THE SUBMARINE REVIEW

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ARTICLES — PAGE

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FROM THE CHAIRMAN

The Naval Submarine League is a growing and vital organization. Our numbers have grown to over 3300 members since our start in July 1982. The NSL Advisory Council which was organized over a year ago has been instrumental in researching the proper path and correct speed to develop and expand. They have provided your Directors with many short and long term initiatives which have been adopted and will provide an agenda for action for several years. However, as always, action requires resources.

I have surveyed our corporate members on their willingness to increase their support to the NSL. Uniformly they felt, based on our mission and track record, that a modest increase of corporate membership dues was supportable. Your Directors have effected this and included a sliding scale to accommodate the smaller companies.

I have always advocated that our membership dues were a show of support and an investment in our submarine force and the security and deterrence it brings to a free country. In this era of budgetary constraints our concern needs to be relayed to the public and responsible officials through our expanding educational programs. Our membership dues were never considered payment for which the individual received a product or service. Hence the rejoinder "What's in it for me?" is best answered by "having the satisfaction that you help in a small way to keep our submarine deterrence strong and vital." The fact that the Soviets respect our submarine force as none other is abundantly clear and documented. We need not try to build that case here.

The bottom line is that we have increased individual membership dues by $5.00 per year effective on 1 April, 1987, the start of our new fiscal year. I ask that you rally round the NSL and support this most needed and necessary decision. I ask for your positive support and continued membership. We have a great deal to do -- together -- as a team.

"Bob" Long

FROM THE PRESIDENT

I am pleased to report that pursuant to an NSL Advisory Council recommendation to include more corporate and business experience for your Board of Directors, the number of Directors was increased by four. The following individuals were appointed to fill the new vacancies:

R. I. Arthur,	President of Sippican, Inc.
H. Galt, Jr.,	Vice President and General Mgr. Rockwell Int'l, Autonetics Div.
W. M. Pugh,	Vice President, Tracor Inc.
C. R. Bryan,	Past President, Webb Institute of Naval Architecture

The Directors in their appointment of "Russ" Bryan also noted that as a submarine qualified Engineering Duty Officer, and past Commander of Naval Sea Systems Command, he was well qualified to advise the Directors on ways to introduce the NSL to the many fine professional NAVSEA employees who are not aware of our organization and mission. In addition, "Russ" will be a valuable source of assistance in fulfilling our educational mission.

In the last issue, I requested that a few of our creative members author articles for the REVIEW. I make that request to the general membership again, but in addition, I would encourage our corporate associated members to consider the value of providing a feature non-parochial article based on some facet of their corporate interest or research. I believe there are many subjects available that can be presented in an unclassified article of great interest to our membership. There are a lot of success stories that need to be told.

The NSL Directors recently approved an award to memorialize RADM Jack Darby who until recently was Commander Submarine Force, Pacific Fleet. The award will be given to the commanding officer who has most excelled in bringing his ship and crew to a high operational readiness and superior morale status. Jack Darby had those intangible qualities of leadership so few have, and was an inspiration to countless submariners and others.

A reminder that our NSL Annual Business Meeting and Symposium will be on 8-9 July at the Mark Radisson Hotel in Alexandria, VA. I would encourage any members who desire to organize mini-reunions at our social hour on the evening of 8 July to bring a ship's banner (or whatever) and we will provide a small area and table for your use while renewing old friendships and telling sea stories.

Shannon

FROM THE EDITOR

Today's submariners may see little usefulness in relating lessons from past submarine experience to present submarine problems. The character and utilization of nuclear-powered submarines seem unrelated to lessons learned from the war operations of diesel-powered submarines. The same might seem true with today's submarine weapons. Could there be any relation between today's submarine-launched, anti-submarine weapons and the weapons used by the old diesels against surface ships?

It can be easily rationalized that modern technologies -- nuclear power, electronically guided torpedoes, etc. -- have so revolutionized the nature of submarining as to make historical submarine experience mainly irrelevant. At the same time, technology changes are so rapid that even a span of a few years might make much of nuclear-powered submarine past experience also irrelevant. Thus, what is dredged up about submarines of the past and printed in the SUBMARINE REVIEW may make entertaining reading, but of little use for today's professionals. Are these REVIEW articles even worth the few minutes that might be spent to comprehend the possible lessons they represent?

Captain Gillette's article on the use of passive homing torpedoes in World War II may be relevant to today's anti-ship torpedoes -- particularly since the passive capability of anti-submarine torpedoes would be certainly suspect with the quieting of submarine targets. But does this apply to surface targets? G. Karmenok's review of Soviet command and control experience in WW II -- in the employment of diesel submarines -- may still have some lessons for today's submarine operations. The use of World War II conventional-submarine lessons, according to Phoenix, are likely to be an influencing factor in the present strategic and tactical employment of conventional Soviet submarines.

For at least the latter examples, conventional submarine history does appear relevant. Professionals would thus be well advised to recall the lessons learned about war operations of diesel boats -- because the Soviets appear to be using these lessons in their present submarine war planning. On this basis alone, the SUBMARINE REVIEW's rehashing of history serves a useful contemporary purpose. Technology may have changed U.S. submarine operations radically, but if the Soviets are going to utilize half of their submarine force -- the diesel boats -- in a fashion reflecting to a great extent WW II operational experience, then relevant REVIEW articles provide a useful service to the present U.S. submarine force.

But more than this appreciation of how a potential submarine-oriented enemy has used history, is the value in refreshing the submarine profession's memory of past submarine matters.

It is popularly held that the corporate memory of an organization is, at best, only a few years. Beyond that, valuable experience is likely to be forgotten. VADM Jon Boyes' experience with ship control automation for the ALBACORE may be one such item -- useful for its recall. THE SUBMARINE REVIEW article dealing with the command and control of submarines in WW II, may be in some way valuable to submarine planners if several optional submarine strategies are under consideration for "fast-changing situations."

The above rationale is not an argument for reading the SUBMARINE REVIEW so much as it is to understand the worth of appreciating the lessons of the past and applying them, where applicable, to the philosophies developed about submarines and their weapons, today. If the U.S. art of submarining is to continue in a preeminent position in the submarine world, a close regard to past submarining lessons seems indicated.

THRESHER'S DEBRIS FIELD

Wednesday: 1300, April 10, 1963. I was on the lower base at New London sitting with Sneed Schmidt in his COMSUBFLOT 2 office, along with John Elmer Dacey, COMDESDEVGRU, and my Chief of Staff, Jim Bellah. The subject being discussed was: increased tactical R&D exchange between SUBDEVGROUP 2, my command in New London, and Dacey's command in Newport, RI.

Sneed's flotilla radioman broke in -- anxiety all over his face -- and said to Sneed, "Commodore, SKYLARK reports something gone wrong with THRESHER." Sneed had OPCON for all subs in the New London and Portsmouth Shipyard OP areas. THRESHER belonged to my SUBDEVGROUP 2.

I cannot remember the rest of the day's events except for massive confusion and concern. Everyone was on the phone at once between Norfolk, New London, Portsmouth, Washington and everywhere else.

