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EDITOR'S COMMENTS

The first thing to notice about this first issue of 1997 is the cover, with the first appearance of the author's name alongside the title of his contribution. We hope it helps in encouraging the reader to follow his interests on first picking up the magazine from his mail box. This small change is actually a reflection of some of the recommendations being formed, incidental to their main considerations, by the Task Force for Future Directions commissioned by the League's President last spring; and we thank that group for including in their efforts some considerations for improving this magazine.

While no big changes are being contemplated for **THE SUBMARINE REVIEW**, such as increasing the size or going to a glossy format, you will be able to notice other minor changes as the new year progresses and we try to stay up with the times in style as well as substance.

The leading feature of this issue is an excerpt about the submarine construction program from this year's Defense Authorization Act. The four-year/four-*prototype* submarine shipbuilding plan formulated last year was retained intact. However, differences between the Navy's request and action by both the House and Senate still indicate less agreement on the matter than would be desirable at this low stage in the nation's production of front line submarines. All League members therefore are encouraged to read this bit of legislation. As with all such documents it is a bit murky in phrasing, but we did try to cut out some of the more obtuse parts.

In his President's Column, Vice Admiral Dan Cooper comments on the two sets of closely related articles in this issue. One consists of three pieces about the Submarine School: the suggestion by a recent student, some history by a former commander of the School, and a response by the current CO, SUBSCOL. All bring up good points which rate discussion, and as Dan observes, since a number of us have gone through Sub School in one form or another, there are many who should be ready to offer opinions on what Rear Admiral Jerry Holland characterizes as an *efficiency vs. enculturation* argument. Let's hear it from both young and old. It would be particularly great to have some basic enlisted school graduates comment on the comparative benefits of a WWII "Spritz's Navy"-type course, the way it was in the mid-Cold War

period, and the way it is now.

A different rationale lies behind publishing Mr. Norman Polmar's recommendation for converting the 688s going out of commission to *CSSGNs* along with Admiral Chiles' recommendation for the like conversion of the four Tridents scheduled to leave service. The point is—there is basic agreement on the need and feasibility of a *Submarine Arsenal Ship*; and that is too important a point to let pass the obvious strength of these combined recommendations.

There are obvious advantages to both courses of action, probably to the extent they are not competing options at all. It is also true that ships of both classes are too good to throw away, particularly in light of all we hear about modularization for specific roles. Therefore we ought to hear more about the need and the feasibility of the *Submarine Arsenal Ship*. Also perhaps we can discuss the possibility of special-mission conversions being counted in excess of that Bottom Up Review figure of 45-55 SSNs. **THE SUBMARINE REVIEW** stands ready to publish on this subject—all we need is knowledgeable, germane commentary from our more-than-capable membership.

There is another series starting in this issue of the **REVIEW** which deserves comment because it comes as a gift for our readers from an old friend. Commander Richard Compton-Hall, one of the Royal Navy's experts on their submarine history, is preparing a number of articles about RN submariners who won their nation's highest award, the Victoria Cross. The tales of their deeds of undersea daring and accomplishments again prove the old adage that skill, audacity and exuberance are awfully useful in our business.

Jim Hay

FROM THE PRESIDENT

This edition of **THE SUBMARINE REVIEW** has several very interesting articles but two *series* are certainly thought-provoking.

In March 1996, shortly before his death, the CNO, Admiral Mike Boorda, personally requested that Norman Polmar submit his thoughts on a possible submarine arsenal ship. The response, dated 3 April, discusses a *CSSGN* utilizing a Los Angeles (688)

class converted to carry the missiles. We are indebted to Norman for sharing with us the information about Admiral Boorda's request, and for his very cogent recommendations. The subject of a U.S. *SSGN* or *CSSGN* has been discussed within the submarine community and it is very heartening to know that the logic is appreciated at high levels. Admiral Hank Chiles, USN(Ret.), the first naval officer to serve as the Commander-in-Chief, U.S. Strategic Command, was asked to discuss his thoughts on the subject. Both articles should stimulate discussion.

A second *series* discusses Submarine School. Lieutenant Thompson has authored a thoughtful article, SubScol 2000: A Multi-tiered Approach to Training for the Next Century. To lend some historical perspective and to explain the reasons for many of the decisions leading to the present structure and curriculum, Rear Admiral Jerry Holland, USN(Ret.), and Captain John Brandes, a past and the present Commanding Officer of the Naval Submarine School, have been kind enough to contribute. Since all submariners have *been there...* I expect every view expressed in the three articles will find its share of both pro and con opinions.

In the October **REVIEW**, I quoted the letter which Admiral DeMars had written concerning the extremely successful SEAWOLF propulsion trials (ALFA trials). Let there be no doubt that SSN 21 exceeded every prediction for all attributes tested. In the subsequent BRAVO trial, again all expectations were met or exceeded. During those second trails, as the CO explains it, "The *hubcap* came off." (The fiberglass fairing around the wide aperture array (WAA) on one side aft separated from the ship (due primarily to *fatigue failure of the studs*.)) Interestingly, even after the fairing had separated, the WAA continued to work well at the highest speeds. I wanted to point this out to ensure *truth in advertising*.

A great deal of study has followed to ensure any redesign of the structure of the fairing is absolutely correct and the improvements properly made.

Finally, plans for our Corporate Benefactors Day(s) in February, and for the Submarine Technology Symposium sponsored jointly by The Johns Hopkins University Applied Physics Laboratory and the Naval Submarine League in May, are proceeding very well.

Dan Cooper

AN EXCERPT FROM THE NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 1997

Subtitle C—Navy Programs
Legislative Provisions Adopted

Nuclear Attack Submarine Programs (sec. 121)

The budget request included $296.2 million of advance construction and procurement funding for a fiscal year 1998 nuclear attack submarine and $699.1 million for procurement of the third Seawolf class submarine, SSN 23. Research and development funding in the budget request for the fiscal year 1998 submarine was initially reported as $489.4 million but was subsequently corrected to $487.6 million. The budget request included no advance construction and procurement funding for the procurement of a second nuclear attack submarine in fiscal year 1999, as called for in the National Defense Authorization Act for Fiscal Year 1996 *[Editor's Note: See THE SUBMARINE REVIEW, April 1996]* and the Navy's six year shipbuilding plan that was submitted in conjunction with the budget request.

The House bill contained a provision... (for) ...$504.0 million for advance construction and procurement for a fiscal year 1999 nuclear attack submarine that would be built at Newport News Shipbuilding.

The House bill would also authorize an increase of $188.0 million to pursue...advance submarine technology initiatives that were identified in Report on Nuclear Attack Submarine Procurement and Submarine Technology, submitted to Congress by the Secretary of Defense on March 26, 1997. The added funds would also be used for design initiatives intended to ensure that new technology is incorporated into the design of four developmental submarines that would begin construction at the rate of one per year during the period fiscal year 1998 to fiscal year 2001 and on serial production submarines that would not be authorized until fiscal year 2003. It would also revise the basis of the competition for serial production so that it would be based on best value vice price.

Additionally, the House provision would direct the Department of Defense to implement specified acquisition simplification

strategies in order to expedite the fielding of more capable, less expensive nuclear attack submarines.

The Senate amendment *(to the House bill)* contained a provision (sec. 123) that would authorize $804.1 million for procurement of SSN 23, $296.2 million of advance construction and procurement funding for a fiscal year 1998 nuclear attack submarine that would be built at Electric Boat, and $701.0 million for advance construction and procurement for a fiscal year 1999 nuclear attack submarine that would be built at Newport News Shipbuilding. This authorization would satisfy all procurement funding requirements for SSN 23 and all advance construction and procurement funding requirements for the fiscal year 1998 and fiscal year 1999 submarines.

The Senate amendment would increase funding for advance submarine technology by $1000.0 million to pursue... advance submarine technology initiatives. The Senate amendment would also place limitations, similar in intent if not in detail, on the expenditure of fiscal year 1997 procurement funds until the Secretary of Defense and the Under Secretary of Defense for Acquisition and Technology take certain steps to comply with section 131 of the National Defense Authorization act for Fiscal Year 1996.

The conferees agreed to authorize $699.1 million for procurement of SSN 23, $296.2 million of advance construction and procurement funding for a fiscal year 1998 nuclear attack submarine that will be built at Electric Boat, and $701.0 million for advance construction and procurement for a fiscal year 1999 nuclear attack submarine that will be built at Newport News Shipbuilding.

For research and development the conference agreement:

(1) authorizes $60.0 million to mature and transition the core technologies identified in the Secretary of Defense's Report on Nuclear Attack Submarine Procurement and Submarine Technology with emphasis on hydrodynamics, alternative sail designs, advanced arrays, electric drive, external weapons, and active controls and mounts;

(2) directs that of this $60.0 million, $20.0 million is to be equally divided between Electric Boat and Newport News to ensure the two shipbuilders are principal participants in the process of including new technologies in the design of future attack submarines. The conferees intend that the shipbuilders be allowed

access to naval intelligence data and that there be continuing interaction among the shipyards, the Navy laboratories, and the Defense Advanced Research Projects Agency; ... *and* ...

(7) affirms that the serial production of future nuclear attack submarines to follow the four developmental submarines will occur not earlier than fiscal year 2002 and only after a competition based on price.

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REMINDER
1997 SYMPOSIA

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SUBMARINE TECHNOLOGY SYMPOSIUM

- **May 14 thru 16, 1997**
- **Secret Clearance Required**
- **Johns Hopkins University Applied Physics Lab**
- **Invitation only:** Contact Pat Dobes
  (703) 256-1514

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NSL FIFTEENTH ANNUAL SYMPOSIUM

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MARK YOUR CALENDARS AND SAVE THESE DATES!!

THE SUBMARINE ARSENAL SHIP

The Chief of Naval Operations, Admiral Mike Boorda, on 21 March 1996, asked Norman Polmar for his opinions on the concept of a submarine arsenal ship. The following is from Mr. Polmar's memorandum to Admiral Boorda, dated 3 April 1996, which was made available to ***THE SUBMARINE REVIEW*** *after Admiral Boorda's death. Mr. Polmar served on the ARPA study panel that led to the current Navy-ARPA project for developing such an arsenal ship.*

Memorandum for Admiral Boorda

Subject: Submarine Strike Ship (CSSGN)

Dear Admiral,

Further to our discussion of modifying SSN 688s to an arsenal or strike ship configuration, I would submit the following:

1. Concept. The highly promising arsenal or strike ship project should consider the value of a submarine variant—in essence an underwater cruiser (CSSGN).

There appear to be six advantages in pursuing the CSSGN concept:

(1) stealth features of a nuclear-propelled submarine, i.e., low visibility—permitting unobserved deployment if desired—and high survivability.

(2) self-contained platform, requiring no escort or support functions from other ships.

(3) rapid response time (i.e., high submerged SOA regardless of surface weather conditions).

(4) use of existing Los Angeles (SSN 688) hulls that have 10+ years of service remaining.

(5) employ existing systems and technologies with high demonstrated reliability, i.e., *zero risk.*

(6) provide additional work for both submarine construction yards (Electric Boat and Newport News Shipbuilding) and, if desired, a submarine overhaul yard (Portsmouth Naval Shipyard).

2. Proposal. The Navy should undertake an objective analysis of the CSSGN concept.

3. Background. The basis of the CSSGN concept is to insert a hull section containing Vertical Launching Systems (VLS) in an SSN 688 submarine. The concept of converting submarines to different roles through the insertion of major hull sections has been used by the U.S. Navy for more than a half century.

For example, at the end of World War II several diesel-electric submarines were converted to the radar picket (SSR) role by the insertion of 30 foot hull sections and other changes. The best known U.S. submarine *conversions* were the construction of the SKIPJACK (SSN 585) design with the addition of a 130 foot section to produce the first U.S. ballistic missile submarines of the GEORGE WASHINGTON (SSN 598) class. More recently, the attack submarine PARCHE (SSN 683) was converted in 1987-1991 to a deep sea search/recovery submarine with the addition of a 100 foot section.

The Soviet-Russian Navy also made major modifications to nuclear-propelled submarines. For example, three of their early Polaris-type submarines of the Yankee (Project 667A) class have been reconfigured as cruise missile submarines with a new, elongated midships section inserted. These submarines can each carry some 40 of the SS-N-21 land-attack missile, similar to the U.S. Tomahawk (the Russian designation is RKV-500 Granat).

The SSN 688 design is capable of accommodating the conversion because of its large size and powerful nuclear propulsion plant. For example, compared to the Skipjack design that was converted to the Polaris configuration, the SSN 688 has twice the shaft horsepower available.

From a technical viewpoint, the conversion of the SSN 688 to a cruise missile configuration would involve no technical risk; the only performance degradation would be the loss of a couple of knots in speed. (Note that the SSN 688 is the fastest U.S. submarine now in service with an underwater speed of 30+ knots.)

4. Discussion. The U.S. submarine community has proposed the conversion of some or all of the four Trident SSBNs that will be retired from the strategic role to an arsenal ship configuration. This proposal is not recommended because of the large size of the Trident submarines and hence higher conversion costs, the need to remove Trident fire control systems, etc.

Also, the relatively small support base for maintaining 10 to 14 Trident SSBNs after the year 2000 in comparison to the support

base for some 40 (or more) SSN 688s make it more efficient to support strike ships based on the attack submarine.

The proposed CSSGN would consist of a basic SSN 688 submarine with the following modifications:

- reconfigure the *front end* of the SSN 688 to provide for 12 VLS (as in Improved SSN 688s)
- insert a midships section of approximately 100 feet fitted with approximately 100 to 120 VLS tubes
- provide appropriate fire control equipment

The SSN 688 would retain four torpedo tubes (amidships Mk 67), and full sonar and torpedo fire control capability. The current stowage of 20+ torpedoes, however, may be reduced in favor of additional Tomahawk missiles (torpedo tube launched) or some stowage space may have to be reconfigured for fire control equipment. (In addition, four torpedoes/missiles can be kept in the tubes.)

There would be few if any additional personnel required in the reconfiguration of an SSN 688 to the CSSGN role.

It is envisioned that the VLS sections (bow and amidships) would be fabricated at Electric Boat or Newport News Shipbuilding (both yards having built SSN 688s); installation could be undertaken at those yards or at the Portsmouth Naval Shipyard, which currently overhauls SSN 688s.

Norman Polmar

TRIDENT SSGN

by ADM Hank Chiles, USN(Ret.)

Admiral Chiles is a former CINCSTRAT and COMSUBLANT.

Instead of that other publication's "Nobody Asked Me, But..."[1] column, this article falls into the "Somebody Asked Me, So..."[2] category. Actually, I'm delighted to comment on the Arsenal Ship concept, in general, and Norman's letter to Mike Boorda, in particular. The surface community vision of embodying submarine-like principles in an honest to goodness warship design is overdue on three counts: stealth, crew size and firepower.

The submarine community has touted the advantages of stealth for my entire career: too much perhaps. The one stealth surface craft built 12 years ago was strictly for R&D. Current platforms are likely to be far too visible to the high speed, low radar cross-section, low emission weapons of the future. We need to push the technology envelope to reduce visibility with a surface warship that will demonstrate these advantages to the surface community and stimulate additional thought.

Study of much smaller crews on surface warships is wise. TICONDEROGA (CG of about 8000-9000 tons) and ARLEIGH BURKE (DDG of roughly the same size) have crews of 400 and 340 people, respectively. Of course, the 688s of comparable size have crews of about 140 people. Similarly, surface ships of rough equivalence to Trident have much larger crews (for example, Iwo Jima class LPH with 680 vice 175 on Trident). Even with two crews on SSBNs crew size is one of the principal reasons submarines are the least expensive ships in the Navy (for their size) to operate. I don't know if the Arsenal Ship will make its goal of 50 people for the crew, and I'm not sure it matters. The process of rigorous examination of how to get along with far fewer crew members is clearly appropriate provided they are able to safely operate the ship, fight our battles, and handle casualties.

We've had massive firepower in our Polaris/Poseidon/Trident

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[1] Naval Institute Proceedings.

[2] Dan Cooper, Jim Hay.

fleet for three and a half decades. Truthfully, today's surface fleet has many missile tubes (22 Ticonderoga class cruisers with 122 missiles each; plus we're building towards a force of 56 Arleigh Burke destroyers with 90 missiles each). Arsenal Ships could have as many as 800 missiles on one ship. All these ships can send a forceful message.

Having made a few observations, I sincerely believe we (submariners) should applaud the effort of our surface brethren to fundamentally rethink their 21st century needs and incorporate some key submarine attributes into a unique design. They will grow in the process and so should we.

With that background, consider Norman Polmar's discussion of a submarine strike ship. Clearly, the idea of a true submarine complement to the Arsenal Ship makes sense. Five of the six advantages cited by Norman appear valid. Unfortunately, he's got the wrong submarine. It seems to me that it would be wiser to convert the Tridents that will standdown during implementation of START II (assuming there is a START II) for the following reasons:

- Los Angeles class ships are basically a much older design; with no space/weight margin as currently configured. It's unclear how that problem could be alleviated with the addition of the new missile compartment section. There is plenty of margin in Trident.
- The Trident hulls will probably be certified for longer than a 30 year life giving roughly 20 years for service in this new role. Modifying 688s for only 10-25 years of service certainly does not appear cost effective. No plan exists for 688 life extension.
- Trident is a quieter ship; enough said. Stealth counts.
- Trident is slower than Los Angeles, but the ship can still get there in time to make a difference. If the modifications were feasible to 688s, the ship would probably be slowed by much more than the couple of knots postulated by Norman.
- Trident offers the advantage of a spacious multi-mission platform. Los Angeles class ships in this configuration could be multi-mission also, but Trident facilitates stowage of considerable special warfare equipment, the potential for carrying large numbers of mines, remotely piloted vehicles as well as off-hull, submerged vehicles and a large kit of command, control, intelligence-related components. Trident SSGN or Trident SSN could easily be utilized as part of the screen for the Arsenal Ship and

configured for shallow water. Los Angeles class ships are superb, but unlikely to have the space we'll need for the submarine new technologies of the next century.

- Cost to convert the Lost Angeles class ship to this *enhanced strike* role is likely to be the same order of magnitude as for Trident. The 688 buoyancy must be solved. If there's a waiver of START II tube counting requirements or the modification is permitted without Trident missile tube removal, the Trident SSGN modifications conceivably could be cheaper.

- The Trident support base is not considered a drawback. Yes, there are two Trident bases (and probably only a few attack submarine bases) envisioned in 2000, but today we periodically work on Tridents at our SSN homeports and elsewhere without detriment. Also, from a support perspective we intend to refuel the later Tridents and the SSGN conversion postulated here would assist in preserving a key industrial base.

On balance then, I favor converting the four Tridents which could be lost with START II to Trident SSGNs. It makes better warfighting and financial sense. This concept deserves rigorous analysis. ■

DARING THE DARDANELLES
December 1914
by CDR Richard Compton-Hall, MBE, RN(Ret.)

The Victoria Cross, Britain's highest military award, has been won by a total of 14 Royal Navy submariners in both world wars. The VC, a bronze cross simply inscribed "For Valour", compares with the U.S. Congressional Medal of Honor. This is Part I of an eight part series on British submariner VCs.

The Gallipoli Campaign, conducted by British, Australian, New Zealand and French forces from the end of 1914 to the beginning of 1916, was fought on and around the Turkish peninsular bounded by the Dardanelles Strait on the east and the Aegean Sea on the west.

As perceived by Winston Churchill, First Lord of the Admiralty, the object was to open an Allied seaway to Russia from the Eastern Mediterranean through the guarded and mined Dardanelles channel winding northeastwards to the lake-like Sea of Marmara, and thence up through the slim Bosporus neck of water, bordered by the Turkish capital Constantinople, to the great land-girt Black Sea and Russia. This route, hitherto inaccessible to the Allies, would be used to supply and assist Russia in fighting the central European powers; to dispose of Turkey as an ally if Germany; and thereby to relieve a major threat to Egypt and the Suez Canal.

However (and remembering that no air reconnaissance was yet available) the Dardanelles passage was by no means plain to view from where the Allied fleet was gathered at the Mediterranean mouth by the end of 1914. Somebody had to look round the first corner to see what was there, and gauge the defences. The blockading submarines—three British and three French—were the answer for that. They were nominally helping to prevent the re-emergence of the German battleship GOEBEN and cruiser BRESLAU which had escaped the Royal Navy's Mediterranean fleet and sped to Turkey, but the youthful submariners would welcome more immediate excitement.

The three British boats were of the B class, designed for no more than coastal defence; and they were already obsolescent, albeit only nine years old, such was the speed of warship technology. They had recently been transferred eastwards from Malta whither they had deployed, long before the outbreak of hostilities,

some 2000 miles from England: they clattered along, creditably under their own power, with single 600 bhp 16 cylinder Wolseley-Vickers gasoline engines, at an economical eight knots. No modern submersibles were yet available outside home waters.

The potential performance of HMS B9, B10 and B11 was undeniably limited, nor could it be claimed that their crews, each comprising two officers and thirteen men, were truly ready for war: practice-attacks in peacetime were scarcely encouraged for early *submarine boats* because there had been too many collisions and accidents since their arrival in 1901. Exercises were seldom realistic; and the results were apt to be fudged by submariners and destroyer men alike. Indeed, even basic submarining was still quite a novel art, more dependent on individual skills or sheer knack than on consistent service-wide training. The Royal Navy's Submarine Service was, after all, only just reaching its teens when called to battle.

Thus practically any warlike operation, especially one so far from a friendly coastline, was bound to be adventurous—but adventure was very much how submarine officers thought about fighting in 1914. War consisted of going on *jolly good stunts* (the enemy, by contrast, perpetrated *spasms*); crews were *on the grin* when they sailed for patrol while those who stayed behind were *poor brutes* to be pitied; and the important thing, when unforeseen dangers and difficulties arose, was not to be *a pompous ass*.

Lieutenant Commander G.H. Pownall was the Royal Navy's Senior Submarine Officer in the Dardanelles arena; and he naturally determined that the British half of the Franco-British submarine flotilla should outdo the French, with whom a healthy (sic) rivalry existed. When one of the Frenchmen poked his nose past Sedd-el-Bahr on the northwestern shore of the entrance, Lieutenant Norman Douglas Holbrook, 26 years old and commanding HMS B11, capped the feat by (somewhat fatuously) chasing a Turkish torpedo gunboat a few miles beyond Kum Kale at the southeastern point.

Minor *stunts* like these did nothing except dispel boredom; but they did demonstrate that the submarines were in working order. They also suggested that the straits, overlooked by numerous guns, searchlights and torpedo tubes, and thickly sewn with mines—an assembly which could well make the passage too risky for surface vessels—might be penetrated underwater if only the grave danger of mines could be avoided. Accordingly Pownall sketched a

design for submarine mine-guards to push mine moorings aside.

Given these guards, permission was soon forthcoming from Admiral Carden in the combined fleet flagship for a submerged submarine to test the device on the Turkish minefield which sealed the strait with five successive parallel lines (373 deadly eggs in all) from four miles short of the well-named Narrows (the ancient Hellespont at the middle of an S-bend) and up to a mile or so short of their sluicing commencement abreast Chanak (Canakkale), a fishing port on the Asiatic side. If the field was navigated successfully it should be possible to gauge the worth and practicality of further ventures.

Of course, all the British and French captains were keen to be first. But Holbrook won the competition when he told Pownall: "It will be a pretty heavy strain on the battery (against a current varying from two to four knots) and B9 or B10 couldn't possibly look at it with their old boxes. We got a new set of cells (159 for the complete battery) at Malta recently and B11 is the only boat that can do it. I'm all for having a try."

It was a bold statement—possibly brash—because there is no evidence that the proposition was evaluated properly (the *pompous ass* syndrome coming into play, perhaps), but Holbrook and his Second Captain (Exec) Lieutenant Sydney Winn surely perused the plot with care when they got down to business.

The mines, making allowance for current, lay at depths between 16 and 30 feet where they would catch big surface ships. The normal maximum diving depth for a B-boat was 50 feet (measured at the surface waterline) consistent with Vickers' shipyard guarantee of safety down to 100 feet. B11 could therefore dive below danger; but unfortunately the 16-30 feet mine-bracket was just where she would need to be when using the periscope for taking fixes—obviously a frequent necessity on this trip. Moreover there was a severe trimming hazard which was not precisely known: close to the surface the water was thought to be nearly fresh due to rivers running into the strait; but at some depth, estimated at 8-10 fathoms (48-60 feet), it was salt or brackish and more dense. Passing from one stratum to another would create havoc with the delicate trim, and a 316 ton B-boat's pumping system—supplied by two bilge pumps of 25 hp and 15 hp respectively—was feeble. The suspicion of a deep counter-current added another complication. Local legend related that the Sultan, presumably on a tour of his southern estates, tired of one of his

wives, put her in a sack and dumped her upstream in the strait. It was a recognised and definitive method of disposal from palaces at Constantinople and elsewhere in the Ottoman Empire; but here in the Dardanelles, to the Sultan's dismay and irritation, the package returned of its own accord to sender. Such is the stuff of Naval Intelligence...

With her new battery B11 was capable of 6.5 knots submerged (top speed) for three-and-a-half hours (22 miles) or 4.5 knots for 50 miles. If forced to surface, in the face of 11 well armed Turkish forts with 72 guns in all, the petrol engine might be coaxed to drive the five foot three-bladed propellor at 400 rpm, giving 12 knots—but there could be no question of recharging the battery which was a slow process even when, with no energy needed for propulsion, the maximum 143 volts could be applied. Meanwhile, depth-keeping was never easy; it depended mainly on the after hand-cranked rod-rack-and pinion diving rudders which were supplemented by hydroplanes at the bows: the latter required 23 turns of a control room handwheel to put them from hard-a-rise to hard-a-dive, that is, through 50 degrees. Planesmen, the coxswain and second coxswain at diving stations, worked very hard indeed for their submarine pay.

The magnitude of the task which lay ahead for B11 is apparent. In traditional submariner's terms the escapade was going to be fraught with interest.

A jumping wire and streamliners for the hydroplanes forward were extemporised on board the ad hoc tender BLENHEIM at the island of Tenedos. A heavy sinker, suspended by a wire, was then hung out underwater from her main derrick: B11 charged this several times and each time the wire was pushed aside without tugging at the derrick. Good enough: Holbrook optimistically convinced himself that if the submarine fell foul of a mine-mooring the mine would not be pulled down to strike the hull.

Early in the morning of Sunday, 13 December 1914 B11 slipped and got underway on her main engine. By 0415 she was three miles from the gateway to the Dardanelles. Just before dawn Sydney Winn trimmed the boat and dived. Nobody on board had any doubts about what the submarine was undertaking; every man had written a letter home and left it in the support ship—only to be posted if B11 failed to return.

Alone in the tiny conning tower, Holbrook watched through the scuttles: the grey light of pre-dawn gradually shaded to dark green

as the boat slid below the surface. The shore was just distinguishable through the rudimentary periscope which had a fixed forward-looking ocular box: this, while allowing a viewer to remain stationary in the confined space while the periscope was trained (either by a geared handwheel or a one-half hp motor), caused the image to rotate from a normal horizon right ahead to upside down astern—a great help, captains averred, to judging the relative bearing of a target. It was theoretically possible to raise and lower the instrument by means of a chain drive from a two hp motor, but it is probable that the periscope was kept permanently up in action: it was easier for the submarine itself to change depth to expose or dip the stick. In any event, though, a considerable footage of the four inch periscope was bound to be exposed for quite long periods.

On this occasion the lens seemed to be shaking more than usual when the boat dived, and when Holbrook climbed down to the control room he could feel the deck vibrating beneath his feet. Something was loose, and it had to be outside the hull.

The Turkish searchlights were switched off at 0500 and full daylight was approaching: if Holbrook had to rise it was now or never. He ordered main ballast to be blown, opened the hatch, and clambered down on to the casing. Sure enough, the tubular steel guard on the port forward hydroplane had come loose and was twisted into a hook, ideally shaped to catch mine-wires. Two artificers fatalistically disengaged the entire structure with spanners and dropped it over the side: the port hydroplane thereupon became a mine-trap, but Holbrook was not about to turn back now.

Meanwhile, it was certain that B11 was being watched with interest from the sombre shore. Mentally shrugging, Holbrook gave the order to flood main ballast, and by 0600 the submarine was on her way again, keeping about 1500 yards from the European shoreline.

