Admiral Ralph Edwards, COMINCH Ernest J. King's deputy, indicating the results of the fish net tests. "As you can imagine it is very discouraging to a commanding officer to ... see the smoke of his torpedo come up under his target

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[24] Blair, 251-253; Roscoe, 145-147.

[25] Lockwood to Blandy, 11 July 1942, in ***Lockwood MSS,*** Container 12; Blair, 251-253; Roscoe, 145-147.

with no bang," noted Lockwood.[26] His appeal had the desired result; on 21 July King ordered BuOrd to recheck its data concerning Mark XIV depth performance.[27]

Ordnance finally accepted Lockwood's claims. Newport ran new tests in early August and confirmed that Mark XIVs, when fired from submarines at periscope depth, ran approximately ten feet deeper than set. The Bureau quickly disseminated this information to the operational commands, although most had already taken corrective action upon learning of Lockwood's tests. Newport continued to investigate the causes of deep-running, and by late 1942 produced and distributed conversion kits to improve depth performance.[28]

BuOrd chief Blandy discussed the depth problem with Newport in a remarkably revealing letter dated 12 September 1942:

> the deep running can ... be attributed to our complacency in being satisfied with merely running torpedoes *under* the target *at all times*. I blame this on no particular officer or group of officers. Every officer in the service who has fired torpedoes in this manner during the past twenty years is as guilty as anybody else, and I include myself in this category ... It is essential to *correct* excessive depth performance as quickly as possible, in order to restore the confidence of fleet personal in all marks of torpedoes as quickly as possible.[29]

Blandy thus recognized not only the failure of pre-war testing but also the loss of operational confidence.

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[26] Lockwood to Edwards, 11 July 1942, in ***Lockwood MSS,*** Container 12.

[27] Blair, 253; Morison, 222.

[28] Handwritten BuOrd route slip (author unknown), 6 August 1942, in ***BuOrd Corr.,*** File S75-1 (83), Box 250; Freeland Daubin to Blandy, 6 January 1943, in ***BuOrd Corr.,*** File S75 (Mk 14), Box 240; Blair, 253-254.

[29] Blandy to Newport NTS, 12 September 1942, in ***BuOrd Corr.,*** S75-1 (26), Box 136.

The resolution of the deep-running problem marked the first successful operational intervention in torpedo matters. Lockwood's initiative forced Bureau recognition of the defect's severity in the face of considerable opposition. In the process operational forces had demonstrated that BuOrd and Newport did not monopolize torpedo expertise.

Mark VI Magnetic Exploder

The Mark XIV's depth problems masked a more serious flaw in its exploder. From the first war patrols, submarine commanders expressed reservations about the Mark VI exploder. Torpedoes either hit targets without exploding, exploded prematurely, or passed under targets. Most commanders suspected deep-running, as already described, but some believed the Mark VI to be defective. Tyrell Jacobs, for example, on board *Sargo* in December 1941, complained about deep-running only after deactivating the Mark VI's magnetic feature. A growing number of sub skippers chose Jacobs' method and deactivated the Mark VI during 1942. Most did not report their actions and swore their crews to secrecy, since tampering with equipment technically constituted a court-martial offense. Command severely reprimanded those few skippers who decided to report deactivation. John DeTar, commanding *Tuna* out of Pearl Harbor, deactivated the magnetic feature while on patrol in January 1942 and detailed his actions in the subsequent patrol report. ComSubPac Thomas Withers gave DeTar a thorough dressing down, including warnings of

dire consequences for any similar action in the future. George Crawford took over Division 43 comprising four Pearl Harbor subs in March 1942. Crawford, aware of magnetic exploder troubles, ordered his commanders to deactivate the Mark VI. Withers countermanded Crawford's order and delivered another stern lecture.[30]

Withers supported the Mark VI for good reasons. He had served as Newport's commander for several years before the war and trusted the station's handiwork. BuOrd continued to express unwavering confidence in the exploder despite ongoing technical problems; the Bureau pointed to operational reports showing that only one out of ten Mark XIVs fired during early 1942 failed because of mechanical faults. More importantly, Mark XIV torpedoes were in short supply. The Newport and Alexandria Naval Torpedo Stations seemed unable to cope with wartime production demand; as a result torpedoes became increasingly scarce.[31] Since the Mark XIV mounted a small warhead, using the contact exploder rather than the magnetic feature meant using more torpedoes per target. The submarine commands simply could not afford this expensive practice. Command scrutinized each submarine's torpedo expenditure, and scolded inefficient skippers.[32]

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[30] Edward Beach, ***Submarine!*** (New York: Henry Holt, 1952), 21-25; Blair, 184-185, 189-190; Roscoe, 255-256.

[31] See Chapter III.

[32] Blandy to Lockwood, 11 August 1943, in ***Lockwood MSS,*** Container 13; Blair, 185; Roscoe, 261; Morison, 232.

Despite these considerations submarine force commanders could not completely ignore complaints about the Mark VI. As 1942 progressed, private expressions of discontent drifted through the Navy hierarchy. Withers advised BuOrd chief Blandy of operational difficulties with the exploder in January.[33] Wither's replacement as ComSubPac, Robert English, expressed his confidence in the Mark VI to Blandy on 9 April but recommended that Ordnance test the exploder for prematures, since there was "some evidence, admittedly very meager, which tends to indicate near hits and only superficial damage."[34] Lockwood in the southwest Pacific also harbored doubts about the exploder. Immediately after assuming command in May 1942, he wrote to Admiral Edwards that "the Mark VI is regarded with grave suspicion," and acknowledged that some commanders had been "cutting out the influence feature" to avoid prematures or duds.[35]

Rough handling and a delicate mechanism caused many of the exploder's failures. Problems ranged from flooded exploders to faulty firing springs. The Mark VI's generator brush assembly typified these technical bugs. The exploder operated electrically and carried its own generator. The generator's wire brushes were mounted on a fragile assembly that apparently buckled under the slightest pressure. Upon firing, this deformation caused the brushes to contact the exploder's metal frame during generator operation. The resulting short circuit

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[33] Withers to Blandy, 29 January 1942, in ***BuOrd Corr.,*** File S75-1 (26), Box 112.

[34] English to Blandy, 9 April 1942, in ***BuOrd Corr.,*** File S75-1 (26), Box 136.

[35] Lockwood to Edwards, 22 May 1942, in ***Lockwood MSS,*** Container 12.

detonated the warhead prematurely. Both BuOrd and operational commands recognized this problem. The Bureau generally blamed rough handling, and felt the problem could be resolved by improved procedures in the field; operational commands requested a redesign of the brush assembly. ComSubPac English notified BuOrd in September 1942 that "redesign of the brush rigging assembly ... is considered to be an urgent necessity."[36] English again requested a redesign on 11 November, noting that "reports recently received indicate 5 instances [of] premature explosions [with the] Mark 6 exploder ... It is believed that [the] recent increase in premature explosions [is] caused by faulty brush action."[37] Blandy accepted the validity of English's request and advised Newport on 26 October of the "urgent necessity" for a redesign of the brush assembly. He blamed rough handling in the field, but recognized the unavoidably extreme conditions caused by combat; he therefore directed Newport to consider more robust brush assemblies.[38] The Bureau finally abandoned the generator altogether and replaced it with a battery. As Blandy stated: "[the generator] is too uncertain an element to use in a torpedo exploder mechanism." BuOrd obviously understood the need for Mark VI improvements, but its solutions were too slow for the submariners.[39]

While BuOrd pondered the Mark VI's technical problems, the operational commands gradually lost confidence in the exploder. Pete Ferrell, commanding

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[36] English to Blandy, 17 September 1942, in ***BuOrd Corr.***, File S75-1 (26), Box 136.

[37] English to Blandy, 11 November 1942, in ***BuOrd Corr.***, File S75-1 (26), Box 136.

[38] Blandy to Newport NTS, 26 October 1942, in ***BuOrd Corr.***, File S75-1 (26), Box 136.

[39] Blandy to Newport NTS, 3 December 1942, in ***BuOrd Corr.***, File S75-1 (26), Box 136.

Seadragon, blamed the exploder for his lack of success on an August 1942 patrol. The *Thresher* had problems in September; the *Saury, Gudgeon and Tautog* all reported Mark VI failures in October. One of Lockwood's best commanders, Lawson Ramage of the *Trout,* experienced one premature and five duds out of fourteen torpedoes fired in December.[40] Lockwood's letters during this time generally expressed confidence in the magnetic exploder principle, but as evidence for the Mark VI's operational inadequacy mounted, Lockwood's confidence waned. He seriously considered the possibility of Japanese magnetic countermeasures, even suggesting that a U.S. submarine attack and board a Japanese merchant vessel to determine if such countermeasures existed (none did). No one pursued this action, but it indicated Lockwood's growing desperation.[41]

The operational command structure changed in January 1943. ComSubPac Robert English died that month in a seaplane crash. Navy command chose Lockwood as the new ComSubPac in Pearl Harbor. He now held the Navy's most influential submarine command, and exploited his position in the coming months. Ralph Christie, former Newport technician and father of the Mark VI magnetic exploder, replaced Lockwood as ComSubSoWesPac in Australia.[42]

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[40] Blair, 266-267, 315, 325-331.

[41] Lockwood to Murray, Connolly, and Thorp, 10 September 1942, in ***Lockwood MSS,*** Container 12.

[42] Blair, 339-342; Roscoe, 202.

Bureau-submarine relations reached their lowest point shortly thereafter. Lockwood attended an April 1943 submarine officers conference in Washington. He took the opportunity to blast BuOrd for its lack of progress on the exploder problems as well as electric torpedo delays.[43] As he later related, "Spike [Blandy] wanted to know after my talk to the usual projection room crowd if it was part of my mission to discredit the Bureau of Ordnance."[44] Anxious to avoid ill will, Lockwood sent Blandy a cordial follow-up letter, urging him to "put your massive brain to work on this very vital problem of ours and pull for us a couple rabbits out of your hat; the rabbit in this case to be in all respects similar to and interchangeable with a perfect exploder."[45] Ruffled feathers aside, the Washington conference marked the submariners' first open declaration of their frustrations.

BuOrd continued its attempts to resolve the Mark VI's many faults and belatedly sought operational advice. Newport submitted an extensive progress update to Blandy on 2 January 1943 discussing brush assembly redesign, improved watertightness, and internal electrical fault correction.[46] An Ordnance technician arrived at Pearl Harbor in May to make several experimental exploder modifications for submarines departing on patrol. Blandy anxiously awaited this conversion's operational performance.[47]

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[43] See Chapter II.

[44] Lockwood to James Fife, 26 April 1943, in ***Lockwood MSS,*** Container 13.