At that moment, Schmidt, Andrews and Dacey did not know that some 180 minutes earlier, THRESHER, on a deep dive 220 miles east of Cape Cod, had lost depth control -- probably due to major flooding from ruptured internal sea water piping -- and passed through crush depth. She then imploded and broke up severely, making a 3-5 knot falling-leaf descent to the ocean floor nearly a mile below. All 129 crew and technical ship riders on board were lost.

At 1300, THRESHER lay on the floor of the Atlantic continental shelf in 8200 feet of water, broken into three major and many, many smaller parts, in a debris field perhaps 2000 feet long and 400 feet wide. (See Figure 1). All of this took place in perhaps a twenty minute period from 10:00 a.m. to 10:20 a.m. on a middle -of-the-week work-day.

Much was written in the sixties about the THRESHER accident, the deep ocean searches conducted in the loss-area in the summers of 1963 and again in 1964, the Court of Inquiry held at the Portsmouth Naval Base in 1963, and later the wide-reaching, costly but necessary Sub-Safe program which was initiated by THRESHER's loss.

FIGURE 1.
The approximate location of THRESHER on the continental slope east of the Gulf of Maine

Many of the old timers know the facts of all this because they were there. But, I'll review some of the details, from my personal view, for those who have forgotten or who simply never had a chance to review them. And, there is something new here that most submariners, even the old ones, know little about -- that is, the photo mosaic made in 1964 of the THRESHER hull debris field. It shows the final product of that very sad day.

REVIEW OF SOME HIGH POINTS

In the fall of '62 and spring of '63, THRESHER completed a Post Shake-down Availability (PSA) at the Portsmouth Naval Ship Yard. As first of a class, THRESHER had been subjected to a full set of extended sea trials in the '61-'62 period -- including a severe, close-aboard depth charging off Key West, Florida.

During the PSA, all internal piping found to be weeping or leaking as a result of the sea trials was fixed. However, a non-destructive test of all internal and external joints was not done because of cost and time. On April 9, 1963, after nine months in the yard at Portsmouth, THRESHER went to sea with USS SKYLARK to execute a series of PSA tests off the Gulf of Maine.

In keeping with the practice of the day, THRESHER made her way into extra deep water (beyond the 1000 fathom curve) for the usual set of deep dives. On the morning of April 10, 1963, a first dive to test depth was scheduled. The rendezvous and underwater telephone contact with USS SKYLARK were made, and the dive commenced. Sometime around 10:00 a.m. THRESHER reported via UQC "undergoing difficulty - everything under control." Shortly thereafter ballast tank blowing noises and then break-up noises were heard on SKYLARK's bridge where the UQC was manned. No tapes were made.

What happened? The evidence is circumstantial. The only real factual information assembled proved to be a review of shipyard test data and the ocean floor photographs taken during the search.

My view, based on my own involvement with the search for THRESHER, on a review of findings of the Court of Inquiry, and on discussions with the NSRDC structure people is as follows:

- During the deep dive -- maybe at 500 to 700 feet -- a silbraze joint in one of the many, many sea pressure systems carried away catastrophically.

- In many ways, the THRESHER engineering plant (outside the reactor) was built like that of a surface ship. Many, many yards of internal sea water piping, servicing a large number of distributed heat exchangers were similar. In late 1962, Dean Axene, commissioning CO of THRESHER had pointed out that the lead paragraph in his "first-of-class" year-one report to the CNO were approximately, "the literally miles of internal sea water piping in the THRESHER are its greatest single design deficiency. In effect, the ocean does not stop at the pressure hull of THRESHER, but is all over its insides." The joints in THRESHER piping were not welded but rather were coupled by a form of expanded-on joint with a silbraze type of solder as the main strength bond. The silbraze joints had great strength but tended to pull apart under great tensile stress. (It should be noted that the Sub-Safe program replaced much of the THRESHER-design internal sea water piping, hence now only a very few internal systems are under constant sea pressure.)

- The stream of sea water pouring into the engineering spaces sprayed salt water all over the place in a horrendously chaotic way. The noise, the inundating sea water, sparks, and electrical equipment shorting out -- all over the place -- compounded the confusion.

- The reactor was scrammed and main propulsion was shifted to battery power.

- The operating procedure of the day was to SCRAM the reactor whenever internal flooding or fire occurred. Simultaneously the main steam stop valves between the steam generator and the balance of the main propulsion plant were closed -- eliminating the main source of propulsion power. Drawing down steam pressure in the steam generator was considered intolerable because of the potential thermal stress on the reactors. It was subsequently estimated, however, that SCRAMMING the reactor but continuing to draw down the steam pressure in the steam generator would have given THRESHER a speed of 10 knots or so for several minutes. (Importantly, a new operating procedure in which the main steam stops would remain open was instituted within a week after THRESHER's loss.)

- "Blow all ballast!" The emergency blow valves unpredictably froze up. Lights went out all over the submarine. There was near panic in the control room. Battle lanterns were turned on. The THRESHER was taking a large up-angle, yet her depth gauges showed an increasing depth. More speed available? No! Reactor is scrammed. The Commanding Officer, at the UQC felt he shouldn't panic the people up on the surface. (Wes Harvey, THRESHER's skipper had been a starting back for Navy. He had done the Nuke course. He had served in NAUTILUS's wardroom.) He kept thinking "We'll pull it out." But deeper and deeper the THRESHER sank. Then the after end crushed.

(Post accident tests in May-June, 1963, by the Portsmouth Shipyard demonstrated that the THRESHER class' high pressure blow valves could freeze up when used in an emergency situation. The design was unsat.)

- The engineering spaces centered at about the main propulsion turbines imploded. A high-pressure shock-wave moved forward, knocking bulkheads down. The air compressed to maybe eighty atmospheres -- moved everything big and small before it -- finally knocking the front end of the boat off. The boat then split into the parts shown in the debris picture. All life was quickly snuffed out.

- This scenario was based on tests conducted by the structures people at NSRDC in late 1963. The basic assumption was that THRESHER was flooding aft, losing depth rapidly, but with a large up angle.

- Hanging loosely together, the major parts made a falling-leaf path to the ocean floor a mile or so below.

- Enroute to the bottom, turbulent flow over the broken parts gradually pulled them apart, but not all that much. Light debris spilled out and drifted out of the vertical. -- but the center of mass still moved at three to five knots downward in a straight line.

- Everything settled to the ocean floor about 15 to 20 minutes after the catastrophic passage through crush depth.

<u>Construction of the Photo Mosaic of the Debris Field</u>

Most of THRESHER debris was photographed by USNS MIZAR operated by the Naval Research Laboratory. The search-study tool was a camera/magnetometer combination, towed from an "erector set" type structure about 10 feet x 2 1/2 feet x 2 1/2 feet.

The towed "fish" was lowered from a large center-well designed into MIZAR for deep ocean-floor surveillance work. Normally, 12,000 feet of tow cable was used, though the water depth of the debris field was only 8200 feet. The towed "fish" wandered almost directly under MIZAR most of the time.