The plan was to stay down at 50 feet, to avoid mines, except for an excursion to periscope depth every three-quarters of an hour to check position. Precious amps were wasted on the pumps at every change of depth, due to the dramatic change of densities, while the boat struggled along at four knots against the current, making good no more than an estimated two knots over the ground. The after hand-worked planes were abominable stiff, but Pownall had lent the Spare Crew Coxswain (most likely on the *you*

will volunteer principle) to work in shifts with B11's own Coxswain.

Life in a B-boat was once described as "like living under the bonnet of a motor car", but there were a few creature comforts. A breakfast of cold tea, cold ham, bread, butter and jam was consumed with relish while Holbrook himself enjoyed half a cold lobster which one of the French officers had generously given him at the last minute.

By 0830 one-third of the battery capacity had been used. Nevertheless B11 was on schedule and was now approaching the first known row of mines, stretched between Kephez Point and the European side. Holbrook and Winn took a careful fix—no speedy matter relating relative bearings, called down the tower from the periscope, with the ship's head mirrored into the hull through a projector tube from the external magnetic compass on the casing above and corrected for variation and deviation. The boat was then taken deep to 80 feet. The next hour was uneventful, but the movement of the minute hand on the control room clock was said to be painfully slow.

At 0940 Holbrook's EP showed he was nearing the Narrows: coming shallow again he found that B11 had made better headway than expected and he had cleared the minefield. Over on the starboard bow lay Chanak. The port was empty; but the indentation which formed Sara Siglar Bay to the right was occupied—by a battleship. It was the Turkish MESSOUDIEH at anchor.

The huge target was on the submarine's quarter about 2000 yards distant when sighted (the periscope had no ranging graticule) so an approach would not be difficult—were it not for the current sweeping B11 across the line of sight. Due allowance has to be made for that current when firing one of the two bow tubes: it was imperative to steal closer to minimise its effect.

Holbrook turned towards, went deep, and speeded up for five minutes to halve the range. When next he looked he was 1000 yards away and a little abaft the target's beam. During a torpedo's running time—about one minute—the current would take it some 200-300 feet towards the battleship's stern; so Holbrook manoeuvred carefully to point his tubes exactly at the target's bow. Then: "Stand by One...Fire!" and an 18 inch torpedo was on its way. Winn, at the trim, overcompensated for the sudden loss of weight and the periscope was dipped when, less than 60 seconds later, a violent explosion shook the boat.

The single torpedo was sufficient. When Holbrook could look again it was obvious that the giant was mortally stricken, although all guns that could be brought to bear opened fire on the periscope at point blank range. Holbrook put the helm to starboard, dipped the stick deliberately, and swung away while the battleship started to settle by the stern.

Now things started to go wrong. Shells exploding on the water had fogged the compass projector tube; and shore batteries were soon joining in; there were no distinguishing marks on shore to assist navigation, yet Asia was unpleasantly close to port. Then the submarine hit the bottom with the depth gauge showing 38 feet.

Holbrook reasoned that if he had got into trouble by turning in one direction he might as well try another, so he reversed the helm to port and cheerfully went on to full speed, noting that "the submarine was frequently touching bottom from 1010 to 1020, when we got into deeper water". Just as B11 ceased to bump and grind the last glimmer of light from the compass disappeared. Murphy, mercifully rather late in the day, was exercising his implacable Law.

The solution, of course, was to keep the periscope exposed and con by verbal orders to the helmsman—it was unlikely that, when B11 was in mid-channel, the comparatively distant forts would see the tip sufficiently well to aim their guns. However, there was no choice but to pass through the mined area deep at 80 feet, and simply hope that the boat was steering a straight course the while.

When, eventually, it was safe to surface, the hatches on B11 had been shut for nine hours—much too long for a tiny B-boat when some of the crew were engaged in strenuous activity: the air was so foul that the engine would not fire until the ventilation fans had run for half-an-hour.

Holbrook was award the Victoria Cross—the first submariner to win the highest honour—and every member of the crew was suitably decorated. Even better, the Prize Court agreed that they were all entitled to prize bounty stemming from an Act of Parliament dated 1708 (which cynics might argue had a good deal to do with Britannia ruling the waves for the last two centuries). The possibility of financial reward did not enter Holbrook's mind in December 1914, but he received £601 10s 2d in due course for sinking MESSOUDIEH (equivalent to about $75,000 today); and able seamen were each awarded £120 6s 1d (say $15,000 to-

day)—a veritable untaxed fortune amounting to at least two years' pay. (What a splendid encouragement to submariners it would be if Prize Bounty were revived: Congress and Parliament please note.)

Norman Holbrook was not outstanding in terms of peacetime promotional reports. Nor, with the exception of Martin Nasmith whose story is told next, were any of the Royal Navy's 14 submariner VCs deemed to be exceptional by normal naval standards. However, in action, they proved supreme. Foremost amongst those wartime winning qualities, so well exemplified by Holbrook, was determination: maybe this single word covers pretty much all that was, or is, essential for a first class submarine captain. ■

IN REMEMBRANCE

CAPT John W. Haizlip, USN(Ret.)

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JAPANESE SUBMARINE OPERATIONAL FORCES IN WORLD WAR II
Will America's SSNs Make the Same Mistake?

by CDR Donald D. Gerry, USN

A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Operations Department.

Introduction

At first glance the gap between the 1941 Japanese submarine force and the American attack submarines of present day appears immense. Exploiting all that modern engineering can offer, the United States has incorporated nuclear power, precision guided munitions, sleek hulls, and computer based sensors into its boats. Today's American nuclear attack submarine, the SSN, is a technological marvel vastly superior to its Japanese ancestor. Still, the two submarine forces exhibit many striking parallels. Both were designed to protect the global interests of island nations critically dependent on imported raw materials. Numerically among the largest submarine fleets of their day, both were manned by elite, hand-picked, superbly trained crews. Possessing state-of-the-art equipment, both forces had the ability to deliver some of the finest weapons of their era anywhere in the world. Most importantly, both forces practiced remarkably analogous command and control and were expected to excel in many of the same mission areas.

The similarities between the World War II Japanese submarine force and contemporary American attack submarines should give today's operational commander reason for pause and concern. Japan expended a great deal of national treasure developing its underseas force but received little for its investment. Like Japan, the United States has also staked a substantial portion of its defense budget and infrastructure on its submarines. Yet, America's SSNs are struggling to define their mission, an adequate command and control arrangement, and their place in the *Forward...From the Sea* Navy. U.S. attack submarines may be poised to repeat the mistakes of their Japanese forerunners.

When the Japanese attacked Pearl Harbor in 1941, their submarine employment strategy had been in place for almost two decades. Dissatisfied with the 5:5:3 (American:British:Japanese) capital ship ratio established by the 1921-1922 Washington Naval Conference, Japan looked to its submarines as a force multiplier. Expecting any forthcoming naval war to be a series of major engagements between battleships and aircraft carriers, the Japanese planned to use long range submarines as a means to attrite advancing U.S. fleets.[1] With high hopes for his underseas force Rear Admiral Shigeru Fukudome, Chief of Staff of the Combined Fleet, spoke for many when he wrote:

> "It was my belief that, even if the Task Force's aerial attack on [Pearl Harbor] ended in failure, the Submarine Force's operation would not fail. My belief was based on the expectation that no hitch would arise in the submarines' operations."[2]

As foreseen by pre-war planners, the first eight months of the war provided Japan's submarine force with a chance to excel. Pearl Harbor, Coral Sea, and Midway were major engagements between main battle fleets. Japan, on the offensive in each of these battles, had reasonable opportunity to position her submarines against American forces advancing along known threat axes. The performance of the submarines was, however, far below expectations. At Pearl Harbor Japanese submarines (using aircraft carried on the back of the boats) performed reasonably well in their secondary role of reconnaissance, but sank no enemy shipping.[3] During the Battle of Coral Sea the Japanese fared no better. Despite adequate positioning by some of the newest Japanese boats, no enemy shipping was attacked and superb chances to report American carrier positions were missed.[4]

The Japanese planned massive submarine involvement for the assault on Midway Island. Of approximately 60 units in the submarine inventory, 19 were sortied to Midway in support of the Combined Fleet, while an additional six were sent to the Aleutians as part of a northern feint.[5] Once again, results were disappointing. Although the American aircraft carrier USS YORKTOWN was sunk by the Japanese submarine I-168, the forward submarine screen failed to execute its primary function of intercept, warning,

and attrition.[6] Despite the substantial number of Japanese submarines in the vicinity of Midway, none was able to locate the American carriers prior to the main fleet engagement. In fact, inadequate submarine reconnaissance was a principal reason the Combined Fleet was surprised by the U.S. Task Force. Moreover, the only reason the I-168 was able to attack YORKTOWN was that the carrier was dead in the water—the victim of a previous air bombardment.[7]

Long before the Midway debacle, Japanese submariners realized that their performance had been unacceptable. The Sixth (Submarine) Fleet Commander, Vice Admiral Mitsumi Shimizu, reported after Pearl Harbor:

> "We have ascertained that it is very difficult for submarines to attack warships and block a well guarded harbor. We are of the opinion that the main targets of submarines should be merchant ships and not warships."[8]

Thus, in April 1942 the Sixth Fleet issued a new operational priority. Japanes submarines were to concentrate their efforts on attacking merchant shipping.[9] Oddly, while Combined Fleet Headquarters acquiesced to the shift in Sixth Fleet's priorities, Imperial hierarchy still felt that the submarine's basic mission was sinking combatants. Japanese naval planners fashioned future operations, such as Midway, accordingly.[10]

During the later half of 1942 Japanese submarines not involved with Combined Fleet assaults concentrated their efforts in the Indian and Southwest Pacific Oceans. Following Sixth Fleet's directives, they attacked enemy shipping and achieved some measure of success. Sinking more than 100 merchants, the submarines were playing to their inherent strengths.[11] Unfortunately for the Japanese, the performance of its submarine force had reached its pinnacle.

By November 1942 the Japanese defense of Guadalcanal was desperate. Unable to supply its garrison, the Army concluded that the only way to get ammunition and food to its troops was by submarine. Asserting its influence over the Navy, all available boats were diverted to Rabaul for supply operations. Suffering tremendous casualties in this new stage of the war, submarine crews were disgusted by duty for which they had neither proper training nor equipment. Compounding the loss of men and ships, most submarines participating in conveyance missions were

diverted from formerly successful anti-shipping operations in the Indian Ocean.[12] Supply operations marked the beginning of the end for the Japanese submarine force. With most of its units prevented from conducting offensive operations and losses of experienced manpower in the Guadalcanal supply effort mounting, Imperial Navy submarines ceased to be a serious threat by early 1943.[13]

Japanese Submarine Operations in World War II: An Analysis

By most accounts, Japanese submarine performance in World War II was dismal. Japan's underseas fleet sank a mere fraction of American totals (184 merchantmen, 15 warships for Japan; 1,079 merchantmen, 201 warships for the United States) despite rough numerical equivalence with the United States. Even more damning was the fact that the Japanese torpedo at the start of the war was far better than any weapon the Americans ever possessed.[14] As Admiral Fukudome remarked:

> "The Japanese Navy expected too much from its submarines...But when it came to the test of actual warfare, the results were deplorable."[15]

Why did the Japanese submarine force perform so poorly? A review of the operational design of the Imperial Navy reveals many of the answers.

The Japanese lacked an adequate operational control (OPCON) scheme for their submarines. The Sixth Fleet Commander held OPCON of all submarine squadrons and divisions as a default condition. But when a major offensive was planned, OPCON could take many forms. For the Pearl Harbor attack Sixth Fleet retained OPCON until the aerial bombardment commenced, then control shifted to the Task Force Commander. At Midway the Combined Fleet Commander held OPCON throughout all stages of the battle, including preparatory reconnaissance. The Imperial Army gained OPCON when submarines began supply transport duty during the struggle for Guadalcanal.[16]

Usually a submariner, the Sixth Fleet Commander nominally understood the strengths and limitations of his boats. Not surprisingly, most success occurred under this OPCON. When another commander took control, problems quickly developed. For example, the Combined Fleet Commander's submarine

specialist for the Midway invasion advised him that many of the boats intended for the mission were in unacceptable material condition. Ignoring this warning, the Combined Fleet Commander ordered the boats to assume forward reconnaissance positions. When many of the submarines could not complete the journey to the Central Pacific, an unobstructed passage was left for the American fleet to traverse. As fate would have it, the hole in the Japanese submarine surveillance screen was exploited by the American carriers as they cruised unmolested to Midway.[17]

Another problem with Japanese OPCON was substitution of micromanagement for commander's intent. The inclination of Japan's admirals was to centralize operational and tactical control of the boats. Instead of assigning large patrol areas in which to conduct unrestricted submarine warfare (as was the practice in Germany and the United States) individual unit captains were given precise locations and inflexible tasking. To make matters worse, operational commanders frequently positioned their submarines like pieces on a game board. Often the speed the boats were ordered to make by shore directive could only be achieved by traveling on the surface. Many submarines were lost during these ill-advised transits.[18] Japan's admiralty was so enamored with micromanagement that they also allowed themselves to be dragged into prescribing tactics. In one particularly stunning instance, the officer holding OPCON was expected to dictate the number of torpedoes that were to be expended on a given target.[19] Japan's ad hoc OPCON systems and smothering leadership produced disastrous results. Unit Commanding Officers (COs) obediently followed orders but rarely demonstrated initiative, cunning, or daring. Paucity of operational intent, combined with timid COs, rendered the entire submarine force impotent.

Another glaring problem for the Japanese submarine force during World War II was lack of operational focus. Specifically, operational commanders frequently tasked boats with missions for which neither the crews had been trained nor the boats designed. The most dramatic example of this problem was the use of submarines for supply missions. Although the Navy strongly opposed the concept of submarines as supply ships, desperate Army generals persuaded Imperial leadership to go forward with the idea. Japanese submarines successfully destroying merchant shipping in the Indian Ocean were recalled, torpedo tubes were removed, weapons were offloaded, and cumbersome external

transport devices were attached. Angered by the Army's interference, the Navy made minimal effort to address critical shiphandling issues or mission safety. Defenseless and often wallowing on the surface attempting to deliver insignificant quantities of food and munitions, Japanese submarines suffered devastating losses executing these poorly conceived ventures.[20]

Supply delivery was not the only example of poor Japanese mission selection. Commanders frequently ordered submarines completing patrols to stop near allied bases and attempt shore bombardment. Equipped with small caliber deck guns and lacking rapid topside reload capability, the boats found themselves outgunned and under attack by the very installations they were supposed to destroy. Instead of letting the submarines conduct missions for which they were designed (offensive mining, for example) Japanese leadership continually assigned shore bombardment as a means to interrupt harbor operations.[21]

Communications were an additional deficiency that plagued the Japanese submarine fleet. Using decoded enemy tasking messages, U.S. convoys bypassed known submarine patrols. By taking advantage of precise Japanese station keeping, American antisubmarine warfare (ASW) assets also frequently turned knowledge of Japanese submarine positions into kills. For example, in 1944 U.S. intelligence determined that 10 Japanese submarines had formed a screen in the Philippine Sea. Armed with this information, three U.S. destroyers systematically dissected the screen and sank six boats. The other submarines in the group managed to reposition and escape, but only after they intercepted American messages intended for Hawaii. Strangely, the surviving boats were never warned by Sixth Fleet Headquarters.[22]

A final indictment of Japanese submarine operations lies in leadership's total disregard for technological developments. By 1943 most American vessels were fitted with effective radar sets. Yet, the Japanese did not install them on their boats until late 1944, despite impassioned pleas from submarine COs.[23] Chief among the reasons the Sixth and Combined Fleets hesitated to force the Naval Technical Department to install available radars was fear of expending political capital on a device of questionable utility.[24] As numerous nighttime ambushes on Japanese boats attest, the Fleet Commanders' priorities and vision were fatally flawed.

Contemporary American Attack Submarine Operations versus the Japanese War Experience: A Comparison

Few U.S. Commanders-in-Chief (CINCs) have submarine experience and none has ever had a Joint Task Force opposed by a credible submarine threat.[25] Since today's leaders face many of the same submarine operational dilemmas that confronted the admiralty of the Imperial Japanese Navy, a comparison of present day American attack submarine operations with those of the Japanese in World War II provides valuable insight.

A significant issue a CINC must resolve early in any major regional contingency is OPCON of submarine assets. Prior to the end of the Cold War the Fleet Commander merely delegated OPCON to the Type Commander or a submarine Task Force Commander. In this simplistic but effective system, a submariner always had OPCON of SSNs. However, after the U.S. military drawdown of the early 1990s, several changes were undertaken by submarine leadership to make SSNs more palatable to Carrier Battle Group (CVBG) Commanders. One initiative was to shift OPCON of assigned SSNs to the battle group.

A CVBG commander possessing submarine OPCON is confronted by a significant problem that the Japanese grappled with a half century ago. Unless the SSN exposes an antenna, neither the submarine nor the battle group possess organic means with which to reliably communicate with each other. Indeed, the physics of underwater electromagnetic propagation have not changed since World War II. Only very low radio frequencies transmitted from large shore based antenna arrays have the capability to transmit signals that can be received by submerged SSNs. Therefore, the principal obstacle to uncomplicated OPCON—communications—remains a major problem.[26] Since the CVBG Commander can't immediately talk with his submarines and only knows the SSNs' approximate position, he can't instantly direct their actions. He must rely on previously transmitted intent!

Like the Japanese Task Force Commanders before him, the CVBG Commander will be tempted to solve his SSN connectivity deficiencies. Should he choose to remedy the situation with additional communications requirements (i.e., more antenna time), the CVBG Commander places the SSN at risk to radio geolocation or visual counterdetection. The major strength of the SSN, stealth, is sacrificed. Moreover, extensive transmissions from emerging high baud systems (such as video data links) significantly

increase the probability of enemy decryption. When one transmitted periscope picture contains as much digital information as a month's worth of conventional satellite communications, the opportunity for the enemy to piece together the American operational security puzzle is significantly enhanced.[27] Should an ASW capable enemy even partially decrypt a submarine tasking message, a disaster similar to that suffered by the Japanese in 1944 in the Philippine Sea could occur.

A CVBG Commander not inclined to solve his submarine OPCON problem with increased communications might be enticed to micromanage his submarine's position and speed. When Japanese commanders did this, submarine performance suffered. Japanese COs reluctant to shift from an ordered position let many attack opportunities slip away. Furthermore, the boats were frequently placed at risk when Task Force Commanders forced them to transit at unreasonable speeds, often on the surface. In today's tough ASW environment, where a few knots of speed is the difference between being an effective or useless acoustic sensor, the CVBG Commander could hazard his SSNs by essentially rendering them deaf. Additionally, the CVBG Commander is likely to find, as the Japanese did, that precise station keeping robs submarine COs of the initiative they need to be effective.

When the U.S. Submarine Force was threatened by cutbacks, submarine leadership endeavored to ensure SSN participation in every possible military operation. *Count me in!* became the Silent Service's motto. Emphasis shifted from deep water to the littorals. Instead of opposing Soviet ballistic missile submarines (SSBNs) in the Arctic, SSNs actively participated in a wide range of CVBG operations. Long overlooked missions, such as swimmer delivery and strike, became priorities. Even the pace of budget enhancing VIP tours and media sessions markedly increased. Some could question whether operational focus was lost.

The Japanese experience indicates that CINCs should be concerned with the number of missions they expect their SSNs to accomplish. Consider the case of ASW. Modern SSNs and diesels can be detected at ranges of only a few thousand yards, if at all.[28] As illustrated by the recent collisions of U.S. and Russian submarines in the Barents Sea, tracking of opposing underseas forces is getting more difficult.[29] Yet, today's CINCs need assurance that their fast sealift ships will not fall victim to a Russian Akula II class SSN or Iranian Kilo class SS interdicting a critical sea line of communication. The difficulty of the contem-

porary ASW problem and the Japanese submarine experiences after 1942 suggest that as long as U.S. SSN efforts are directed across a wide spectrum of missions, CINCs may not receive the anticipated level of performance in critical areas such as ASW.

Japanese submariners thought they would fight World War II in deep, unrestricted seas. Their boats were designed for open ocean and that is where they trained. By 1945, though, most of the underwater war had been fought where operational leadership had sent the boats—the littoral. U.S. submariners confront a similar fate in 1996. Despite the fact that their ships were built as deep water, sea control platforms, the Navy's Forward...From the Sea doctrine thrusts them into the world's shallow waters.[30] While U.S. SSNs have exhibited superior peacetime adaptation to this new environment, Japan's ordeals indicate that war could yield entirely different results. Take, for instance, the situation with mines. In the deep waters of the world mines are difficult to employ effectively. On the other hand, mine warfare in the littorals is easy and cheap. Had one of the Iraqi floating mines that seriously damaged USS PRINCETON or USS TRIPOLI in the Persian Gulf War struck a submerged SSN, it is questionable as to whether the submarine could have survived.[31] In fact, U.S. SSNs not only have limited capability to endure a mine explosion, they have practically no chance of finding most modern mines.[32]

Swimmer delivery is another littoral mission that may produce unpleasant wartime surprises. As older SSN classes are decommissioned, the Los Angeles class will be tasked as a drydeck shelter (DDS) host submarine. Already notoriously poor at shallow, slow speed depth control, a Los Angeles class SSN fitted with the bulky DDS could easily find itself broached in unfriendly waters.[33] Whereas in peace an exposed submarine is threatened by little more than embarrassment, a DDS equipped SSN wallowing on the surface in a war zone may find that it is just as easy a target for coastal patrols as the large, unwieldy Japanese supply submarines were.

The Japanese submarine force paid dearly for its leadership's lack of technological vision. While radar was revolutionizing submarine warfare, the Sixth Fleet Staff comfortably claimed that radar sets were "useless".[34] Today's CINCs must not let the U.S. Submarine Force make the same mistake. Let us again examine the case of ASW. While America's primary ASW sensor—acoustics—yields ever diminishing returns, other nations have looked elsewhere for answers to the underwater detection and

tracking problem. Non-acoustic ASW sensors are prominent on several of the latest British and Russian boats. Corresponding devices are nowhere to be found on U.S. SSNs.[35] One can only wonder why the world's other top submarine fleets find these apparatus desirable. Similarly, the U.S. Navy relies solely on acoustics for torpedo homing, despite known deficiencies in shallow water and anti-surface warfare (ASUW) applications. Other nations, such as Russia and Iran, use wake homing technology as a remedy for ASUW acoustic shortcomings.[36] Although the United States has the world's finest deep water, heavyweight torpedo, America does not employ wake homing technology.[37]

Recommendations

There are those that believe there is no task more service unique than operating a submarine at war. The lessons of Japanese submarine OPCON clearly lend credence to that opinion. Whenever a non-submariner directed Japanese boats, disaster quickly followed. Not surprisingly, every other nation that has conducted a successful underseas war (including the British in the Falklands[38]) has had a submariner retaining OPCON of attack submarines. American leadership would do well to consider the lessons of others and keep submarine OPCON where it has traditionally been—in the hands of submariners.

An SSN is a distinctive warfighting machine with missions only it can accomplish. No other armed service or equipment can conduct under-ice ASW, covert mining, or swimmer delivery. Additionally, few would argue that SSNs are the principal ASW platform of the United States. While any number of ships can launch Tomahawk missiles, only an SSN can track down a rogue Russian SSBN in the Arctic or covertly mine Bandar Abbas, Iran. With submarine unique capabilities valuable force multipliers, CINCs should carefully consider the ramifications of lost proficiency due to lack of focus in critical mission areas. CINCs should ensure that the Submarine Force remains adequately focused on the tasks which it does best or only it can do.

U.S. SSN wartime missions in shallow, restricted waters are another area in which CINCs should proceed carefully. The poor mine detection and slow speed handling characteristics of the Los Angeles class SSN will certainly exact a heavy price in littoral warfare if not corrected. The Japanese provided a valuable illustration in underseas littoral warfare. When they lost sight of

what their submarines could and could not do, they paid a severe price. With the possibility of less than 50 SSNs in the U.S. submarine inventory, America can't afford the same mistake. If operational leadership truly wants the SSNs to fight in the littorals, then they should make sure U.S. boats are designed to fight and survive there.

Drawdowns are difficult times for military leaders. Research and development, particularly in a mission area where there seems to be minimal threat, is often hard to justify. But throughout today's world submarines are prolific and popular. Money is being invested in submarine warfare and new technologies are emerging. If CINCs want to ensure their boats are a match for any opponent, new ASW and torpedo technologies must be explored and developed. We must not ignore or discard the radar of our generation!

Conclusion

The U.S. Submarine Force has a long and proud tradition. In both World War II and the Cold War it served America superbly. As it struggles to find its place in a world which is no longer bi-polar, the U.S. Submarine Force must rely on the nation's operational leadership to ensure costly mistakes of history are not repeated. The similarities between the Imperial Navy's submarines and contemporary U.S. SSNs, combined with the sobering nature of Japan's operational failure, compel present day CINCs to heed history's lessons. As patrols off both American coasts by Russian Akula class SSNs in 1995 remind us, other nations would be delighted to possess the world's premier submarine force should the United States choose to relinquish the title.[39] With one eye on where others have been, the time has come for today's operational leadership to carefully assess where the U.S. attack Submarine Force is headed.

■

REFERENCES

1. Dorr Carpenter and Norman Polmar, Submarines of the Imperial Japanese Navy. Annapolis: Naval Institute Press, 1986, p. 1.

2. Ibid., p. 13.

3. Ibid., pp. 12-17.

4. Ibid., p. 23.

5. Ibid., p. 24.

6. Erminio Bagnasco, Submarines of World War Two. Annapolis: Naval Institute Press, 1973, p. 176.

7. Carpenter and Polmar, pp. 24-25.

8. Bagnasco, p. 174.

9. Carpenter and Polmar, p. 11.

10. Military History Section, Headquarters, Army Forces Far East, Submarine Operations in the Second Phase Operations, Part I, April - August 1942. Office of the Chief of Military History, Department of the Army: 1952, p. 1.

11. Carpenter and Polmar, pp. 29-33.

12. Mochitsura Hashimoto, Sunk, The Story of the Japanes Submarine Fleet 1942-1945. London: Cassell and Company, 1954, pp. 60-67.

13. Carpenter and Polmar, p. 42.

14. Bagnasco, pp. 176, 213.

15. Carpenter and Polmar, p. 68.

16. Ibid., pp. 11-31.

17. Ibid, p. 36.

18. Hashimoto, p. 105.

19. Ibid, pp. 34-35.

20. Hashimoto, pp. 60-67.

21. Ibid., pp. 27-32.

22. Carpenter and Polmar, pp. 46-47.

23. Ibid., p. 45.

24. Hashimoto, pp. 115-125.

25. RADM W.J. Holland, Jr., "ASW is Still Job One", U.S. Naval Institute Proceedings, August 1992, pp. 31-32.

26. Vinny DiGirolamo, Naval Command Control: Policy, Programs, People, and Issues. Fairfax, VA: AFCEA International Press, 1992, p. 152.

27. Dr. Richard Thompson, "C4I: How Much is Enough? How Much is Too Much?", The Submarine Review, January 1996, p. 88.

28. Tom Clancy, Submarine, A Guided Tour Inside a Nuclear Warship. New York: Berkley Books, 1993, p. 184.

29. Barton Gellman, "U.S. and Russian Nuclear Subs Collide", The Washington Post 23 March 1993, p. 14.

30. U.S. Department of the Navy, Forward...From the Sea. Washington: 1994, p. 2.

31. GEN Bernard E. Trainor, The General's War. New York: Little, Brown, and Company, 1994, pp. 343-345.

32. ENS Jim Crimmins, "Mine Warfare and Submarines", U.S. Naval Institute Proceedings, October 1994, p. 81.

33. LCDR Kevin Peppe, "Attack Submarines Should Attack! Attack! Attack!", U.S. Naval Institute Proceedings, September 1991, p. 64.

34. Hashimoto, pp. 115-117.

35. CAPT Richard Sharpe, Jane's Fighting Ships, 98th Edition. London: 1995, pp. 554, 761.

36. Antony Preston, "Submarine Weaponry", Naval Forces, Vol. XIV, No. II/1993, p. 50.

37. Sharpe, p. 798.

38. Ruben O. Moro, The History of the South Atlantic Conflict: The War for the Malvinas. New York: Praeger, 1989, p. 78.

39. Charles Aldinger, "Russian Subs Said to Shadow U.S. Warships", Reuters, 8 December 1995.

SUBMARINE LESSONS FROM WORLD WAR II

by CAPT W.J. Ruhe, USN(Ret.)

A host of lessons were learned about submarines in war, as I noted in my World War II journals and are documented in my book, War in the Boats. The lessons concern submarines, not diesel submarines, in particular. They seem as applicable today as they were in a war half a century ago.