[45] Lockwood to Blandy, 14 March 1943, in ***Lockwood MSS,*** Container 13.

[46] Newport NTS to Blandy, 2 January 1943, in ***BuOrd Corr.,*** File S75-1 (26), Box 240.

[47] Blandy to Lockwood, 21 June 1943, in ***BuOrd Corr.,*** File S75-1 (26), Box 240.

The submarine force could wait no longer. Impatient for action, Lockwood in April 1943 ordered eight Pearl Harbor subs to deactivate the Mark VI on their next patrols as an experiment. Results were somewhat encouraging; magnetic attacks remained distinctly discouraging. Still searching for answers, Lockwood even entertained the possibility of *shallow*- running torpedoes causing prematures -- a real switch from the previous year. He wrote to Ralph Christie in Australia: "If there were a decent place to do it here I would buy some fish net and fire test shots ... for talking to the Bureau of Ordnance on the subject appears to be a waste of time."[48]

The exploder clearly seemed inadequate and deactivation appeared the only real alternative. Lockwood advised Blandy on 9 June that, barring news of the success of the conversion, deactivation would soon follow.[49] Blandy replied shortly therafter, discussing at length BuOrd's interest and efforts towards fixing the Mark VI: "I have personally lost more sleep over that gadget than any other one of the thousand problems that confront me in running this five billion dollar a year ordnance program ... this bureau is not a closed corporation. I wish the submariners would look on it as their bureau as much as of the rest of the Navy's."[50] Blandy's pleading came too late. The *Trigger* experienced several prematures while attacking a Japanese aircraft carrier in June. Lockwood

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[48] H.C. Maynard to Lockwood, 6 April 1943; Lockwood to Christie, 3 May 1943, both in ***Lockwood MSS,*** Container 13.

[49] Lockwood to Blandy, 9 June 1943, in ***Lockwood MSS,*** Container 13.

[50] Blandy to Lockwood, 19 June 1943, in ***Lockwood MSS,*** Container 13.

learned of this failure on 23 June; he "reluctantly" requested permission to deactivate, and on the following day, 24 June 1943, CincPac Chester Nimitz issued an order to deactivate all Mark VI magnetic exploders. This order applied only to Pacific Fleet units under Lockwood's command. Ralph Christie in Australia refused to abandon his brainchild; SoWesPac subs still sailed with active Mark VIs.[51]

Although BuOrd stubbornly believed that the Mark VI's technical faults could be corrected, no amount of tinkering could resolve the exploder's underlying problem. The Mark VI could not discriminate between variations caused by poorly-understood ambient magnetic complexities and those caused by ship hulls. The sensitive exploder operated effectively only under specific circumstances and failed to compensate for rapidly changing wartime conditions. The British and German navies experienced many of the same difficulties with their versions of the magnetic concept. German U-boats in particular suffered numerous exploder failures during early Arctic operations because of unpredictable magnetic fields. Admiral Raeder eventually ordered the German exploder's deactivation in the spring of 1940, foreshadowing the American action. Germany's well-funded program never solved the problem. The magnetic exploder's difficulties clearly resulted more from technological shortcomings than developmental failures.[52]

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[51] Lockwood to Merrill Comstock, 23 June 1943, in ***Lockwood MSS,*** Container 13; Blair, 402-404; Beach, 66-73; Roscoe, 258.

[52] Cajus Hekker, ***Hitler's Naval War*** (Garden City: Doubleday, 1974), 119-138; Blair, 50.

BuOrd dimly perceived these shortcomings. As early as August 1942 the Bureau requested information from Lockwood regarding target magnetic headings.[53] Newport technicians, unaware of the exploder's fundamental flaw, concentrated on resolving the Mark VI's technical faults during 1942 and early 1943. Blandy drafted an information letter in early July 1943 describing various magnetic conditions faced by operational forces, and recommending suitable actions for such conditions. Submarine commanders needed to account for latitude, target magnetic heading, submarine magnetic heading, depth, possible countermeasures, and several other factors. These complex instructions seemed a tacit acceptance of the Mark VI's flaws, since sub skippers could not realistically process such data under combat conditions.[54] The letter sparked an internal debate at BuOrd. One officer commented:

> I frankly do not feel that this letter does anything to clarify the situation. To me it is all rather confusing, because so many elements enter into the problem of when, how, and why we may expect prematures or duds in the different areas. That introduces a doubt as to the reliability of the exploder and, in my opinion, makes the forces afloat question its usefulness.[55]

This comment nicely summarized the entire Mark VI problem; unfortunately, the officer made it in July 1943, after twenty months of frustration. Despite this dissent, Blandy finally issued the letter to the operational commands on 31 August, with the following caveat: "The Bureau is aware that the magnetic feature of the subject mechanism has been inactivated in some areas but this information [concerning theoretical considerations] is furnished for such use as

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[53] Lockwood to Edwards, 19 August 1942, in ***Lockwood MSS,*** Container 12.

[54] Blandy draft, 10 July 1943, in ***BuOrd Corr.,*** File S75-1 (26), Box 240.

[55] W.S. Delany to T.D. Ruddock, 6 July 1943, in ***BuOrd Corr.,*** File S75-1 (26), Box 240.

may be appropriate." This half-hearted comment hinted at Blandy's own disillusionment with the Mark VI.[56]

Ralph Christie in Australia refused to deactivate his creation for the remainder of 1943. During those months a curious situation developed: submarines transiting between Pearl Harbor and Australia deactivated and reactivated the magnetic feature depending upon their location. Those subs operating in the SoWesPac area continued to report prematures and duds. Finally, in December 1943 the new SoWesPac fleet commander Thomas Kinkaid, under pressure from Lockwood and Nimitz, ordered Christie to deactivate his Mark VIs, the last magnetic exploders in service.[57] The submarine forces had demonstrated BuOrd's failure in torpedo design. The operational resolution of the situation against stiff Bureau opposition presaged operational dominance in design and modification matters.

Mark VI Contact Exploder Mechanism

Deactivating the Mark VI's magnetic feature exposed the final defect in the back-up contact exploder. Lack of confidence in the contact feature had influenced Christie's refusal to deactivate the magnetic exploder. Dud torpedoes plagued the Navy's submarines for many months, but during that period the problem seemed related to the magnetic exploder. After the June 1943 Mark VI

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[56] Blandy to all torpedo users, 31 August 1943, in ***BuOrd Corr.,*** File S75-1 (26), Box 240.

[57] Lockwood to McMorris, 9 December 1943, in ***Lockwood MSS,*** Container 13; Blair, 475.

deactivation, all shots relied on the back-up contact exploder; the premature explosion rate dropped nearly to zero, but the dud rate rose alarmingly.[58]

In this case the operational forces chose to solve the problem without consulting with BuOrd first. Less than one month after the Mark VI deactivation, in July 1943, Daniel Daspit on the *Tinosa* attacked a slow Japanese freighter. An early long-range shot disabled the vessel, and *Tinosa* moved in for the kill. Daspit fired nine torpedoes into the stationary freighter at short range, and observed all to hit the ship. Sonar confirmed the torpedo impacts, but to Daspit's amazement none of the warheads exploded. Enraged by the duds, he saved one torpedo and returned to Pearl Harbor by early August. During shore tests the torpedo's exploder functioned normally.[59] Lockwood puzzled over this incident for a time before ordering a unique test. The *Muskallunge* fired three torpedoes into the cliffs at Kahoolawe, Hawaii on 31 August. Two exploded and the third failed to fire. A local diving team courageously retrieved the live warhead; subsequent inspection revealed that the warhead's firing pin mechanism had crushed on impact.[60] Further shore tests (dropping torpedoes suspended from a crane onto steel plates) confirmed that the firing pin assembly warped under the pressure of a right-angle impact. The pin failed to strike the booster charge with sufficient force; the booster never exploded, and in turn the main warhead failed

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[58] Lockwood to Daubin, 7 September 1943, in ***Lockwood MSS,*** Container 13.

[59] Lockwood to Comstock, 5 August 1943; Lockwood to Edwards, 27 August 1943; Lockwood to Blandy, 30 August 1943, all in ***Lockwood MSS,*** Container 13; Blair, 408-411; Roscoe, 259-260.

[60] Lockwood to Comstock, 6 September 1943, in ***Lockwood MSS,*** Container 13.

to detonate. Lockwood set his base mechanics to work on devising a jury-rig modification. With barely contained excitement he advised Blandy on 9 September of the Kahoolawe and follow-up tests, and recommended a temporary remedy.[61]

BuOrd had known of the dud problem for some time but apparently never suspected the firing pin mechanism. Blandy wrote to the Bureau of Ships in May 1943: "The Bureau [of Ordnance] has received reports from time to time which indicate that there is a definite feeling among operating personnel that our warheads are not as effective as those used by the enemy." Blandy requested caissons from the Bureau of Ships to simulate ship hulls for warhead tests, although he worried more about warhead explosive characteristics than firing pin operation.[62] No mention of such caisson tests, however, appears in the Bureau's correspondence files before Lockwood's cliff tests in September. Newport quickly verified Lockwood's findings during September, and within one month distributed conversion kits to remedy the exploder fault.[63] In the meantime, submarines departed from Pearl Harbor in September 1943 with torpedoes redesigned for improved depth performance, carrying deactivated magnetic exploders and jury-rigged contact exploders -- the first fully reliable Mark XIV

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[61] Lockwood to Blandy, 9 September 1943, in ***Lockwood MSS,*** Container 13.

[62] Blandy to Bureau of Ships, 21 May 1943, in ***BuOrd Corr.,*** File S75-1 (42), Box 241.

[63] Blandy to Schools and Training Command, 27 October 1943, in ***BuOrd Corr.,*** File S75-1 (26), Box 241.

torpedoes in nearly two years of war, resulting from operationally-designed corrections.

Failure of confidence, as much as failure of weapons, characterized the Mark XIV episode. Morale was crucial to the military's success. Torpedo failures potentially cost lives, not simply inconvenience. Submarine commanders already operating under extreme pressure could not tolerate any damage to crew morale. Nine out of ten Mark XIVs functioned properly from 1941 to 1943, but any failure damaged faith in the weapon, particularly when failure could not be predicted -- witness Lawson Ramage's experiences on *Trout* in December 1942. Time and again Lockwood in his correspondence with Blandy stressed the harm done to submarine morale by torpedo failures.