Successful search/photo tactics were: (a) at speed 1 to 2 knots MIZAR moved the towed unit through the area of high probability -- the towed fish 8200 feet below MIZAR and maybe 15 feet above the ocean floor -- with camera illumination OFF, and with magnetometer energized; (b) upon receipt of a strong magnetometer signal -- up the cable to MIZAR's control center -- MIZAR would be turned into a tight circle, camera light energized, and everyone hoped!! (c) at the end of an hour of camera action, the tow cable would be hauled in -- a 60 to 90-minute task -- and the camera film pack taken to the dark room for development, with pictures, if lucky.

The good photographs were assembled into a montage or mosaic to produce an artist's sketch.

The individual photographs when developed covered perhaps 15 feet by 15 feet of ocean floor, and no more. Many photographs overlapped sections of each other. Also, individual photographs would have different orders of magnification based on the distance of the camera from the object. Additionally, TRIESTE obtained a few photographs (maybe 5%) which also became part of the final photo mosaic.

WHAT THE PHOTO MOSAIC SHOWS

The photo mosaic carefully developed represents the excellent craft work of NISC (Dick

Silby) in Suitland, Maryland, where location, and photographs were assembled to scale, on a large floor of one of the NISC buildings. It shows the tail section is in the southern-most portion of the debris field. A section of the main pressure hull -- identified as frames 78 to 67 -- is over at the easternmost side of the field. The nose section and a portion of the superstructure and hull surrounding the control room is at the northern end of the field. Nearby are a stern plane with added PUFFS hydrophones, along with an air flask, a torpedo shutter door and finally a section of the hull holding the forward escape trunk. There was light, scattered debris all over the area, but their photographs were not included in the mosaic. They required too much detail with too little accurate navigational data. Examples would include: storage battery plates, air flasks, a compartment ladder, twisted metal pieces, a RADCON booty marked "SSN", a torpedo handling davit, a sonar internal strut, twisted cabling and superstructure plating.

A guess is that the main pressure hull hit first with the reactor-end penetrating deeply into the muddy bottom. Heavily plowed terrain adjacent to this section indicates the impact of a massive body.

The stern section is clearly imploded. It could be approximately frame 78 on aft. This imploded tail section supports the scenario of flooding aft and loss of depth control with a large up-angle.

The nose and hull sections are close together and represent the third largest section of debris.

The many other small, yet identifiable submarine parts (anchor, stern plane, sail, torpedo tube shutter) plus much lighter debris not shown, are testimony to the enormous release of energy which must have taken place when THRESHER went through crush depth. One calculation suggests an energy release comparable to the explosion of a ton of TNT inside the boat.

In summary: THRESHER debris field is at latitude 41 44.5 N, longitude 64 56.4 W in 8250 feet of water (See Figure 1.)

The ship broke into three large pieces, four smaller pieces, and a snowfield of light debris which was much too detailed to present in the photomosiac.

No unusual radioactivity was ever observed in the debris field. The reactor compartment was never sighted and is probably buried as an extension of the part of the main pressure hull. TRIESTE (with pilot, Brad Mooney) actually sat on this section for over an hour on one of her dives.

THRESHER's loss was undoubtedly due to design deficiencies -- silbraze joints, excessive internal seawater piping, frozen blow valves and an over cautionary concern for reactor thermal stress.

Risk is part of technical progress. THRESHER paid the price for improved operating safety in today's submarine force.

Frank Andrews

[Editors note: Frank Andrews was Commander of the THRESHER search operation in the summer of 1963 and again in 1964. This article is based on his memories from 20-odd years ago.]

"FLYING" THE ALBACORE

ALBACORE was the Navy's high-speed, experimental submarine with the whale-like hull, driven by a very large propeller and a specially designed high-capacity silver zinc battery.

Paralleling the ALBACORE tests and trials in the late 1950s were those of two British high-speed, hydrogen-peroxide research submarines. Much rapport developed between the American and British submarine forces over these three submarines, and not a little bit of competition, too. So, we had a marvelous exchange of data and human experience to rely upon, as these research submarines went through their high-speed operations.

There is a similarity between aircraft and submarine "flight" in that each vehicle performs tri-axially in its operational envelope. This flight character is predictable in a specific mode of operation with the control system positioned at certain settings at an established speed over a specific period of time.

For example, underwater tests conducted by ALBACORE showed that when she was moving at very high speeds -- over 30 knots -- maintenance of a satisfactory path through the water required considerable skill, anticipation and automation.

An aircraft conducting similar maneuvers, like high-speed turns, experience changes in flight performance, but not exactly similar to those of the ALBACORE. This is due to differences in the lift dynamics involved.

Turning back to the modern high-speed submarine, we find similarities between its control concepts and those of multi-engine aircraft. While there are significant differences in speed and size between the submarine and the aircraft, they become more equal for computerized control purposes if the limited operating envelope of the submarine is considered.

How submarines will perform in their operating envelopes and their predictability, seem related to the lessons I learned about control systems for high-speed submarines -- when I was commanding officer of the ALBACORE, some thirty years ago.

The naval architects of the USS ALBACORE provided her with specially designed control surfaces and a fully automated control system so that she could be used in high speed maneuvering tests, acoustic evaluations and tactics. Her controls were designed for operation with one to four men, with or without selected automation. We learned to prefer a single operator or possibly two men, using full automation.

Most of ALBACORE's high-speed submerged operations under varying situations were intended to provide information which formed the basis not only of how similarly configured combat nuclear submarines would perform within their operating envelopes, but also to establish the parameters of the best man-machine relationship.

Before ALBACORE's tests of her automated ship control system, the wardroom officers went up to Lakehurst to fly in blimps and learn how to use a one-operator fully automated flight control system which had many similarities with the system installed in ALBACORE. Then, prior to ALBACORE going to sea to test a program, the David Taylor Model Basin calculated the event and determined with considerable accuracy what was probably going to happen. Of course, in those days of the mid- and late 1950's, computers though not as capable as those of today, still gave consistently good results.

One test trial was with ALBACORE traveling at a certain depth at speeds in excess of twenty-five knots; go into a thirty degree dive, and when a specified rate of descent was reached, to reverse propulsion or controls. At times in this maneuver, we took heels of over forty degrees with down angles around fifty degrees -- learning from this important lesson about ship equipment and human performance.

It was evident that ALBACORE performed significantly better with automated controls programmed by a single operator than she did with a standard four-man team of diving officer, helmsman, bow planesman and stern planesman. In fact, a very intelligent, alert and well-trained person -- using man override of the automated controls -- assured that there would be no human failures due to lack of coordination or human slowness of reaction.

Recovery from high-speed malfunctions provided another lesson. We learned that use of full-rudder in high-speed maneuvers could, if applied quickly, stall the ship out to a safe recovery position.

Later, in other tests and exercises at sea, we found that in automated flight ALBACORE was frequently quieter than when in a manual-operator control mode. We found also that when operating at high speeds the ship's sonar detection range of certain surface and submerged targets was somewhat longer than when in human operator control mode.