Before WWII, the lessons which should have been learned concerning the effectiveness of submarines—specifically, the German U-boats of WWI—were evidently forgotten. That U-boats sank 10 battleships and 18 heavy cruisers and 11.5 million tons of merchant shipping in four years of war, was ignored in the planning guidance for winning the Pacific War against the Japanese—the U.S. Top Secret War Plan Orange. This Plan, a U.S. Grand Strategy for the war, visualized the U.S. Fleet centered around battleships, at the outset of war, sailing across the North Central Pacific to retake the Philippines and on the way meeting the Japanese Fleet which it would defeat in Mahanian style. Then the U.S. Fleet would go on to the Japanese homeland and force the Japanese to sue for peace. This scenario, however, neglected the impact U.S. submarines would have against Japanese warships and their merchant fleet. U.S. submarines were not considered to be influential in determining the war's outcome.

Similarly, the failure of U.S. leaders to recall the effectiveness of U-boats in WWI, was just as culpable for the Atlantic sea war as for the Pacific one. No plans were developed for a U-boat war off the east coast of the United States. Yet, on 12 January 1942, Admiral Doenitz had five, 750 ton, Type VII U-boats with only 14 torpedoes per submarine, deployed a few miles offshore, for the highly successful operation called Drum Beat. Admiral Stark, the CNO, had wrongly thought that the Germans were incapable of employing their 6000 mile range submarines off the U.S. east coast. Supposedly, they couldn't get there and then get back to their bases in western Europe. But Admiral Doenitz had brought two 4200 ton *Milch Cows* to replenish and rearm his Type VII U-boats for a second round of attacks before sailing back across the Atlantic. Also, our naval leaders, failing to learn from the history of WWI, made no attempt to convoy the coastal shipping until the U.S. had suffered more than two million tons of sunken ships. (In the first two months, the Drum Beat submarines sank 105 ships of over one-half million tons of independently sailed ships.)

Pearl Harbor with its loss of U.S. battleships finished off the validity of War Plan Orange. And the entry of Germany into the war then made submarines of great importance in the Atlantic sea war.

When the CNO sent an ALNAV in the afternoon of 7 December 1941: "Execute unrestricted air and submarine warfare against Japan", the U.S. Submarine Force was taken by surprise, in that pre-war efforts had been directed towards support of the surface forces. Whereas, this directive initiated an attrition war against enemy warships and enemy merchant ships, for which there had been few exercises—but many for protecting battleships. (The U.S. torpedoes were too light in warhead size for either merchant ship or warship attrition, while the wake-making trail of this steam driven torpedo created many misses due to evasion maneuvers of alerted ships. The 560 pound warhead of the Mk 14 submarine torpedo and the 350 pound warhead of the old Mk 10 torpedo merely tended to damage big ships. On the other hand, the Japanese Long Lance wakeless torpedo with its 1100 pound warhead, sank most ships outright.)

A lesson that I learned on my first war patrol was that any submarine no matter how decrepit and inefficient it might be, is feared out of all proportion to the damage it might cause to enemy ships. This was proved true of the antique U.S. S-boats deployed in the Solomons area. The *"Rusty Old Sewer Pipes"* as they were affectionately labeled, with their Mk 10 torpedoes, produced only six confirmed sinkings in the first year of the war. Yet the Japanese allowed these old boats to disrupt their flow of shipping to Northeast New Guinea and Guadalcanal, assuring a breaching of their inner and outer perimeters of island defenses. They also caused faulty decisions to be made by their naval leaders. (The sinking of the 4700 ton troop-carrying OKINOSHIMA on 11 May 1942, the S-44's sinking of the big supply ship SHOEI MARU and the S-37's sinking of a troop transport—all in the St. George's Channel area, caused the Japanese to use only destroyers in their unsuccessful attempt to take northeastern New Guinea. While the S-44's sinking of the KEIJO MARU, the S-38's sinking of the troop transport MEIYO MARU, and the S-44's destruction of the heavy cruiser KAKO seemingly stopped the use of merchant ships to reinforce the Japanese troops on Guadalcanal.)

A submarine's quality of ubiquitousness—a major asset—causes an unreasonable expenditure of enemy efforts on false contacts, produces irrational responses in enemy operational decisions and

causes much wasted time and naval resources trying to combat submarines everywhere they might be. The excessive employment of Japanese fleet destroyers in the 1942 Solomons campaign, their willy-nilly dropping of depth charges and their frequent changes in transit patterns on the suspicion of a submarine being somewhere, demonstrated a paranoia about the invisible submarines.

Enemy surface and air commanders understand little about submarines. They claimed easy sinkings of subs while irrationally fearing a submarine's capability to counter their operational actions. The *sighted sub, sank same* syndrome, for example, as used by Japanese aircraft pilots after attacking the S-37 with bombs when it had submerged, and Admiral Mikawa's wrong-headed decision to turn away after a decisive cruiser victory at the Battle of Savo Island, in fear of the S-boats in the vicinity of Lunga Roads, were such Japanese actions.

Submarine crew habitability, so important in peacetime, proved far less important in wartime. The crew *learned to live with it* particularly when it had patrol successes. Miserable habitability, i.e., hot bunking, being plagued by cockroaches, lack of privacy, lack of water for personal cleanliness, lack of air conditioning, and a submerged environment of high temperature, high humidity, slowly increasing pressure and slowly decreasing oxygen content in the submarine were for the most part accepted without a gripe. Lack of operational success lowered crew morale far more than unsatisfactory living conditions—as experienced in S-37.

The submarine is basically an offensive unit. It is poor, at best, in the defensive or blockade role. Despite the historical proof of this dictum, the submarines deployed in the Solomons areas in the first year of the war were all positioned at the foot of St. George's Channel or off Savo Island in a blockading role preventing ships from Rabaul to transit to New Guinea or to Guadalcanal. Hence, submarine sinkings were sparse. Only when these defensively oriented submarines moved out from their assigned patrol areas were there sinkings of critically important Japanese ships. The S-44's destruction of the Japanese heavy cruiser KAKO north of New Ireland, and the S-38's sinking of a critical troopship for reinforcement of the Japanese troops on Guadalcanal, were these important sinkings made possible.

The submarine can operate independently with great effectiveness when allowed to operate freely over a large area of the ocean. It can offensively attack surface ships without the support of other

naval forces, and can attack the ships selectively with total surprise and then use a blanket of water to successfully evade counter attacks. (CREVALLE's attacks were of this nature.)

Attacking with **surprise** is the submarine's most important quality. It makes the submarine the equal or better than the biggest of warships. With a fraction of the crew size of the big warships and an even greater disparity in weapon power it can sink these big ships and get away successfully. Defensively, however, though many targets might be presented to the submarine's fire control system, its chances of achieving attack surprise are small because the targets are normally alerted to the possibility of an attack. (When many DDs came through the S-37's blockade area, their topsides were jammed with lookouts, looking for the S-37's periscope. Additionally they tried to give a wide berth to the area where S-37 had last charged its batteries on the surface—knowing that she could move only a few miles from that position.) Moreover, the lookouts in the tops of Japanese merchantmen or warships had superior binoculars and could see a submarine's high periscope before the U.S. submarine could see the topmasts. And their destroyers exhibited a long-range passive listening capability far superior to that of the U.S. submarine.

Few submariners were wounded in submarine warfare. There were few Purple Hearts awarded to submariners. It was a matter of all or nothing. Even though the Submarine Service was the most lethally dangerous military service, submariners were fatalistic about their chances of dying—with the optimism of youth about their indestructibility. They were **resolute in their acceptance of death** as a consequence of their profession—like good samurais.

Being a Silent Service, for the most part, served the submarines well both for the generation of surprise in attack and for overall safety. (When Admiral Fife at Brisbane had two of his submarines, GRAMPUS and AMBERJACK *acknowledge* 107 of his messages in early 1943, the Japanese with a good RDFing capability pinpointed the two submarines and sank GRAMPUS in February 1943, and AMBERJACK in March of 1943.)

When the oxygen content of a submerged submarine's air gets low—even if the carbon dioxide is absorbed from the air in the boat—almost everyone makes mistakes in their thought processes, as illustrated by SEADRAGON's torpedo attack against a large Japanese troop carrier late in the evening of 25 December 1942. (Replenishing the O_2 was forgotten.)

Depth charging made equipment balky to operate and even necessitated hand operation of the equipment. This called for great strength to operate the gear in a manual mode. (SEA-DRAGON's Strength Club proved invaluable, particularly for *hand diving* the boat and for continuing the fighting capability of their submarine.)

A submarine's high speed is at a premium in an attack on a high-speed valuable enemy warship (as with CREVALLE's four hour, 20.5 knot chase of a Japanese aircraft carrier—before a torpedo attack materialized.)

A submarine camouflaged for invisibility by using light gray paint on its vertical surfaces, is far less visible under all conditions of low visibility than an all-black painted job or a zig zag painted submarine to prevent a good estimation of its target angle. The light gray FLASHER and the traditional black-painted CREVALLE conducted visibility tests as they came south off patrol. The gray-painted FLASHER proved more difficult to see even on moonlit nights. Hence the day after their arrival in Freemantle, CREVALLE was painted gray except that her bridge shadow areas were painted white. A new idea.

The Japanese, in not allowing themselves to be taken prisoner after CREVALLE sank their gunboat, demonstrated a Japanese belief that a man who allowed himself to be taken prisoner was a *contemptible* person—and was to be so treated when he became a prisoner of war. The bad treatment of submariners who allowed themselves to be captured can be thus rationalized.

The weaker of two assailants in high seas warfare (in this case, the Japanese) will cause his operations to gravitate to shallow waters where mines can restrict the mobility of the stronger enemy (the U.S. Submarine Force) and bays and inlets can be utilized for protection. At the same time, hugging the coast reduces the escort requirements by allowing escorts to protect only the outboard flanks of the ships they are protecting. (CREVALLE's third war patrol off Borneo demonstrates this principle.)

Significantly, although some *Burn* messages of decoded Japanese ship movements were received by CREVALLE which might have been capitalized on, they never were. In some cases, Japanese ships might have been missed because of own navigation errors.

Submarines can be highly selective in their targeting of enemy ships and can attack deliberately—controlling the tempo of the battle. (This was well illustrated by CREVALLE's attack of a

large tanker, the last and most important ship in an eight ship convoy. The tanker was sunk after letting the other seven ships with their outboard escorts pass on by at close range before six torpedoes were fired at the converted whale ship.

Women in a submarine caused bad judgements by her male officers who might have been trying to show off for the fairer sex. This resulted in a near disaster for the boat. Additionally, they were not compatible with the submarine's design. (This was CREVALLE's experience when she evacuated 16 women from the Japanese-held Island of Negros in the Philippines.) Submarines throughout the war carried out *Special Missions*. They rescued downed flyers, landed coast watchers and saboteurs, rescued Allied personnel after ship sinkings, evacuated friendly people from Japanese-held territory, did coastal reconnaissance, allowed cartel and hospital ships of the enemy a free passage, and laid mines to restrict enemy ship movements.

From the air, a surfaced submarine proved difficult to identify as such. (This weakness in the enemy's ASW was capitalized on by CREVALLE when she sped on the surface to the head of a convoy with air escort.) The Japanese pilots also proved susceptible to spurious voice communications as when CREVALLE's Executive Officer sent a Wolfpack *diving* message and then kept CREVALLE on the surface. This caused the air escort to break off his search for CREVALLE when he had closed to less than 10 miles, and returned to his station over the convoy.

The destroyer escorts of a slow moving convoy on CREVALLE's fourth war patrol in 1944 indicated a good passive listening capability. This was shown by their leaving the convoy and heading to intercept the speeding noisy CREVALLE, on the surface and trying to get to the head of the convoy. When CREVALLE markedly slowed, reducing her noise, the destroyers broke off their investigation and returned to the convoy. (There was no intelligence on this possible German passive array sonar technology.)

General observations about submarines throughout the war would be:

- U.S. submarines proved to be tough warships. They were difficult to sink and were readily repaired at sea by their technologically competent crews. Their damage control equipment was well designed and the damage control measures were well thought out and proved very effective.
- Submarines, at best, proved to be poor pickets for a rapidly

moving fleet of surface ships, (the mission for which they were designed). This defensive mission with its poor sonar detection ranges on enemy surface ships, and only limited visual and radar detection ranges, provided little coverage for distant surface or submarine threats.

- Appreciating sound layers in the ocean (with the introduction of the bathythermograph in submarines) proved of great value in effective evasion and in achieving attack surprise.
- Submariners were virtually all volunteers. They were phlegmatic while under a depth charging or bombing attack; there was no yelling within the submarine; they never showed signs of being afraid (with only one man going catatonic from fear—but he was identified as a psychological misfit who should have been screened out of submarines); they liked each other, showing no signs of having spats (no marked up faces or angry words tossed at each other); it was indicated that submarining was a young man's game, requiring the endurance of healthy youths; there was little need for discipline of the men; they had a high esprit de corps, feeling that they were in an elite service; and they were offensive minded, wanting to go on the next and the next and the next patrol and not be stuck in a shore assignment, (for a 15 man draft for new construction I got only three volunteers). Most importantly, submariners were well above average in intelligence. So I must confess that I'm alive today because, unlike those where were taught that: "When in danger or in doubt, run in circles, scream and shout", a submariner on CREVALLE was resourceful enough to order "All back emergency!

It should be emphasized that, for the most part, these submarine lessons of WWII are apparently universal and timeless: the mystique surrounding submarines was seemingly continued through the Cold War; their quality of ubiquitousness was maintained (but perhaps to a lesser degree) despite major technical advances in undersea surveillance devices; and the threat posed by Polaris submarines was an offensive one despite its being labeled *defensive*.

Admiral Rickover was well aware of the public's ignorance in regard to submarine matters as he rehashed their past performance in war in his testimony before Congressional Committees—in order to justify the expenditure of funds for his nuclear submarine project. The Admiral argued that the far greater mobility and usefulness of a submarine when nuclear power was well worth its cost. And so it has proved. ■

INSPECTION PERFORMANCE VERSUS READINESS
Why These Concepts are Incompatible

LT Douglas H. Koekkoek, USN

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On the wall of the debriefing room at Attack Center Number One in the Trident Training Facility building on the Subase in Bangor, Washington, is a quotation often repeated in the Submarine Force:

> "You are going to fight like you train, so you better train like you intend to fight."

It is interesting to consider this statement. Currently, the Submarine Force spends a great deal of its training time preparing, either directly or indirectly for a series of annual inspections. The two most important, and thus the most prepared for inspections are the Operational Reactor Safeguards Exam (ORSE) and the Tactical Readiness Evaluation (TRE). Throughout my four year tour on two submarines as a junior officer, the preparation devoted to making the crew and ship ready for these inspections was phenomenal. The requirements of ORSE preps were routinely granted a higher priority than anything else going on aboard the ship. A recent incident in the Submarine Force underscores the widespread attitude that inspection results, and hence, inspection preparations, are more important than mission readiness.

In addition, the notion that doctrine is determined by the inspection teams is very pervasive. Several lectures at the Submarine Office Advanced Course I am currently attending contained the phrase "The TRE team is going to want to see this", or "You shouldn't do the procedure that way, that is not what the TRE team will expect." A similar attitude concerning ORSE came out during my tour on a Trident submarine. There exist several engineering procedures for the Trident reactor plant which can be performed with varying sets of initial conditions. In the most limiting of conditions, these procedures took much longer to perform, were more plant limiting, and were more susceptible to error in performance. A conscious decision had to be made to place the ship in these limiting situations. It is unreasonable to

assume that circumstances would force the performance of these evolutions from the most limiting conditions. In one specific instance, my Commanding Officer's Standing Orders required the establishment of the least limiting circumstances. He further stated that the procedure would not be completed without establishing these conditions. However, the ORSE consistently required the performance of this evolution. So our submarine was forced to routinely practice an evolution its CO had forbidden in order to satisfy the desires of an inspection team.

A quotation attributed to a Russian tactical document is posted in the offices at Submarine School.

> "One of the serious problems in planning against American doctrine is that the Americans do not read their manuals nor do they feel any obligations to follow their doctrine."

My advice to the Russians is to ignore our doctrine as we do, and instead concentrate their efforts on our TRE and ORSE lessons learned messages, once again, as we do. In addition, they need to get the parts out of our lectures where the instructor says, "OK, all of this is good and everything, but what the TRE really wants to see is..." Then, they may be able to plan against us.

On my second boat, the CO provided scripts to all of the major players for engineering drills, The OOD, Engineering Officer of the Watch, Engineering Watch Supervisor, and all other major players were given detailed guidance on how to respond to a wide gamut of casualties and evolutions. This guidance included verbatim instructions on what word to pass, who to pass it to, and when to pass it. It left absolutely no room for error or independent thought. The watchstanders were little more than trained puppets, capable of fighting the pre-planned casualties quite well. During our ORSE workup, the captain's drill comments were invariably of the form "The watchstander failed to use the words contained in the drill supplement to the Engineer's (or CO's) standing orders." We got an excellent on that ORSE, since the CO got to pick what drills were given to what watch sections. It took him hours to figure out what watch team could follow which script best based on what drills were scheduled. I do not think that all ships of the force prepare for inspections to this same degree. However, my experience during ORSE on three ships

under five commands leads me to believe that inspection preparation follows the above outlined format to some extent. Indeed, inspections are currently seen as the goal in the Submarine Force, not as a means of measuring performance. In fact, submarine COs seem to feel that inspection results are the single most important factors on their fitness reports and hence at a promotion board. The Submarine Force has lost its perspective on the relative importance of inspections versus the development of tactical and operational expertise. This is not the first time this has happened to our relatively young community.

We learned a lesson written in blood at the beginning of the Second World War. We had just spent 22 years in relative peace. Our war fighting skills were virtually nonexistent. Our Commanding Officers and most of their crews were incapable of performing at the level required for the conduct of war. And yet, these same COs and crews regularly passed all required inspections. It took the Submarine Force almost two full years to weed out the non performers and give commands to warriors who could and would fight their ships the way that they had to be fought. During those two years, we lost the lion's share of the 52 submarines that never returned from patrol. Looking at how inspections are performed in the current Submarine Force leaves little doubt as to how this turn of events came to pass. Our Submarine Force does not train to perform its mission. It trains to pass inspections. We do not have the luxury to spend two years at the beginning of the next war to unlearn how to pass inspections and learn how to fight our ships. The next war will not last two years. Unless we are ready at its inception, we will not survive it.

Our goal in training and operations should be to develop the submarine and its crew into an optimal war fighting unit. Such a unit could and would routinely receive scores of outstanding on ORSE and TRE. The converse of this statement is not necessarily true. To fight a war, the crew must be ready to respond to numerous, usually dangerous and short fuse, external stimuli. They must be able to draw on their experience and knowledge base to determine the proper course of action in any situation. They must be able to improvise in the absence of proper materials and equipment, and in the face of mortal danger. No script will exist to guide watch officers through the events in which they are immersed. More importantly, a war experience will not follow the regular, formatted inspection routine that ships prepare for.

I am not advocating the elimination of inspections in our Force. Many requirements, the most important of which is maintaining the public trust, require that we periodically, and somewhat regularly, open our hatches for an external inspection. However, we must examine the conduct of and the reasons for these inspections. During an ORSE, the Fleet Commander's Nuclear Propulsion Examining Board (NPEB) comes down to the ship and through level of knowledge exams, interviews, admin reviews, and drills, determines if the crew can safely operate its nuclear propulsion plant. TRE teams have undergone several evolutionary changes, but now consist of a Type Commander's Inspection Team. This team comes down to the ship, and through level of knowledge exams, interviews, admin reviews, and drills, determines if the crew could safely and effectively operate and fight its ship. While the formality of TRE admin review and interviews is not the same as that of the ORSE, the inspections are conducted in virtually the same way. In both cases, the ship is underway for two to three days in order to conduct the inspection. These inspection results are used throughout the chain of command to determine the readiness of our ships.

Periodic inspections are required to ensure that our crews meet the minimum requirements to operate properly and safely and fight their ships. However, these inspections are commonly scheduled several years in advance. The intense, specific preparation for the inspection does little to bear up the premise that the inspection results reflect the ability of the crew to operate proficiently on a day-to-day basis. One solution to this problem already exists in the current inspection routine; the surprise ORSE is useful to test ships without benefit of a longer ORSE workup. It actually helps to determine if the ship is capable of conducting business safely on a day-to-day basis. Normally, ships do very well on a surprise ORSE, even though their grades are not as good as they might be on a normally scheduled ORSE. The reason for this discrepancy is the aforementioned ORSE workup.

Any submarine that is scheduled to undergo an ORSE spends three to ten weeks preparing for the inspection. On board my second submarine, this workup started the day we left on patrol, two months prior to the start of the inspection. For the first two-thirds of the patrol, the crew performed two drill sets a day five days a week, a four or five hour field day every week, and between six and twelve hours per man of training every week.

This was in addition to all normal underway routines. During the last several weeks, we shifted to three drill sets a day, five days a week, added a few extra field days, and increased the training load. On my first patrol, the whole crew then stayed up for the last 12 hours prior to the inspection cleaning the ship's engine room. During this entire time, we performed no more than the absolute minimum required number of drills other than nuclear engineering drills, This equates to about 1 in 14 drills. Needless to say, we were on an ORSE patrol. That ship would have been capable of fighting a war, but it was not optimally prepared. No consideration was given to making it optimally prepared, since the *inspection du jour* was an engineering inspection. When some of the junior officers aboard pointed out this apparent discrepancy, the XO's position was that the ship was not a war fighting platform—it was a training and inspection platform, and it was wasteful to perform training that did not directly bear on the upcoming inspection. The ship did well on that inspection, but our performance in front of the NPEB did not reflect our ability to operate the reactor plant day to day, nor did it demonstrate our ability to combat reactor plant casualties.

I believe that the current inspection policy is misguided and suboptimal. However, it strives to perform a valuable and necessary function. The fundamentals of a good program are present, but the process can be greatly improved. I propose the following changes to the current policy of conducting ORSEs and TREs.

- Combine the ORSE and TRE as a single submarine tactical mission performance inspection.
- Do not publish the inspection schedule in advance; do not provide ships with more than 72 hours notice of an impending inspection.
- Change the inspection periodicity. Require an inspection every 8 to 22 months with an average interval of 14 months for the Force as a whole.
- Change the grading criteria to SAT or UNSAT. Allow for specific comments to be made in any examined area.

The above alterations are sweeping changes and will require much effort to implement. I feel that this effort is worth it, since the new inspections will foster a Force which is more capable and

proficient.

The single greatest change is to combine the ORSE and TRE. This step will ensure that the ship will not spend an inordinate amount of time concentrating on a single area of operations; that training time and drills are directed toward simultaneous achievement of all mission objectives. The ships will not have to get underway twice for these two inspections, and will be able to meet a more flexible schedule. As previously discussed, the two inspections are conducted in a similar manner. They could easily be integrated to be performed during the same time period, and designed to complement each other. In addition, provision could be made to place engineering drills and procedures in the context of ship operations and mission requirements and vice verse. This also allows the ORSE a natural incentive to change some of its operating precepts. The interview and level of knowledge phase of TRE takes place as inspectors observe watchstanders standing watch. They critique actions taken and discuss watch routine and motives in spot checks with random watchstanders. During an ORSE, each and every watchstander is placed in a one-on-one, off watch, decidedly uncomfortable position with an inspector. This technique may be more efficient, but it does not examine how the ship is actually operated. The formality of such an interview does little to ensure that a clear picture of conditions and practices aboard the ship is obtained. Furthermore, ORSE drills are run sequentially on each watch section in quick succession. Everybody knows a drill is coming; and the crew does not respond as they do in a real casualty. By conducting all drills sporadically throughout the inspection, a better idea of crew preparation will be determined. We will get away from having the Casualty Assistance Team standing by in the Machinery Room, the Fire Team dressed out in fire fighting gear with emergency breathing apparatus at the ready, and other unrealistic scenarios. The ability of the ship to combat simultaneous casualties fore and aft could also be determined.

By removing the long lead time scheduling, the squadron and group can exercise more flexibility in mission and inspection scheduling. In addition, crews will not train up specifically for an inspection. This will allow the inspection team to gain a clearer picture of how business is actually conducted aboard the ship. It will stimulate the crew to being consistently ready to perform their jobs. No longer will ship readiness follow a sine curve which

peaks at the time of an inspection then falls off. In addition, by removing the once a year for each ship requirement, there will be little ability to *game* the system and guess at the timing of the inspection. The prudent CO will simply ensure that his crew is consistently prepared for the inspection. The desired corollary is that the ship will be consistently prepared to effectively carry out its mission. By requiring an average periodicity, the Force as a whole can ensure that it continues to meet the minimum requirements of readiness.

Changing the grading requirements to SAT or UNSAT will remove much of the stimulus to place inordinate emphasis on inspection results. CO fitreps, Battle E designations, and readiness determinations can be made based on actual performance, not the grades of an inspection team. Many if not most of the sailors in the Submarine Force want to be graded on their performance over the entire year, not on the results of a two day inspection.

The culture of ORSE, TRE, and other periodic inspections is ingrained in the psyche of the Submarine Force. We as a whole need to recognize both the good and the bad that these inspections do to the readiness of the Submarine Force. I realize that no system of inspections will be perfect. I believe that the changes outlined above will improve Force readiness and provide a better means to measure our ability to perform our mission. ■

THE MODERNIZATION OF CHINA'S SUBMARINE FORCES*

by LCDR Duk-Ki Kim, RKN

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The Chinese realized that with an accelerated force modernization program, they would be the only ones to fill the power vacuum which now exists in Southeast Asia as a result of the end of the Cold War. During the 1980s, furthermore, three incidents helped speed up the People's Liberation Army's (PLA) doctrinal change to one designed to deal with local, limited or peripheral wars in the south and which involves the use of combined-arms forces offensively. The first two were heightened tensions along the Sino-Indian border in the Spring of 1987 and Sino-Vietnamese border tensions the same year. The third was more serious, when Chinese and Vietnamese frigates clashed in the Spratly Islands in the South China Sea on 8 February 1988. On 14 March, another naval engagement took place in which 120 Vietnamese sailors were killed.[1] The PLA has been pushing to acquire more up-to-date weaponry since 1989.

At the fourth session of the 7th National People's Congress (NPC), which was held in March 1991, proposals for the advancement of military modernization were raised in successive speeches by representatives elected to the Congress from the military. This trend was influenced by appropriate lessons from the defeat of Iraq's Chinese-style army by the West's superior technology in the Gulf War. During 1991, the first warship-borne helicopter force began operations as a formal detachment of the Navy. In

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* *Editor's Note: For a brief survey of China's relative position among present and future submarine powers, see* ***THE SUBMARINE REVIEW****, October 1996, Book Review of Jane's Fighting Ships 1996-97.*

[1] For a Chinese version of the maritime clash, see Ji Guoxing, "China's Modernisation and Security Policy", Asian Defense Journal (hereafter ADJ), No. 10/88 (October 1988), pp. 55-58, and Jean V. DuBois, "New Direction in Chinese Strategy", International Defense Review (hereafter IDR), Vol. 22, No. 11 (1989), p. 1484.

February 1992, furthermore, the NPC passed The Territorial Water Law defining China's maritime boundaries, which reasserted its claims to the Spratly and Parcel Islands, as well as the Senkaku (Diaoyutai) Islands. It is represented by China's neighbors as evidence of aggressive expansionism, and could be seen as an attempt to draw a *line in the water* in response to developments like the angry Taiwanese/Japanese exchanges over the Senkaku Islands in 1991 and growing charges of piracy and disorder in the East China Sea. In April 1992, a Chinese Navy Deputy Commander was quoted in the Chinese press as saying that it was high time China readjusted its maritime strategy and made more efforts to recover the oil and gas resources in the South China Sea.[2] Recently, there is no doubt that, as a result of the Spratly situation, the Navy figures prominently in military modernization. But even more significantly, the PLA Navy's capability to protect sea lanes of communications (SLOCs) and its power projection capability will make the Navy a key element in future Chinese military strategy.[3]

Maritime Strategy

During the 1980s, the Chinese gave up the Maoist doctrine of *people's war*, which relies on ill-equipped man power to go against any enemy invasion. In June 1985, the Chinese changed their military strategy from a focus on general war to fight *local and limited wars* around their strategic borders. Chinese military officials have known that "wars for the remainder of the century would be small and intensive, would increase due to the growing military strength of regional power and would be located around China's periphery".[4] Since 1987, China's military strategy focused on five types of limited wars, two of them are important: (1) small-scale conflicts restricted to contested border territory; and (2) conflict over territorial sea and islands. Thus, they are

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[2] The International Herald Tribune, June 19, 1992.