The Mark VI exploder's pre-war secrecy exacerbated this "confidence gap." Blandy blamed exploder problems on "the fact that they [exploders] have in some cases been in storage for some years in a Secret status." He concluded that operational forces lacked the technical knowledge necessary for proper handling and maintenance.[64] Submarine commanders naturally distrusted unknown equipment. As failure followed failure, and as the rumor mill kicked into high gear, any remaining confidence among sub skippers quickly disappeared. Senior operational commanders such as Lockwood retained faith in the exploder for a longer period, since they understood its strategic and technical merits. Still, these

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[64] Blandy to Newport NTS, 23 February 1942, in ***BuOrd Corr.***, File S75-1 (26), Box 112.

officers could not ignore the devastating impact on morale caused by repeated failures; even Ralph Christie admitted as much, although his devotion to the design outweighed such considerations. Eventually, morale triumphed over technical merit.

BuOrd never presented itself to the submariners as responsive to operational needs. Blandy maintained frequent, generally friendly contact with the operational forces, and the Bureau's internal correspondence indicated a genuine concern for supplying the fighting forces with adequate weapons. But the Bureau unfortunately chose to rely on Newport rather than the operational forces. Lockwood continually notified Blandy of operational Mark XIV failures, and Newport in turn constantly downplayed those reports. The station believed it could resolve the Mark XIV's problems, which it felt were largely the result of misuse in the field. Newport ignored operational results and suggestions instead of exploiting them. The submarine force, having lost all confidence in BuOrd and its Mark XIV, took the initiative in resolving the Mark XIV's defects. Operational units forced the Bureau to acknowledge and correct deep-running; they identified and resolved through deactivation the magnetic exploder's flaw; and they identified and corrected the contact exploder's defect without BuOrd participation.

Chapter Two - The Mark XVIII Torpedo

While the Mark XIV's problems demonstrated BuOrd's failure to identify and correct defects in its own torpedo, the Mark XVIII electric torpedo project exposed BuOrd's inability to direct civilian torpedo development. Poor coordination between the civilian contractor, Westinghouse, and the Newport station stalled the project for more than one year. This delay occurred while the submarine force struggled with the Mark XIV, thereby worsening an already strained relationship. Operational intervention finally forced the Bureau into action once again, shifting more responsibility away from BuOrd. The Mark XVIII eventually enjoyed far more success than the Mark XIV, mainly because of operational participation in its development.

Early Electric Torpedo Development

Despite its complex exploder mechanism, the Mark XIV utilized conventional torpedo propulsion technology. The torpedo's engine ran on steam produced by shooting a stream of water with compressed air through an alcohol flame. Safe and generally reliable, this steam engine propelled the Mark XIV at 46 knots to a range of 4,500 yards.[65] These steam torpedoes had two serious drawbacks. Their inadequate range forced sub commanders into dangerous situations when attacking, and the steam torpedoes left a visible wake of smoke and bubbles along the attack run. Such a wake pointed directly back to the sub for any counterattacking vessel and gave the target a chance to evade the attack.[66]

BuOrd pursued two alternative means of torpedo propulsion, "oxygen" torpedoes and electric motors, to resolve these deficiencies. "Oxygen" torpedoes addressed the range issue. These torpedoes used liquid hydrogen peroxide instead of compressed air, providing more power for an equivalent amount of propellant. Pre-war U.S. experimental models ran 16,500 yards at 46 knots -- almost four times the Mark XIV's range. The famous Japanese "Long Lance" torpedo utilized this "oxygen" technology, achieving an extraordinary range of 40,000 yards (almost 23 miles) at 36 knots. The U.S. Navy never used this technology during the war, however. American submariners were suspicious of the oxygen

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[65] Roscoe, 252. The Mark XIV also had a low-speed feature designed to extend its range to 9,000 yards at 31 knots. Submariners reported only infrequent use of this feature on patrol, however. BuOrd eventually dropped the lower speed; the later-model torpedo was designated the Mark XXIII, in every other respect identical to the Mark XIV.

[66] *Ibid.*, 250-251.

torpedo. They did not like carrying hydrogen peroxide, a volatile substance vulnerable to mishandling or battle damage.[67] The torpedo also left a visible wake similar to that from steam torpedoes. Numerous technical problems plagued the low-priority oxygen torpedo program before the war. Once the war began, emphasis fell on Mark XIV production and development of the electric torpedo. Oxygen torpedo research continued throughout the war, but there was never any serious production effort.[68]

The electric torpedo appeared far more promising; its wakeless run meant no warning for the target and no marker for anti-submarine ships to pursue. The scientific and technical communities also did not have to grapple with theoretical advances, since electric motors were relatively well-understood. Adapting such technology to the realities of torpedo design proved to be another matter entirely, since numerous engineering obstacles hampered development. The major difficulty lay in reducing the various motor components to a size capable of fitting inside a torpedo, while still leaving room for an adequate warhead.[69] Batteries, in particular, posed a vexing problem. Small batteries were too weak for propulsion, and large batteries consumed far too much space inside the cramped torpedo. Also, standard battery designs often expelled dangerous quantities of hydrogen

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[67] Japanese submarines and surface ships used oxygen torpedoes almost exclusively throughout the war; no handling accidents were ever reported. Blair, 255.

[68] Blair, 254-255.

[69] Recall that torpedo size was a major factor driving development of the magnetic exploder.

gas -- not necessarily a problem in well-ventilated settings, but potentially disastrous in a submarine's close confines.[70]

Monetary problems had long plagued early electric torpedo research. The U.S. Navy awarded a small experimental contract to the Sperry Gyroscope Company in 1915. This contract expired at the end of World War I due to budgetary constraints. BuOrd simply did not possess sufficient manpower or monetary resources during the interwar years to address electric torpedo development. Most available effort went into the Mark XIV and the magnetic exploder. One Newport technician, however, continued work on the electric concept in his spare time. This dedicated individual finally produced a single working prototype, which promptly sank during its first test firing in 1931. Lacking the funds to recover the prototype, the Bureau left it at the bottom of Rhode Island Sound. The torpedo lay there for several years until a ship accidentally snagged it and brought it to the surface. Meanwhile, BuOrd had suspended work on the electric torpedo concept.[71]

Wartime Development and Delays

Such was the pathetic story of the U.S. electric torpedo before 1941. Then, with war seemingly imminent and funds newly available, BuOrd revived the electric torpedo project. Newport technicians dusted off the old design plans for

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[70] *Ibid.*, 255-256; Roscoe, 262.

[71] Rowland and Boyd, 21, 111-112; Blair, 256.

their new developmental model, designated the Mark II. The project proceeded as a team effort, with work parcelled out to General Electric (propulsion motors) and the Electric Storage Battery Company (batteries), in addition to in-house development of control mechanisms at Newport.[72] Despite this renewed interest, work progressed slowly. BuOrd's emphasis in the months immediately before Pearl Harbor still lay in perfecting the Mark XIV. Manufacturing sufficient quantities of that model, and resolving the Mark XIV's many difficulties, took priority over developing new torpedo technology.

More troubling, the Bureau exhibited early signs of its inability to coordinate a "team" project. Each member worked on its own design problem in relative isolation from the others. But each member's component design depended on its relation to every other component. The project's success hinged upon close coordination at every stage of development. Though logically best suited for such overall project direction, Newport's technicians instead concentrated on their own portion of the puzzle. Higher Bureau authorities failed to designate any sort of directing unit. As a result, a project that required careful management instead suffered from divided responsibility and a lack of coordination.[73]

The outbreak of hostilities in December 1941 pressured BuOrd into accelerating the electric torpedo program. The operating forces placed increasing

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[72] Blair, 256; Rowland and Boyd, 112.

[73] Rowland and Boyd, 113.

demands on Newport and BuOrd for more and better torpedoes. Although complaints about the Mark XIV were still vague in those early months, Ordnance personnel nonetheless perceived the submarine force's growing discontent with the standard torpedo. Further, a wakeless torpedo's tactical desirability became more apparent as the submarine campaign intensified. The realization that both Germany and Japan possessed torpedoes significantly more capable than the Mark XIV provided the major impetus for the electric program. In particular, German U-boats scored a series of stunning successes along the U.S. east coast in early 1942, due in large part to their own electric torpedoes. Several such torpedoes ran up onto U.S. beaches after missing targets. The Bureau's analysis of these torpedoes impressed COMINCH King enough for him to request that BuOrd expedite development of the electric torpedo.[74]

At this point BuOrd had two choices: speed up development and production of its own Mark II or copy the captured German design. Blandy passed these choices on to Newport, instructing the station to concentrate on copying the German design if that would speed production. As BuOrd's official history put it, "Every emphasis was placed on an early accomplishment and only minimum military characteristics established as an aid toward expediting the project."[75] Newport technicians chose to speed work on its own design; the station formed a new unit specifically charged to push Mark II development through the

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[74] Blair, 256; Rowland and Boyd, 113.

[75] Rowland and Boyd, 113.

existing coordination obstacles. Unfortunately, Newport soon discovered it possessed insufficient resources to develop and produce the Mark II while simultaneously manufacturing the Mark XIV at maximum output. General Electric, moreover, decided it was unable to take over electric torpedo production due to other production commitments.[76]

In desperation Ordnance representatives met with Westinghouse Manufacturing Company in March 1942 and asked it to assume development and production of the Mark II. After reviewing Newport's design data Westinghouse informed the Bureau that copying the German design would be quicker than developing the Mark II. BuOrd agreed and ordered Newport to lend all possible aid to Westinghouse before proceeding with any work on the Mark II.[77] What followed at Westinghouse constituted a minor miracle of weapon design. The company, anxious to receive a lucrative production contract, assigned design chores to a small engineering team that completed the basic design copy within one month. The following month BuOrd and Westinghouse agreed on a letter of intent for the company's West Sharon (PA) plant to produce 2,000 electric torpedoes with attendant equipment. Westinghouse delivered five test models, designated Mark XVIIIs, to Newport at the end of June 1942, only fifteen weeks after beginning work. One submarine officer commented that

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[76] Blair, 256-257; Rowland and Boyd, 113; Roscoe, 262.

[77] *Ibid.*

Westinghouse's rapid design "proved the value of bringing in outside competition and the profit motive."[78]

This remarkable progress excited officers in operational sectors as well as the Bureau. An unidentified official apparently sent word to the fleet promising electric torpedoes within several weeks. Admiral Lockwood, at this time still in Australia, mentioned the torpedo in an 11 July 1942 letter to BuOrd chief Blandy: "It would be nice to have an electric torpedo but don't worry much about that as we are able to get hits with air torpedoes unless the ranges used are excessive." Despite Lockwood's nonchalance, the submarine force eagerly awaited a new torpedo, particularly in light of the Mark XIV's continuing problems; deep-running had almost been solved but the magnetic exploder exhibited growing signs of trouble.[79]

Optimism soon turned into frustration. Early prototypes contained numerous technical bugs. Westinghouse had difficulty adapting portions of the German design to American technology. Certain German components possessed seemingly incomprehensible functions. The company needed to alter the torpedo's dimensions to fit American submarine tubes; this in turn forced substantial modifications to the torpedo's internal layout. Batteries posed a special problem, as they always had, by venting too much dangerous hydrogen

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[78] Quoted in Blair, 257; Rowland and Boyd, 113-114.