Using this experience and knowledge, and relating it to operations against ASW forces, particularly the tracking and attack of high-speed destroyers, ALBACORE was operated deep, at top speed and with single-operator, fully-automatic control. Targets were quickly closed, ALBACORE was brought smartly to periscope depth, the target was locked in, firing was simulated and then ALBACORE was spun on her tail to go after other destroyers.

If conditions were considered just right, ALBACORE was moved into an optimum position relative to the target. In such a situation, while holding the speed and maneuverability advantage, ALBACORE could fire at very close range with low relative bearing change -- or might scoot under the target releasing simulated vertically-launched missiles, at very short range.

ALBACORE's Executive Officers were trained to be at the controls during high-speed operations. Both Lou Urbanczyk and Ted Davis, became highly proficient single operators and I, as commanding officer, prized their abilities. We worked as a team. I concentrated on the fire control problem and they on the ship in its tactical moves to complete the action. If we were doing tests or dangerous trials, the highly qualified single operator using fully-automated ship control was always uniform in performance and steady as a rock.

I recall an exercise in the deep water off Key West in which ALBACORE was pitted against SARSFIELD, another destroyer, and overhead VPs and blimps. We had superb results to the enjoyment of ALBACORE guests, the CNO, Admiral Arleigh Burke, and Lord Louie Mountbatten, First Sea Lord. In this engagement, ALBACORE closed the destroyers at high-speed and fired "green flares" against both, went deep, skirted the MAD and sound buoy barrier and arrived at the Sea Buoy ahead of schedule, returning to port undetected.

From our experiences on ALBACORE and those of her other commanders, we learned how to best exploit and use speed, people, and ship controls. Later as submarine division commander of nuclear submarines PLUNGER and sister subs, we tried some aggressive but fundamental single-operator, automated ship control tactics in fleet exercises and in some special situations. The interest of Will Adams and the other skippers was high, but unfortunately we were limited by policy and automated controls which were less flexible than those of the ALBACORE.

A recap of what this ALBACORE experience demonstrated shows that in any environment in which vehicles perform -- space, atmosphere or underwater -- the vehicle operator can be provided the predictability of performance of his platform. Consequently, he knows what actions to take to maintain the desired performance or correct or overcome any abnormal ship behavior caused by an irrational element in the control loop.

For instance, the irrational behavior of an electrical, photonic or mechanical unit due to degradation or failure is correctable through fault-sensing-correcting or redundant element features in the control loop.

Irrational conduct or malperformance in a control loop is overcome by either someone else's override or in sophisticated control loops by machines which sense such faults and through offsetting features provide prompt reaction.

What I found to be difficult to counter in an irrational inductive situation in the control loop was when the vehicle operated beyond the boundary of safety. This condition continues to exist for both aircraft and submarines when the vehicle structure passes through recovery altitude. In the case of an aircraft it crashes into something, or a submarine passes through crush depth resulting in structural collapse. To prevent ALBACORE from being endangered near the boundary we had certain prescribed procedures.

Theoretically, to emulate performance predictabilities, when irrational behavior influences are induced, modeling or simulating with machines can be first used before operations are conducted -- with programs designed to experience what is desired to happen. Later, under known and programmed conditions the machine in flight or under sea will then perform in a uniformly consistent manner in carrying out prescribed control functions.

On the other hand, individual operator performance is difficult to emulate with models or simulating machines because each human is different. The differences vary widely depending on individual physical, emotional, mental and cultural characteristics as well as the level of training and discipline of the individual operator in the control loop. We have not as yet been able to establish dependable "measurements of human effectiveness." It is possible, however, to have some confidence in what an operator might do in certain situations if the human's norm of experience is established over a long period of time.

However, even this human norm will react erratically or differently under stress and fatigue conditions.

But, the problem of predicting human performance in the control-loop emulation through simulation grows increasingly complex if more than one operators' characteristics are placed in the control system. The system's performance obviously becomes more variable and, thus, less consistent. If a human supervisor is placed over several operators in the control system, then performance certainly becomes even less predictable.

In simple control situations such as moderate steady speed in flight, automated control with human override is superior to human control alone because well-designed, and tested machines do not get fatigued, bored or distracted as do humans. Machines can be programmed to carry out uniformly specific functions if the situation is then interrupted suddenly. In addition, the need for assurance of predictability of flight is why a single-operator automated system is used to control air and spacecraft regardless of mission, platform size or flight environment. As aircraft become more maneuverable and faster, their designers turn to higher-performance control machines to offset: human limitations in sensing and reacting, a lack of uniformity of performance, and, limited adaptability to performing multiple requirements simultaneously. Today, aircraft operations transition smoothly through takeoff, normal flight, maneuvering and landing, as these functions are accomplished with man-machine systems.

It is interesting to note the new control concepts for future jet fighter aircraft. The Soviets are experimenting with ground-to-air programmed control for the fighter aircraft, freeing the pilot to do other functions. In the newest of U.S. fighter designs, computers will fly the plane at speeds beyond human reaction capabilities, the pilot can intervene up to a point as needed.

Many years have passed since the days of ALBACORE, but I have always maintained a strong interest in automation and tactics. The development of better control systems and expert knowledge computers have helped to improve the predictability of performance of vehicles in which they are employed.

I believe that someday a nation with nuclear submarines capable of diving to over 4000 feet while traveling at speeds in excess of forty knots will be "flown" with automatic controls with pilot override. Such submarines will maneuver at low risk and more effectively than others more restrained. Such boldly operated and capable submarines will not face the inherent dangers and limitations of multi-operator controls. Rather, they will be the best in their environment.

Vice Admiral Jon L. Boyes, USN(Ret.)

SOVIET CONVENTIONAL SUBMARINES

Just after the start of World War II, I reported on board "a rusty old sewerpipe." That's what we called our S-boat of WW I vintage. But, she'd sunk a Japanese destroyer in the Java Sea a month earlier, and on my first patrol we sank a small Japanese seaplane tender just off the entrance to Rabaul -- an important and well-defended Japanese forward base.

Yet, the old S-boats were supposed to be "obsolete" and of little practical use in a modern war. Despite that, they were mustered for front-line war duties, to spread out the U.S. submarine effort in the far Pacific. In a sense, they were there to dilute the Japanese ASW effort against U.S. first-line "fleet" boats -- which were far larger, more long-legged and all less than six years old.

Today, a similar situation seems to exist. The Soviets -- great students of history -- seem well aware of the war contribution made by "obsolete" old submarines, like our S-boats. The Soviets maintain a large force of conventional, diesel/battery powered submarines most of which are of considerable age, but they're expected to supplement the large force of Soviet nuclear submarines. Though diesel boats have considerable limitations, the Soviets continue to build improved types of conventional boats. They also keep the old ones modernized and operational and indicate an expected use of all their boats in a wide variety of roles and missions. A latest count shows approximately 180 Soviet diesel submarines in commission, with another 60 to 75 in some sort of semi-active but reserve status. With about 200 Soviet nuclear submarines in an operational status -- about 50% more than U.S. nuclears -- there is seemingly little need to use this large additional number of submarines, the diesels.