[3] Jean V. DuBois, "New Direction in Chinese Strategy", *op. cit.*, p. 1488.

[4] Philip L. Ritcheson, "China's Impact on Southeast Asian Security", Military Review, Vol. 74, No. 5 (April 1994), p. 46.

trying to build up the Navy and Air Force, and concentrate on technology and quick-strike forces.[5] In the end, China has claimed sovereignty over all the islands, bays, sandbars, banks, and islets in the South China Sea. China has not only used violence to support its claims and national interests but also made clear that it will pursue them.

China appears committed to improving its naval force structure in order to prosecute its territorial claims in the South China Sea and to support its other interests. Its PLAN currently possesses only coastal (or near-coastal) capabilities, but relaxation of tensions with Moscow has allowed the Navy to build toward a blue-water navy. Concomitantly, the Navy has developed a new *offshore defence doctrine*, intended to effectively control territorial waters extending to the boundaries of its 200 mile EEZ, "although it stretches to more than 1,000 km in the South China Sea if the Spratly are included".[6] In April 1992, Admiral Zhang Xusan, the Navy Deputy Commander-in-Chief, publicly outlined a shift in military strategy when he said that it was "high time" for China to readjust its naval strategy and make greater efforts to recover South China Sea oil and as disputes. Admiral Zhang added that his forces were ready to "offer assistance to the economic development" of the area, including the disputed Spratly Islands.[7]

Recently, the Chinese have considered the Navy as a major

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[5] For more comprehensive analysis of this point see, Paul H. Godwin, "Chinese Military Strategy Revised: Local and Limited War", The Annals of the American Academy of Political and Social Science, Vol. 519 (January 1992), pp. 191-201; "Changing Concepts of Doctrine, Strategy and Operations in the Chinese People's Liberation Army 1978-1987", China Quarterly, No. 112, (December 9187), pp. 578-81; "Asia's Arms Race: Gearing Up", The Economist, Vol. 326, No. 7799 (20 February 1993)' p. 24; Michael T. Klare, "The Next Great Arms Race", Forvign Affairs, Vol. 72, No. 3 (Summer 1993), p. 143; and Osamu Namatame, "Crisis China and the Security of East Asia", Global Affairs, Vol. 4, No. 4 (Fall 1989), pp. 100-101.

[6] Tai Ming Cheung, "Emerging Chinese Perspectives on Naval Arms Control and Confidence-Building Measures" *op. cit.*, p. 10.

[7] He confirmed that the armed forces were engaged in further group reductions, with the focus being shifted toward modernization of the navy, including efforts to build a powerful ocean fleet. See Strait Times, April 7, 1992, and Far Eastern Economic Review, April 1995, p. 20.

element for protecting their sea channels, and as assuming greater significance for national security and economy. In addition, the development of naval power, which Chinese analysts considered a weakness for China's defense, is being given priority compared to those of land and air power in order to not only keep the Spratly Islands, which are coveted by other Southeast Asian countries but also protect their underlying natural resources. The Navy's missions can be divided into four areas as follows: sea denial and control; the protection of SLOCs; projection of its power and presence; and a peacetime instrument of foreign policy means. In a major war or peacetime, the Navy will be heavily engaged in their performance of four overlapping missions.

The History and Modernization of Submarines

The naval forces of the PLA have improved their capabilities substantially, with annual budget increases. The build-up of China's naval capabilities is a strong indication of military strategy designed to back up its territorial claims in the South China Sea. China's strategic perspective for defense modernization in the 1990s aims at equipping its naval force with modern technology in order to win local and limited wars in the next two decades. Even though the Navy posesses *brown water* capabilities, it is today successfully developing *blue water* capabilities, especially in respect to nuclear submarine strength. Furthermore, *sea denial* and *naval presence* capabilities will influence China's effort for economic and maritime modernization in the next two decades as they concentrate on improving their SSBNs, SSNs and patrol submarines. So that the Navy can develop a better strategic force as well as improved ASW capabilities which a modern patrol submarine fleet would possess.

The development of China's submarines depended on Soviet technology in the 1950s, but Beijing moved to have a capability of making their own way into the nuclear age. They launched their first SSN of the HAN class in 1972 and 20 years later deployed five. About 100 meters long, they displaced some 4,500 tons surfaced and could reach maximum 25 knots underwater on power supplied by a pressurized water reactor. This submarine enabled the Navy to keep one SSN in an operational status and gave it a theoretical capability for sustained long range interdiction and surveillance operations.

The Navy continued to place development of its submarine forces as a top priority. The modernization program was marked by further progress in October 1982, when a submarine-launched ballistic missile designed for the new SSBN made a successful test flight amid much public concern. The Chinese submarine force is the third largest in the world. There are an estimated 90 submarines, including two strategic missile submarines (one Xia class SSBN and one Golf class SSB); five Han class (SSN) attack submarines; one cruise missile submarine (SSG); and 80 patrol submarines which include 27 reserves. The details for the modernization of submarines are as follows:

Type	Class	Number	Completed	Displacement	Armament
SSBN	Xia	1	1987	7000 tons	12 Julang-1 SLBM. Six 5333 mm TT
SSN	Han	5	1974-91	5000 tons	Six Ying Ji SSN. Six 533 mm TT
SSB	Golf	2	1982	2350 tons	One Ju Lang-1 SLBM. Ten 533 mm TT
SSK	Song	1+2	1995	1700 tons	Six 533 mm TT
SS	Ming	13	1976-93	2100 tons	Eight 533 mm TT
SS	Romeo	65*	1974-	1475 tons	Eight 533 mm TT
SSG	Modified Romeo	2	1987-	1650 tons	Six Ying Ji SSM. Eight 533 mm TT

* 27 units are in reserve. Source: Captain Richard Sharpe, RN (ed.), Jane's Fight Ships, 1996-97, (Surrey: Jane's Information Group, 1996), pp. 116-17.

Nuclear Powered Submarines

The Navy has one Xia class SSBN (Type 092, 6500 tons). This class represents a considerable improvement over the Golf construction of the first XIA begun in 1978 and completed in

1987. A milestone in development was the successful launch of a Juilong (JL)-1 (Sea Dragon) SLBM from the submerged XIA in September 1988. The Navy hailed the launch as an important step towards an operational, sea-based deterrent, although it is believed to be the only test firing of the JL-1 so far. Navy officials say the XIA can carry up to 20 missiles with an underwater endurance of three months, although Western analysts count only 12 missile tubes on the submarine. Some analysts believe, however, that the Chinese have limited production of the XIA, which is able to accommodate a more powerful multiple-warhead SLBM, expected to begin production in the mid 1990s.[8] The first of a new class (Type 093) is expected to start being built in 1996/1997 but this may be delayed. This class has a larger displacement than Type 092.

The Han class (SSN), which entered service in August 1974, marked a major boost in China's submarine capabilities. Its range and endurance almost double the Romeo class. At the end of 1985, a Han sailed submerged for more than 20,000 nautical miles and 84 days to test its maximum endurance capability.[9] Although it was proudly noted that this surpassed the record of the U.S. nuclear submarine NAUTILUS, it only emphasized that the Han lags some 25 years behind U.S. and Soviet technological levels. Because of serious technological and safety problems, including radiation leakage, the Hans have been largely limited to short voyages. Only three of these early generation Hans were built between the 1970s and the early 1980s.[10] Subsequent improvements to iron out major problems saw the resumption of production in the latter half of the 1980s, with two improved Hans believed to have been built, the newest vessel being commissioned in 1991. Over the next two decades, China will continue to

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[8] Gene D. Tracey, "China's Navy in the 1990s", ADJ, No. 10/89 (October 1989), p. 44.

[9] "Reports Visit Nuclear Submarine Base", Jianchuan Zhishi (Naval and Merchant Ships), 8 August 1989, in FBIS/China, 31 January 1990, pp. 62-63/

[10] Chinese and Western naval analysts say that funding for the Han program was so tight, appropriations for the fourth Han, which is estimated to cost, excluding electronic systems and weapons, at least Rmb 300 million (U.S. $65 million), was stretched out over seven years.

develop nuclear powered submarines with initial work under way on a follow-on to the five-strong Han class of attack submarines and a follow-on to the single Xia class SSBN.

Conventional Submarines

Even the Romeo class has been updated since it was completed in 1962, these submarines still remain an increasingly outmoded 1950s design. Their maximum endurance is limited to 7000 nautical miles and 35-45 days at sea. The Ming class (SS), first launched in 1975, was intended to improve upon the Romeos. Since 1975, China has been producing two kinds of indigenously designed conventional submarines, such as the Ming and the advanced Ming which are built with 1950s technology, displacing 1594 tons surfaced.

Recently, the modernization of conventional submarines is based on two main categories: purchase of Kilo class submarines from Russia and an upgrade program for the Song and Ming class submarines. Acquisition of advanced arms from Russia has accelerated this process, highlighted in February 1995 by the delivery of the first of four Kilo class diesel electric submarines, known as Type 877 EKM, including the transfer of technology methods and production to China.[11] In March 1995, furthermore, China decided to purchase six Kilo class submarines from Russia. Thus, the Navy's submarine service will be able to fully exploit the potential of these submarines through deployment at the Zhanjian South China Sea Fleet base.[12] Some reports contend that China may ultimately obtain up to 22 Kilos, but sources with a closer knowledge of the program dismiss this. The number is

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[11] Two 877 EKM types for export purposes and the other two new 636 type, which have never before been sold to any other country. Lien Ho Pao, "Newly Purchased Russian Submarines Transits Taiwan Straits", Hong Kong Newspaper in SWB, 22 February 1995, p. FE/2234, G/5; and Jane's Defence Weekly (hereafter JDW), November 19, 1994.

[12] "China Planned to Purchase Six Attack Kilo-Class Submarines from Russia", Bukbang Ilbo, 6 March 1995, p. 2; and Paul Beaver, "China Plans Its Greatest Leap Forward", Jane's Navy International (July-August 1995), p. 11.

likely to stay at six and ten Kilos.[13]

The second category of the submarine modernization plan covers an upgrade of the Ming class (Type 035) patrol submarines, of which 11 are active. These submarines are equipped with few electronics and primitive mountings for the main machinery. The upgrade program has been undertaken with the help of Israel. Israel may also be involved with the Song class program that should form the major Chinese conventional submarine in the future. This ship is expected to include technology from both the Kilo and the Israelis; the first of which was launched at the Wuhan Shipyard in May 1994 and started sea trials in August 1995. This class is the first new diesel electronic design to be developed by China in over two decades. The Song class is also expected to be able to fire anti-ship missiles when submerged.[14] This class will eventually replace the Romeo and Ming classes.

While the Chinese have mastered the basics of conventional and nuclear submarine design, the pace of development of tactical models appears to have been slowed in the 1980s. On the other hand, the Navy has approached several countries in an attempt to remedy shortfalls in modern submarine systems. In 1985, for example, the Navy bought a French DUUX-5 sonar which is in the Han class SSN, Ming and Romeo classes SSs. Over the next two decades, the Navy will continue to place development of its submarine force as top priority with a new generation of major surface combatants and an aircraft carrier plan. At the tactical level, it believes that its submarines can help achieve a relatively large operational radius of action, reaching the first islands of the South China Sea. At the strategic aspect, the nuclear submarine force is regarded as the PLA's most reliable second strike deterrent.

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[13] You Ji, "The Chinese Navy and Regional Security", *op.cit.* pp. 12-13; and Robert Sea-Liu, "Submarine Force Priority for China's Modernisation Plan", JDW, March 18, 1995, p. 3.

[14] You Ji, "The Chinese Navy and Regional Security", op.cit., pp. 12-13; and Robert Sea-Liu, "Submarine Force Priority for China's Modernization Plan", JDW, June 6, 1995, p. 18.

Conclusion

China continues to improve its military capability, particularly its Navy. It is now foreseeable that submarines will be the key to Chinese sea power.[15] After reviewing a naval exercise and a military review in 1995, Chinese President Jiang Zemin, also Chairman of the Central Military Commission, stressed the importance of improving the Navy and accelerating its modernization to ensure coastal defenses. He also said that, "The current situation has placed new requirements on consolidating the Navy."[16] Recently, Chinese interest in acquiring modern attack aircraft carriers remains a priority with military professionals. In addition, China is interested in the acquisition of frigates, corvettes and surveillance systems for maritime patrol boats and warships, submarines and ASW technology.[17] For example, China's defense budget has been increased for consecutive years to 13.8 percent. Furthermore, Chinese military acquisition and modernization strategies will make easy power-projection operations and help establish a *blue water navy*.

Over the next two decades, China will pose the most complex submarine challenge outside of Russia as a result of its commitment to increased training, the steadily expanding scope and complexity of its exercises, and an active acquisition program targeted at modern technology. ■

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[15] Paul Beaver, "Carriers Key to Chinese Air Power", JDW, September 25, 1993, p. 23.

[16] "Navy's Role Highlighted", Beijing Review, Vol. 38, No. 45 (November 1995), p. 5.

[17] For more detail of China's modernization programs including air forces, see Edmond Dantes, "The PLA Air Force Build-Up: An Appraisal", ADJ, No. 11/92 (November 1992), pp. 42-44; and Tai Ming Cheung, "Loaded Weapons: China on Arms Buying Spree in Former Soviet Union", Far Eastern Economic Review, Vol. 155, No. 35 (September 1992), p. 21.

THE IMPROVED LOS ANGELES CLASS FAST ATTACK SUBMARINE
A Fleet Submarine for the '90s and Beyond

by LT Kelly D. Price, USN

A Naval Submarine League/Submarine Advanced Officers Course Essay Contest winner.

Rear Admiral Edgeman[1] was relaxing in his office reflecting on his naval carrier, a lifetime made evident by the myriad of photographs scattered throughout his large office. There were snapshots of individual ships and battle groups to which he had been assigned. There were obvious differences between the photos of battle groups of the '70s and the joint task forces of the '90s. The photograph of the REAGAN task force, which he had the distinction of commanding, displayed how these forces have grown leaner and become more joint in the last decade. This picture also showed something much more distinct—leading the way of the mighty REAGAN was the sleek outline and large wake of an improved Los Angeles class fast attack submarine (688I). Also prominent in this snapshot were the additional two 688Is flanking the carrier. Rear Admiral Edgeman remembered that fall day when his task force assembled off the coast of Virginia. He also recalled the feeling he had when the trio of submarines were ordered to break formation. As the submarine drew away from his flag ship he couldn't help but see the three SSNs as his personal wolf pack. He realized he was experiencing some of the same emotions Grand Admiral Doenitz had felt during World War II.

This moment of reflection was suddenly broken when Captain Steve Jones, the admiral's Chief of Staff, and Commodore Brian Smith, the Destroyer Squadron Commander, entered his office. The Chief of Staff handed him an urgent message from the Fleet Commander. These orders gave direction for the REAGAN Battle Group to prepare for immediate sortie. It seemed that the President had opted for military action against the radical

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[1] Although the names throughout this story are fictitious the author incorporated those positions within the battle group hierarchy which, based on recent coordinated operations experience, contained major submarine proponents.

fundamentalists of Vulgaria. The Vulgar's kidnapping and torture of 150 foreign nationals, many of whom were Americans, was more than the Commander-in-Chief could endure.

Although the first words out of the President's mouth had been, "Where is the nearest carrier?", the first words out of the admiral's mouth were, "Where is our nearest submarine" "HAWKBILL is just two days out and..." The admiral cut off the Chief of Staff in mid sentence. "That's nice, Steve, but I want to know about our nearest submarine!" The boss was not using the term our to mean a collective United States asset but a possessive our, to mean his asset. "Well, HAMPTON is four days out, three if we pushed her hard", responded Commander Ray, who himself had been in just such a position six months ago as Commanding Officer of SPRINGFIELD during the last Vulgarian uprising. "Well, call SUBLANT and get her headed that way!" barked the admiral, "and have SEAL Team Nine embark BOISE. We will need them in position at least three days before D-day. Get everyone working this problem, Steve. Brian, bring your Chief Staff Officer over here to work the sea combat aspects of this operation with my people."

None of the admiral's statements were meant to demean or insult HAWKBILL. It was just that the admiral wanted his submarines in this fight. He was a sports oriented man and knew the benefits of good teamwork. His submarines were members of the REAGAN team; maybe even the most valuable members. These 688Is had operated extensively with the battlegroup over the last year. The admiral was familiar with the commanding officers and knew the capabilities and limitations of each crew. The boats in turn knew what was expected of them by the battlegroup commander and each of his warfare commanders, and felt extremely comfortable operating with the men and women of REAGAN, her aircraft and escorts.

The staff immediately broke up into separate elements and began to tackle the huge task of getting the force to sea and developing the plan that would send a definite message to the Vulgarians. Although the country of Vulgaria was not a super power, like most Third World countries their naval capability was not insignificant. Two new diesel submarines with capable torpedoes, four aging frigates and 25 fast patrol boats equipped with surface to surface missiles, and 30 fighter bombers, which recently have been observed conducting anti-shipping exercises,

were just a few of the problems the staff would have to develop potential counters for in the next week. Meanwhile, Lieutenant Commander Dell, the battlegroup submarine liaison officer, picked up the secure phone and called SUBLANT. He concisely described what would be needed from HAMPTON and BOISE. The COMSUBLANT watch officer had the subs headed in the right direction within a few hours and control of the boats would be shifted entirely to the battlegroup commander within 24 hours.

Although this scenario is fictitious, and may appear more like a Hollywood script than an actual dialogue within a naval organization, this feeling of ownership and respect for submarines' capabilities could well be repeated by any current battlegroup commander. The fast attack submarine in general, improved 688s in specific, have literally burst on the battlegroup scene. The 688I's stealth and unlimited endurance have immediately opened up the commanders' options. To coin a well used phrase, the SSN is a true *force multiplier*. Even George Will has become a submarine proponent, declaring that, after the victories in the Cold War, submarines may have replaced aircraft carriers as the capital ship, "those vessels that when present, control the sea".[2] As the focus of the Navy shifted from blue water to littoral warfare the contribution of the submarine to force defense has increased significantly. Rear Admiral Ya'ari, of the Israeli Navy, describes the benefit that a submarine in the littoral provides as one of "bidimensional maneuverability"[3]. Surface units, who must deal with extremely short detect-to-engage timelines, are much more at risk in the littoral while "a submarine's unique maneuverability can reduce exposure dramatically while maintaining a constant effective presence offshore. This brings the risk imbalance back to a workable equilibrium".

A 688I submarine brings more to the table in terms of capability than any other single platform within the battlegroup. Submarine builders are openly marketing 688Is as battlegroup assets proclaiming, "Every battlegroup commander should bring a

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[2] G.F. Will, "Wonders of the Deep". Newsweek, 4 September 1995, p. 68.

[3] RADM Yedidia "Didi" Ya'ari, Israeli Navy, "The Littoral Arena—a Word of Caution". Naval War College Review, Spring 1995.

concealed weapon. A submarine." And "Why assign submarines to battlegroups? It's simple, they add depth."[4] A 688I can play a significant role for any warfare commander, whether it is undersea warfare (USW), surface warfare (SUW), strike warfare (STW), air warfare (AW), or command and control warfare (C^2W). The 688I can also play an extensive role in special operations. This submarine, in a short time period, has become totally integrated into the mind set of battlegroup staffs and can only continue to expand their role in the future. Before discussing the advantages of a 688I in detail, it might be useful to discuss the general issues associated with recent Submarine Force integration into coordinated operations.

How is it that the Submarine Force, with improved 688s leading the way, experienced success integrating into battlegroups while other forces, P-3s for example, continued to stay on the periphery of coordinated operations, never really breaking out of the Cold War mold? This success can be grouped into three distinct categories. First, the ground work for success was put into place by insightful senior leadership who recognized the need for and benefits of coordinated operations. Secondly, key players accepted the challenge of this totally new mission and immediately displayed innovative tactical thought and flawless execution. Lastly, and most importantly, the 688Is which have conducted integrated operations are extremely efficient warships capable of carrying out the most demanding assignments.

Senior Leadership

Early in the development of coordinated operations it was recognized that it was beneficial to assign experienced submarine officers as advisors to the principal commanders who would have the most control over submarines. To ensure the safety of the waterspace management of assigned submarines a post-command submarine officer was added to the battlegroup staff. This officer provided a submarine presence of equal seniority to the other principal advisors on the Admiral's staff. These dynamic

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[4] General Dynamics, Electric Boat Division advertisement displaying a surfaced 688I. This advertisement appears in numerous periodicals including THE SUBMARINE REVIEW and Naval Institute Proceedings.

commanders and captains provided the fire power necessary to maintain maximum utilization of battlegroup submarines. These officers, through hard work and charisma, greatly expanded their roles on the battlegroup staff beyond what was originally envisioned. Currently, many of these officers hold the position of Command and Control Warfare Commander. In becoming not only senior advisors but warfare commanders they have established themselves as peers of the Air Wing Commanders, Cruiser Commanding Officers, and Destroyer Squadron Commanders.

Senior submarine leadership also directed extensive review and development of tactics associated with the conduct of coordinated operations. The current version of the Coordinated Operations Manual is one of the best written and most understandable tactical documents in the fleet. Additionally, Submarine Development Squadron Twelve continues to work with other warfare centers of excellence to provide new and innovative tactics for use in coordinated operations. In general terms, senior submarine leadership embraced coordinated operations as another SSN mission area and provided the necessary effort to ensure its success. It is only a matter of time before a submarine flag officer will command a battlegroup.

Key Players

Throughout the Cold War, SSN commanding officers relied heavily on intraship teamwork to become successful. As an offshoot, battlegroup submarines have had minimal trouble adapting to the intership teamwork characteristic of coordinated operations. This environment relies on each platform to provide the give and take necessary to maximize the capability of the Force. All SSNs which have conducted extensive coordinated operations have shown the capability to change an operational mind set. Officers and senior enlisted personnel became involved in planning with their battlegroup counterparts. This direct interaction and teamwork greatly advanced coordinated operations.

Much of the day-to-day control of submarine tasking and waterspace management is conducted by the Battlegroup Submarine Liaison Officer (SLO). The SLO, in combination with the Destroyer Squadron USW Officer, are the principal submarine officers who work with their counterparts to develop warfare plans. Much like the post-command submarine officer, these

individuals have expanded the scope of their involvement in tactical decisions. As tacticians they developed into more than just a liaison officer or advisor. Using extensive knowledge of force capabilities they became key planners in the areas of undersea, surface, and strike warfare.

Platform Capabilities

In the past two years, improved 688s greatly extended the support role characteristic of the first years of coordinated operations. Examining each mission area it rapidly becomes obvious why the 688I became totally integrated in task forces and grew into such an important component of battlegroup littoral warfare. In addition to the below mentioned factors, add the important aspect that the SSN is the only platform which can conduct any of these missions prior to the achievement of air supremacy/superiority.

Undersea Warfare. The SSN is the perennial leader in this area of warfare. Very few battlegroup commanders will take surface ships purposely into known submarine operating areas. Recent advances in anti-diesel tactics coupled with the 688I's BSY-1 sonar have allowed for rapid shifting from open ocean USW to littoral operations. The ADCAP torpedo remains the weapon of choice against a diesel submarine in deep or shallow water.

Surface Warfare. The SSN provides the capability directly to observe sorties from port and engage surface units prior to their coming within range of surface assets. The heavyweight torpedo, in most circumstances, is the weapon of choice against medium to large surface combatants. Anyone who has seen the video of a Mk 48 torpedo versus a destroyer will understand why.

Strike Warfare. A 688I with vertical launch capability routinely carries a substantial percentage of the battlegroup's Tomahawk inventory. In addition, SSNs are the only platform which can rapidly shift missions. As a result, 688Is became the strike planners choice for last minute changes or backup assignments.

Air Warfare. The forwared SSN's ability to detect early the launch and intentions of hostile aircraft gives the AWC a great advantage in the near land air battle.

Command and Control Warfare. The surveillance capability of the SSN remains one of the principal missions assigned to

battlegroup submarines. The capability to exploit signals propagating within the evaporative duct remains unique to SSNs.

Special Operations. The SSN is the platform of choice for SEAL and Marine Force Recon insertion/extraction. Special forces are confident that if they are inserted by an SSN then the submarine will be there to extract them. Important to the carrier aviators, the SSN can provide combat search and rescue operations.

Future Innovations

Given the constraints of the current Navy and government budgets, building enough new submarines (Seawolf class and New SSNs) to continue with current mission loading while decommissioning 688 class submarines with useful ship life remaining may not be viable. Currently there are several innovative programs which if implemented on 688Is would greatly benefit submarines working within a battlegroup and extend their useful lifetime well into the next century.

Advanced Communication Systems. Higher frequency communication systems are already being installed on surface ships and submarines. These systems will eventually allow voice and video communications ship to ship and ship to shore at much higher data rates than are currently available.

Off Hull Sensors. Recently a submarine demonstrated the ability to video link with and control an unmanned aerial vehicle. In addition, a plan is envisioned to equip SSNs with an unmanned undersea vehicle.[5] Both of these sensors will greatly enhance a submarine's surveillance capability.

Naval Surface Fire Support. The Navy is conducting a feasibility study to determine if the Army Tactical Missile System can be launched from a SSN.[6] This will provide a 688I with not only a deep strike capability (Tomahawk) but also a capacity to

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[5] James E. Miller, "Submarine Launched Unmanned Undersea Vehicles: A Rationale for Operational Utilization with Concepts for Shipboard Integration". THE SUBMARINE REVIEW, January 1995.

[6] RADM D.A. Jones, USN, Office of the Chief of Naval Operations (N87), address to the Naval Submarine League, Ft. Meyer, VA, 8 November 1995.

provide real time support to ground forces, expanding the already growing SSN support of amphibious and joint operations.

Conclusion

The 688I is currently a significant battlegroup asset, and will remain so in the foreseeable future. Although this platform's capabilities and the men who operate them are phenomenal, this rapid and smooth integration into fleet operations could not have happened without a radical change in submarine tactical perspective. From senior leadership to the key players involved in coordinated operations everyone recognized an opportunity was at hand to realize the long-held dream of submarines to work directly with the main battle line of the Navy. Maximizing the synergy of the Force required a change of the Cold War mentality and paradigms of submarine operations of that era. The bottom line is that littoral warfare is a team sport. Submarines tasked to conduct coordinated operations must realize, like those who have made coordinated operations successful to this point, the importance of team work. Whether the assigned mission is inserting SEALs, conducting a multi-sensor search for diesel submarines, eliminating hostile surface vessels, or maintaining continuous surveillance of a port, a 688I will remain the weapon of choice for battlegroup commanders into the 21st century. In sports terms, 688Is have allowed the submarine community to evolve from a last round draft pick a few years ago into the most valuable player of littoral battlegroup operations. Move over Aegis, there is a new favorite on the team! ■

U.S. NAVY TORPEDOES
Part Three: WWII Development of Conventional Torpedoes 1940-1946

by Frederick J. Milford

As we have noted earlier, the entry of the United States into WWII led to major changes in the torpedo situation. Huge quantities were required, operational experience exposed problems in service torpedoes and there were needs for new kinds of torpedoes. In this part we consider the new conventional, by which we shall mean non-homing, torpedoes that were developed as part of the WWII research and development effort.

The explosive growth in the number of torpedoes under development, 21 distinct marks, during the four years of U.S. involvement in WWII, was remarkable. The pace was much slower, both before and after; 20 in the entire 50 years from 1889 through 1940 and only 13 since 1950. Another change was the involvement of the National Defense Research Committee (NDRC) in torpedo studies, which marked the beginning of the end of the Newport Torpedo Station's monopoly on torpedo research and development. University and industrial laboratories became involved through the NDRC. These organizations greatly expanded both the industrial capabilities and the intellectual scope devoted to torpedo research and development and became the primary performers in this realm. Torpedo production was expanded by using manufacturing firms and Government Owned Contractor Operated (GOCO) plants as well as the traditional Navy facilities. Of the roughly 64,000[1] torpedoes produced during WWII the Naval Torpedo Stations produced about 46 percent, the GOCOs about 31 percent and the industrial firms about 23 percent.