[79] Blair, 257; Lockwood to Blandy, 11 July 1942, in ***Lockwood MSS***, Container 12.

gas.[80] Compounding the problem, Newport's technicians chose to concentrate on their own Mark II torpedo design and offered virtually no assistance to Westinghouse on the Mark XVIII project, echoing the earlier "team" project's failure. This lack of action clearly conflicted with BuOrd's March 1942 order concerning assistance. Westinghouse floundered in the absence of clear guidance from Newport and the company's original May letter of intent (essentially a temporary production contract) expired in September 1942 with no sign of any useable torpedoes. At Westinghouse's request Blandy extended the contract into early 1943.[81]

Operational curiousity about the Mark XVIII increased as 1942 drew to a close. The Atlantic submarine commander, obviously expecting the Mark XVIII's imminent deployment, wrote to Newport on 30 September 1942. He requested instruction in the Mark XVIII's use before their deployment "so that the [Submarine] School staff [in New London, CT] may keep apace of developments ... This is considered necessary in order to insure getting the best performance out of these torpedoes as soon as possible after they are issued to the submarine service."[82] Blandy replied soon thereafter on Newport's behalf, discussing the assignment of submarine personnel to Westinghouse's Pennsylvania plant for "instruction in the assembly and adjustment of the Mark

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[80] Roscoe, 262; Rowland and Boyd, 114-115. Westinghouse subcontracted battery development to the Electric Storage Battery Company, the same company that had worked on Newport's Mark II electric torpedo.

[81] Blandy to Westinghouse, 14 September 1942, in ***BuOrd Corr.***, File S75(Mk 18), Box 136.

[82] ComSubLant to Newport NTS, 30 September 1942, in ***BuOrd Corr.***, File S75(Mk18), Box 136.

18 torpedoes." He provided a brief description of the electric torpedo and closed with the following comment: "The Bureau has endeavored to provide in the Mark 18 measures which overcome the principal objections to existing torpedoes as they have been brought out by war operations."[83]

BuOrd inadvertantly added to the Mark XVIII's delays during the project's early stages by supporting a design distraction at Westinghouse. On its own initiative the company drew up plans for an all-electric torpedo while working on the Mark XVIII. This new design featured electrically-operated control surfaces and an electric detonator, in addition to the electric motor used in the Mark XVIII.[84] Westinghouse had suggested electric controls in March 1942 when the Mark XVIII project began. At that time, according to Westinghouse, the Bureau encouraged the company "to give thought to such a development if and when it would not interfere with the expeditious prosecution of the Mark 18 development."[85]

Westinghouse apparently believed any potential interference to be minimal, for company engineers turned to the all-electric design upon completion of the first five experimental Mark XVIIIs. Representatives from BuOrd and Newport

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[83] Blandy to ComSubLant, 10 November 1942, in ***BuOrd Corr.,*** File S75(Mk 18), Box 136.

[84] The Mark XVIII torpedo carried a conventional contact exploder. The sources consulted for this paper provide no explicit reason why a magnetic exploder was not used. Two considerations may explain the use of a contact mechanism: (1) the German design copied by Westinghouse utilized a contact exploder; (2) more likely, the only existing U.S. magnetic exploder (the Mark VI) may not have functioned properly in the presence of electrical equipment. Apparently Westinghouse overcame this problem in its all-electric design, because the proposed exploder operated through both impact and influence. BuOrd attempted various influence exploder designs for the Mark XVIII, without success.

[85] G.A. Hyland, Westinghouse, to Blandy, 9 November 1942, in ***BuOrd Corr.,*** File S75(Mk 18), Box 136.

offered "numerous constructive suggestions" concerning the all-electric torpedo during an October 1942 visit to the Westinghouse plant.[86] Westinghouse submitted a formal all-electric torpedo proposal to Blandy in November 1942. The company claimed its proposed design was simpler than the Mark XVIII, contained fewer critical (rare) materials, required less intricate machine tooling, and would be cheaper to produce. The company felt comfortable submitting the proposal since the October plant tour discussions "disclosed no basic technical difficulty in the design as developed to date."[87]

BuOrd reviewed this proposal for almost two months before responding. Blandy informed Westinghouse on 30 December 1942 that BuOrd generally liked the design. He suggested a variety of technical and production changes, advising Westinghouse that BuOrd approval seemed likely upon submission of a revised proposal. Blandy concluded optimistically: "If the new torpedo meets the performance characteristics now believed possible, discontinuance of production of the Mark 18 would appear to be the proper procedure."[88] The all-electric proposal progressed no further than the drawing board, however. BuOrd's correspondence files surprisingly contain no further reference to Westinghouse's design after Blandy's 30 December letter. Presumably Westinghouse failed to submit a revised proposal, despite Blandy's strong encouragement. If that indeed

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[86] *Ibid.*

[87] *Ibid.*

[88] Blandy to Westinghouse, 30 December 1942, in ***BuOrd Corr.***, File S75(Mk 18), Box 136.

was the case, the company's reasons remain unknown. The Bureau's official history does not discuss the all-electric proposal.[89]

This curious episode exemplifies the fundamental cause of the Mark XVIII development delay. Three separate electric torpedo designs competed for attention during the latter half of 1942: Newport's Mark II, Westinghouse's Mark XVIII, and Westinghouse's all-electric model. The Mark XVIII project, supposedly BuOrd's top priority, instead languished in relative obscurity while both Westinghouse and Newport developed their respective in-house designs. No higher authority ordered any different course of action. The entire electric torpedo project lacked central direction or coordination.

Operational Intervention

American submariners entered their second year of war still awaiting the long-promised electric torpedo. A full year of combat patrols clearly indicated the need for wakeless torpedoes. In addition, the Mark XIV's magnetic exploder problems continued unabated, although deep-running had been cured in the summer of 1942. The submarine force's impatience with BuOrd grew steadily, given the Mark XIV's problems and the Mark XVIII's delays.

The submarine *Lapon* arrived at Newport in early 1943 to assist in Mark XVIII test firings, spending six unhappy weeks at the station. As the sub's

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[89] Westinghouse did produce a limited quantity of small electrically-powered acoustic homing torpedoes in mid-1944. This design, nicknamed the "Cutie," may have incorporated features from the all-electric torpedo, although that is unclear. Blair, 762-764.

executive officer, Eli Reich, later recalled: "What we found at Newport was simply sickening. The Mark XVIII was an extremely promising weapon. But the Newport guys -- the steam torpedo guys -- had a big NIH -- Not Invented Here -- attitude toward the Westinghouse torpedo. Maybe sabotage is too strong a word, but they weren't helping one bit."[90] Reich and *Lapon's* commander Oliver Kirk composed a long memorandum for Admiral Lockwood, by now commanding Pacific Fleet submarines at Pearl Harbor. Kirk and Reich criticized both Newport and BuOrd for the Mark XVIII delays. The officers reserved particular criticism for the project's lack of coordination: "... basically it's the Bureau's fault .... What this set-up needs is a 'Pushing Officer' with lots of enthusiasm and the backing of the Bureau, and (very important) some rank .... This officer should be familiarized with the devious workings of this queer place, then, with the authority and backing of the Bureau, he can do wonders."[91] Of Newport's attitude, Kirk and Reich stated that "what latent enthusiasm there was here has now petered out and it won't rise again until they know their efforts are amounting to something."[92] Reich used harsher words in a letter to Lockwood's operations officer Richard Voge: "I don't think these people are war-minded .... As far as I can see it's still peacetime procedures here."[93]

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[90] Quoted in Blair, 375.

[91] Attachment, Lockwood to Blandy, 9 June 1943, in ***Lockwood MSS,*** Container 13.

[92] *Ibid.*

[93] Reich to Voge, 20 March 1943, in ***Lockwood MSS,*** Container 13.

Lockwood decided to pressure the Bureau into action on the Mark XVIII, as he had with the Mark XIV. He forwarded the Kirk-Reich memorandum through the chain of command hoping for official action. He got it -- on 5 April 1943 COMINCH King ordered the Navy's Inspector General to begin an inquiry into the Mark XVIII project's "apparently excessive delay."[94] The IG delivered his report two months later. He stressed the absence of overall direction: "The delays encountered were largely the result of the manner in which the project was prosecuted and followed up. These difficulties indicated that the liason officers of the Bureau of Ordnance failed to follow up and to properly advise the Westinghouse Company and the [Electric Storage Battery] Company during the development of the Mark XVIII torpedo." Concerning Newport: "The Torpedo Station had its own electric torpedo, the Mark II, and the personnel assigned to it appear to have competed and not cooperated with development of the Mark XVIII."[95]

The Vice Chief of Naval Operations, Admiral Horne, provided in his attached report endorsement a partial explanation for Newport's delays. Horne stated that "the urgent necessity for correcting defects [in the Mark XIV torpedoes] discovered through their use in combat" had delayed work on the Mark XVIII. According to Horne, Blandy believed that current torpedo supply

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[94] King to Naval Inspector General, 5 April 1943, in Secretary of the Navy/Chief of Naval Operations, Secret Correspondence, File S75, Box 710, Record Group 80, National Archives, Washington, D.C. [Cited hereafter as ***SecNav/CNO Corr.*** All SecNav/CNO records are located in Record Group 80.]

[95] Naval Inspector General report with endorsements, June 1943, in ***SecNav/CNO Corr.***, File S75, Box 710.

and performance took priority over new torpedo development. Horne nevertheless faulted Newport for a "lack of drive" concerning the Mark XVIII's development. Newport's commanding officer, Captain Frank Roberts, and his second-in-command were relieved because of "insufficient liason with the manufacturer."[96] Once again operational intervention had forced BuOrd's hand.

The Kirk-Reich memorandum and the Inspector General's report fueled the tension between BuOrd and the submarine force, already bitter over the Bureau's failure to correct the magnetic exploder bugs. Spring 1943 marked the relationship's lowest point, culminating in Lockwood's bitter comments at the April submarine officers' conference in Washington.[97] Lockwood soon realized that he had needlessly antagonized Blandy, however. Lockwood sent Blandy an explanatory letter on 9 June along with a copy of the Kirk-Reich memo:

> When you first read this memo I know that you will feel resentment ... but when you think it over I believe you will realize that these lads are in dead earnest, that they are fired up by enthusiasm for the torpedo and that they are bitterly discouraged by the apparent lack of concern on the part of the Bureau and the Torpedo Station about the development of this torpedo for which the submarine service has been waiting so long and on which we have pinned so many hopes.