But, Admiral Gorshkov, the past Head of the Soviet Navy, has stressed that "modern technology" has forced naval power underseas, and that "the transfer of the main efforts of naval warfare (is) to the subsurface medium." Also, that "submarines have become the main arm of the forces of modern navies." And Admiral Chernavin, the new Head of the Soviet Navy, has indicated an equally strong support of his submarines for today's naval wars.

Thus, all sorts of submarines -- conventional diesel-powered ones as well as nuclears -- have important roles to play in Soviet naval planning for wars which "embrace the expanse of the World Ocean." Particularly, because of the global nature of the big wars envisioned, having large numbers of submarines -- far more than their some 200 nuclear-powered operational units -- the Soviets feel that by operating submarines in ocean areas worldwide, they can overwhelm an enemy's ASW efforts. Recalling history: "For every German submariner at sea (in World War II) there were 100 British and American anti-submariners." The Soviets apparently believe that many more Soviet submariners at sea can thus "break the camel's back."

This Soviet emphasis on submarines, diesel-electrics as well as nuclears, stems from their stated belief that "modern technology" -- electronic warfare, good worldwide communications, very long range broad ocean surveillance, computerized data collation and computer generated decision making -- have put a particularly high and critical premium on the achievement of surprise in today's naval battles. And even conventional submarines, the Soviets apparently feel, can be so operated as to achieve a high element of surprise in their employment.

Why do the Soviets seemingly disregard our pessimism about the utility of diesel boats versus modern ASW forces?

Salient characteristics of Soviet conventional submarines, which are presently in commission -- as indicated by Jane's Fighting Ships and, for the most part confirmed by Norman Polmar's Guide to the Soviet Navy -- to a great extent explain the Soviet's continuing involvement with conventional submarines.

In general, Soviet conventionals are regarded as being quieter when operating on their batteries than enemy nuclear submarines -- their primary enemy. They are relatively small as compared to today's nuclears. They are double-hulled and apparently have degaussing coils between the hulls. They are well designed for shallow water operations -- i.e. for mining, shore surveillance, landing of commandos, penetration of port areas, etc.. They are for the most part old submarines -- 25 years or more -- but they have not been extensively used within their lifetimes. And they are recognizably considered to be expendable. Their underwater mobility is still relatively limited. But the conventional submarine is understood to have a greatly improved "maneuver" characteristic due to the weapons it now has available. Missiles and long range torpedoes "have made it possible for maneuver by weapon trajectories to replace maneuver by the platform, to a considerable degree." Thus, along with greatly improved organic sensors, including linear arrays for passive acoustic sensing, and with external means for providing targeting information (mainly airborne i.e. satellites, recce aircraft, and a manned space station with a good visual surveillance capability of the oceans -- rarely equated) the diesel boats' radius of effective action has been greatly increased. Also, with an indicated use of an external coordinating command for directing conventional submarine operations, the numbers of enemy targets susceptible to surprise submarine attacks are multiplied. Despite an irresponsible labeling of many Soviet diesel boats as being "coastal," virtually all of their conventionals are long-legged -- even the ROMEOs and WHISKEYs which have about a 9000-mile range on the surface. Evidently the so-called "coastal" boats are, for the most part, to be operated in the Baltic, Black, Mediterranean and Okhotsk Seas. Still they need not be restricted to inland sea operations.

The most significant difference between Soviet diesel-battery boats and World War II counterparts is their submerged endurance -- their time between snorkeling or surface battery-recharges. The old FOXTROTs have demonstrated more than seven days of submerged endurance while the newer TANGOs are credited with "significantly more battery capacity than the FOXTROTs" and hence greater submerged endurance. The JULIETTs with reportedly silver-zinc batteries may have even greater submerged endurance.

Perhaps the most significant proof of the believed utility of conventionals in modern warfare is the Soviets' continued building program of new types of conventional submarines. The KILOs are understood to have a present building rate "equal to the FOXTROT program at its peak." This would equate to about 7 a year.

One area of conventional-boat capability -- and probably the most important -- is the kind of weapons they carry and the efficiency of those weapons relative to their firing platform characteristics. Also, all of the Soviet boats carry a large load of heavy torpedoes, and seemingly all are likely to have nuclear torpedoes aboard during at-sea operations, as evidenced by the WHISKEY-on-the-rocks incident in Swedish coastal waters. The Soviet conventionals are covert. Are their weapons equally so? The Soviets have developed torpedo-tube-launched cruise missiles. How proliferated are they to the diesel boats? Anti-air weapons housed in the sail are ascribed to the KILOs and possibly the TANGOs. Is an anti-air capability to be expected in many of their diesels? And, with the Soviet emphasis on "destroying or diverting enemy weapons in their trajectories," how difficult will it be to obtain a hit in a Soviet conventional boat with ASW weapons of the West? Are these unknown factors part of the reason why the Soviets have retained such a large number of conventional submarines?

Briefly, the Soviet diesel-electric boats in commission comprise:

- thirteen KILOs of 3200 tons, with a shape like the ALBACORE but with a lesser submerged speed of about 25 knots, and a depth capability of an estimated 300 meters. The first KILO was launched in 1983 and has so few limber holes that it appears designed for continuous submerged operations -- requiring only occasional snorkeling charges of the batteries of short duration due to the use of high capacity diesels. Its bow planes are low-down near the bow. It has what is thought to be an "anechoic" tile-coating but which may be primarily designed for drag reduction. Its hull is believed to be amagnetic, and it has 6 standard torpedo tubes up forward.
- twenty TANGOs of 3900 tons and considered to be the successor to the FOXTROT class. The TANGOs have an estimated surface range of 17,000 miles, were constructed between 1972 and 1982, have 6 torpedo tubes forward and 4 aft, fire the SS-N-15 missile with nuclear warhead, and have a submerged speed of about 15 knots.
- sixty FOXTROTS of 2400 tons, built between

1958 and 1967 and credited with a snorkeling range of 11,000 miles at 8 knots -- but of far greater range on the surface. With 10 torpedo tubes, they are considered to be an anti-shipping threat on the high seas.

- fifteen JULIETTs of 3700 tons, built between 1961 and 1969, they carry four Shaddock 400-mile cruise missiles with a 2200-pound warhead -- launched from two pairs of topside deck-tubes. They can run 9000 miles at 7 knots on the snorkel, 16 knots on the surface and 14 knots submerged.
- fifty WHISKEYs of 1350 tons, built between 1951 and 1957 and still being widely used, "but rarely seen out of area." The WHISKEYs have a range on the surface of about 9,000 miles.
- fourteen GOLFs of 2700 tons and built between 1958 and 1962. They carry three SS-N-5 ballistic missiles.
- and an assorted bag of diesel boats for specialized uses including transport of minisubs, communications, oceanographic research, rescue and salvage, training-targets, etc, -- as well as a considerable number of midget submarines for "Spetznaz" operations. (The many intrusions into Swedish waters by "unknown" small submarines would indicate a strong emphasis on this type of conventional submarine, battery-powered.)