The Navy, however, did not dominate WWII torpedo research and development. Of the new homing torpedoes, which will be discussed in a subsequent part of this series, only one, the Mk 34, was developed entirely by a U.S. Navy activity. Two others were

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[1] The number quoted in Buford Rowland and William Boyd, "U.S. Navy Bureau of Ordnance in World War II" Washington: GPO, n.d. 56,653, appears to exclude homing torpedoes possibly as a security measure.

developed in joint Navy/contractor programs. In the realm of conventional (non-homing) electric torpedoes the Navy led the NTS Newport/GE/Exide team that developed the Mk 20 and worked with GE to develop the Mk 36. In addition to the Mk 34, the Navy was solely responsible for the development of the Mk 23, single speed version of the Mk 14, and the Navol torpedoes Mk 16 and 17. A Navy (NTS Newport) monopoly of the torpedo business such as existed with steam torpedoes from 1922 to 1941 disappeared and has not been re-established in the years since WWII.[2] Full scale production of torpedoes at NTS Newport ended in 1946 and the Goat Island facility was totally closed by 1951. Navy torpedo research and development did continue in the Newport area at a new facility at Coddington Cove.

Conventional (Non-Homing) Torpedoes

In addition to modifications of existing torpedoes, entirely new and significantly changed conventional torpedoes were developed. The two major areas where new developments were made were propulsion and warheads. The major propulsion developments were the use of Navol (a 70 percent solution of hydrogen peroxide, H_2O_2, in water) to supply the oxygen for combustion in steam torpedoes and the development of successful electric torpedoes. The most important, but often overlooked, warhead development was the conversion from TNT to Torpex with the attendant increase in underwater damage by over 50 percent for a fixed weight of high explosive. Altogether nine of the eleven conventional torpedoes shown in Table 1 were under development during WWII. The other two were the last two conventional torpedoes developed by the U.S. Navy and are included to complete the history of conventional torpedoes.

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[2] Occasional comments imply that the Navy was not entirely happy with the torpedo establishment. The use of *mine* rather than *torpedo* for the Mk 24 and several other weapons is sometimes claimed to have had a secondary objective of avoiding involvement of the torpedo establishment. BuOrd also delayed Bell Telephone Laboratory access to torpedoes and torpedo technology as it existed in late 1941, presumably in order to get a fresh perspective. M.D. Fagen, ed., A History of Engineering and Science in the Bell System: National Service in War and Peace (1925-1975), Murry Hill: Bell Telephone Laboratories, 1978.

Table 1

Non-Homing Torpedoes Under Development During WWII

(Service Torpedoes in Bold)

	Design and Development	Service Dates/ Total Production	Platform	Comments
Mk 16	NTS Newport & NRL	1944-1975/1700	SS	Naval(high test peroxide)
Mk 17	NTS Newport & NRL	1944-1955/458	DD	Naval
Mk 18	Westinghouse	1943-1955/9000	SS	Electric
Mk 19	Westinghouse	NIS/10	SS	Mk 18 w/electric controls
Mk 20	NTS-Newport, GE & Electric Boat Storage Bat. Co.	NIS/20	SS	Final version of El. Mk 2 (electric). Sporadic developing starting in 1915.
Mk 23	NTS Newport	1943-1946/9600	SS	Single speed Mk 14
Mk 25	Columbia U., Div War Res	NIS/25	A/C	Improved Mk 13
Mk 26	Westinghouse	NIS/25	SS	Mk 18 w/electric controls and seawater battery
Mk 36	NTS Newport & GE	NIS/07	SS	All electric, seawater battery, pattern running
Mk 40*	NOTS Pasadena	NIS/07	A/C or missile	Test vehicle, solid propellant driving gas turbine.
Mk 42*	NOTS Pasadena, NOL, NTS Newport, Penn State ORL & Stevens Institute of Technology	NIS/09	SS	Turbine powered, pattern running, etc. The ultimate non-homing torpedo.

* Mk 40 and Mk 42 were not WWII developments, but they were the last two conventional torpedoes considered by the U.S. Navy. Neither was developed into a service weapon.

Of these eleven torpedoes only four were issued as service weapons, and of these four only one, the Mk 16 survived after 1950. Further, the Mk 23 was a simplification of the existing Mk 14 torpedo that was made to accelerate production. This does not mean, however, that these torpedoes were unimportant. The wakeless electric Mk 18 sank about a million tons of Japanese shipping in the last years of WWII and the Mk 16, though not used in combat during WWII, was a standard submarine weapon until 1975.

Propulsion

Ever since Robert Whitehead invented the self-propelled torpedo, a key problem has been how to carry enough energy on board to provide the desired range and speed. Burning organic fuels, hydrocarbons or alcohols, represented a huge improvement over compressed air alone, but further progress required improved oxidants. There are two obvious problems in using compressed air as the oxidant, air is only 23 percent oxygen and storing enough air for reasonable range and speed requires air pressures over 2500 psi and consequently a heavy, high performance air flask. Two workable solutions to the oxidant problem were found before the end of WWII, the use of pure oxygen (or a mixture of oxygen and air) and the use of a concentrated solution of hydrogen peroxide in water. Each of these has been tried with varying degrees of success by several navies and high test peroxide (HTP) torpedoes are still being produced, particularly in Sweden. The U.S. Navy experimented with pure oxygen[3], but did not go very far with it. Experiments with *chemical* propulsion, that is, propulsion using energy derived from exothermic reactions, started with internal funding in 1915 at Westinghouse Electric and Manufacturing Co. and continued there with Navy funding from about 1920 until late 1926. The Navy returned to the study of

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[3] The U.S. Navy program apparently ran for about two years, 1929-1930, and produced a power plant that was dynamometer tested. The program was discontinued in favor of *chemical* power sources. Other navies also had short lived programs, but the Imperial Japanese Navy developed and issued for service several torpedoes that used pure oxygen as the oxidant. The best known of these was the 24" Type 93, known as the Long Lance which had a range of over 29,000 y. at speeds of 48-50 k and carried 1080 pounds of Type 97 high explosive (roughly equivalent to TNT in performance) in its warhead.

chemical propulsion in 1929 with a program at the Naval Research Laboratory. By 1934 Navol, a concentrated solution of hydrogen peroxide in water, and alcohol became the preferred energy source. This system produced some thermal energy from the exothermic decomposition of the hydrogen peroxide, which also yielded free oxygen. Additional energy was produced by using the oxygen to burn alcohol. The first Navol or *chemical* torpedo was a converted Mk 10 which was subjected to tank dynamometer testing and ranged at Newport. It achieved a range almost three times that of a conventional Mk 10. With this success, a Mk 14 was converted and achieved an almost four fold increase in range. These results led to plans for the production of Mk 17 torpedoes as armament for new destroyers. The program was interrupted shortly after Pearl Harbor by the need to produce standard torpedoes, especially Mk 13 and Mk 14, in an attempt to satisfy urgent fleet requirements. There was no further progress until 1943 when a re-examination of the program determined that the supply of Navol was inadequate. Plans were made for a new production plant, but it was delayed and not finally started until the fall of 1944. Also in 1943 the design of the submarine launched Mk 16 Navol torpedo, with the same envelope as the Mk 14, was begun. Solid knowledge and speculation about the very long range, high speed Japanese 24" Type 93 destroyer launched torpedo[4] probably fueled the development of Navol torpedoes. Several hundred each of Mk 16 and Mk 17 torpedoes were completed before the end of WWII, but neither saw use in combat.

The virtues of hydrogen peroxide are that it is a liquid, over 90 percent oxygen by weight as compared to air which 23 percent oxygen, and has a specific volume (volume per pound) about one-fifth that of 2800 psi air. In the decomposition of the peroxide, $2H_2O_2 \rightarrow 2H_2O + O_2$, over 48 percent of the oxygen becomes available. Thus about 34 percent of the oxygen in standard Navol (70 percent hydrogen peroxide dissolved in water with stabilizer added) is available for combustion. Navol will provide oxygen to burn about 50 percent more fuel than the same weight of air. In addition the decomposition is exothermic and the heat so produced

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[4] BuOrd OP 1507 Japanese Underwater Ordnance, April 1945 indicates that at the time of writing only one Type 93 had been recovered by the U.S. Navy. The Type 93 became famous as the Long Lance—a name that seems to have been coined by Samuel E. Morison.

is also useful for propulsion. The water in the Navol and that produced as a decomposition product are converted to steam reducing the amount of fresh water that must be carried. Essentially the entire weight of Navol is used for propulsion. Also, Navol is a liquid and requires only about one pound of steel tankage to store one pound, whereas 2800 psi air requires about four pounds of air flask per pound of air. When all of these factors are taken into account, Navol can, for a torpedo of fixed range/speed performance and size, dramatically reduce the weight and volume devoted to fuel and oxidant. The same amount of energy as provided by a pound of alcohol, air, water and tankage can be supplied by about a quarter of a pound of alcohol, Navol, water and tankage and the volumetric saving is even greater. The weight and volume so saved can be used to increase the range and/or provide for a much larger warhead. In addition, there is no inert nitrogen, the principal component of torpedo wakes, in the fuel or oxidant. The combustion products themselves are very soluble in water and so the torpedo is practically wakeless. Unfortunately, there is a risk of uncontrolled decomposition of Navol and the attendant explosive hazard. HMS SIDON was lost in 1955 to just such an accident. The comparison between the Mk 14 and Mk 16 is shown in Table 2.

Both a larger warhead and greater range were provided in the Mk 16 with no sacrifice of speed. Some other components of the Mk 16 differed slightly from those of the Mk 14, in particular, the turbine axis was horizontal rather than vertical and gearing consisted entirely of spur gears. High pressure air, to pressurize expendables containers and power the control, was provided by a five cubic foot, 2800 psi air flask, a little over two feet long. Subsequent Mods of the Mk 16 had slightly larger warheads, substantially increased range and in some cases a pattern running capability. After WWII the Mk 16 family was extended through Mod 8 and remained in use in submarines until the mid 1970s. Its performance made it a truly formidable weapon. There were occasional problems with spontaneous decomposition of the Navol, and opinions about safety differed with some individuals feeling it was too risky for submarine service. The Mk 17 destroyer torpedo was a larger version of the Mk 16. Both of the Navol torpedoes were good weapons, but their development programs were slow and erratic. One must wonder what impact these would have had if they had been available in 1943 or 1944, especially in view of their larger warheads.

Table 2

CONVENTIONAL TORPEDO PERFORMANCE

	Envelope	Weight	War Head	Type	Range/Speed	RV*
Mk 14 Mod 3A	21"x246"	3282 lb	660 lb TPX	Steam	4,500y @46.3k	9.6
Mk 16 Mod 1	21"x246"	3922 lb	920 lb TPX	Naval	11,000y@46.2k	23.4
Mk 18	21"x245"	3154 lb	565 lb TPX	Electric	4,000y@29.0k	3.4
Mk 26	21"x246"	3200 lb	approx 900 lb	Seaw. Bat	6,000y@40k	9.6
Mk 36 Mod 0	21"x246"	4000 lb	800 lb HBX-1	Seaw. Bat	7,000y@47k	15.5

*Maximum speed in knots squared times range in yards at that speed times 10^4—a sometimes useful figure of merit for propulsion comparison.

Electric propulsion systems have two apparent advantages: they are wakeless so they do not provide either warning of attack or indication of the location of the attacker[5] and they require both less manufacturing effort (estimated for Mk 18 at 70 percent of that required for a comparable steam torpedo, Mk 14) and a lower average manufacturing skill level. These advantages are, however, purchased at the price of significantly shorter range and lower maximum speed; Mk 18 had a range of 4000 y at 29 k.[6] U.S. Navy interest in electric torpedoes began in 1915 with a project at Sperry Gyroscope Co. Successor in-house projects, again sporadic, produced designs and development models designated *EL* and Electric Torpedo Mk 1. Interest was, however, limited by the inferior speed-range characteristics of electric torpedoes. Shortly before U.S. entry in WWII, possibly stimulated by knowledge obtained from British sources that the German Navy was using electric torpedoes, work resumed on electric torpedoes. The resulting design was first designated Electric Torpedo Mk 2 (1941) and later Mk 20 (1943). Twenty of these torpedoes were eventually produced by the General Electric Co. Slow progress on the Mk 20 led to the Mk 18 project which came to be based on the German G7e and was ready for production significantly sooner than the Mk 20.

The major problems in building electric torpedoes are storing

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[5] The U.S. Navy Operations Research Group compared the effectiveness of Mk 18 electric and Mk 14/Mk 23 steam torpedoes. The conclusions were that for attacks at ranges under 4000 y: 1) the percentage of successful attacks against enemy ships of all types except large combatants was higher for Mk 14/Mk 23 than for Mk 18. This was attributed to better lookouts in the large combatants and consequent evasive maneuvering by the target. There was no correlation between the torpedo Mark and the occurrence of counterattacks in attacks on merchantmen. In the case of attacks on large warships there were more counterattacks when Mk 14/Mk 23 torpedoes were used. Overall, it was concluded that "...if in 1944 all U.S. submarines had carried full loads of Mk 18 torpedoes the enemy would have lost about 100 fewer merchant ships...the exclusive use of the Mk 18 would not have prevented a single U.S. submarine casualty." These comments clearly omit consideration of both morale and manufacturing. Philip M. Morse and George E. Kimball, Methods of Operations Research, New York: Technology Press and John Wiley, 1950 (an unclassified version of Vol 2A of the NDRC Division 6 Summary Report which bears the same title.)

[6] Note also the propulsion figure of merit given in Table 2.

enough energy on board to give adequate range and speed and providing, within stringent weight and space constraints, a sufficiently powerful electric motor to achieve the speed. A 21 inch torpedo requires about 100 hp to make 30 k and well over 300 hp to make 45 k. Thus at 30 k a five minute (5000 y) run requires a power plant capable of delivering about 75 kilowatts of power for five minutes—6250 watt-hours. Even with the inevitable losses and taking into account the rapid discharge, batteries that could deliver the required power for four to six minutes could be designed with late 1930s technology, but their weight, about 1500 pounds or roughly half the weight of a Mk 14 torpedo, and volume, over ten feet of a 21 inch torpedo envelope, were serious constraints. These constraints were not significantly lifted until the advent of seawater batteries which enabled U.S. electric torpedo speeds and ranges to exceed 35 k and 5000 y. Severe though the battery problem was, the motor problem was even more difficult. Conventional design of a 100 hp motor might have produced a machine that would fit into a torpedo, but it would have weighted 500 to 1000 pounds. What was required was relaxation of some of the design rules. The critical point was the recognition of the fact that the torpedo motor needed to run only five or so minutes after which it was either lost or, in exercise shots, could be refurbished. Thus severe but short term heating, e.g., 100°C in five minutes, and sparking commutators, among other engineering anathemas, could be accepted. With these and other concessions, it became possible to build motors in the 100 hp range that weighted about 250 pounds, a weight that the 21 inch x 21 feet envelope could accommodate.

The first knowledge of German electric torpedoes came from recovered fragments of the four that sank HMS ROYAL OAK in September 1939. Additional information was obtained from the torpedo that struck SS VOLUNDAM. The first complete German G7e torpedoes were acquired when the German submarine U-570 was captured by the RAF on 27 August 1941. One of these was made available to the U.S. Navy in January 1942 and other G7e torpedoes were found, at about the same time, on the East Coast U.S. beaches. This information stimulated U.S. Navy interest in quickly obtaining electric torpedoes. Following a preliminary meeting on 10 March 1942, Westinghouse was placed under contract to produce an electric torpedo, which, it was quickly agreed, would be an American version of the G7e. The new torpedo was designated Mk 18. This project was of course competitive with the Mk 2/Mk 20 project and so got little help

from NTS Newport. Never the less, in late June of 1942, just 15 weeks after starting work on the project, the first Mk 18 was delivered to Newport for testing. The testing did no go well, Newport was unhelpful if not obstructionist and production was delayed. Again, as a result of pressure from the operating forces action came from CNO/COMINCH Admiral King, who ordered an Inspector General investigation on 5 April 1943. The much quoted report of that investigation, which was issued in June 1943, says in part:

> "The delays encountered were largely the result of the manner in which the project was prosecuted and followed up. These difficulties indicated that the liaison officers at the Bureau of Ordnance failed to follow up and properly advise the Westinghouse Company and Exide Company during the development of the Mark 18 torpedo. ... The Torpedo Station had its own electric torpedo, the Mark 2, and the personnel assigned to it appear to have competed and not cooperated with, the development of the Mark 18. ... Failure to provide experienced and capable submarine officers to the Bureau for submarine torpedo development has been a very serious matter and has contributed largely to the above deficiencies."[7]

Deliveries of the Mk 18 to the fleet finally began in mid 1943 and they were taken on patrol as early as September 1943. There were, however, continuing difficulties with the new torpedoes, which were not fully resolved until late in the year. About 9000 Mk 18s were produced and they accounted for 30 percent of the torpedoes fired by U.S. submarines in 1944 and 70 percent of those fired in 1945. Though slow and short ranged, the Mk 18 served well in attacking Japanese merchant ships which were the main targets for U.S. submarines during WWII, especially late in the war. Mark 18 accounted for about a 1 million tons out of the 4.8 million ton total of Japanese merchant shipping sunk by submarines during WWII.

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[7] Quoted in Theodore Roscoe United States Submarine Operations in World War II, Annapolis: U.S. Naval Institute Press, 1949, p. 262. In addition to these problems Westinghouse seems, albeit with Navy concurrence, prematurely to have turned their attention to the all electric Mk 19 and allowed the Mk 18 to languish.

Warheads

The second major development, new warheads, involved the switch from TNT to Torpex as the high explosive. Torpex is a mixture rather than a pure chemical compound as TNT is. The components are TNT 41 percent, RDX (Cyclonite, Hexogen) 41 percent and aluminum powder 18 percent.[8] Torpex is attractive because of the increased explosive energy and higher detonation velocity of RDX as compared to TNT and the prolongation of the pressure wave by the aluminum. On a weight basis, Torpex is conservatively about 50 percent more effective than TNT as an underwater explosive against ships. Torpex is, however, more sensitive than TNT and RDX was expensive and difficult to make safely. The process of converting to Torpex torpedo warheads (and depth charge loadings) began with an order for 20 million pounds in early 1942.[9] The first Torpex loaded warheads[10] followed late the same year. The 640 pounds of Torpex in a Mk 14 warhead was at least the equivalent of 960 pounds of TNT[11] almost twice the destructive power of the original Mk 14. The reaction of the submariners to Torpex is apparent from an entry for 19 March 1943 in the fourth war patrol report of USS WAHOO:

> "0515H; Fired one Torpex torpedo at medium sized freighter identified as KANKA MARU, 4,065 tons, range 750 yards, 12° port track, speed 9 knots. Hit. After part of ship disintegrated and the forward part sank in two minutes, and 26 seconds. These Torpex heads carry a [sic]

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[8] Torpex ranges from 45 percent TNT, 37 percent RDX, 18 percent Al to 41 percent TNT, 41 percent RDX, 18 percent Al.

[9] Interestingly, the U.S. Army was willing to produce cyclonite, RDX, for the Navy's use in Torpex, but was reluctant to use it for Army munitions because of safety concerns.

[10] Torpex and TNT warheads were interchangeable. If there was a substantial change in weight, some adjustment to the depth gear was required.

[11] Comparisons with Japanese torpedoes often neglect the difference in high explosives. Japanese torpedoes used Type 97 high explosive, which is not significantly more powerful as an underwater explosive than TNT.

awful wallop."

This very substantial improvement in warheads is often overlooked in part because the torpedo identification does not automatically identify the warhead and even the warhead Mark doesn't unequivocally identify the high explosive. Some Mk 14-3A torpedoes were fitted with TNT warheads, most commonly Mk 15, and others with Torpex warheads, most commonly Mk 16. Furthermore torpedo warheads could be easily changed by a tender or depot. The standard COMSUBPAC format for war patrol reports did not require listing torpedo or warhead Marks and Mods until after April 1943.[12]

Other Developments

Several other interesting and important developments were incorporated into WWII conventional torpedo development programs. The most prominent of these were electric controls, seawater batteries and pattern running. Electric controls were standard in homing torpedoes, but the control system dynamics are different for gyroscopic course control. The Mk 18 electric torpedo, as we have noted, used pneumatic controls for several reasons: The German G7e used pneumatic controls; the reliability of pneumatic controls was well established; and there was a risk that using an electric control system might introduce instabilities that would be time consuming to resolve. The Mk 19 torpedo was a Mk 18 with an electrical proportional servomechanism for depth control and solenoid positioned vertical (course control) rudder. The Mk 19 gave way to the Mk 26 which had similar controls and a seawater battery. About 25 Mk 26 torpedoes were produced but large scale production was deferred in favor of the NTS Newport and General Electric Mk 36 which was also an all electric and seawater battery powered design that was an outgrowth of the Mk 20 program and incorporated a pattern running capability. One or two developmental models of the Mk 36 torpedo may have been built, but it too was deferred in this case in favor of the Mk 42.

The seawater battery was important in that it made possible electric torpedo performance comparable with that of the Mk 14 steam torpedo. Two developmental seawater battery powered torpedoes have been included in Table 2 for comparison purposes.

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[12] Rear Admiral M.H. Rindskopf letter 3 June 1996.

The seawater battery powered Mk 26 was a little slower but longer ranged than the Mk 14 and had the same propulsion figure of merit. The projected Mk 36 represented a substantial improvement over the Mk 14 and had a figure of merit exceeded only by that of the Navol Mk 16.

The basic idea of the seawater battery is to construct a primary battery using seawater as the electrolyte. With this electrolyte a magnesium anode and a silver chloride cathode make a useful 1.55 volt cell. It required some development effort to produce a satisfactory cathode—the principal problem was the high electrical resistance of silver chloride, but these problems were solved. Bell Telephone Laboratories designed and the General Electric Company built the battery for the Mk 26 torpedo. These batteries were evacuated to keep the electrodes dry before use and to provide for rapid filling when the torpedo was launched. They delivered about three times as much energy as the lead acid batteries in the Mk 18 and weighted significantly less. With this sort of performance seawater battery powered torpedoes became competitive and, though none of those under development during WWII became service weapons, both the Mk 44 and Mk 45 post war service torpedoes used this propulsion scheme. The consumption of expensive silver and the attendant high cost, $6000 to $8000 per unit, was an obvious drawback.

For completeness, we now briefly consider pattern running. The concept is to program a torpedo to make a straight run to a target rich area, for example, the middle of a convoy, and then execute a pattern hoping to hit a target. This is obviously distinct from homing although some homing torpedoes have been programmed to run a straight course and then execute a search pattern for the purpose of acquiring a target on which to home. The pattern running concept has some instinctive appeal in that it would appear to improve the probability of hitting some target. This appeal was enough to induce the German Navy to mount two programs FAT and LUT.[13] The U.S. Navy included pattern running in the Mk 36 and Mk 42 development programs, but neither of these entered service. Some Mods of the Mk 16 were equipped with pattern running controls which caused the torpedo to run in circles of 300 yard radius after a straight run of preset length. Pattern running mechanisms in the days of electromechan-

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[13] FAT and LUT are discussed in Eberhard Rocssler Die Torpedos der deutschen U-Boote, Herford: Koehler, 1984 Chapter 9, pp. 114-127 (in German).

ical, as opposed to electronic, controls involved complex arrays of cams, gears and levers that were difficult and expensive to design and build. Furthermore pattern running seems to be much less effective than instincts would predict. Roessler sums up the situation in very few words, "This appears unprofitable."

The remaining new non-homing torpedoes comprise the Mk 25 which was an improved Mk 13 air launched torpedo and the clearly asset WWII Mks 40 and 42. Mk 25 was a successful design that completed development late in the war. It was not produced in quantity because of huge existing stocks of Mk 13 torpedoes. Before these stocks had been consumed the anti-surface ship mission of air launched torpedoes had disappeared. the Mk 40 propulsion system was interesting in that it used a multibase solid propellant to produce gas to drive a turbine, which, in turn, drove a pump jet propulser. Such systems became important much later when targets became fast nuclear submarines and will be discussed in more detail in a subsequent part of this series. Mark 42 was an attempt to consolidate into one torpedo all that had been learned about torpedo sub-systems. The program seems to have toppled from its own weight, five organizations had significant involvement in the program, and it was abandoned in favor of a pattern running Mod of the Mk 16. Mark 42 was, however a significant milestone in that it was the last mark assigned to a U.S. Navy non-homing torpedo.

While it does not represent a new torpedo, the large scale research and development program aimed at understanding the dynamics of air launched conventional torpedoes and improving their performance deserves note. This program, carried out mainly at Columbia University and the California Institute of Technology, developed an understanding of the air flight of torpedoes and the problems of water entry. The most visible results were frangible wooden tail extensions and nose drag rings, which were ugly, but stabilized the air flight and reduced the water entry speed. Less visible were the structural changes in the Mk 13 torpedo that were developed to accommodate the large and complex forces associated with water entry.[14]

In the next part of this series we will examine the radically new development of homing torpedoes during WWII.

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[14] This work is summarized in Torpedo Studies, Volume 21 of Summary Technical Report of Division 6, NDRC, Washington: NDRC, 1946.

ST. MARYS, GEORGIA SUBMARINE MUSEUM
Newly Commissioned and Opened to the Public

by Sheila McNeill

Too often by-passed by both submariners and other travelers headed south on I-95 is historic St. Marys, Georgia, the home of the nation's newest submarine base at Kings Bay. The exit to St. Marys and Kings Bay is the last one before crossing over the St. Marys River which separates Georgia from Florida.

Historic St. Marys, in itself a wonderful tourist attraction, is also the home of the new St. Marys Submarine Museum. Since the Kings Bay Submarine Base only offers tours of the upper base, it was felt that visitors to the area should have the opportunity to learn more about submarines and their long history of contribution to the defense of our country.

The museum is located in what had been an old movie theatre that has been extensively renovated at a cost of over $100,000 with monies raised from the community. The officers and enlisted personnel of the Kings Bay Submarine Base have been enthusiastic supporters of the museum project and have donated many hours of time, as well as money, to aid in the construction effort. The museum was officially *adopted* by the Kings Bay Chief Petty Officers' Association representing all Kings Bay commands.

After 16 months of planning, fund raising, and construction, as well as the vigorous search for display materials, the museum was commissioned on March 30, 1996. The Grand Commissioning ceremony, attended by hundreds of active duty and retired military personnel as well as civilians, featured a presentation by Rear Admiral Eugene B. Fluckey, USN(Ret.), recipient of the Congressional Medal of Honor for his submarine combat experience in World War II.

A working periscope that visitors can operate themselves and many displays of submarine models, historical data and memorabilia make this museum a wonderful place for veterans to reminisce and for others to learn and to appreciate the contributions of our submarines over the many years since the first United States submarines were launched.

The museum is also a tribute to the many people whose enthusiasm turned this dream into reality. The short turn off I-95

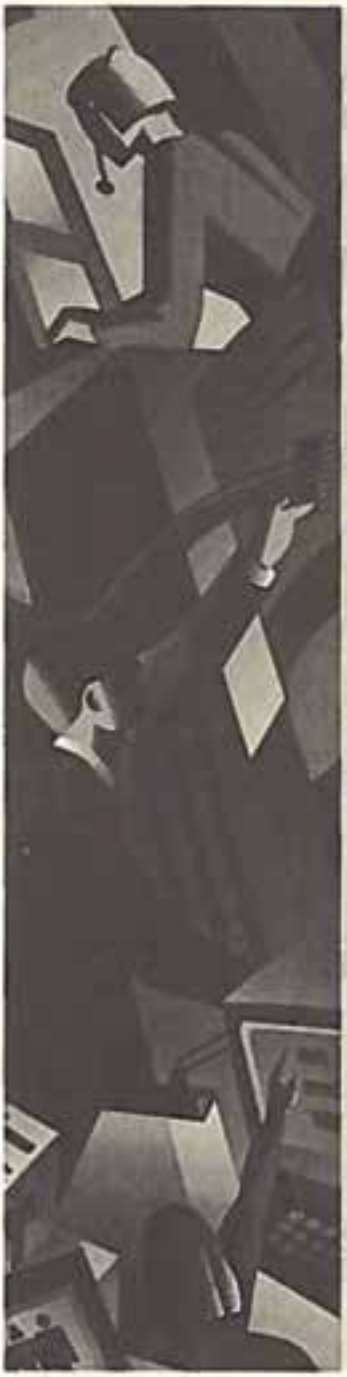
to visit the St. Marys Submarine Museum is well worth the effort and should be placed on every submariner's *must* list when planning his travels.