Appealing to Blandy's early experience, Lockwood wrote:

> You will possibly recall that in our younger days, you and I felt just as bitterly about the delays, red tape and sheer ignorance of the people with whom we had to deal in various Bureaus and Navy Yards. I read in this memo the same thoughts and protests which we have so often voiced ... read this memo carefully and if a purge is necessary somewhere, then for God's sake purge ... unless our torpedo performance can be improved we stand to lengthen an already long war and to sacrifice a lot of submarines and the fine lads who run them.[98]

Blandy replied with an equally impassioned letter on 19 June: "Far from resenting the memorandum ... I was damn glad to get it. I don't mind well-meant

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[96] *Ibid.*

[97] See Chapter I.

[98] Lockwood to Blandy, 9 June 1943, in ***Lockwood MSS,*** Container 13.

constructive criticism .... I have not only read the memo thoroughly, but am having copies made, to be read by everybody concerned in the bureau ...." He in part blamed the misunderstanding over the Mark XVIII deployment timetable:

> ... some damn fool in Operations promised Comsubpac ... that they were going to have electric torpedoes in June [1942]. I understand that he explained to my people that he did it (without referring to Bureau of Ordnance) 'just to cheer up the submariners ....' There are too many people outside the bureau who haven't the foggiest notion of material development and manufacture, who make asinine statements and promises like that about such matters.

Blandy then defended BuOrd's role in developing the Mark XVIII:

> The bureau initiated all the action there has been on this torpedo, no directive or request having been received from anyone outside ... no stress was ever laid on it in writing by Cominch [King] or Opnav [Horne] until recently. It was *this bureau* which got this job underway, and nobody else. The bureau undertook it primarily as a *quick production* torpedo, rather than as a *better* torpedo than the Mark 14 [emphasis in original].[99]

He commented on the "irony" that the Mark XIV's production bottlenecks had been resolved. He believed this fact obviated the need for a "quick production" Mark XVIII, which he saw as the Bureau's original goal. Blandy advised Lockwood that "now ... all hands are fully alive for the great demand for the electric torpedo, as being considered *better* than the Mark 14 ... it is being pushed with all the speed we can give it [emphasis in original]."[100]

Blandy's remarks concerning the role of BuOrd were somewhat misleading. The Bureau had indeed performed considerable work on the electric concept. But Admiral King provided the major impetus for electric torpedo development in early 1942, despite Blandy's claims that no outside agency prompted any Bureau action. Westinghouse, not BuOrd, chose to copy the German model; the company did not use Newport's design data. More important, the Bureau and

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[99] Blandy to Lockwood, in ***Lockwood MSS,*** Container 13.

[100] *Ibid.*

the submarine force clearly held differing opinions on the Mark XVIII's purpose. Blandy considered the Mark XVIII a stop-gap measure rather than a next-generation torpedo. Production outranked development for Blandy; he supported the Mark XVIII only because it could relieve Mark XIV production pressure. Lockwood and the submarine force, on the other hand, believed "new" weapons necessarily meant "better" weapons. The new Mark XVIII promised certain tactical advantages over the current Mark XIV, and the Mark XIV's technical problems heightened the fleet's anticipation for the electric torpedo.

The Lockwood-Blandy exchange nevertheless resolved some of these misunderstandings. BuOrd, devoting full attention to the Mark XVIII, suspended all work on Newport's Mark II. Within a month several pre-production Mark XVIIIs arrived at Pearl Harbor for operational trials, accompanied by several Westinghouse technicians. The flow of test Mark XVIIIs continued for the next several months. Blandy commented in an 11 August letter to Lockwood that "it would be worth a lot in the Mark 18 development if you will give us the results of the first ones fired ...."[101]

Such operational involvement in the Mark XVIII project marked a significant shift in Ordnance procedure. Newport previously had viewed as unhelpful submarine force comments and suggestions regarding the Mark XIV. Now the Bureau was requesting the fleet's assistance in "debugging" the Mark XVIII. Lockwood's Pearl Harbor technicians discovered a variety of problems.

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[101] Blandy to Lockwood, 11 August 1943, in ***Lockwood MSS***, Container 13; Blair, 480.

Hydrogen leakage from batteries caused several fires and explosions in torpedo tubes (the *Flying Fish* experienced an intense fire that melted the warhead's explosive filling); torpedo control surfaces proved too fragile; battery compartment deformation prevented smooth torpedo launches; cold water lowered the temperature of the battery, which thus generated insufficient power for the torpedo's motor. Westinghouse technicians and the Pearl Harbor torpedo shop, drawing upon many months of operational experience, corrected most of these problems in relatively short order. A hydrogen-burning device harmlessly destroyed leaking battery gas. Improved insulation helped maintain proper battery temperature. Structural improvements strengthened the control surfaces and the battery compartment shell.[102] Submarines carrying the first combat-test Mark XVIIIs departed from Pearl Harbor in September 1943 -- the same month that the submarine force discovered and corrected the last Mark XIV defect. Glynn Donaho and the *Flying Fish* scored the Mark XVIII's first confirmed kill on 18 October 1943.[103]

The Mark XVIII became quite popular, although many sub commanders at first did not like the torpedo. Following an October 1943 patrol the *Sawfish's* division commander reported: "The results were disappointing, and indications are that considerable testing and proof firing will be necessary before the Mark

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[102] Roscoe, 262; Blair, 480.

[103] Three of Donaho's six Mark XVIII's ran erratically. Blair, 481, 484. The famous *Wahoo*, commanded by Dudley "Mush" Morton, may have recorded the first electric kill. The *Wahoo* carried several Mark XVIIIs on its autumn 1943 patrol into the Sea of Japan. Japanese records indicate that several ships were torpedoed in the *Wahoo's* operational area during early October. The *Wahoo* never returned from this patrol, so these kills cannot be confirmed as electric. Blair, 481-482.

XVIII is satisfactory for service use."[104] The Mark XVIII's slow 27-knot speed hampered many attacks; the torpedo could not overtake high-speed targets from astern. The Mark XVIII's many tactical advantages -- wakeless run, reliable exploder, dependable depth control -- soon outweighed this initial skepticism. Later modifications boasted improved speeds approaching 40 knots, eliminating the fleet's primary complaint. Continued tinkering by Westinghouse and Pearl Harbor further improved the torpedo. Mark XVIII use remained voluntary, but by July 1944 most departing submarines carried loads of eighteen Mark XVIIIs and six Mark XIVs. During the war's final six months, Mark XVIIIs accounted for 65 percent of all war shots.[105]

The Mark XVIII project, like the Mark XIV, exposed BuOrd's limitations as a torpedo supplier. By bungling project coordination the Bureau once again failed to provide adequate torpedoes to the submarine force. The Bureau once more presented an unresponsive image to its customers in operations. This time, however, a new producer replaced BuOrd in the torpedo realm. Westinghouse had organized its design effort in a similar fashion to Newport's, and the company did not actively seek operational advice until after the Inspector General's report. But because the company eventually did include operational forces in the project's development phase, it appeared more responsive to submarine needs than did BuOrd. A civilian contractor proved its ability to

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[104] Quoted in Blair, 482.

[105] Roscoe, 263; Rowland and Boyd, 115; Blair, 668.

produce quality torpedoes just at the time when the Bureau of Ordnance amply demonstrated its own shortcomings.

Chapter Three - Production, Communication, and Coordination

BuOrd's problems become even more obvious when viewed from a functional perspective. The Bureau's existing torpedo organization had three primary functions: producing torpedoes; communicating information to and from torpedo users; and coordinating torpedo design and development. The organization failed in each area, and the Bureau's response to these failures unintentionally eliminated Ordnance cognizance over torpedo design, development and production. The Newport and Alexandria assembly facilities could not meet production demands and BuOrd therefore initiated civilian production of finished torpedoes, which unintentionally shifted torpedo design and development away from Newport as well. Civilian manufacturers, lacking any inherent knowledge of military requirements or guidance from Newport, eventually bypassed the station and communicated directly with torpedo users.

The torpedo users, in turn, lost patience with Bureau delays and corrected problems on their own. BuOrd's use of civilian contractors also created coordination problems, culminating in the Mark XVIII delays. The Bureau created a new agency that resolved this difficulty, removing Newport's last important function.

Production

BuOrd considered torpedo production a military function from the inception of the technology. The Navy established a torpedo factory at Newport, RI in 1907 under Ordnance jurisdiction. The station quickly became the center for American torpedo design, research and production.[106] As American involvement in World War I grew increasingly likely, the Bureau took several precautionary measures to insure adequate torpedo supplies. BuOrd expanded Newport's production capacity in 1916 by adding personnel and facilities. A second torpedo factory was established in Alexandria, VA. The Bureau also contracted with E.W. Bliss & Company for production of specific components once hostilities began, but torpedo assembly remained primarily Ordnance's responsibility. The Newport and Alexandria factories possessed ample production capacity throughout the war. American submarines, unimportant in the battleship-dominated Navy, did not sink any enemy vessels during the war. Those surface ships that carried torpedoes never engaged in combat. BuOrd's

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[106] Blair, 10-11.

torpedo factories thus avoided any supply problem during their first wartime test.[107]

Monetary woes struck the Navy following the war. The national military budget declined rapidly in the post-war political climate. The Navy's share of that budget decreased proportionately, particularly following reductions mandated by the 1922 Washington Naval Conference. In response to such problems the Navy reduced ordnance activity through the 1920s to the bare minimum required to maintain the fleet's armament.[108] Given the submarine's irrelevance in the big-gun Navy, torpedo production became a very low priority for the financially-strapped Ordnance bureau. The Alexandria factory closed in 1922. Newport's 1930 budget of $70,000 barely covered station maintenance, let alone torpedo research and production. BuOrd that year had to supply the entire fleet with a staff of only 24 officers and 64 civilians.[109]

This budget crunch disappeared during the 1930s. The growth of German and Japanese naval might renewed national interest in a strong navy. Franklin Roosevelt's industrial recovery and public works programs encouraged government spending. The Navy thus benefited from massive spending increases, helped by Carl Vinson, chairman of the powerful House Naval Affairs

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[107] Blair, 20; Rowland and Boyd, 124.

[108] Kenneth Hagan, ***This People's Navy*** (New York: The Free Press, 1991), 259-281; Rowland and Boyd, 1.

[109] Luther Gates Ingram, Jr., "The Deficiencies of the United States Submarine Torpedo in the Pacific Theater: World War II" (M.A. Thesis, San Diego State University, 1978), 15; Rowland and Boyd, 2.