It is probably unwise to postulate that the Soviet conventionals will be operated from a few "homeland" bases in time of war. Increasingly, the Soviets have developed overseas bases from which Soviet conventionals may possibly be operated -- to spread out the Soviet threat worldwide. (Seemingly, much of the Soviet submarine threat is like that of the old "S-boats.") Cuba, Guinea, Syria, Aden, the Seychelles, Camranh Bay -- all appear to be usable forward basing areas already partially developed to support submarine operations. Moreover, if supplemented by submarine tenders and other types of auxiliary ships, the Soviet problems of logistic support appear solvable. The Soviet Navy, today, has far more auxiliary ships (about 775) than the U.S. Navy. They have 6 UGRA-class 9,600-ton submarine support ships with a SAM-2 battery for anti-air protection; 6 DON-class submarine support ships of 9,000 tons; and 6 ATREK and 5 DNEPR class sub tenders of about 5,500 tons. None of these ships are specified as "nuclear" submarine support ships and are ostensibly, for the most part, for probable use at overseas bases. With long, submerged-endurance the quiet battery-powered boats, used in defense of such bases, can make their elimination a thorny problem.

In summary: although much of the threat that may be posed by the great numbers of Soviet conventional submarines might supposedly be neutralized by ASW forces of U.S. allies in time of war, the Soviets' global deployment pattern -- threatening critical wartime shipping -- might overextend U.S. ASW resources needed for areas not covered by U.S. allies. And, this is seemingly a major Soviet reason for keeping their old, S-boat-like conventional submarines in commission.

PHOENIX

CONTROL OF SUBMARINES IN OPERATIONS ON ENEMY SEA LANES

[Ed. Note: This is an astute Soviet article, apparently designed to indicate how submarine control should be exercised today.]

Many questions of the theory of naval art in the war years have been studied, analyzed, and clarified in the postwar period. One of them is the control of submarine forces in general and in operations on enemy sea lanes in particular. A careful analysis of this experience and skillful utilization of it will unquestionably promote refinement of the theory and practice of controlling submarines. It is very relevant here to recall the wise words of V. I. Lenin, "It is impossible to learn how to perform missions with new procedures today if yesterday's experience has not opened our eyes."

Combat operations on sea lanes in World War II were begun from the very first days of the war, but results were comparatively meager. This can be explained by the following considerations: low intensity of enemy maritime shipping and inadequate reconnaissance information on enemy operations at sea; underestimation of the danger of mines, failure to take account of combat experience with the use of submarines in World War I and the initial phase of World War II; and the lack of unified, smooth-working control organs.

However, as the submariners acquired combat experience, improved the quality of tactical training for commanding officers, and especially refined the methods of using submarines, they became more successful with each month.

Submarines operated under different conditions in different theaters. In various theaters, submarines had to operate under conditions of counteraction by the enemy, who sent all available ASW forces and means against them. In the North, for example, patrols were deployed near the bases, ports and on the approaches. Enemy ships and aircraft patrolled certain sectors of coastal sea lanes. Within a month after the start of the war the enemy switched to a system of convoys, usually consisting of 2-4 transports sailing in single-column formation escorted by 3-4 ships and one or two aircraft. Moreover, all the German coastal sea lanes were protected on the seaward side by mine fields.

The Soviet submarines in all theaters patrolled in small areas located in shallow water and in the immediate vicinity of coasts occupied by the enemy and provided with submarine detection equipment. Up to 40 percent of submarine endurance was used transiting to the regions of combat operation. And, although the submarines were up to the standards of that time, their sailing range and independent cruise capability were low.

On the eve of the war and in its very first phase, submarines were controlled by fleet commanders. This centralization of the organization of control followed from the views adopted in prewar years concerning the use of submarines in combat.

Organizationally speaking, the submarines of the navy were grouped in brigades and divisions. The brigade, the highest operational-tactical unit, consisted of 3-5 divisions (a total of 20-25 submarines) and was headed by a commanding officer subordinate to the military council of the navy. The division was the lowest tactical unit and included 6-9 submarines.

During peacetime the brigade commanding officers were usually not involved in the process of combat and operational training for performing the missions of controlling submarines at sea. They were only assigned to train crews and ships for combat operations and to organize repair and restoration of their fighting effectiveness after returning from combat missions.

When the war got underway however, the control of submarines in all three active fleets was transferred partially (in the Baltic Fleet) or entirely (in the other fleets) to the brigade commanding officers who, although they were the best prepared specialists, had significant difficulties at first organizing and waging combat operations. This was a result of the lack of experience and the lack of trained control organizations. Specifically, the brigade headquarters did not have specialists in operational and reconnaissance training. Moreover, the tactical-technical performance and condition of the submarines in the prewar period did not fully correspond to the missions that they were assigned. Experience showed that the process of controlling submarines is complex and demands high qualifications from all who participate in it.

Full-fledged operational control demands a clear idea of the conditions in which combat operations are taking place, a knowledge of the specific conditions of the use of forces, and constant refinement and adaptation of tactics depending on how the situation develops. It is essential to give submarines full and accurate information on the enemy at the right time, to organize the process of guiding them to convoys, and to lead them away from strikes by escort forces. It was necessary to continuously summarize combat experience and anticipate the development and changes in the operational situation in the theater and the region.

Control was made complex by the specific operational-tactical properties of the diesel submarines, the remoteness of the regions of their combat operations from their bases, and the impossibility of using other naval forces there. There were also difficulties with organizing reliable underwater communications among submerged submarines and radio communication with cooperating forces and the control organization.

The functions of operational control at sea were then assigned to the commanding officer of the submarine brigade and his staff in addition to the missions of preparing the subs for performance of combat missions and restoring their fighting effectiveness after their return from the mission.

As a result, brigade commanding officers at the start of the war used the simplest methods. In the course of the war they acquired skills in operational control, refined methods of operation in attacking the enemy and overcoming his resistance, and devised new methods. A directorate was formed in the Main Naval Staff, and submarine departments were organized at the headquarters of the fleets to summarize experience as to the use of submarines in combat and to direct the operational-tactical training of command personnel.

At first, submarines in all fleets were used according to prewar ideas, chiefly the positional method where each sub was assigned a patrol area of about 25 miles on a side, within which it was to wait for the appearance of the enemy. No provision was made in this system for guiding subs to a target that had been detected.

There were a number of reasons for this. The fleets did not have reconnaissance personnel and equipment which could work in the interests of submarines, nor did they have stable operational communications with the subs. The brigade command had no experience using submarines in other ways. And the patrol area method was simple to organize. It made it possible to know the location of the subs at all times and alleviated fear that they would attack one another. In addition, it was considered necessary to assign a position if other naval forces were supposed to operate in the vicinity.

Meanwhile the amount of enemy maritime shipping increased and it became more and more important to disrupt it. The fleets searched for new forms and methods of using their forces. They began switching to commerce-raiding patrols of submarines in large regions of the theater and to the positional-maneuvering method. The introduction of these methods expanded the initiative of submarine captains. They could hunt actively for enemy ships and transports at sea. The effectiveness of submarine operations rose.