Although well stocked with displays, the museum would welcome memorabilia or other submarine artifacts, either as a loan or for permanent display, from **THE SUBMARINE REVIEW** readers. Credit is prominently provided on each display and it is a proud moment for many visitors when they can point out to relatives or friends their own part in making submarine history. Artifacts Chairman John Crouse can be reached at the museum by calling (912) 882-ASUB (2782) or by mail at 117 Osborne Road, St. Marys, Georgia 31558, for answers to any questions. ■

Sheila McNeill is a member of the Naval Submarine League and is currently George State President of the Navy League. She is a 1996 recipient of the Meritorious Public Service Citation awarded by Secretary of the Navy John Dalton and was recently appointed by the Secretary of Defense to serve as a member of the Defense Advisory Committee on Women in the Services (DACOWITS). She is a founding member of the St. Marys Submarine Museum and served as its first President.

REUNION

U.S. submarine veterans and enthusiasts are invited to the 34th International Submariner's Convention being held in 1997 at Friedrichshafen, on Lake Constance, Germany from April 30 to May 3. For further information, contact: John Maguire (406) 449-6054 or CDR Jürgen Weber in Starnberg, Germany 49-8151-2486.



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AN UPDATE ON AUSTRALIA'S COLLINS CLASS*

by Dr. Dora Alves

The Collins class, the world's biggest, most advanced conventional submarine—the Swedish Kockums Type 471 adapted for operation in the warm, tropical waters of Australia's north—is being built at a *greenfield* site at Osborne, near Adelaide, South Australia. Work officially began on the Australian Submarine Corporation's (ASC) A$120 million facility on August 17, 1989.[1] Refits for the submarines will in the future be done at Osborne.

While work went on at Osborne, future COLLINS crews were trained at HMAS Stirling, Garden Island, Western Australia. Stirling, nearer to Singapore than to Sydney, was commissioned July 28, 1978. Development accelerated once the Royal Australian Navy's (RAN) two ocean policy was endorsed.[2] On March 16, 1993, Governor General Bill Hayden opened the purpose-build facility, the Submarine Training Systems Centre. The A$50 million center would be managed until 1996 by ASC's College of Customized Training, Rockwell Ship Systems of Australia and Scientific Management Associates. On 2 March 1996, then Deputy Prime Minister Kim Beazley (this was before the Labor Party's election defeat) opened the Maritime Operations Division Stirling to test and evaluate the Collins class. Former Minister of Defence, now Leader of the Opposition, Kim Beazley has always been a strong supporter of the two ocean policy and the relocation of the RAN's submarine base from Neutral Bay, Sydney.

Ships and submarines operating in the strategically important

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* *Editor's Note: See THE SUBMARINE REVIEW, April 1995, for Dr. Alves' initial account of the Collins class building program.*

[1] The Australian Submarine Corporation is a consortium owned by Kockums Pacific Pty Ltd. (49 percent), the Australian Industry Development Corporation (AIDC) (48.45 percent) and RCI Ltd. (2.45 percent). Rockwell Autonetics and Missile Systems Division and the Loral Librascope Corporation are major U.S. participants in the combat system development.

[2] HMAS Stirling is, in addition, base for: guided missile frigates ADELAIDE, DARWIN and CANBERRA; destroyer escorts SWAN and TORRENS; submarine ORION; training submarine OVENS; fleet oiler WESTRALIA, patrol boats BUNBURY and GERALDON; and hydrographic survey ship MORESBY.

north and northwest areas have an increased effective operating time from Stirling. Besides having ready access to deep water, Fleet Base West—the official RAN designation—is without the east coast impediments to northward passage of the Great Barrier Reef and the narrow gaps of the Torres Strait. The RAN ensures the security of the trade routes, at a time of increasing economic development, and of Australian coastal waters. The decision to locate half the fleet on the west coast was influenced by considerations of Middle East oil and the mineral wealth of the Pilbara region, notably in iron ore and liquid gas.

The six contracted submarines—there are options for two more—are named for noted admirals and heroic other ranks of World War II. COLLINS, the first submarine, was launched in May 1993 and in November 1994, after harbor trials, underwent sea trials in the Gulf of St. Vincent, off South Australia, staying submerged for 14 hours. On December 15, 1995, FARNCOMB was launched on Adelaide's Port River. HMAS COLLINS had many parts fabricated in Sweden and other countries with assembly and installation in Australia. However, then Minister of Defense Robert Ray was able to claim at FARNCOMB's launching that the ship was almost entirely—more than 90 percent—Australian made.

A lurking Australian insecurity seems to mistrust the locally-made in many fields. The media seized on and headlined every setback, inevitable though they were in a first undertaking of the complexity of the Collins class. Headlines such as "Computer Bugs Delay $5.6B Submarine Project" and "Navy Takes Delivery of Faulty Sub" were not uncommon.[3] Delays were due to *software development issues*, and the first deep dive was postponed until the RAN's A$20 million new submarine rescue system, able to rescue crews at *crush* depth, was in place. Twelve to eighteen months of naval trials are considered necessary before the submarines are fully accepted. Despite the glitches, the crews are impressed by the submarines' capabilities—and the ability to stay submerged, completely covert. The essence of a submarine's role is to cause maximum disruption to enemy shipping for very long periods.

The RAN insisted that delays were to be expected, and that

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[3] The Australian, November 2, 1995, p. 3, and The Sydney Morning Herald, July 16, 1996, p. 4.

what mattered was getting things right so that later ships could profit. The original contract delivery dates were: WALLER, December 1997, DECHAINEUX, September 1998, SHEEAN, November 1998 and RANKIN, October 1999. It is expected that WALLER, the third submarine, will be ready for sea trials early in 1997. ASC has achieved considerable production savings by modular construction. Considerable *off-site* work is done in other parts of Australia where the necessary industrial capabilities already exist.

On January 23, 1996, the South Australian newspaper, The Advertiser, reported that a world-class standard of performance had been achieved by COLLINS' first successful deep dive. She had spent two hours at approximately 300m depth—approximately, because precise depth is classified. Speed, endurance, and living condition trials were to follow, but Mr. Hans Ohff, ASC's managing director, considered that COLLINS had probably outstripped its competitors.

On July 15, 1996, COLLINS, 75 meters in length, about 8 meters in diameter, and having a displacement of some 2,500 tonnes, was handed over to the RAN and commissioned on July 26, 18 months behind schedule. The ASC and the RAN have emphasized that there was no penalty to Australian tax payers in this delay, one to be expected in a technically complex project.

The original schedule was set in 1987 and it was a remarkable achievement for a country which had never previously built a submarine to compare very favorably with results achieved by other countries (including the United States) that are more experienced in submarine construction. Difficulties encountered in the development of the combat system software were the principle cause of the delay—the task was simply of greater magnitude and complexity than anticipated. The strategy has been to develop incremental versions of the software to meet each phase of COLLINS' sea trials, with each version more capable, building on experience and correcting faults found in the previous versions. This will continue until the combat system software is fully functional—probably in 1998. The software remains a focus of management attention, but significant progress is being made.

Media accounts notwithstanding, at commissioning, the version of the combat system then fitted had sufficient functionality to allow the submarine to maneuver and operate in complete safety at all speeds and depths, to provide most combat functions, and to allow provisional acceptance into naval service, allowing the

submarine to progress to the next important trials phase of operational test and evaluation. Where full integration and functionality are not, for the moment, possible, work-arounds and *stand alone* arrangements are being incorporated. Although a fully compliant combat system is unlikely to be available before late 1998, the submarine could, if required, be deployed on operations.

Asked, in late August 1996, whether the Australian government will consider acquiring long range, stand-off strike missiles, including the Tomahawk, Defence Minister Ian McLachlan said that the government had "no proposition before us at the moment". Technical definition studies will be made before a decision is taken on this sensitive issue. At present, no Southeast Asian nation has such weapons.

What are the prospects for a further two submarines?

In its pre-election policy statement, the government said it would consider the requirement for additional submarines toward the end of its first period in office (of three years) in light of strategic circumstances and other competing priorities at that time. After spending 17 hours at sea in COLLINS last May, the Minister said that the government would await the outcome of further operational trails, and any decision was at least a year away. Therefore, a decision on additional submarines might be expected sometime in the latter part of 1997 or during 1998.

Kim Beazley said on July 23, at a business function in Adelaide, that Australia should order two more submarines to combat increased regional militarism and to create local jobs and economic growth. He added that the capacity for bluff was sustained by a small number but not the reliability of interdiction. Expansion from six to eight Collins class would, in Beazley's view, lock in the capability that has been developed for both Australian industry and its defense industry future. Controversy about submarine numbers has surfaced because others maintain that, rather than two more submarines for A$1 billion, Australia should acquire the much needed airborne early warning and control system (AWACS) without which no modern defense force can adequately protect its air space, or the missiles.

The submarines are very cost effective, but the question is whether or not additional submarines are a higher priority than other competing acquisition priorities. At the time of the last assessment, Navy and Defence did not consider additional submarines to be a sufficiently high priority to defer other projects

competing for scarce resources.

Editor's Note: As an update note to this account, Dr. Alves submitted the following from the Melbourne Herald Sun of November 1, 1996:

"Combat capabilities onboard Australia's Collins class submarines will not be operational for two years, Federal Parliament was told yesterday.

The 1996 projection for the conclusion of the submarines' software design is about three years later than originally planned.

But Defense Minister Ian McLachlan has thrown doubt on the project's ability to even meet that demand, saying "when and if it comes good".

The remark during question time was immediately seized on by Independent MP Graeme Campbell, who said it showed the minister was wavering on his opinion of the subs' potential.

Mr. Campbell, who has been pursuing the Collins issue for 10 years, questioned the competence of the subs' acquisition team.

He said later the Collins project was in real trouble and the project's $5 billion cost could blow out to about $10 billion.

Mr. McLachlan, responding to Mr. Campbell's question in the House, said an interim system was in place but did not yet meet the design criteria." ■

QUICK & EASY PRESSURE-TO-DEPTH CONVERSIONS

LCDR Butch Bornt, USNR

I developed the following mental conversion methods while attending Submarine Officer Basic Course. They seem so simple-minded, someone must have already developed them. If not already familiar, perhaps some will find them useful.

While riding the Dive Trainer during the Submarine Officer Basic Course, students sometimes focus on one depth indication. The instructors break this bad habit by making that indicator fail.

In self defense, I developed the following methods of quickly converting Ballast Control Panel (BCP) sea pressure indication in psig to depth (feet) and BCP sea pressure indication in feet to pressure (psig). Both use the 44 psig/100 ft conversion factor as a starting point.

I realize that plastic laminated cheat sheets are taped to BCPs throughout the fleet. However, they may not be visible to the DOOW or the OOD, or they may become misplaced. I prefer to have the option of doing the conversions in my head.

Sea Pressure to Depth Conversion

It is easier to demonstrate this method than to explain it.

Step 1: Read BCP gauge and round off to nearest 10 psig 127 → 130

BASIS: Simplifies calculations

Step 2: Multiply by 2.5

130x2 = 260
+ 130/2 = 65
325

BASIS: You take 44 psig/100 ft. and invert it: 1 ft/0.44 psig. Multiply this by 1.1:

1.1 ft/0.44 psig = 1.1 ft/(1.1 x 0.4) psig
= 1 ft/0.40 psig
= 2.5 ft/psig

Step 3:	Reduce the Step 2 value by	325	
	10% (rounded to nearest 10')	-30	
	and round to nearest 10':	295	→300'

BASIS: This offsets the 1.1 multiplier in Step 2

If you use the 100 ft/44 psig multiplier directly, you would get a depth of ~290' for a sea pressure of 127 psig.

On some BCPs, sea pressure is displayed in feet. This gives the DOOW or OOD a convenient check on depth. However, the COW needs sea pressure in psig so he can pressurize AUX-3 or -4 when using the Depth Control System. It is possible to do the conversion in your head, as follows.

Step 1:	Read BCP gauge and round off to nearest 10 feet	330	
Step 2:	Divide by 2	165	
Step 3:	Reduce Step 2 value by 10%	165-16 =	149
		= ~	150 psig

BASIS: Start with 44 psig/100 ft:

0.44 psig/ft = ~0.45 psig/ft
= [1/2 - (1/10)x(1/2)] psig/ft

If you use the 44#/100' multiplier directly, you would get a sea pressure of ~145 psig for a depth of 330'. The error is in the conservative direction, because the tank pressure must be greater than sea pressure. ■

SUBSCOL 2000: A MULTI-TIERED APPROACH TO TRAINING FOR THE NEXT CENTURY

by LT Joseph M. Thompson, USN

"Call it a quality of life. Call it a matter of readiness. But do not fail to call it the first principle of war fighting. Provide sailors with tools that allow them to fight and win!"
VADM George W. Emery, USN, COMSUBLANT

One of the tools that allows sailors *to fight and win* is training and, as we enter the 21st century, two major developments which effect training are emerging. The first development is the downsizing of the fleet. As the submarine fleet becomes smaller the importance of training as a *force multiplier* increases. The second major development is that, in the words of Admiral Emery, "Russia has seized the undersea initiative" in the area of submarine technology[1]. As the technological advantage of our submarines erodes, the importance of training as a *force equalizer* and as a *hedge* against future erosion increases. (Although the SSN 21 and the NSSN are designed to restore the technological advantage, the low production rates and uncertain futures of these platforms will limit the rate of that restoration.) Given the increased importance of training due to these developments, it is essential that the submarine training is the best it can be.

Unfortunately, in my opinion, the training currently provided by the Naval Submarine School (SUBSCOL) is not as efficient or as effective as it could be.

The Current Approach

Today, the submarine school employs a *one-size-fits-all* approach to training. All submarine officers attend the same school and are taught the same material regardless of their ultimate assignments. The material taught is mainly applicable to Atlantic Fleet fast attack submarines. Students not going to these particular ships are taught information that, while *nice to know*, is not

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[1] VADM George W. Emery, USN, "Keynote Address to Annual Symposium", Naval Submarine League Submarine Review, July 1995, pp. 13-18.

directly pertinent to them. They must *dump* much of the information they are taught and then arrange to learn the *right* information once they get to their boats. This approach is not efficient because all submarines and all submarine billets do not have identical training needs. This approach is also not effective because it guarantees that all of the material will not be applicable to all students. In fact, the current approach can be quite frustrating. In the words of a recent Submarine Officer Advanced Course (SOAC) graduate, the current purpose of SUBSCOL seems to be "to make you want to be at sea" instead of being at school.

The inefficiency of the current school is especially pronounced for students who will serve on SSBNs. Almost one-third of the current curriculum focuses on systems and missions not applicable to *boomers*.[2] To compound matters, there is a large volume of SSBN specific information that is either not taught or is outdated (by several years in some cases). As a result, SSBN officers must attend follow-on schools to learn this material. This leaves many of these officers questioning the usefulness of their original SUBSCOL training.

The bias toward SSNs will become less acceptable as the size of the SSN fleet decreases through the end of the decade. By the year 2000, SSBNs will account for more than one-third of all submarine officer billets.[3] This means that the needs of a large portion of the students who go through SUBSCOL and the needs of a large portion of the fleet will largely be ignored. The bias toward a specific fleet's procedures produces similar effects to those discussed for SSBNs. The main differences are that less material is involved, but more students are affected. Clearly *one-size* does not fit all.

The Multi-Tiered Approach

In contrast, a multi-tiered approach would acknowledge that

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[2] The current SOAC curriculum is 684 hours long, of which approximately 140 hours is directly non-applicable to SSBNs. Another 70 hours (approximate) of training has SSBN applications, but the training is done on specific systems which are not actually carried by these ships.

[3] Scott C. Truver, "Tomorrow's Fleet: Part I", U.S. Naval Institute Proceedings, June 1995, pp. 90-95.

officers going to different types of submarine have different training needs. Under this approach, SUBSCOL would not be a single training facility, rather, it would be a network of training facilities integrated to provide the best trained officers to the fleet. Under this system, all submarine officers would initially attend a common school to learn universally applicable subjects but would then go to training facilities at their ultimate duty station to learn class specific topics. Students would only be taught information that was relevant, and just as important, all relevant information would be taught to the students before they left the SUBSCOL pipeline. There would be not additional schools required after graduating. When the graduates went to the fleet, they would be *up to speed* and ready to go to sea.

The principles of this multi-tiered approach can be applied to all SUBSCOL courses. This paper though will only focus on the SOAC course as a representative example of each tier. Representative curriculums for each tier of the other SUBSCOL courses are shown in Table 1.

The first tier in the SOAC curriculum would be vastly revised form its current form. This tier would cover universal topics such as approach and attack tactics, anti-diesel submarine warfare, tactical oceanography, basic navigation, and Target Motion Analysis (TMA). It would also cover subjects applicable to all department heads such as supply fundamentals, military justice, and leadership. For the first time, the SOAC curriculum would also teach ship handling skills and provide the students with hands-on time maneuvering YTBs or YPs. Topics would also be presented on *jointness* and how other Services operate. Much of this tier would be taught by post department head officers. This would allow students to learn from the valuable experiences and insights of these seasoned officers who have *been there*. Utilizing these officers would also provide additional duty assignment opportunities for XO(SS) and CO(SS) officers.

The first tier of this SOAC curriculum would feature extensive use of tactics seminars and student versus student wargames. This would encourage the exchange of different viewpoints and ideas and allow students to hone the skills they are taught against thinking opponents instead of canned scenarios. The new format would also stimulate students to develop and test new, innovative tactics that will be required for the future. Ideally, a system could be developed that would allow two or more different attack centers

to go *head-to-head* so that all participants would receive the most realistic training possible.

The first tier school would not be based around a competitive series of exams and rote memorization. Instead, the primary emphasis would be on providing the students with fundamental principles, promoting tactical innovation, and encouraging the exchange of ideas. Individual awards could be presented based on ship handling ability, most innovative new idea, and tactical proficiency. The total length of this first tier would be about three months.

The second tier of this approach would take place at the training facilities in each homeport. All department heads going to the same type of submarine at the same port would attend the same school. The purpose of the second tier would be to teach those unique weapons, sensors, missions and procedures used by each class of ship.

This training would be more classroom orientated than the first tier and would feature the same *hands-on/button-pushing* emphasis of the current SOAC curriculum. In fact, it would closely parallel the core topics currently taught with the exception that all of the material would be relevant. In this tier, all SSBN officers would learn the fundamentals of Emergency Action Messages, strategic connectivity, the basics of the SIOP, etc. All SSN officers would learn the fundamental of battle group operations, active sonar employment, offensive electronic warfare, etc. The length of instruction would be approximately three months.

In the third tier, all department heads would receive training unique to their individual billets. This tier would closely resemble the current follow-on schools given to SSBN navigators and strategic weapons officers except all department heads would attend these schools—including engineers and combat systems officers. Training would include a mixture of classroom and hands on training. Sample curriculums might include conventional weapons handling supervisor certification and peacetime safety rules for weapons officers. Navigators might be taught port-specific Surface Piloting and Navigation (SPAN) trainers and Security Manager responsibilities, for example. Engineers might be taught plant-specific operating procedures and class material concerns. The length of instruction of this tier would vary depending on the specific billet and would be about two months long.

Advantages of the Multi-Tiered Approach

The multi-tiered system has many advantages compared to the *one-size-fits-all* system. First and foremost, it matches the training product to the specific needs of each submarine. This method of training would be more efficient in that graduates of SUBSCOL would not need to attend other schools to receive necessary training. Besides being more efficient, this type of training would also be more effective by only teaching students material that was relevant to them. This would result in more student interest and less student frustration.

The multi-tiered approach would also ensure that all submarine officers had a thorough understanding of the combat systems on their specific class of ship. Much of the combat systems training received by officers today, especially by junior officers, is one in an informal, often hectic fashion. Too often the goal of current training is not to learn the systems, but simply to get a signature on a qualification card. Consequently, it is not uncommon for officers to leave their ship after an entire tour with a poor understanding of these crucial systems. The class specific training offered in the multi-tiered approach would eliminate this problem and standardize the level of knowledge of all officers.

Shifting much of the training to facilities in each homeport provides additional advantages as well. For one thing, it ensures that these valuable facilities and their staffs are fully utilized. This would ensure the facilities will continue to receive the best possible funding and allocation of resources. Conducting two tiers of the training in each homeport would also provide students with more time to take care of their families and personal affairs before going out to sea. Officers would not have to show up at a new duty station just in time to get underway for a deployment. The additional time spent at the officer's ultimate duty station would also give more stability to the sea-shore duty rotation. This would improve the quality of life of submariners and their dependents. A final advantage is that each training facility would teach the actual procedures used by the boats. As a result, students would not be taught outdated information and would gain familiarization with the actual references they would have access to underway.

In the specific case of the revised SOAC curriculum, additional advantages can be realized. Shortening the length of the Groton portion of the school would save the Navy money by eliminating Permanent Change of Station (PCS) moving costs. Students would

only need a single PCS move from their shore duty station to their ultimate duty station. This would give additional stability to families by requiring one fewer relocation ordeal. In addition, the third tier of the SOAC course would provide engineer officers with plant specific training they normally have to learn on their own. Finally, and perhaps most importantly, the revised SOAC curriculum would place renewed emphasis on *Innovation*—a traditional hallmark of the submarine service.

Disadvantages

Shifting to this type of multi-tiered system does have its disadvantages too. For one thing, the shorter length of instruction at a common location provides detailers with less flexibility to modify orders. The shorter Groton tier of the revised SOAC curriculum would also result in this portion becoming an unaccompanied tour. This might result in additional family separation for those students who currently bring their families with them, but that would be partially offset by shortening the family separation of the current SOAC *geographic bachelors*. In addition, the extended length of instruction would delay the reporting dates of some officers. The inconvenience of this delay would be largely countered by the fact that these officers would not need to go to any additional schools after reporting aboard.

There would also be financial implications of shifting to the milt-tiered approach. It would cost money to alter and restructure the current system. New curriculums and lesson plans would need to be developed, current facilities might need to be modified, and billets might need to be moved or created to account for this approach. Shortening the first tier portion of the SOAC curriculum would also mean per diem might have to be paid to some students. While these disadvantages are not trivial, they do not outweigh the advantages of the multi-tiered approach.

Conclusion

In conclusion, the importance of training as a *force multiplier*, a *force equalizer* and as a *hedge* against future technology is increasing. Given this fact, the submarine service can no longer afford a *one-size-fits-all* mentality towards teaching its officers. It is time to fix submarine school—not because it is broken, but because it can be much better. Efficient, effective, and specialized training that meets the needs of both the students and the fleet is

required to propel the Submarine Force into the next century. This training must recognize the different training requirements of different assignments, it must promote innovation, and it must provide sailors with the tools that allow them to fight and win. The training that can best meet the needs of the next century is the multi-tiered training approach.

As a final thought, consider the words of Admiral William A. Owens, USN(Ret.), former Vice Chairman of the Joint Chiefs of Staff and submariner:

> "...sometimes caution can lead to stagnation; and failure to adjust to global changes, advances in military technology, or innovations in the conduct of war can lead to the same kind of disasters that cautious bias about change and innovation was supposed to prevent.
>
> I think we are in such a period. The world swirls with changes that a few years earlier were simply unimagined. The kaleidoscope of international relations seems to twist so much faster now. Technology pushes beyond the frontiers we took as impenetrable limits only a few years ago. The world of incremental change in which we lived in the last four decades has ended, but history has not. In this new era, it is far more dangerous for American military institutions, and for the U.S. Navy in particular, *not* to change."[4]

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[4] ADM William A. Owens, USN, "High Seas: The Naval Passage to an Uncharted World", Annapolis, Naval Institute Press, 1995.

Table 1 - Representative Curriculums for Each Tier

	SOBC	SOAC	PXO/PCO
Tier 1 SUBSCOL Groton, CT	Introduction to the submarine service, basic submarine concepts and missions, TMA theory, and basic ship handling. Fundamentals of leadership and time management. ~2 months	Advanced tactics, management, and leadership courses. Universal department head related courses. Advanced ship handling. ~3 months	Advanced submarine missions, national level command and control, integrated operations, personnel management, etc. Detailed UCMJ/-legal and supply topics. ~2 months
Tier 2 Homeport Training Facilities	Courses teaching class specific missions, weapons, sensors, communications and fleet specific procedures. ~3 months	Courses teaching class specific missions, weapons, sensors, communications and fleet specific procedures. ~3 months	Courses teaching class specific missions, weapons, sensors, communications and fleet specific procedures. ~1 months
Tier 3 Homeport Training Facilities	Courses required for junior officer initial submarine qualification. ~2 months	Courses providing specialized training in topics pertinent to each Department Head. ~2 months	Courses teaching specific OP-ORDs, local WSM/PMI, QA manual, Maintenance manual, COMSEC, etc. SPAN trainers ~1 month

SUBSCOL 2000—NOT A NEW ISSUE

by RADM W.J. Holland, USN(Ret.)
A Former CO, Naval Submarine School

Lieutenant Thompson has reopened issues hotly debated in the '60s and '70s. Most of the arguments he raises were discussed and some of the changes he advocates were tried in the years of explosive growth during the early SSBN building program. His discussion however touches only one side of a dual issue: the balance between tailored training for the student's next submarine versus cultural education for the Submarine Force.

One facet of Lieutenant Thompson's proposal which is new from those earlier debates is the presence in all the home ports of first rate training facilities ashore, advanced attack teachers and simulators. These facilities, for which the Submarine Force owes the persistence, skill and foresight of Mr. George Horne of the CNO Staff, make Lieutenant Thompson's ideas on split training and class specific courses feasible today where lack of these facilities precluded such an option in the past. A reduction in the Force size and concomitant number of officers being trained should also reduce the pressure on the training which is simulator dependent. In my experience, no review of any course which used simulators—diving trainers, damage control simulators or attack teachers—was satisfied that there was enough trainer time to achieve the skill levels which were desirable and attainable. The lack of trainer time was a bottleneck even though attack teachers and diving simulators operated two shifts and occasionally around the clock. Lieutenant Thompson's dispersal plan to use the trainers in places less impacted than Submarine School has great merit in this regard.

Although there are more trainers now, and most are better,[1] the significant constraint probably remains skilled and knowledgeable officer instructors. The pressure for officers to do things besides teach has grown—the Goldwater-Nichols requirements for joint duty being the most significant factor as officers are siphoned off to joint duty billets. This and other similar demands limit the

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[1] Economy has forced us out of escape towers and into deep swimming pools. And the periscopes in the trainers do not match the fidelity of the model decks left to us by our World War II veterans.

number and quality of officers available to conduct the very important basic skill training. Dispersing those instructors over many training sites will not be as efficient or as effective as concentrating them in one place.

Lieutenant Thompson proposes the SOAC students develop tactics and innovative operations and tactics. While officers are all very much smarter and more capable now than they were fifteen years ago, I suspect their level of knowledge on entry to SOAC continues to be such that learning is required, not research. The skills of the profession need to be learned and digested before very much personal innovation can take place. SOAC is a place where these skills are taught and improved upon. The students are not competent enough to invent new tactics.

However, the same is not to be said about the instructors—even though their level of seniority may not be very much greater than the students. The concentration of talent, their immersion in the subjects and exposure to a wide range of experiences while teaching make these officers a unique source of information, innovation and thought for the Force. Dispersing the instructors to many places rather than concentrating them dilutes their interaction and waters down this singular and highly valuable experience. Nowhere is this more evident than in tactics. Eklund range and Lynch plots were named for Sub School instructors. The second order effect of dispersing this well of talent seems to me to mitigate against such a move.

But the most significant argument against Lieutenant Thompson's dispersal plan relates to the Submarine School's mission to educate by enculturation. The Submarine Force creates doctrine not by writing books but by inculcating a set of cultural imperatives and tactical procedures into its officers from their earliest days and continuing consistently through PCO training and into the fleet operations. The uniformity of this culture is remarkable and often unappreciated by the members of the Submarine Force until they witness the lack of agreed standards and commonality of processes in other military organizations. Only the Marines come close to rivaling the Submarine Force's culture but by straight-jacketed discipline rather than an intellectual commitment. In most other activities of the Navy the general lack of agreed standards, of commonly held virtues and techniques, appalls the submariner. *McHale's Navy* is too strong a description but conveys the idea. Twenty years ago the Surface Warfare School

was created along the lines of Submarine School because of the evident effectiveness of the centralized enculturation which arose from the Submarine Force's one school or the Marine Corps' Basic School. The damages to this encultration which would be suffered by a shortening or dispersal of training is tantamount to failing to include the fundamentals on which the culture is based in the curricula of the overarching schools. This culture is characterized by insistence on high standards of excellence, an appreciation for solid technical knowledge of equipment and processes, common agreement on procedural operations while fostering wide latitude in thought and technique, and a universal spirit of tactical aggressiveness. Though sneered at as characteristics of *nukes*, these are not owed to Rickover but are the legacy of the World War II submariners and the rigorous centralized training they established. Obtaining intellectual commitment to the culture requires immersing the students as a group in it while exposing them to role models who preach and practice it. This is not a short term or easy task.