Committee. Vinson sponsored several Navy expansion bills during the 1930s, from the 1934 Vinson-Trammell Act to the 1940 "Two-Ocean Navy" bill.[110]

This expansion quickly overwhelmed Newport's production capacity. Although submarine numbers remained relatively small, destroyers and newly-important carrier aircraft required substantial torpedo supplies. Even on a 24-hour schedule Newport could only manage two or three torpedoes per day, hopelessly inadequate for the fleet's needs. Newport carried a $29 million backlog of orders by 1937; projections indicated a shortfall of 2,425 torpedoes by 1942 if production remained constant.[111] BuOrd once again decided upon internal growth. The Bureau requested in 1937 that the Alexandria factory be reopened. Political pressure blocked this request, however. Newport-area politicians and labor leaders felt that any expansion should occur at their station. BuOrd finally opened the Alexandria plant in early 1941 by funding the factory as part of the adjoining gun factory. Samuel Eliot Morison terms this episode "one of the worst" instances of political interference in the Navy.[112]

This delay in reopening Alexandria forced the Bureau to look elsewhere for torpedo production. Several commercial sources supplemented Newport's parts manufacturing capability by late 1940, although the station still assembled all Navy torpedoes.[113] Even with this additional parts supply Newport fell behind.

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[110] Rowland and Boyd, 3; Ingram, 24; Hagan, 281-289.

[111] Rowland and Boyd, 125; Blair, 48.

[112] Morison, 232, 233n.; Rowland and Boyd, 125; Blair, 48.

[113] Furlong to Stark, 17 September 1940, in *SecNav/CNO Corr.*, File S75, Box 146.

Secretary of the Navy Frank Knox wrote in May 1941 that "the need for additional sources of supply for torpedoes is self-evident."[114] The Bureau opened negotiations with the American Can Company in June 1941 for a torpedo assembly plant in Chicago. Such an arrangement marked a significant shift in BuOrd practice: for the first time a civilian contractor assumed responsibilty for assembling American torpedoes.[115] Until the new plant opened, the Newport and Alexandria plants assembled every Navy torpedo: the Mark XIV, the air-launched Mark XIII, and the surface-launched Mark XV. Newport managed a production rate of five torpedoes per day in September 1941, while the newly-reopened Alexandria factory only assembled seven to ten torpedoes per week. This meager output did not satisfy Blandy, but he promised the CNO, Admiral Stark, that matters would improve by January 1942.[116] Pearl Harbor dashed that hope.

Wartime operational demands swamped BuOrd. Projected expenditures based on early submarine combat patrols more than doubled current production rates. The Philippines submarine base lost 233 torpedoes in a single air raid, leaving Asiatic Fleet subs with virtually no reserve supply. Pearl Harbor could find only 101 reserve torpedoes. The submarine force's unexpected importance

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[114] Knox to Office of Production Management, 13 May 1941, in *SecNav/CNO Corr.*, File S75, Box 146.

[115] Rowland and Boyd, 126. Two companies, E.W. Bliss and Excel Foundry & Machine, assembled torpedoes for the Royal Navy through a British government contract. The machinery required for manufacturing these torpedoes was not compatible with American torpedo specifications. Retooling these plants for American production would have been quite difficult, and would have eliminated a primary British supply source. Rowland and Boyd, 127.

[116] Blandy to Stark, 15 September 1941, in *SecNav/CNO Corr.*, File A3, Box 274.

complicated Ordnance's situation. Pre-war estimates assumed minimal torpedo consumption on the part of submarines; planners intended a scouting role for submarines. Accepted doctrine called for battleships, not submarines, to engage enemy naval forces in the event of war. The destruction of the Pacific Fleet at Pearl Harbor rendered this doctrine moot. Submarines now constituted the Navy's only forward strike force. As a result, torpedo expenditures far exceeded any previous expectation.[117] Submariners fired over 1,400 torpedoes, primarily Mark XIVs, during 1942. Over that same period BuOrd's two factories assembled some 2,000 Mark XIVs; many of these torpedoes had not reached the operational forces by year's end due to transportation difficulties. Torpedo consumption therefore nearly equalled production, an intolerable situation for military commanders.[118]

The Bureau accelerated its civilian contractor program in early 1942 to meet this crisis. American Can agreed to open a second factory in St. Louis; International Harvester and Pontiac Motors collaborated on a Michigan facility. These plants opened in late 1942, but did not reach full capacity until 1943.[119] BuOrd juggled production priorities while awaiting completion of the civilian plants. Submarines expended more torpedoes than surface ships or aircraft, so the Bureau concentrated its efforts on the Mark XIV -- much to the dismay of

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[117] Blair, 98, 111; Roscoe, 261.

[118] Blair, 374; Roscoe, 261.

[119] Rowland and Boyd, 127.

pilots and destroyer commanders. American Can's Chicago plant, first to be completed, assumed production of Mark XIII torpedoes in mid-1942. This freed Newport and Alexandria for Mark XIV and XV production. BuOrd delegated further Mark XIII and XV production to civilian plants as soon as possible.[120]

The shortage placed extreme pressure on the flawed Mark XIV. Inadequate supplies dictated severe conservation measures at the tactical level. Force commanders instructed their subordinates to fire a minimum number of torpedoes at any one target. This restriction in turn accentuated the defects of the Mark XIV; attacks with one or two torpedoes depended upon the magnetic exploder for success. Sub commanders quickly discovered the Mark XIV's unreliable nature.[121] The operating forces proposed various measures for alleviating the crisis. ComSubPac Thomas Withers suggested in 1942 that Ordnance eliminate the Mark XIV's little-used low-speed feature to speed production. BuOrd intially rejected this proposal, claiming that too little time would be saved in dropping a "desirable" feature, but it eventually abandoned the low-speed setting in 1943.[122] Admiral Ralph Edwards, COMINCH King's deputy, suggested to Lockwood in Australia that submariners consider using mines, in view of the "acute" torpedo shortage.[123] Edwards proposed yet another drastic

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[120] Blandy to Horne, 30 December 1942, in ***SecNav/CNO Corr.,*** File S75, Box 510; Rowland and Boyd, 127; Roscoe, 261.

[121] See Chapter I; Roscoe, 261-262.

[122] Withers to Blandy, 2 April 1942, in ***SecNav/CNO Corr.,*** File S75, Box 510; Roscoe, 252.

[123] Edwards to Lockwood, 21 June 1942, in ***Lockwood MSS,*** Container 12.

solution in September 1942, scrapping the Mark XIV entirely in favor of the British torpedo. This idea found little support; as Edwards described Blandy's response: "[BuOrd] can't shift production now without getting so far behind that we would have to postpone the war for a while to wait for armament ..."[124] Neither of Edward's proposals was adopted, but they suggest the desperate nature of the situation.

In fact the Bureau never really solved the Mark XIV production problem. By assuming Mark XIII and XV assembly the civilian factories relieved some of the pressure, but the Mark XIV shortage ended only when operational demand declined in 1944. The submarine force preferred Westinghouse's Mark XVIII electric torpedo, and Mark XIV use fell dramatically once the fleet received the electric models. The Mark XIV's obsolescence solved the production crisis.[125]

BuOrd stubbornly believed in its own primacy concerning torpedo matters. It assigned the production of "less important" Mark XIII and Mark XV torpedoes to civilian facilities, while retaining Mark XIV production at Newport and Alexandria. The importance of the civilian plants lay in freeing Bureau factories for Mark XIV production. Ordnance officers believed that the Mark XIV was too important for civilian manufacture. The Mark XVIII represented the ultimate expression of this policy. Westinghouse received the electric project only because the Bureau intended the torpedo as a stop-gap measure. Blandy

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[124] Edwards to Lockwood, 14 September 1942, in ***Lockwood MSS,*** Container 12.

[125] See Chapter II; Roscoe, 261-262.

cautioned Lockwood not to expect that the Mark XVIII "will replace the Mark 14, as the facilities at Newport and Alexandria are not adaptable to making electric torpedoes ...."[126] Blandy clearly believed that his plants comprised the Navy's main torpedo production facilities. The submarine force could not expect *better* torpedoes from civilian manufacturers -- for these submariners had to come to BuOrd.

But submariners also needed large quantities of torpedoes, and here Blandy's plants failed. The same pride and manufacturing skill that prompted retention of Mark XIV hampered rapid large-scale production. Ordnance personnel believed that torpedoes demanded "meticulous, small-scale" manufacture by "craftsmen who knew the proper trade secrets."[127] Newport and Alexandria never became assembly-line factories and consequently never met operational demands. The Bureau's temporary solution to the production crisis, utilizing civilian facilities, exposed the fallacy of "meticulous" manufacture. Westinghouse's Mark XVIII proved more reliable and more popular than BuOrd's carefully crafted Mark XIV. Civilian factories not only produced more torpedoes faster; they also made better ones.

The torpedo problems occurred within a broader context of massive naval expansion. The Bureau, however reluctant, could not escape its inevitable reliance on civilian manufacturers given the enormous operational demands.

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[126] Blandy to Lockwood, 19 June 1943, in ***Lockwood MSS,*** Container 13.

[127] Rowland and Boyd, 91, 93.

Even bureaus accustomed to extensive civilian contractor programs initially faltered under the immense war expansion pressure. The Bureau of Ships, for example, fell behind in landing craft production because of extraordinary warship construction demands.[128] These problems, though, were largely ones of scale, requiring only sufficient civilian capacity and definite production priorities for solutions. BuOrd also had to overcome its prejudice against civilian production of high-technology ammunition before the torpedo's problems could be truly solved.

Communication

Production problems alone cannot account for the depth of operational frustrations with BuOrd. These emotions resulted from the Bureau's seeming unresponsiveness to submarine torpedo needs. The breakdown in Bureau-submarine force communications thus generated much of the controversy that surrounded this episode. The Mark XVIII's success, when contrasted with the Mark XIV's failure, demonstrates BuOrd's solution to the communication crisis.

The Mark XVIII's popularity resulted from two factors. First, its wakeless run possessed certain tactical advantages over the steam torpedo, as discussed in Chapter II. Second, the operational force actively participated in the Mark XVIII's development. Technical bugs were quickly discovered and corrected, in

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[128] Robert G. Albion, ***Makers of Naval Policy: 1798-1947*** (Annapolis: Naval Institute Press, 1980), 524-525.

contrast to the Mark XIV's slow modification. Effective communication between Westinghouse and the submarine force, once implemented, eliminated unnecessary delays in modifying the Mark XVIII. Neither BuOrd nor Westinghouse consulted operational forces during their respective design phases. Specialists in both organizations believed themselves capable of meeting basic design requirements. Indeed such specialists by definition possessed independent knowledge sufficient for torpedo design. Westinghouse and the Bureau differed in their approach to the development process, when the basic design became a usable weapon. Ordnance technicians developed the Mark XIV in secret, isolated from operational units. The Bureau believed that its structure guaranteed operational consultation. Westinghouse, on the other hand, recognized its unfamiliarity with operational needs and welcomed the submarine force's active participation.