This made it possible to operate against the enemy in a large sector of his sea lanes with a limited complement of forces in the particular theater. The desire to constantly increase attacks against enemy warships and maritime shipping, especially in those cases where this was dictated by the situation on the coastal flanks of ground forces, led to constant refinement of the forms and methods of using submarines and controlling them. For example, 2-3 subs were required to destroy a small German convoy if the subs attacked it simultaneously or in sequence at intervals which prevented the enemy from restoring his defense or thwarting the attack of other ships. To achieve this the subs were used in a group, and guidance to the target was handled by the commanding officer of the group until the moment that the torpedo attack began or the subs were authorized to cross dividing lines, go into neighboring regions, and continue the attack on the convoy until it was completely destroyed.

In this way the techniques of massing several submarines against one enemy target for the purpose of reliably destroying it were realized in practice. Our own losses here were minimal. In 1944 the Northern Fleet used the "hanging screen" method, a variation of the maneuvering method. This involved the following: based on information from other forces (submarines or aircraft) the submarines of the screen would be guided from waiting areas located seaward of minefields to the enemy that had been detected. They would then attack him and return to their initial areas.

As experience showed, during operations in limited maritime theaters it is especially important for data on the enemy and control signals to move rapidly from the command post to the submarines. Communications equipment at that time did not allow this to be done quickly, and often the information was so old that it could not be used. In rare cases it was usable by the captains of one or two subs which had time to meet the convoy and carry out one or two attacks, but because of heavy resistance and the fact that they did not have superiority in sailing speed they would lose the convoy. Under these conditions the tactical level of submarine control was important. To accomplish this, a group commanding officer capable of independently organizing the hunt for the enemy in a large region and organizing a combined attack by several subs would be assigned to one of the subs.

During the War our submarines normally operated independently in the patrol areas assigned to them on enemy sea lanes. The Northern Fleet attempted to organize combined actions as part of tactical groups and cooperation with reconnaissance aircraft. For example, when sonar equipment was installed on K class submarines in January 1943 the command of the fleet decided to use them in tactical pairs. During the transit to the region of combat operations they tested the capabilities of the new equipment, practiced sailing in a quarter line formation -- on the surface at night and submerged during the day, and carried on a sonar search for the enemy. Communication among the subs when submerged was unstable and often interrupted, and they would lose touch with one another.

In 1943, cooperation with reconnaissance aircraft was sporadic because sea lanes were scouted irregularly, mainly during the daylight hours when our subs were under water and could not receive radio messages. While, aerial reconnaissance data received during the hours of darkness would become out-dated.

Cooperation with aviation improved in late 1943. Submarines located in a waiting region would, upon receiving data on the movement of a convoy from reconnaissance aircraft and the shore command post, sail out to intercept the convoy and, after attacking it, would withdraw to their former position. Control was exercised by the commanding officer of the brigade who would send a communications officer to the air force headquarters for better organized cooperation.

In 1944 the Northern Fleet began to receive aircraft and new classes of torpedo boats and the fleet command began conducting special operations to disrupt enemy sea lanes with participation by submarines, aircraft, and torpedo boats. The organization of such combined actions by mixed naval forces against convoys demanded flexible control from the command.

The first operations demonstrated the complexity of organizing combined operations with mixed naval forces, especially during the period of polar night and under unfavorable meteorological conditions: the airplanes could not always take off at the scheduled time because of non-flying weather and the torpedo boats could not go out in storms. Despite the difficulties, a number of operations conducted by submarines in cooperation with other naval forces, above all aviation, were successful in 1944 and submarines became the leaders among forces of the Northern Fleet for numbers of ships sunk.

WW II experience also showed that where there was one operations command for one brigade of submarines in the theater, control was exercised more precisely and operationally, as in the Northern Fleet. But when there were several brigades in the theater, as in the Baltic, it became complicated for several command levels (brigade commanding officers) to carry out control functions. At first each brigade was assigned its own region of combat operations. However, because of uneven utilization of the submarines of different brigades in combat and a decline in the overall productiveness of operations, it was necessary to combine all of them in a theater into a single operational-tactical force and to appoint a single operational command. This made it possible to move subs from one position to another and stepped up the introduction of stable, concealed communications between the headquarters of the consolidated force of submarines.

The question of the location of the command posts from which control at the operational and tactical levels was exercised was largely solved. Operational control, in brigade headquarters, was located on the shore, while tactical control was on the submarine at sea. This made it possible to obtain more complete data on the situation, maintain communications with the submarines, notify them while at sea of the presence and location of an enemy, carry out cooperation among different groups of submarines and with other naval forces, and organize joint actions by them in battle.

The experience of World War II confirmed the important role that submarines play in operations on enemy sea lanes. At the same time, it demonstrated the significant difficulty of using and controlling them in maritime theaters of restricted dimensions -- on sea lanes running along a coast occupied by the enemy. Under these conditions combined actions by submarines and other naval forces and precise organization of control over them become especially important.

The continuously increasing complexity of the control process led to a division of control functions.

Assessing the importance of the problem of control under contemporary conditions, Commander in Chief of the Navy Admiral of the Fleet of the Soviet Union, S. Gorshkov, notes that "It is not possible today to accomplish assigned missions if the organization of the control system, its readiness, the available technical equipment for control (automation, communications, and situation illumination equipment), and the work methods of the commanding officers, their staffs, and other control organs do not correspond to the objective laws of warfare and the conditions of waging combat operations at sea.

Because combat operations at sea in the future will assume global scope, it becomes especially important to combine the centralized and decentralized methods of control optimally.

Giving a certain degree of independence to the commanding officers of tactical groups operating in the ocean (and in certain cases to the captains of individual subs as well) makes it possible to improve the stability of control.

It is very important today for commanding officers and staffs, using the latest advances of military science, to constantly refine the system and means of control of naval forces, to maintain them in a high degree of combat readiness, to develop their ability to work in a fast-changing situation, and to try to reduce the time required to make decisions and transmit commands and signals to ship at sea.

By Captain 1st Rank G. Karmenok

(This condensed article is from Morskoy Sbornik, No. 5, 1983.)

THE TRIDENT II MISSILE: MYTHS AND REALITIES

As part of an overall and orchestrated effort to oppose the current on-going modernization of the country's Triad of strategic nuclear forces, certain critics have turned their attention to the TRIDENT II, (D-5), submarine-launched ballistic missile (SLBM). These criticisms rarely reflect an understanding of deterrence. Moreover, the portrayal of the D-5 as "extravagantly wasteful" and the allegation that the decision to deploy this missile escalates the arms race and undermines crisis stability are incorrect. Let us examine these myths and some additional strengths of this flexible system.

MYTH: The D-5 is wasteful.

Some critics assert that the $7 billion spent to date and the $45-50 billion planned over the next decade is too expensive, especially in light of the passage of the Gramm-Rudman balanced budget bill. The research, development and acquisition costs associated with the D-5 appear less objectionable when viewed from the proper perspective of weapons systems life cycle costs. Once the missile is acquired and deployed, its costs drop off sharply. Inasmuch as D-5s will be in the fleet long after their initial deployment, average life cycle costs will be much lower than those suggested by critics who focus exclusively on near-term costs. According to a recent Congressional Budget Office study of the cost of various alert ballistic missile weapons generated over missile life, the D-5 ($.9M/reentry vehicle) costs less than the Peacekeeper ICBM ($1.1M/reentry vehicle) and the small ICBM ($5.6M).