The Submarine School plays a vital role in this inculcation. Without the centrality of the School, the dilution of the culture becomes more likely and the maintenance of the tradition harder. Having a central body for the beginning of all submarine training, and for its most important career building moments is a vital ingredient. Dismantling that which contributes to the natural doctrine should be approached with great caution and recognition of the second order effects.

While I cannot speak for the present curricula at Enlisted Basic School, Officers Basic or Submarine Officers Advanced Courses, in my time as a student and teacher, all had been incrementally developed. None of these overarching courses were the products of a careful analysis of needs or with an architecture derived from a blank sheet of paper. For that reason if no other, regular reexamination of the course content is a worthy effort. Further in my experience, every such examination found something which needed to be pitched over the side because it was outdated, too dull to be learned in school, or a great idea which had been inserted at the direction of higher authority or on the initiative of a CO, Sub School, Head of the Officers Department, or a well meaning Lieutenant instructor which had turned out to be trash. But attempts to shorten the schools' lengths for the sake of saving time have always come a cropper. The 13 week SOAC went to

18 and back to 24 after only short trial runs for the reasons outlined above.

Submarine School's Advanced Course is another step on the road to making good Commanding Officers. Considering the curriculum solely as preparation for Department Head on SSN/-SSBN 999 is too narrow a vision and a short sighted approach to the needs of the Navy. ■

SUBMARINE RACES

The U.S. Navy will officially host the 5th running of the International Submarine Races (ISR), one of the world's most unusual engineering design competitions. The biennial event will be staged June 23-27, 1997, at the Naval Surface Warfare Center's Carderock Division in Bethesda, MD.

"The Naval Surface Warfare Center is proud to host the 1997 International Submarine Races at its David Taylor Model Basin", said Captain James E. Baskerville, Division Commander. "We are pleased to be able to once again support such an outstanding educational and engineering endeavor." The race also is supported by many volunteers including senior Navy personnel, individuals from major corporations, research centers and other interested companies and organizations.

The International Submarine Race challenges designers to compete against the clock in one- and two-person human-powered submersibles. The first ever human-powered submarine race was organized by the H.A. Perry Foundation and Florida Atlantic University Department of Ocean Engineering in 1989. This race and the 1991 ISR sponsored race were held in the ocean at Singer Island, Florida. The 1993 ISR was held offshore of Ft. Lauderdale, Florida. The 1995 race was the first ISR contest staged at an indoor facility, the David Taylor Model Basin, the Navy's premier hydrodynamic research facility. For the 1997 race, invitations have been sent out to hundreds of engineering colleges and universities in the United States and throughout the world. Interest already has been expressed from schools as far away as Russia.

SUBSCOL 2000—A REALITY CHECK

by CAPT John C. Brandes, USN
CO, Naval Submarine School

Lieutenant Joseph M. Thompson's article entitled: SUBSCOL 2000: A Multi-Tiered Approach to Training for the Next Century raises some interesting issues regarding how we should train in the next century. The article challenges us to think about how we conduct our business at SUBSCOL, our plans for the future, and the perception of the fleet on the quality of our product. The Submarine Force's strengths always have been the quality of our boats, our computer processing technology, and our personnel. Recent sound quieting advances by our former adversary, as Lieutenant Thompson noted, have eroded our advantage, and the opening of international trade markets has put our technological processing advantage in harm's way. What remains is the quality of our personnel, and the effectiveness of our training is an important aspect of that quality. The premise that SUBSCOL is not as efficient or effective as it could be is flawed—especially in light of Lieutenant Thompson's proposed changes. There is always room for improvement and the Submarine Force continually evaluates the training pipelines, but more on that later. Given the limited training funds and educational technologies, this paper will illustrate why the current process is the best fit.

Although Lieutenant Thompson's proposed multi-tier program bears some similarity to the approach used at the Surface Warfare Officer School (SWOS), there are key differences and several defects with his proposal. First-and-foremost, the Submarine Force's thrust is to provide just in time training on Submarine Warfare at the apprentice, journeyman, and two master levels. Additionally, an effort is made to assist the apprentice level (SOBC) and journeyman level (SOAC) students with their upcoming qualifications—Contact Coordinator/Diving Officer of the Watch and Command Qualifications, respectively. Next, the issue of pipeline length (i.e., how long the trainee is kept from the fleet) must be considered, as well as the associated impact on the cost of the training. Finally, numerous costs mentioned in Lieutenant Thompson's plan are not fully evaluated. The cost of additional instructors to conduct the added training in home ports, the cost of additional training equipment to allow training on each

different ship's set of equipment, and the cost of Yard Patrol Craft (YPs) have to be evaluated and the cost tradeoffs considered.

Let us consider each area mentioned above. Submarining is the name and submarine warfare is the game—regardless of whether you are a fast attack or a boomer sailor. It would therefore follow that our core competency is submarine warfare, and since the officer corps is interchangeable from one platform to another, they all must have the same relative knowledge level or foundation blocks. With this concept in mind, SUBSCOL has focused its main training thrust at this area. We also cover the basic department head skills that every Command Duty Officer, Executive Officer and Commanding Officer will need (e.g., navigation and combat systems fundamentals) and build from there. Since every officer is exposed to essentially continuous nuclear training, SUBSCOL does not have to provide any significant training on engineering skills (self study is encouraged, routinely under utilized, and the resources are available on request). In order to achieve the various levels of submarine warfare training, we believe it is necessary to teach some basic level concepts (e.g., mental gym, sonar fundamentals, target motion analysis, etc.). We also must teach the theory/guidance contained in the Naval Warfare Publications (NWPs) and then familiarize the students with the basic fundamentals of the Combat Control Systems. Time has demonstrated to the warfare and nuclear power training pipelines that you do not have to train on equipment identical to that of your future ship to get concepts and fundamentals across to the student.

During the course of instruction a number of order modifications (ORDMODs) occur. We see about seven ORDMODs per 40 students in the average SOBC class and about three per eighteen students in the average SOAC class. An important difference, however, is SOBCs have their orders when they arrive, and the SOACs only have a letter of intent. SOAC students do not get their orders until they are about half way through their training, and our experience indicates that frequently about 40 percent to 50 percent of the actual orders (seven to ten students in addition to the three noted above) are different from the letters of intent. The key point is flexibility in detailing, which implies that all of the officers should have the same basic submarine warfare skills so they are interchangeable from one ship or job to another at any point in their career. The rebuttal to this thought is that the multi-

tiered approach would compensate for the order modifications because the specific training is in the home port. While this statement might sound good, it fails to account for the fact that many modifications come at the last minute and could contribute to unpredictable student loading, which is a big problem for any school. It is for this reason, that SSBN specific training is conducted following SOAC/SOBC to provide the officers with the specific additional information they need to perform their next job.

SUBSCOL is committed to taking as long as required to complete the training deemed necessary, but we also are driven by the goal to do it as quickly (i.e., efficiently) as possible in order to get trainees to the fleet. All training facilities were tasked recently to review their pipeline courses with the goal of reducing them by 20 percent. This concept runs contrary to LT Thompson's plan, which would lengthen all of the training pipelines to accomplish platform specific training and assignment specific training. There is no free lunch, and his plan has several hidden costs. First, submariners will spend more time in the training pipelines, which has both a dollar cost and an impact on shipboard manning. The cost of training a SOAC student is approximately $42,000, which would equate to $8,400 per training month. We teach approximately 290 SOBC students annually and 120 SOAC students per year. If we add one month to the pipeline, we incur an additional cost of $2.4 million for SOBC (the monthly cost for SOAC approximates that of SOBC) and $1.0 million for SOAC. The multi-tiered approach adds two to four months to SOBC and one to three months to SOAC. For every man year spent in training, there is one less man year available for fleet use. Stated differently, as the total inventory of officers in training increases, sea tours would have to increase (assuming the total number of officers remained constant).

When we consider the other costs associated with Lieutenant Thompson's plan, the problems truly become staggering. To support homeport training facilities, their manning will have to be increased. While it can be argued that this will be offset somewhat by SUBSCOL presumably being able to decrease their manning (assuming the teaching load will decrease), it is not a one-to-one trade. Each site will have to be manned to support peak loading. Furthermore, each site essentially will have to be a clone of SUBSCOL's Combat Systems Branch. The efficiencies of a centralized organization will be lost, and at approximately

$78K per officer instructor ($35K for enlisted), the increased manning will be quite expensive. In addition to manning, significant amounts of training equipment will have to be acquired to model the nine plus variations of the Combat Control Systems that are currently in the fleet. While technology that emulates these systems will be significantly less than their $50 million average price tag, it will not be free. If the additional equipment does not fit in the existing facilities, then additional infrastructure must be located or created, which is usually a non-starter under the current fiscal climate. Finally, there are maintenance considerations for the systems. Some maintenance force, in the form of contractors or additional sailors, will have to be available to get the work done on a not-to-interfere basis with the mission essential training.

Other costs also must be considered. Would we preclude a homeport change based on lack of training equipment in the new location? How would we account for ships in overhaul who need the training facilities more than most—would we only overhaul at a yard with the correct training equipment nearby, or would we be forever updating the training facilities? YPs were deleted from the curriculum at SWOS due to cost. The fact that the Navy has contracted out tugboat services in many ports is indicative of how costly it is to operate these small ships. Instead of YPs, the Submarine Force is investigating the feasibility of using virtual reality systems to accomplish this underway training. These systems should have a life cycle cost orders of magnitude less than the YPs, which will allow us to cost effectively train on ship handling and fused watchsection surfaced operations.

The proposed multi-tiered approach seems to be based on the concept that there are SSNs and SSBNs and no variation within these two groups—a fact that is very far from the truth. At least seven variations of SSN Combat Control Systems exist without considering engineering changes or other upgrades/perturbations. Although SSBNs have fewer variations, they are not all alike. When you have a trainer that is applicable to only a few ships (e.g., CCS-MK2/BQQ-5E), the utilization of that trainer goes way down making it more expensive per capita to operate and therefore more difficult to justify. We needed to build at least six SSN 21s to justify the cost of all planned training equipment. Most of the equipment was canceled when the ship class was reduced to its current numbers. Instruction in each homeport will generate small

classes, which in turn will lead to trainer utilization that is not cost effective and thus makes this option unrealistic.

What will be the source of watch standing manpower to man all the Fire Control Party stations when training a small number of students? A nominal SUBSCOL class size of 18 SOAC students split between six home ports to train on their ship specific equipment would only yield three of the necessary watchstations. We do not face this issue now because the SOAC class size allows us to man all approach and attack positions with students. The normal response to the previous question is from the waterfront, but as the number of available SSNs/SSBNs decrease, the number of assets next to the pier will make this process hard. Even now it can be difficult at times to get the training support you need from the waterfront.

Currently, Submarine and IUSS Training Requirements Reviews (SITRRs) are conducted periodically to assess effectiveness within a given training pipeline. These SITRRs base their decisions on survey results received from the fleet (both department heads and Commanding Officers are surveyed), fleet representation (including the TYCOMs) at the review meeting, and the cumulative experience of senior training personnel from the key training commands. Three of these reviews have been conducted for officer training since 1992 and all concluded that while some fine tuning/strengthening of specific topics was required the training currently conducted best meets the needs of the fleet. With regards to more department head training, the surveys indicated a need for some expansion, but only minor changes have been incorporated (e.g., security manager training for Navigators). Nothing was identified to be deleted and many of the suggested additions were nice to have but within the capability of the ship to provide. There was a general reluctance to lengthen the course for the cost reasons cited above. Of final note, feedback seems to suggest that the well advertised dichotomy between Pacific Fleet and Atlantic Fleet procedures is being addressed adequately. Some minor differences (most of them related to water space management) exist, and every effort is being made to discuss the significant issues. Currently, most of the major differences have been eliminated, which is really the correct approach.

The Submarine Force and SUBSCOL continue to evaluate our officer pipeline curriculum and make adjustments based on

feedback from the fleet and consideration of limited training dollars. We continue to support and stimulate innovation in our students through various avenues, including writing for **THE SUBMARINE REVIEW**. Students may forget what they have learned from a lack of daily use, but there should be no need to unlearn any of the information provided at SUBSCOL. Given the budget dollars available for training today, the distinct probability that these budgets will be leaner in the coming years, and the success of the program to date, there does not seem to be any advantage gained from shifting to a multi-tiered approach. ■

REGULUS SAILORS

The Naval Submarine League is putting together a list of all who served in submarines on patrol with the Regulus submarine launched cruise missile. If you are one of those stalwart sailors, please send your name along with the name of your ship and dates of service aboard to: Naval Submarine League, P.O. Box 1146, Annandale, VA 22003.

USS FINBACK (SSN 670) DEACTIVATION

Remarks by
RADM Robert C. Austin, USN(Ret.)
First Commanding Officer, FINBACK
August 29, 1996

I pay special tribute to Mike McQuown, the commissioning Engineer Officer whose enormous energy and dynamic capability was an inspiration to all who served on the commissioning crew. Mike went on to be the Officer in Charge of NR-1 and had reported to relieve as the Commanding Officer, USS GURNARD when he lost his life in a tragic automobile accident.

Admiral Mies, Admiral Campbell, Captain Hutton, distinguished guests, crew members of FINBACK past and present, wives, families and friends.

What a great honor to once again stand on the deck of this magnificent submarine. I had the opportunity to visit her yesterday, and, Admiral Mies, I am sure I heard her murmur "I'm not ready to be retired". If material appearance inside her hull is any indicator, she looks as ready as she did on the day we commissioned her. With 750,000 miles having passed beneath her flood grates, I think she is straining at the bits as much today to show her prowess and excellence as she was on commissioning day. It makes this occasion one of mixed emotions. One of sadness to see this grand *cold warrior* no longer called upon for the readiness and service and naval influence which she projected over the past quarter of a century. At the same time it is a day of true gratitude and admiration for all who have been wed to FINBACK in one way or another. Included in this gratitude, for their effort and dedication, are the craftsmen at Newport News who built her, the tender crews who helped maintain and sustain her, the shipyard personnel who overhauled her, the squadron staff who assisted in her readiness and training, and most especially the wives and families who sacrificed and bore the responsibilities of the home front while their submariners were off to sea. Above all, must be the nation's gratitude to each and every FINBACK sailor whose talent, hard work, and devotion created this submarine's spirit and emboldened her performance.

My visit to FINBACK reaffirms the marvelous strength of our Submarine Force that is embodied in the small group of young

Americans in their late teens and early twenties who devote enormous energy, time and effort to master the extremely technical details of these most complex and lethal of modern warships, while developing the highest standards of accountability in fulfilling extraordinary responsibilities as crew members of a submarine. I am sure that some today would question if it is possible to find people committed to diligent work, continuous study and training, qualification and requalification, zero drugs, and meeting exacting standards of performance and readiness. Ask FINBACK and she would reflect over her years and say "You will find them here and it has been every thus". She might add "It may seem astonishing to some, but my missions and my safe operation demanded nothing less and these great Americans who were my crews understood and made it so".

FINBACK's namesake was USS FINBACK (SS 230) which was commissioned at Portsmouth Navy Yard on January 31, 1942. The United States had been at war for two months. The commissioning was secret, no ceremony, and after a brief shakedown and training period at New London, she sailed to the Pacific. Enroute to the Panama Canal, Admiral King's intelligence provided the approximate location of 20 German submarines along her track, an indication of the submarine war that ravaged the Atlantic. FINBACK fought gallantly in the Pacific, claiming her share of the tonnage. Not the least of her exploits was to save a downed young naval aviator, George Bush, from a loss at sea.

Allow me to reflect. I first stood upon this submarine a little over 27 years ago, with her bow dome pointed slightly skyward on the building ways at Newport News. The year was 1968 FINBACK was to be the first Navy ship to be launched on the day of December 7th since the attack on Pearl Harbor in 1941, 27 years before. The first cadre of the commissioning crew were assembled as a most gracious sponsor, Norma Baird, the wife of the Under Secretary of the Navy, pronounced, "God bless FINBACK and all who serve in her". With the crack of a champagne bottle the ship majestically glided down the building ways. What followed was the frantic pace of construction. Within a year we took over each piping system, component and piece of equipment, checking each against building specifications and testing their operability while proceeding smartly through reactor plant testing and the ensuing five sea trails. It was a period of enormous intensity, working days, nights, and testing on

weekends until FINBACK was ready to join the fleet. As the last 637 class on order that was being built at Newport News, she had already made a contribution to that fleet, #3 torpedo tube to SPADEFISH, her clutch to SEA DEVIL and her diesel blower to LAPON with their refurbished components now installed in her. Such was a necessity with the construction pace supporting five to six deliveries a year from the nation's shipyards. A snow storm coated the pier and sub freezing temperatures greeted the guests at the commissioning. A few days later breaking ice in the James River, she tied up at Pier 23 and joined Submarine Squadron Six where she has been assigned to this very day. From a bitter cold start, she quickly warmed during the next two years as she engaged in almost every aspect of submarine operations, not as a novice, but much more as an accomplished and seasoned veteran of plying the ocean's depths, thanks to a tireless and talented crew who made *ready now* their hallmark. From SSBN security to advanced ASW exercises, to testing new development towed arrays, to firing countless Mk 48s during this new torpedo's operational evaluation, to major exercises with the fleet and a deployment of great significance to our nation, FINBACK proudly began its service. What followed with successive crews was a continuum of operation that mirrored and expanded upon these early beginnings. FINBACK had its equipment modernized, its vital systems overhauled and became even more capable. Until this day, she remained a formidable redoubt of our security on and under the seas.

When I stood on her bridge on the day of launching, I vividly remembered that very day 27 years before. As a 10 year old boy in Madison, Wisconsin listening to a Green Bay Packers football game on the radio, the only electronic device in our house, we paused in shock as did the nation with the broadcast interruption that announced the attack on Pearl Harbor. The entire nation went to war in a manner that only those who bore witness truly understand. A year and a half later, I stood on a barren sand dune at Virginia Beach. Tall watch towers stood every couple of miles, a barrier of barbed wire lined the beach and oil, a life raft, and other debris from sinking ships wallowed in the surf. As I looked seaward, I witnessed a column of smoke and flame from a distant torpedoing off of these very shores. That war engulfed the oceans as it was fought from the seas, on the seas and under the seas. United States submarines were instrumental in the victory, most

especially in the Pacific. The first FINBACK contributed her vital effort. Clay Blair entitled his book which chronicles that submarine war Silent Victory. At the war's end, this nation resolved—never again. The Cold War years followed and this submarine, as all of the submarines of the United States Navy, deterred and influenced the outcome in profound ways, much of which will remain untold. If a book could be written today, it might be entitled *Stealth Victory*. Americans are now content that their nation's security is not at risk. That content in large measure is owing to those who assemble on this pier today and at like ceremonies scheduled at a rate of seven a year. With one a year commissioning to replace them, the Submarine Force is rapidly downsizing. What is the right size force to insure this content, which I speak of, is not misplaced? Time will judge and it will be the awesome responsibility of Admiral Mies, of our national defense leaders, and the sustained impeccable performance of our submarine crews. May God bless them, bless the United States of America, and all those who served in FINBACK.

Captain Hutton, I want to personally thank you and the members of your crew for allowing me to briefly serve once again on this marvelous submarine. Thank you. ■

USS FINBACK (SSN 670) DEACTIVATION

Remarks by CDR Vernon Hutton, USN
Commanding Officer, FINBACK
August 29, 1996

What a great day! Today we celebrate the inactivation of USS FINBACK. I really mean celebrate. This is not a funeral. A celebration. Some people may think it's a funeral. But it is not. Just like our planet, this is the passing of the old for the new. It is regeneration. Our country's Submarine Force is going through the same process. FINBACK has plenty of life and capability but it is time to put her to rest, and use our resources to renew and recapitalize.

But let's celebrate the ship. There are a lot of Navy folks here today who understand sailors. But there are also a lot of people who aren't familiar with our service. For them I'll explain a little of what a submarine is... A hunk of steel filled with wires, machines, books, motors, doors, gadgets, radios, a nuclear reactor, turbines, hydrophones, antennas, etc. A lot of hardware. But it is all for naught until you put sailors in her, and unlike other naval warships, a submarine sailor is a special breed. A submariner's reliance upon himself and the rest of the crew is unmatched on any other vessel. Even since she was launched on 7 December 1968 FINBACK's life has been her sailors. I talked to Mrs. Norma Baird who sponsored and christened FINBACK 28 years ago. She was proud to launch FINBACK and pleased to see such continuous outstanding service to the country by her sailors. She knew her sailors are special and specifically asked about them, not the ship.

I met a FINBACK sailor yesterday. His name is Don Hitchcock. He's part of the first FINBACK that earned 12 Battle Stars in 11 war patrols. Sailors like him are our legacy. Courage, Honor, Commitment. He was the Battle Stations Bow Planesman. They rescued five pilots one day and one later became President George Bush. That's commitment to the Naval service.

These sailors made FINBACK. Created her. Developed her. Gave her character. And established her reputation. Their average age is 23. Bob Austin created that life with her 100 commissioning crew sailors, plankowners, many here today. I want all past and present FINBACK sailors to please stand. (Applause.) FINBACK's sailors did it all. FINBACK's reputation was always out front. Under Skipper Bob Austin she went on

her first deployment right after commissioning and earned her first Navy Unit Commendation. Later she was the envy of all submariners in the mid '80s under the legendary Rocky English, making four deployments and earning two Navy Unit Commendations, a Meritorious Unit Commendation and two Battle E's. Later her sailors took the ship into the Mediterranean for Desert Storm earning another Meritorious Unit Commendation. She did what submariners do best, effectively, quickly and unobtrusively. Even as recently as last year, her sailors deployed to the Mediterranean and almost immediately were in the Adriatic supporting the ROOSEVELT and AMERICA Battle Groups and the strikes on Bosnia. This last deployment earned her sailors a Navy Unit Commendation. All told FINBACK has sailed for more than three quarters of a million miles.

I have the privilege to be FINBACK's Commanding Officer. Her sailors are my privilege to recognize. It is they who make FINBACK the proud and successful ship she is. I'm lucky. I get to stand on top and say go that way. These sailors make it happen. They work long hard hours. They train, stand watch, perform maintenance and keep her running smoothly. Some of you know that we sail her to Seattle next month. But if only I could just keep sailing her—take her in harm's way—that's where she belongs—that's where her sailors excel and make FINBACK great.

Oh—to get back to sea—how I want to say to Chuck Hamilton, get the ship underway. I want to be at Battle Stations and say "Firing Point Procedures", "Commence missile launch", or especially, "Shoot on generated bearing".

Then to hear Matt Zerphy yell out "Set!" To hear Petty Officer Schroder say "Standby", then "Fire tube 1". To hear Petty Officer Rutar say "Normal launch tube 1". To hear Chief Pittman make sonar's report "Unit running normally!" To hear Chief Diamond report "Primary Search" and of course "Terminal homing!" These are our sailors.

How I want to see again Petty Officer Bobo getting selected as Squadron SIX Sailor of the Year by Commodore Flannery.

To see Petty Officer Haskins also standing there as Junior Sailor of the Year hoping for his selection.

To see Lieutenant Mark Guzzo selected as Squadron SIX Junior Officer of the Year. These are FINBACK sailors.

I want to be back in Crete, sailing into Souday Bay with Petty Officer Psaras, a Reactor Operator, on top of the sail. He's speaking Greek to the Greek Naval Officer helping me pilot the

ship.

I want to see again Petty Officer Thompson twisted around the drain pump brazing a leaking joint keeping the ship on station just off the coast of _____ (sorry can't tell you).

I want to hear screaming and yelling, my running to crew's mess, only to find Chief Leeth running another *pie in the face* contest.

I want to use my general announcing system to call Seaman Payton to control, to see his worried face only to discover he was awarded CSG-2 Mess Management Specialist of the Quarter and a culinary school next month.

I want to get Petty Officer Torres and see him run another Save the Whales campaign.

I want to see Chief Mitchell and Chief Jackson arguing over how best to cook those ribs.

I want to see Petty Officer Culver (who quietly accomplishes any job) get excited. He's the quietest, most professional guy I know.

I want to see Ensign Rich Avila announce his qualification (except for the CO's signature).

I want to see Chief Shultz manage the Chief of the Watch and Senior Chief Lambert the Diving Officer of the Watch while 75 midshipmen swap out the planesman duties.

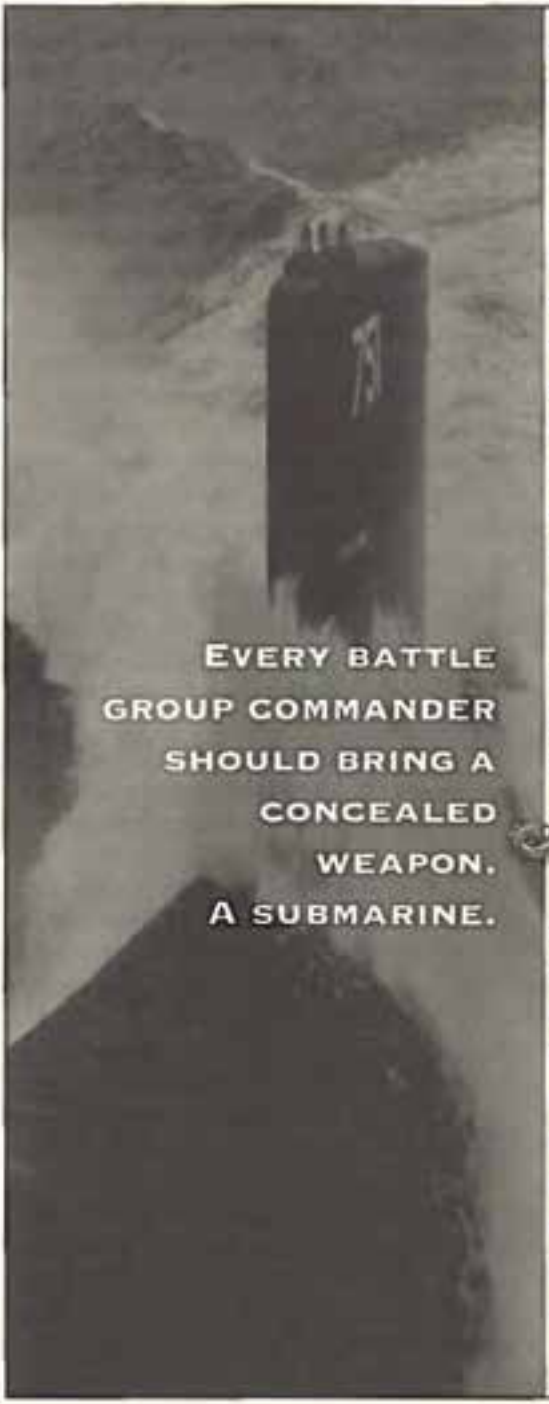
I want to see Petty Officer Catanzaro and Petty Officer Ernest help another midshipman on the planes.

I want to see my corpsman, Senior Chief Caez dress up in my uniform welcoming the new junior officer onboard.

I want the Chief of the Boat to again show me that damn chicken on the XO's desk, and watching Jerry Burroughs, my XO, react.

These are our sailors. Yes they have fun. But you must understand, they work hard, very hard. And their families survive without our sailors. Their families are true friends, companions, spouses and parents. Their support is just as crucial as the sailor himself.

I just want you all to appreciate what kind of sailors FINBACK has. These stories are true, they're also true of Admiral Austin's crew, and Admiral Mies' crew (I saw them in Charleston). I am sure anybody can tell you these same stories. Stories are not of submarines, but of her sailors and the sailor's exploits. God bless them all. It is they who deserve the credit, the accolades. It is they who are our Navy. ■



TODAY'S SUBMARINES OFFER COMMANDERS A UNIQUE COMBINATION OF STEALTH, MOBILITY AND ENDURANCE. PIONEERED BY ELECTRIC BOAT, THESE FEATURES MAKE SUBMARINES IDEAL FOR COVERT MISSIONS, SPECIAL OPERATIONS AND BATTLE GROUP SUPPORT. AND WHILE SUBMARINES ARE MORE MULTI-MISSION CAPABLE, THEY ARE NOW MORE AFFORDABLE SINCE ELECTRIC BOAT HAS RE-ENGINEERED THE INDUSTRY. AS A RESULT, AMERICA HAS A CRUCIAL STRATEGIC ASSET GEARED TO MEET FUTURE CHALLENGES. AND SO DO BATTLE GROUP COMMANDERS.