BuOrd utilized a "line" staff system to meet operational requirements. Selected active-duty, or "line," naval officers served a two-year tour in Ordnance before returning to operations. The Bureau's wartime assistant chief, Admiral W.A. Kitts, summarized this philosophy of this system: "Our ships are designed by men who do not go to sea; and our planes are made by men who do not fly; but by godfrey, our guns are made by men who'll fire them."[129] In BuOrd's opinion the line system inherently provided effective liason with weapon users. Moreover, both Ordnance and its customers were part of the same organization;

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[129] Quoted in Albion and Connery, 46.

the Bureau believed it understood the consumer's needs. Continuing liason with operational forces during weapon development was therefore unnecessary. The Mark VI magnetic exploder project epitomized this philosophy. A submariner, Ralph Christie, directed the exploder's early development during the 1920s; the weapon therefore met operational requirements, since the submarine force had been "consulted." BuOrd saw no need for further operational involvement, particularly in light of the exploder's secrecy. The Mark VI thus disappeared from the submarine force's view, resurfacing as an operational weapon only when hostilities were imminent.

The two-year rotation system, adequate for quiet peacetime needs, broke down under wartime pressure. Operational demands altered in a matter of weeks, not years, and Ordnance personnel quickly lost touch with combat realities in the absence of first-hand operational knowledge or communications. Nearly everyone in the Navy soon recognized this problem. Blandy advised Newport in May 1942 that "it is of course incumbent upon the Bureau of Ordnance to keep the service informed concerning the expected performance of its weapons ...."[130] CincPac Admiral Nimitz requested in November 1942 that BuOrd send personnel to Pearl Harbor "to make an analysis to improve torpedo reliability and results ... An exchange of the latest information between the operating forces, the overhaul units and the shore establishments is considered

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[130] Blandy to Newport NTS, 2 May 1942, in ***BuOrd Corr.***, File S75-1(42), Box 137.

essential now."[131] Even outsiders remarked on the communication problem. A British submarine liason officer serving at Pearl Harbor in early 1943 submitted a report concerning American practices. Among other things he stressed the need for "a closer tie between the seagoing personnel and those connected with the design, manufacture and supply of torpedoes to the fleet ... there is presently no officer at Newport with modern submarine experience. [Such an officer] would undoubtedly have a stimulating effect on development and progress in the right direction."[132]

Submariners contributed to the Bureau's lack of experienced torpedo officers. The all-volunteer submarine force parted with veterans only after much prodding. Blandy chided Lockwood about this tendency:

> ... every time I try to get submarine officers who also know torpedoes, I am usually offered somebody who hasn't made good in the boats themselves, and my efforts to get a good man are usually met with the objection that he is too valuable as a commanding officer. Now you fellows are reaping the harvest ... send me a damn good officer ... and you will get results.[133]

Lockwood responded: "I can't spare them [officers] yet ... there are practically no commanding officers in this force who have made more than 3 or 4 patrols in their present ships."[134]

The liason problem eased in late 1943 and early 1944. Weary submarine officers transferred (not always voluntarily) to shore duty. These officers provided valuable insights into torpedo design gained from months of combat

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[131] Nimitz to Blandy, 14 November 1942, in ***SecNav/CNO Corr.,*** File S75, Box 510.

[132] Attachment, H.C. Maynard to Lockwood, 6 April 1943, in ***Lockwood MSS,*** Container 13.

[133] Blandy to Lockwood, 19 June 1943, in ***Lockwood MSS,*** Container 13.

[134] Lockwood to Blandy, 19 July 1943, in ***Lockwood MSS,*** Container 13.

experience.[135] Until that time, however, BuOrd-submarine communications depended on the relationship between two men, Blandy and Lockwood -- hardly an efficient method of modifying a weapon to meet operational needs.

The electric torpedo program, in contrast, utilized operational recommendations during the development phase. Westinghouse never claimed any inherent submarine expertise. The company understandably assumed that such expertise resided at Newport, and thus looked to BuOrd for guidance. But Newport concentrated on its own electric torpedo rather than assisting Westinghouse's project. The torpedo's development stalled at Newport until higher authority intervened. Following the June 1943 Inspector General's report Westinghouse shipped Mark XVIIIs directly to Lockwood in Pearl Harbor for testing. Submarines carried the torpedoes on patrol and reported back with operational data and suggestions. Westinghouse incorporated these suggestions into improved Mark XVIIIs. The electric torpedo was therefore tested under combat conditions before it entered full operational status. After initial hesitation submariners readily accepted the Mark XVIII, having participated in its development.

Westinghouse's success altered BuOrd's views on operational involvement. The Bureau now solicited information from submariners, whereas previously it never sought operational suggestions. A Westinghouse proposal in May 1944 illustrated the magnitude of this change. An enthusiastic company official

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[135] Blair, 432, 441.

informed the Bureau that "it would seem reasonable for us [Westinghouse] to secure the approval of this group [Lockwood's technicians] on all changes and new development from an operating viewpoint before proceeding with manufacture."[136] Upon receiving a copy of the letter Lockwood realized that such a plan presented major difficulties. He informed Westinghouse that "[BuOrd] does not fully concur with your idea of sending all changes to Pearl Harbor for kibitzing before incorporating them ... this could be carried to extremes and might thereby slow production. However, [BuOrd] promises that no major change will be made without giving us a chance to express an opinion."[137] The Mark XVIII's success clearly had convinced everyone of the value of operational involvement.

BuOrd's bitter experience with the Mark XIV demonstrated the failure of the old philosophy. Submariners felt the Bureau was not sufficiently "war-minded." "Talking to [BuOrd] ... appears to be a waste of time," huffed Lockwood in May 1943. "Certainly somebody needs a damn good kick in the pants."[138] Blandy fired his own shots at the submariners: "I will admit that they [torpedoes] are not perfect, but they are a damn sight closer to perfection than some of the work your [Lockwood's] people do with them."[139] Ordnance alumnus Ralph Christie termed some submariner complaints "indefinite, ill-considered and

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[136] H.V. Putman, Westinghouse, to BuOrd, 1 May 1944, in ***Lockwood MSS,*** Container 14.

[137] Lockwood to Putman, 3 June 1944, in ***Lockwood MSS,*** Container 14.

[138] Lockwood to Christie, 3 May 1943, in ***Lockwood MSS,*** Container 13.

[139] Blandy to Lockwood, 11 August 1943, in ***Lockwood MSS,*** Container 13.

ill-mannered criticism."[140] Lockwood replied: "Your Bureau training has not been wasted."[141] Such comments contributed nothing to solving the Mark XIV's problems, and simply reinforced BuOrd's image as a stuffy "Gun Club."

In fairness to the Bureau two disadvantages beyond its control affected the Mark XIV project. First, no amount of operational consultation would have corrected the magnetic exploder's vulnerability to geographical magnetic variations. BuOrd's inadvertent fault lay in developing the exploder too soon, before science fully understood geomagnetism. Extensive testing might have corrected certain problems, but others likely would have remained hidden. Second, the Bureau had developed the Mark XIV in peacetime. Operational testing at that time, even had it occurred, would not have duplicated the rigors of combat. Submariners comprehended their own wartime needs only after months of painful trial and error. BuOrd could not anticipate those needs when it developed the Mark XIV.

Coordination

BuOrd's organization easily handled pre-war torpedo activities. The Bureau delegated all coordination authority to Newport, the main torpedo design and production facility. One entity therefore housed both production and coordination. In solving the wartime production crisis, however, the Bureau

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[140] Christie to Lockwood, 23 June 1943, in ***Lockwood MSS,*** Container 13.

[141] Lockwood to Christie, 3 July 1943, in ***Lockwood MSS,*** Container 13.

created a new coordination problem. Civilian contractors required guidance in establishing production priorities, meeting operational specifications, and inspecting assembled torpedoes. No efficient organizational method existed within BuOrd for transmitting such information to the contractors. The Bureau's old system assumed that the producer (Newport) inherently understood these requirements.

Blandy recognized the potential for confusion soon after awarding the civilian contracts. He created a Central Torpedo Office (CTO) in May 1942, ostensibly to control all torpedo production activities. The CTO's two sections were supposed to provide liason with torpedo producers on manufacturing and contract issues. Blandy located the CTO at Newport in view of the station's status as the Navy's main torpedo facility.[142]

The CTO performed poorly during its first two years. Blandy's vague directives regarding the Office's purpose hampered activities. In particular he never defined the CTO's relationship to Newport. No one knew if the CTO was subordinate to BuOrd or Newport. For its part Newport virtually ignored the CTO, conducting business as though the Office did not exist. The CTO, uncertain of its position, contented itself with an observer role. The electric torpedo project glaringly exposed this problem. Westinghouse displayed enormous potential with its rapid initial design work. But the company needed help for further development, since it possessed little first-hand knowledge of

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[142] Rowland and Boyd, 128.

military requirements. Newport, concentrating on its own design, failed to provide such guidance and allowed Westinghouse to become distracted with the all-electric torpedo. The CTO, presumably established to prevent such confusion, took no part in the episode. The Mark XVIII project consequently drifted for one year.[143]

The Bureau finally clarified the CTO's role in early 1944. The Mark XVIII muddle and the Inspector General's report exposed the need for a clear coordination authority. In response Blandy's successor at BuOrd, George Hussey, placed the CTO under explicit Bureau control. The CTO became BuOrd's action agency for torpedoes, carrying out all torpedo directives "in the interest of communication." This new system in effect reduced Newport to contractor status. The CTO, not the station, now controlled most torpedo coordination functions.[144]

This reorganization occurred within a BuOrd-wide restructuring program that began in early 1941 soon after Blandy assumed command. The Bureau's century-old structure contained seventeen sections, each devoted to a single ordnance type. The Bureau's chief coordinated all activity. This unwieldy system withstood the minimal demands placed upon it during World War I. The Navy's massive 1930s expansion pushed this system to the breaking point, however. BuOrd's chief could not possibly coordinate Ordnance's increasingly complex

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[143] *Ibid.*

[144] *Ibid.*, 128-129.

activities *and* discharge his responsibilities to the Navy Department as a bureau chief. Admiral William Furlong, Blandy's predecessor, believed that reorganization within the existing framework could resolve the problem. He appointed a study board to investigate the issue. Although the board never completed its review, preliminary results indicated that Furlong's proposals were inadequate.[145]

The situation had worsened considerably by the time Blandy took over in February 1941. The Bureau's civilian contractor program required efficient coordination. Under Secretary of the Navy James Forrestal's procurement reforms emphasized bureau planning and contract coordination.[146] Blandy initiated a radical Bureau reorganization in response to this situation. He created five new divisions defined by function: Administration, Finance, Research and Development, Production, and Fleet Maintenance. Division heads assumed coordination duties for their respective areas, freeing the Bureau chief for general direction and control. Blandy established the Planning and Progress Division in September 1941 for overall planning, policy formulation and issuance of directives.[147] This reorganization closely resembled those undertaken by civilian corporations such as DuPont and Standard Oil.[148]

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[145] *Ibid.*

[146] Albion and Connery, 43-46, 63-68.

[147] Rowland and Boyd, 10-12.

[148] See Conclusion.

Newport had no real place in this structure. As a torpedo factory it belonged in Production; as a torpedo design center it belonged in Research and Design; as a modification center it belonged in Fleet Maintenance. No one Bureau division controlled all of Newport's activities, and as a result the station received minimal Bureau direction. BuOrd apparently recognized Newport's anomolous situation, for the Bureau created a new entity, the CTO, to coordinate torpedo activity. The CTO's initial failure resulted in part from its own ambiguous position. Lacking any clear purpose the CTO tacitly accepted Newport's traditional dominance. But as the station's production and development importance dwindled its continued dominance of torpedo matters made less and less organizational sense. This awkward situation eventually forced BuOrd to assign the CTO all torpedo coordination responsibility. With this action Newport's last major function disappeared. Civilian contractors had assumed torpedo design, development and production. The CTO now coordinated all torpedo-related activity. BuOrd had unintentionally removed itself from the torpedo production business. The Newport station, now irrelevant, closed shortly after the end of World War II.

Conclusion - BuOrd's Changing Strategy

BuOrd's divestiture of its torpedo design and production responsibilities paralleled larger trends within the military. Complex technology and production requirements overwhelmed the military's internal manufacturing capability. The mobilization of civilian scientific and technical resources constituted one of the most important developments of World War II. Decentralized design and production demanded centralized control, and the government therefore established two national coordination agencies: the War Production Board and the Office of Scientific Research and Development. The War Production Board, created in January 1942, grew out of two preceding units, the Presidential Advisory Commission on Mobilization and the Office of Production Management. Both organizations lacked sufficient authority to coordinate industrial production, which prompted the creation of a more powerful WPB. In the scientific arena the Office of Scientific Research and Development similarly

replaced a weaker National Defense Research Committee. The demands of war thus altered national organizations as well as the Bureau of Ordnance.[149]

The Navy, while welcoming the vastly expanded defense industry, never exhibited great enthusiasm for analogous growth in civilian control of military matters. COMINCH King waged a long and ultimately unsuccessful fight to retain procurement authority within his office. The Navy's material bureaus accepted the need for civilian production but opposed extensive civilian involvement in defense research. The bureaus believed that applied technological research belonged in the military, leaving fundamental scientific research to the civilians. This view did not survive the war -- BuOrd's experience with torpedoes illustrates one organization's struggle to adjust.[150]

Three specific historical analogies illuminate the Bureau's approach to this dilemma: the U.S. Army's General Staff reforms of 1899-1917; the British munitions crisis of 1914-1916; and the development of decentralized corporate structures in American business during the 1920s.

The U.S. Army's nineteenth-century bureau system resembled the Navy's structure in many ways. Technical and administrative bureaus controlled virtually all non-operational Army activity. These bureaus nominally reported to the civilian Secretary of War, but in reality each bureau chief presided over

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[149] Robert H. Connery, ***The Navy and the Industrial Mobilization in World War II*** (Princeton: Princeton University Press, 1951), 79-81, 99, 104, 138; Albion, 418-419.

[150] Rowland, 23-25; Albion and Connery, 96-103.

his own fiefdom without much central control.[151] The Army bureau system cracked under the strain of the 1898-1899 Spanish-American War. The rapid influx of recruits swamped Army training facilities throughout the southern U.S. Logistical support completely collapsed. Supply shortages of every imaginable description plagued the growing force. The Cuban expeditionary force never received essential equipment, which sat on wharves in Tampa for lack of a coordinated transport system. Much of the problem stemmed from an absence of planning. The Army lacked a central command authority or planning agency. The bureaus and operational forces worked in isolation from one another, with an inevitable confusion of purposes. With no contingency plans the Army essentially improvised the entire war effort.[152]

Secretary of War Elihu Root, recognizing this deficiency, created the General Staff in 1903. Root intended for the Chief of the General Staff to command both operational and administrative activities, although the Staff's primary function was planning. Many Army officers opposed this centralized system, particularly the bureau chiefs who ignored the Staff's command function. The bureaus dominated Army affairs for nearly two more decades, until Secretary Newton Baker and General Peyton March finally established the supremacy of the Chief-of-Staff in 1917.[153]

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[151] Russell F. Weigley, ***History of the United States Army*** (New York: Macmillan, 1967), 288.

[152] Maurice Matloff, ed., ***American Military History*** (Washington, D.C.: U.S. Government Printing Office, 1973), 322-335; Weigley, 298-306.

[153] Matloff, 346-350, 379-380; Weigley, 314-325, 379-380.

BuOrd's experience with torpedoes, like the Army's disaster in 1898, demonstrated the importance of operational-administrative interaction. The Bureau's exclusion of operational forces hindered torpedo development. Once BuOrd accepted operational participation such development proceeded smoothly. In addition, Ordnance officers never anticipated the massive demand for torpedoes. More extensive consultation with operational commanders may have prevented this difficulty, although many naval leaders did not foresee the submarine's importance. The torpedo episode also suggested the importance of central command over both operations and administration. The Navy traditionally resisted such centralized control, but the 1942 consolidation of the COMINCH and CNO positions proved vital in the Navy's wartime success. Admiral King's directives prodded a reluctant BuOrd into action on several crucial occasions.

The British "Shell Scandal" of 1914-1916 provides a second historical analogy for the Bureau's experiences. The War Office's Ordnance Department controlled all munitions production for the pre-World War I Royal Army. Government arsenals, along with several private manufacturers, supplied the Army's ammunition. The Ordnance Department coordinated production and established ammunition requirements. Once Britain entered the European war Royal Army guns consumed shells on an unprecedented scale. Secretary of State for War Lord Kitchener noted the shockingly low ammunition supply after only two months of fighting. No one in the government or the military had expected

such a consumption rate, and there seemed no end in sight. The crisis forced the government to revamp the existing munitions system. The overwhelmed Ordnance Department insisted on retaining cumbersome peacetime procurement structures that could not meet the Army's enormous needs. In response to severe political pressure the government created a new Ministry of Munitions under David Lloyd George. This ministry streamlined contract procedures, signed up new production plants, and eliminated much of the needless bureaucracy that had paralyzed the Ordnance Department. By 1916 these measures had eased the ammunition shortage.[154]

Similarly, unexpected torpedo expenditure swamped the U.S. Navy's Bureau of Ordnance. It too sought new production sources. More importantly, BuOrd's existing coordination agency failed in its role, as had the British Ordnance Department. Newport concentrated on production rather than coordination, leaving the civilian facilities without central guidance. Like the British, BuOrd created a new coordination agency, the CTO. This agency did not enjoy immediate success, but by 1944 it had assumed Newport's old coordination duties.

The British experience also paralleled the Bureau's in another area. As R.J.Q. Adams writes, the Ordnance Department's officers exhibited "a failure of imagination, an inability to conceive of the problem which faced them, outside the narrow framework of tradition and precedent to which they bound

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[154] R.J.Q. Adams, ***Arms and the Wizard*** (College Station: Texas A & M University Press, 1978), *passim.*

themselves."[155] This statement describes BuOrd as well. The Bureau, and the Newport station, never reconciled the torpedo's conflicting requirements of complex technology and large-scale production. These officers viewed quantity and quality as mutually exclusive, rather than as two facets of a single problem. BuOrd's facilities failed because they concentrated on only one issue: quality. Civilian contractors, operating in a competitive market environment, addressed quantity and quality simultaneously. In so doing they rendered the Bureau's production philosophy obsolete.

American business history yields a third important analogy. Several large corporations, for diverse reasons, created decentralized divisional structures during the 1920s. Blandy's reorganization of BuOrd closely resembled these structures. Standard Oil's experience sheds particular light on the torpedo problem. Standard Oil expanded rapidly during the 1915-1925 period. With each growth spurt the company added new administrative entities until lines of authority and communication became thoroughly entangled. Petroleum demand dropped in 1925, and the company's confused structure hampered the response of management. Standard met this crisis by consolidating various units into specific useful structures -- much as Blandy did in 1941. Ultimately Standard created a central coordinating entity devoid of production responsibility. Standard's reorganization method is particularly important for this analysis. Alfred Chandler demonstrates that Standard proceeded in an *ad hoc* manner

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[155] *Ibid.*, 14.

with little awareness of long-term organizational goals. Company executives conceived of their problems as a series of immediate crises, although the cumulative effect of their solutions created the decentralized structure.[156]

Similarly, BuOrd's structural changes occurred as *ad hoc* solutions to short-term problems. The Bureau never intended to eliminate its own production and design center at Newport. Civilian contractors and the CTO solved immediate problems such as torpedo supply shortages and developmental delays, but they also eroded Newport's various responsibilities. The Bureau, like Standard, finally divested itself of all production responsibility. BuOrd's structure failed to meet its strategy, to use Chandler's terminology. As defined in the official history, its responsibilities were "the design, production, issue, and maintenance of [naval] armament."[157] Applied to torpedoes, the Bureau's existing structure could not meet any of these responsibilities. When BuOrd's strategy expanded to include coordination of civilian plants, its structure failed again. The Bureau chose to meet the challenge by changing its strategy. Temporary measures in fact eliminated BuOrd's design and production responsibilities, while creating a new coordination role. By seeking outside solutions the Bureau of Ordnance rendered its existing structure (Newport) irrelevant. The structure never changed -- it simply disappeared.

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[156] Alfred D. Chandler, Jr., ***Strategy and Structure*** (Cambridge: M.I.T. Press, 1984), 163-224.

[157] Rowland and Boyd, 1.

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Appendix A. Glossary of Terms

BuOrd -- U.S. Navy Bureau of Ordnance

CincPac -- Commander-in-Chief, Pacific Fleet

CNO -- Chief of Naval Operations

COMINCH -- Commander-in-Chief, U.S. Fleet

ComSubPac -- Commander, Submarines, Pacific (Pearl Harbor)

ComSubSoWesPac -- Commander, Submarines, Southwest Pacific (Australia)

CTO -- Central Torpedo Office

Mark II -- electric torpedo prototype

Mark VI -- magnetic exploder for Mark XIV torpedo

Mark XIII -- air-launched steam torpedo

Mark XIV -- submarine-launched steam torpedo

Mark XV -- surface-launched steam torpedo

Mark XVIII -- submarine-launched electric torpedo

Vita

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