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THE SUBMARINE REVIEW

THE SUBMARINE REVIEW is a quarterly publication of the Naval Submarine League. It is a forum for discussion of submarine matters. Not only are the ideas of its members to be reflected in the **REVIEW**, but those of others as well, who are interested in submarines and submarining.

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The League prepares **REVIEW** copy for publication using Word Perfect. If possible to do so, accompaning a submission with a 3.5" diskette is of significant assistance in that process. The content of articles is of first importance in their selection for the **REVIEW**. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the **REVIEW**.

A stipend of up to $200.00 will be paid for each major article published. Annually, three articles are selected for special recognition and an honorarium of up to $400.00 will be awarded to the authors. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League.** The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League. In those instances where the NSL has taken and published an official position or view, specific reference to that fact will accompany the article.

Comments on articles and brief discussion items are welcomed to make **THE SUBMARINE REVIEW** a dynamic reflection of the League's interest in submarines. The success of this magazine is up to those persons who have such a dedicated interest in submarines that they want to keep alive the submarine past, help with present submarine problems and be influential in guiding the future of submarines in the U.S. Navy.

Articles should be submitted to the Editor, SUBMARINE REVIEW, P.O. Box 1146, Annandale, VA 22003.

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TASC, Inc., a wholly-owned subsidiary of Primark Corporation, is one of the world's premier providers of high-end information systems engineering and integration services, with annual revenues in excess of $340 million. From design and development to implementation and support, TASC supplies the advanced technology, professional services and innovative products that government and commercial clients depend on to meet their most complex information needs. For three decades TASC has solved the toughest technical challenges faced by America's intelligence community, the armed services, government agencies, and by industries such as broadcast media, aviation, and financial services. All of these sectors increasingly rely on information technology to achieve their goals. TASC has successfully met these challenges by demonstrating that information technology means more than just the latest software. It means uncovering the potential in each customer organization to use information for maximum advantage.

With TASC's substantial research and development resources, plus its wide range of analytic and support services, customers get an information technology partner. Fueled through a mix of government and internal research funds, TASC spends $30 million on average each year to cultivate next generation technologies and to improve its software tools and techniques. These investments are helping TASC pioneer technologies for our rapidly changing world.

Since its founding in 1966, TASC has maintained a continuous relationship with the Navy's Strategic Systems Program (SSP). SSP is the Manager for the Fleet Ballistic Missile (FBM) Program and has been responsible for the development of six generations of Submarine Launched Ballistic Missiles (SLBMs) and four generations of SSBNs. During this time, TASC has performed a wide variety of engineering and analytic services for SSP.

In the early years, TASC provided SSP's navigation branch with analytic services, which included mathematical modeling, concept evaluation and data analysis. TASC developed ways to characterize the accuracy of the SLBM navigation subsystem.

This allowed SSP to perform sensitive hardware and software tradeoff studies. TASC's methodology was then applied to the remaining Strategic Weapon System (SWS) subsystems, so that eventually TASC became the official *keeper of the accuracy model* for the entire FBM weapons system. TASC continues to play the important role of keeping this extremely complex model up-to-date.

Today, TASC's scope of work for SSP covers a diverse range of services and support. TASC has the lead role in designing statistical models to describe how gravity and weather conditions affect weapon system accuracy. To aid SSP, TASC has developed a library of computer programs to perform sensitivity analyses, study test results, and even tap into a history of the accuracy model. Since 1983 TASC has helped SSP manage its administrative computer facilities, both at headquarters and at their field activities.

Headquartered in Reading, Massachusetts, TASC has more than 25 offices throughout the United States and Europe. TASC's homepage can be found at http://www.tasc.com.

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Custom Hydraulic & Machine, Inc. is a job shop as well as a manufacturer of marine hose fittings, hose assemblies and various hydraulic components all related to submarines and surface ships.

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In 1916 Kollmorgen designed and produced the first periscope for the first operational United States Navy submarine, USS HOLLAND. The early years from 1916 until the 1960s were far from fast paced because periscope design and technology evolved slowly. However, with the introduction of the Type 18 Periscope in 1968, the changes have been more frequent and more dramatic.

- In 1968 the Type 18 was introduced with state-of-the-art visual optics and a variety of imaging sensors and electronic antennas.
- In 1976 Kollmorgen developed and introduced the Model 76 Series periscopes into our allied navies submarine fleets.

Both the Type 18 and the Model 76 Periscopes have been continually improved and their capabilities upgraded to keep them up to date with the operations of the modern submarine.

- In 1985 the Model 90 periscope was developed and included thermal imaging, a laser rangefinder, ESM direction-finding antennas, GPS antenna, two-axis stabilization and other capabilities. The Model 90 became the first true 24 hour (day/night) imaging system for submarines. Today the Model 90 is the most sophisticated periscope produced in the world.
- In 1988 DARPA and Kollmorgen together with the United States Navy developed an idea to replace the traditional periscope with a non-hull penetrating suite of electronic imaging sensors. The system became known as the Non-Hull Penetrating Periscope (NPP) and more recently the Improved NPP. The installation on USS MEMPHIS proved the usefulness of electronic imaging and eventually led to the current Photonics Mast Program.

A further result of the DARPA/Kollmorgen NPP effort was the importing of new submarine mast technology from Riva Calzoni in Italy. The success of this mast on USS MEMPHIS led to the initiation of the Universal Modular Mast program.

- In 1995 Kollmorgen competitively won contracts from the United States Navy for both the Photonics Mast (PMP) and the Universal Modular Mast (UMM) for the New Attack Submarine.

The New Attack Submarine is revolutionary in the fact that it will be the first submarine built with two non-hull penetrating Photonic Masts and no traditional periscopes. State-of-the-art video-based imaging, a very capable ESM suite, and digital signal

processing will be combined to provide full sensor capabilities above the surface of the water. PMP display and control will be accomplished at a standard Navy console in the submarine control room.

The UMM is also revolutionary, with the New Attack Submarine utilizing up to eight of these systems in the sail. The Universal Modular Mast is a drop-in module which adopts a single design to support the various antennas and sensors required by the submarine at periscope depth.

During the last three decades the company expanded into a publicly owned corporation, which today is comprised of eight separate divisions. Also, over the years the company developed a number of successful, non-submarine related products, including riflescopes, projection lenses for the film industry, a number of different armored vehicle sights, and surface ship optical weapon directors. However, despite these and other forays into new markets, Kollmorgen remains dedicated to the supply of systems for our submarine fleet. Kollmorgen has designed every operational periscope used by our submarines and continues to dedicate itself to providing the United States Navy with the most innovative and the most capable systems available anywhere. ■

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A Mk 14 DEPTH PROBLEM

November 2, 1996

I just finished reading Frederick J. Milford's excellent wrap-up article about torpedoes, entitled The Great Torpedo Scandal, 1941-1943 in the October 1996 issue of THE SUBMARINE REVIEW. His discussion of Mk 14-3 torpedo depth keeping and exploder problems was the most thorough and enlightening I have read. He notes that the Mk 14-3A incorporated changes necessary to solve the depth keeping problem. The article also brought back an unpleasant memory of my one experience in firing a Mk 14 warshot torpedo during my command tour.

It was during 1966 and I had command of USS SPINAX (SS 489). We were assigned to sink an old destroyer escort off San Diego. Vice Admiral Ramage, of World War II submarine fame, was Commander First Fleet at the time. The target would be lying to, several hundred miles off San Diego, in deep water. The Sinkex instructions called for SPINAX to proceed south on a track about 2000 yards east of the target position until the target was abeam, then turn west, submerge and fire a Mk 14-5 warshot torpedo at about 1200-1500 yards and sink the target. While we were maneuvering, Vice Admiral Ramage in his cruiser flagship, and other First Fleet ships were to be in a column some thousands of yards to the east of our track. They would turn simultaneously with SPINAX and head towards the target to be in a position to observe the sinking at close range. Needless to say, with the prospects of all those observers and a submarine hero on scene, I was determined that everything would run smoothly as far as SPINAX's performance was concerned.

I had my torpedo officer make ready two warshot Mk 14-5s, and even invited the Squadron Three weapons officer to witness the torpedo preparations. On the day we were ready, having rehearsed the event several times on our own. My division commander, Commander Jack Gillette, a splendid naval officer, was embarked. We had a periscope camera ready to take pictures of the torpedo wake and the sinking target. We were ready for prime time.

Initially, all went according to plan. The line of First Fleet ships to port was impressive. We turned to starboard, submerged,

manned battle stations torpedo and commenced our approach. As we got close to the firing point, I took a quick safety look around and realized that the oncoming First Fleet line abreast had not taken our sudden slow down to three knots into consideration and were closing fast. The thought of a circular run entered my mind. Oh well, it was too late for that because we were almost at the firing point. Just at that instant the chosen warshot decided to malfunction and the tube ready light went out. I switched the firing tube to the backup weapon. "Final bearing and shoot." Away it went, with sonar checking carefully for any signs of a circular run. Speed setting was high, and depth setting was six feet. The target was drawing 11 feet. Gyro angle was zero.

The Divcom and I observed the bubble track and I started taking pictures. "Hot, straight, and normal." Seconds ticket away, the bubbles disappeared under the target...and nothing happened. The torpedo had missed, apparently directly underneath. Sonar confirmed that it was still running—hot, straight, and normal. To say that I was overcome with a blind rage would be a slight understatement of my feelings at that moment. In fact it took the firm, gentlemanly voice of Jack Gillette to get me to put on enough rudder to ensure that we didn't collide with that god-damned-still-floating target.

It was a long few days until the pictures taken from helicopters assigned to record the destroyer escort's demise were developed and printed. They clearly showed the bubble track and confirmed that the Mk 14-5 warshot should have hit except for depth. The squadron weapons officer had observed all the preparations and settings, including the firing settings. We were clean, although mightily disappointed. The errant torpedo went to the bottom in thousands of feet of water. The question remaining was why had the depth mechanism malfunctioned? We never solved that particular problem. Milford mentioned depth spring fatigue in his discussion of Mk 14 torpedo depth keeping problems. I have no idea of the age of the warshot we fired. Certainly it had been in the fleet a long time. Perhaps that would explain it.

Sincerely,
CAPT John F. O'Connell, USN(Ret.)

A Mk 14 RUN PROBLEM

November 5, 1996

The torpedo flap highlighted in your latest issue is the subject of this letter. Probably 15 years ago, I submitted an article to The Proceedings concerning the Mk 14-3A torpedo. It was never printed, but I do believe this information is an important addition to the history being compiled.

Starting in 1965 as COMSUBDIV 72, my division fired 82 torpedoes (Mk 14-3A) from our four submarines. These were canned shots from anchor using a lonely beach in Maui as our range. The alarming loss of SUBPAC exercise shots prompted my division interest. As an ex Sub School torpedo instructor, I wanted to find out why exercise shots were not surfacing at 4500 yards but more likely at 7200 yards.

With the new Fingerprint sonar, we determined that the Mk 14-3A shutdown at about 2000 yards and then ran on air out to over 7000 yards, at constantly decreasing speed, until the exercise head blew. As I taught many Sub School students, this torpedo did not run at 46 knots for 4500 yards in high speed. It ran out of fuel at about 2000 yards and continued on its merry way until it ran out of air.

We fired 82 torpedoes at the beach and fingerprinted each one. They all ran better than 7000 yards, winding down as they went. We retrieved them in a rubber boat and towed them back to the firing submarines.

Torpedo Shop personnel were in on the program and even tied one to the pier and watched it run out of fuel and shut down at approximately 2000 yards by stop watch.

These torpedoes were all made ready by division submarines and shop personnel. All were fired in high speed setting, documented by sonar traces as to speed and range, and observed by numerous people.

A complete report was submitted to BUWEPS by our Squadron Commander, the late Dick Ryzow, who had been my Ordnance Department Head at Sub School when I was teaching torpedoes. The report was forwarded by COMSUBPAC.

BUWEPS said we were crazy. All torpedoes were tested at Keyport and ran as prescribed. Our investigation showed the torpedoes were fired and *clocked* between 1000 and 2000 yards at Keyport. And why were our submarines always successful with

TDC settings of 46 knots? We always fired at torpedo runs of less than 2200 yards. Any runs beyond that range would be affected by the slowing speed as the air pressure decreased. Need I say anything about the effect on the pendulum? Anyway, we had fun and I am sorry I gave out so much bum dope as a Sub School instructor.

Best wishes,
CAPT Ted Davis, USN(Ret.)

THE BATTLE OF MIDWAY

November 10, 1996

Concerning Rear Admiral Giambastiani's symposium remarks, as published in your October issue, the results of U.S. submarine participation in the Battle of Midway were even more distressing than he indicates. Captain Brockman in NAUTILUS readied a salvo of four. One failed to leave the tube, two missed, and the fourth was a dud. KAGU sank without any help from the Submarine Force.

Sincerely,
RADM Ralph M. Metcalf, USN(Ret.)

POST-WORLD WAR II TORPEDOES—REVISITED

November 25, 1996

It is gratifying to know that my articles on torpedoes are being read. (As I stated, "history is easy to reconstruct and hard to verify". I have waded through many volumes of information and talked to many people while developing the article for the NSL readers' enjoyment. However, no matter how thorough the research may be, there are always opposing and perhaps minority views.) I would like to respond to a letter to the editor from retired Admiral Metcalf which was published in the October 1996 **SUBMARINE REVIEW**.

His opening statement was "Your facts concerning the Mark 16 and Mark 23 torpedoes are wrong." Perhaps he meant to say interpretation of the *facts*. The dictionary definition of the word *facts* is "something with certainty, something that has been objectively verified, something having real demonstrable exis-

tence".

His letter to the Editor had three parts. The first had to do with an inference he had drawn relative to the Mk 16 torpedo, the second relative to a typo, and the third was that he disagreed that the Mk 23 torpedo was not as widely used as the Mk 14 torpedo.

In the first part, he stated that no Mk 16 torpedoes were outloaded on war patrol against Japan during WWII. My July 1996 article merely states that the Mk 16 torpedo had a late entry into WWII and that most Mk 16 torpedoes were produced after the war. According to E.W. Jollies' document entitled "A Brief History of U.S. Navy Torpedo Development" (NUSC TD 5436, 15 Sept. 1978), only 60 Mk 16 torpedoes were produced during WWII, but none saw combat. A telecon with retired Admiral Metcalf indicated he drew an inference from my simple statement. All I stated was the torpedoes were produced late in WWII. I indicated nothing about combat use.

The second part has to do with a typo in the article which inadvertently listed the Mk 14 as the Mk 24 under the section "Non-Homing Torpedoes in WWII". A revision sent to the NSL on May 5, 1996 corrected this typo, but may have been too late for the publisher.

The third part disagreed with the following statement in my article: "The Mk 23, a *high speed only* version of the Mk 14, was produced (9600 units) at Newport, Rhode Island during WWII, but was not used to any extent because of its short firing range requirements. Since the fuel consumption goes up at a cubic rate with speed, this torpedo had to be fired closer to the target, thereby endangering the launching submarine."

In Admiral Metcalf's opinion, he felt that the Mk 23 torpedo was used interchangeably with the Mk 14 torpedo. He also stated that his personal experience shows that 2 of the 14 torpedoes he fired on the sixth war patrol of POGY were Mk 23s. He also stated that experience had proved that the low speed feature of the Mk 14 was totally useless.

To this point, there is much literature today that does not agree with this viewpoint. E.W. Jollie writes in NUSC TD 5436, 15 Sept. 1978 that "Due to the changing requirements of the war, however, most of the 9600 Mk 23 torpedoes saw little service. In the latter stages of the Second World War, fewer targets and better/smarter escorts/escort tactics necessitated firing from longer ranges. The Mk 14 torpedo, with its low power and longer range,

became the preferred weapon. Much of the Mk 23 inventory was scraped or converted to torpedoes Mk 14 while other units were cannibalized for spare parts." In addition, Robert Gannon in his 1996 book Hellions of the Deep wrote that firing at longer ranges was more preferable since it reduced the risk factors of the launch submarines. It is also interesting to note from Admiral Metcalf's comments that of the 14 torpedoes fired during the sixth war patrol of POGY, only two were Mk 23 torpedoes. This seems consistent with Jollie's and Rob Gannon's statements that the Mk 14 was the preferred weapon over the Mk 23 torpedo.

Some WWII submarine skippers seemed to indicate that in limited cases, the firing range may also be dependent on the aggressiveness of the skipper and the element of risk to the launch submarine.

I would like to thank Admiral Metcalf for his comments and for pointing out what may be an obvious type error to some but not necessarily to others. I have received several favorable correspondences relative to my articles and welcome more, favorable or otherwise. Inputs from individuals, such as Admiral Metcalf are especially important since they were a part of the activity and point out that there are differences in opinions.

Tom Pelick

SUBMARINE PATCHES

29 November 1996

I need help from old timers in an effort to reconstruct the history of the colorful jacket patches submariners wear so proudly. They were not being worn when I served on SEA CAT in 1950, but I have a vague recollection of seeing some on boats that came around from the West Coast about that time. They must have been officially authorized to be worn some time after that, because I started collecting original patches back in about 1963 and have them from most of the boats that were in commission then. However, I have been able to find out very little about the use of patches prior to that time.

In recent years suppliers have been recreating patches for most of the old WWII boats, based on the insignia that were prepared by Walt Disney and others during the war, or on artwork provided by crew members for reunions. However, to the best of my

knowledge, most of those boats never had patches while they were in commission.

I am particularly interested in identifying any patches that were actually worn during the early post war years, or before the war for that matter. If anyone has examples of such patches, or knows when they were first permitted to be worn, I would appreciate hearing from you.

Sincerely,
John D. Alden
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OF NUKES AND NOSECONES
A Submarine Story

By Captain Arthur Clark Bivens, USN(Ret.)
Gateway Press, Inc.
1001 Calvert Street, Baltimore, MD 21202
1996

Reviewed by CAPT George Graveson, USN(Ret.)

In relating his experiences in the U. S. Navy and the submarine service, Captain Bivens provides different things to different readers. To the submariner who served in our earlier, diesel electric submarines, and did make the transition to nuclear powered submarines, he provides insight into that transition. To the submariners of today, who serve in our latest nuclear powered submarines, he provides a history of those earlier boats and the early days of nuclear propulsion, which gives them a greater insight concerning the roots of today's Submarine Force. To submariners of all ages, from the strictly diesel boat sailor to the strictly nuclear boat sailor, and including those who made the transition, he provides a wealth of experiences with which we all can identify in one way or another. To the non-submariner, Navy or civilian, he provides an understanding of submarines and submariners through the telling of his *submarine story*.

It's a good story. Captain Bivens tells it like it was, in a relaxed and forthright manner. He tells the story as if he is sitting with you and a group of friends or fellow officers talking about the things that happened yesterday, or last week, or on the last patrol. You almost want to jump in with your own anecdote that comes to mind as you read the account of his experiences in QUILLBACK, or SCAMP, or SAM HOUSTON, etc.

One of the main things that Captain Bivens emphasizes is the importance of strict adherence to procedures and clear communications. This emphasis on discipline and formality has always been the hallmark of submarine operations. He speaks of precise terminology, repeat back of orders, double checking of valve lineups, formal conduct by watch standers and thorough turnover by watch standers. These were important—no, essential, in the operation of diesel electric submarines and in the operation of

nuclear powered submarines. Captain Bivens observes that these "good practices" were tightened up under Admiral Rickover's influence in the nuclear boats. Included in this story are experiences indicative of the pressures to get the nuclear boats on the line, the interviews with Admiral Rickover, the sea trials, NTPIs and ORSEs, the SSBN trials, the new hull designs married to nuclear power, etc.

Through the relating of his personal experiences in the early days of nuclear submarines, in attack boats and SSBNs, Captain Bivens provides a clear picture of what it was like during that exciting period. He provides a comprehensive picture of nuclear submarine development and operations from the viewpoint of the junior officer as well as the commanding officer. From construction to operations to upkeeps and overhauls, in attack submarines and SSBNs, we are led through this period of change and challenge as Captain Bivens relates his experiences. Although the title of the book refers to ballistic missile submarines, and Captain Bivens describes these ships in some detail, the book is more about submarines in general and the men who operate them. He pays tribute to the sailors who make up the crews of these magnificent submarines, and the anonymous poem about the Navy wife in Chapter Six appropriately recognizes the part these heroic women play in the life of our Submarine Force.

I recommend this book to all of our members and for others who want to know about our submarines and how they got where they are today.

BACK FROM THE DEEP
by Carl LaVO

Reviewed by LCDR Chris Ratliff, USN

Probably every history of World War II U.S. submarine operations highlights the story of the fatefully crossed paths of USS SCULPIN (SS 191) and USS SQUALUS/-SAILFISH (SS 192), the topic of Carl LaVO's Back From the Deep. Since most who read the book will already be familiar with the major events of the story, I give away little by recapping here. SQUALUS flooded and sank off the New Hampshire coast during a test dive in May 1939, shortly after commissioning. The first vessel to arrive and begin the rescue effort was the sister ship SCULPIN. Those who survived the flooding were dramatically rescued, and their ship was salvaged and sent to the Pacific as USS SAILFISH (retaining SS 192). During a Pacific war patrol in the Fall of 1943, a Japanese destroyer got the better of SCULPIN, resulting in the boat's loss. As 22 of the survivors were being ferried to Japan aboard the aircraft transport CHUYO, SAILFISH engaged and sank the transport. Only one SCULPIN crewman survived to live out the war in a Japanese prison camp.

Back From the Deep is a detailed review of the cradle-to-grave life of both submarines. Supported by his thorough, primary-source research, LaVO offers many insights into the submariners' experience in the Pacific war, with the familiar story of the sister boats providing tight cohesion. Though the first few pages have a pulp fiction style of writing, the book then settles down to a quick, enjoyable read. This project makes it apparent LaVO is a fan of the World War II Submarine Service, but he manages to retain his objectivity throughout. While most of the events he relates are uplifting, a few are less than flattering. His sum result is a superb addition to the library of submarine history.

The most memorable part of the book is the account of Captain John P. Cromwell's Congressional Medal of Honor performance during SCULPIN's last fight. Using primary sources to great effect, he vividly recreates SCULPIN's ill-fated battle with the destroyer YAMAGUMA. This was my first exposure to the heated argument between Cromwell and SCULPIN's Commanding Officer, Lieutenant Commander Fred Connaway, over Connaway's decision to surface for gun action against YAMAGUMA in

a desperate attempt to save his crippled ship. I was inclined to tilt toward Cromwell's case, until a well placed depth charge annulled his argument. At this point, SCULPIN faced certain death no matter what course Connaway chose. LaVO poignantly relates Cromwell's sacrificing himself, in particular his serene demeanor and how he chose to spend his remaining mortal moments. Two of Cromwell's shipmates also chose drowning over capture, while most submarine histories only report one. As LaVO relates, they also faced their end with calm courage. Chapter 15, "The Loss of the Sculpin", is some of the best submarine history I've read.

There are other familiar elements. Since both boats were in the Pacific theater as the war began, inoperative Mk 14 torpedoes and ineffectual commanding officers are part of this story. LaVO doesn't go in to vast detail on the torpedo issue. The reader will find this brevity acceptable, since the topic is not central and is reported in detail elsewhere (for example, see Frederick J. Milford's The Great Torpedo Scandal, 1941-43, in the October 1996 issue of **THE SUBMARINE REVIEW**). However, using the context of Lieutenant Commander Morton C. Mumma's first approach in command of SAILFISH, LaVO puts a dramatic and human face on an otherwise engineering and bureaucratic problem.

But the *skipper problem* is a central part of this saga. Mumma willingly relinquished his command after curtailing his first war patrol because of his emotional breakdown during that first, hapless attack. According to LaVO, Mumma and many others were unsuitable for combat command because they were "older boat captains", and thus timorous. He gives some but ancillary credit to poor tactical doctrine and unreliable torpedoes as reason for their fear to attack aggressively. Certainly there were many commanding officers relieved for unwillingness to engage the enemy, but I must fault LaVO for his attributing the character trait primarily to age.

Many older commanding officers failed, but so did many younger ones. LaVO tells of the relief of Lieutenant Commander William R. Lafavour, a younger skipper of 33 years, for his feckless performance in his first war patrol commanding SAILFISH. He also reports the extreme success of Lieutenant Commander Lucius Chappell, an older skipper at age 36, aboard SCULPIN for many patrols. My guess is that LaVO gave little thought to his conclusion and instead merely reported the opinion of other historians. Fortunately, he prevented the error from

being fatal by not harping on the age issue as commanding officers come and go throughout the book.

While the skipper problem demands further research, I think the accurate conclusion is simple and two-fold. First, some have what it takes for successful combat command, while others don't, regardless of age. Second, there is no way to tell who is a *have* and who is a *have not* before the supreme test of combat. As a perplexing corollary, some began the war demonstrating a willingness and ability to fight, then inexplicably lost their vigor. Such was the case of Lieutenant Commander Raymond Moore, awarded the Navy Cross while commanding S-44, only to be stripped of his SAILFISH command after one dispirited patrol.

Twenty-one SCULPIN crew members (one who survived the CHUYO sinking, plus others transported to Japan aboard another ship) survived nearly two hellish years as prisoners of war. LaVO very appropriately relies on survivors' narratives to tell this vital part of the story, while his background and explanatory information effectively keeps the story moving. Though he is not as ghastly vivid as so many recounts of imprisonment in Vietnam, I was nonetheless left with the impression that the experience was equally harsh. But as I read of the well documented savagery of the Japanese captors, I remained chilled by the eyewitness account of Lieutenant Commander Robert E.M. Ward contemplating murdering his Japanese prisoner aboard SAILFISH and throwing the corpse overboard. Of course, Ward's cruel thought doesn't compare to the brutality of the Japanese toward their prisoners-turned-slave laborers.

Back From the Deep is not exclusively heavy, as perhaps I've implied. The early history of the crews, even before they reported to their boats, is light and enjoyable. LaVO captures the spirit of depression era America in the veterans' accounts of why they joined the Navy and the Submarine Service. His references to the New London Submarine Base suggest the base changed very little throughout its history until the last 10 years. The whole chapter devoted to "Spritz's Navy" documents well the character-building experience of Submarine School. The students and staff gave the school that *nom de guerre* because of the leadership and training methods of the martinet-in-charge, Chief Torpedoman Charles Spritz. The references to Kittery, Maine, birthplace of both boats and final resting place of SQUALUS/SAILFISH, are not so familiar, unless you've had the unforgettable experience of driving

and berthing a ship on the Piscataqua River. (See Captain Paul Schratz's Submarine Commander for a similar description.)

The rescue of SQUALUS survivors from the ocean's bottom is rich in historical references. The first and only use of the McCann rescue bell and the perils faced by the deep sea divers makes for an exciting narrative. Four of the divers were awarded the Congressional Medal of Honor and another 45 earned the Navy Cross for their peace time exploit. LaVO's description of the Momsen lung makes it sound like a veritable contraption compared to our 35 year old Steinke hood. For those of us trained in free ascent escape technique, the method to be employed by a Momsen lung-wearer is nearly unbelievable. Lieutenant Commander Charles B. Momsen himself was on the scene, overseeing the rescue effort and ensuring his experimental equipment worked.

The book's jacket has the subtitle "The Strange Story of the Sister Subs Squalus and Sculpin". As I first opened the cover, I was prepared for a yarn suitable to Ripley's Believe It or Not. Instead, I was delighted to read an excellent account of typical World War II vintage submariners and their typically extraordinary achievements. That's what I really should have expected from Carl LaVO, a professional journalist and editor of a respected newspaper. His Back From the Deep belongs high on the honor roll of submarine histories.

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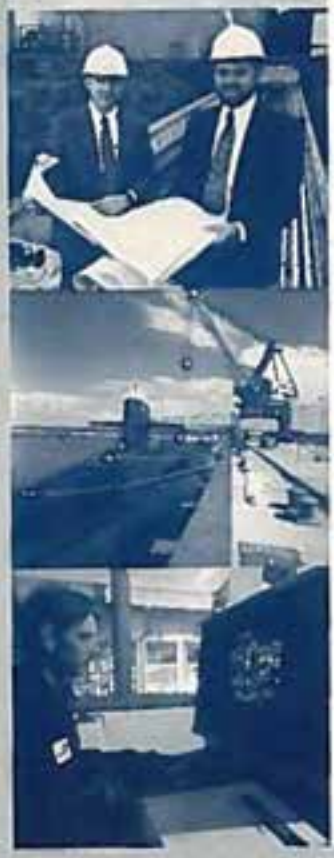

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