Second, the congressionally mandated delay in deploying the second 50 Peacekeeper ICBMs (recommended by the bipartisan Scowcroft Commission and sought by the Reagan administration) is likely to result in the D-5 missile being used to attack a portion of Soviet hard targets planned for the 100 Peacekeepers and targeted today by the aging Minuteman force. Viewed in this light, the importance of acquiring the accurate and flexible D-5 missile increases substantially, making the price more acceptable.

Finally, the assertion that the system's cost is extravagant leads one to wonder what price we put on our own security and the maintenance of peace. Is there a price we are unwilling to pay? Some say that the cost of D-5 makes it unnecessary in a world that already spends too much on wars and war preparation. This argument is illogical. American defense decisions must reflect U.S. specific requirements rather than some global cost aggregate.

MYTH: The D-5 Undermines Deterrence.

The deterrence of nuclear war has been a critical, if not the paramount, U.S. objective in the post-war period. To do this, the United States has relied upon its land, air and sea-based strategic triad. The principal qualities of the sea-based leg are its relative invulnerability and prompt response time. SSBNs remain in constant communication with the National Command Authority. Moreover, they are tied to the NCA or its successors through a redundant network of survivable airborne and surface naval assets which broadcast across the radio spectrum. It is this ability to launch SLBMs promptly that strengthens deterrence by guaranteeing that the United States can respond appropriately to any Soviet attack against this country or our allies, irrespective of the attack's success against our ICBM and bomber forces. With the increasing hardness of the Soviet target base, the D-5's accuracy will allow it to engage a broader portion of enemy assets. This stabilizes deterrence because it provides the United States with credible military retaliatory options between the unsavory extremes of prompt capitulation and massive retaliation. This is why it is incorrect to assert that possessing the less accurate and less flexible C-3 and C-4 SLBMs is sufficient for U.S. deterrent requirements. As noted above, this is especially true if full Peacekeeper procurement is not achieved.

Deterrence is a dynamic requirement. Even if the United States accepted the premise that it could deter the USSR (whose doctrine extols, and counter-military capabilities increasingly reflect, a war-fighting posture) through massive counter-value attacks alone, we would still be required to modernize our forces to respond to Soviet ABM and other defense improvements. But deterrence is far more complex.

The Soviet Union's wartime experiences and its ideology lead it to regard military modernization as a necessary ingredient of deterrence and as an indicator of a state's continuing resolve to defend its interests. Actual or perceived unilateral U.S. restraint in these areas would not be perceived by the Soviets as an amicable, peace-promoting gesture. Rather, it would be viewed as a sign of weakness and an invitation to pursue their interests more aggressively under the protection of the superior and more flexible nuclear forces which are complemented by current superiority in the conventional force balance. Let us remember that it was not Winston Churchill who advocated military modernization in the face of a growing threat, but Neville Chamberlain who by fear of arousing the ire of the Nazis did more damage to the cause of peace.

It is surprising that domestic critics usually identify only the United States as undermining deterrence. This fails to take into account the Soviets' silo-threatening fourth generation ICBMs, or their new DELTA IV and TYPHOON-class submarines with increasingly accurate MIRVed SLBMs. Indeed, it is the invulnerability of the American SSBNs carrying the accurate D-5, a veritable ICBM under water, that convinces the USSR that the chance of a successful damage-limiting attack on the United States is virtually nil, the USSR's increasingly lethal arsenal notwithstanding.

MYTH: The D-5 is a First-Strike Weapon.

The most serious criticism of the D-5 is that its accuracy and short time of flight make it a potential first-strike weapon, one that would place Soviet weapons in a use or lose situation and thus destabilize a superpower crisis. While theoretically plausible, this argument loses its luster upon closer scrutiny.

In the first place, the Soviets, like the Americans, are well aware that increasing missile accuracies threatens the survivability of fixed assets. To circumvent this problem, and apart from continuing interest in active and passive defenses, the USSR has developed and is deploying two new mobile ICBMs as well as large numbers of MIRVed, accurate SLBMs. Thus, in spite of increasing U.S. missile accuracy, a declining percentage of the Soviet strategic arsenal is vulnerable, thus making the "use or lose imperative" appear less compelling. Second, one should note that the entire TRIDENT fleet would never be at sea and in launch zones at one time because some would be in port undergoing replenishment or overhaul while others would be in transit between home ports and patrol areas. It is not at all certain that sufficient D-5 assets would be on station to execute a preemptive attack by themselves against the Soviet Union.

Even in the unlikely event that the United States planned a disarming "preemptive strike", D-5 assets would have to be supplemented by ICBMs. If SLBMs were launched first, Soviet missiles could be flushed from unscathed silos before our ICBMs arrived. And if ICBMs were launched first with SLBM execution staggered to allow all U.S.

missile assets to arrive simultaneously, the Soviet Union would have substantial tactical warning to launch their assets out from under attack. The foregoing suggests that fears of U.S. preemption are less valid than often assumed. In short, the calculus of deterrence is far more complex than any sophomoric equation incorporating only numbers of weapons and missile accuracy.

OTHER BENEFITS OF THE D-5.

Additional military and strategic advantages will accrue to the United States upon the deployment of the D-5. Perhaps most important is the ability to support a key U.S. strategic objective of prompt war termination (on grounds favorable to the U.S.) should deterrence fail. As noted above, the Soviet Union is deploying mobile ICBMs to mitigate the increasing vulnerability of fixed-site assets. Holding these forces at risk throughout a conflict will require forces that offer long term endurance, connectivity and responsiveness. While the other two legs of the Triad exhibit some of these requirements to varying degrees, it is the seaborne leg that claims all three as strengths. A second advantage of this weapon is that its throw-weight is sufficient to carry weapons as required to hold the Soviets' hardest leadership targets at risk throughout the conflict. It is difficult to imagine how, should deterrence fail, the U.S. could encourage the prompt cessation of hostilities if a large portion of the Soviet Union's leadership and nuclear arsenal remained unthreatened.

An additional benefit of the D-5 is that it will provide a good hedge and thus deterrent against any potential breakout by the Soviet Union of the ABM Treaty. The weapon's throw weight will allow it to carry penetration aids that confuse missile defenses. Also, the Soviets' defense requirements will be complicated by the unpredictable attack azimuth of SLBMs launched from mobile and secure SSBNs.

TAKING THE MESSAGE TO THE PUBLIC

In the current atmosphere of fiscal constraint, the military budget has come under increasing fire and the military is likely to be called upon to make difficult choices between various programs, all of which make a positive contribution to the nation's defense and security. Should an arms control regime that reduces the size of our strategic arsenal be realized, the competition for public and congressional support for competing strategic systems will become even more intense. Naval officials should not mistakenly believe that the problems and continuing criticisms directed against the PEACEKEEPER will shield the TRIDENT system from future budgetary forays. The Navy must educate the public and its elected representatives. Presentations in academic forums, editorials, congressional testimony and the like that identify D-5's survivability, endurance, connectivity/responsiveness, and the ability to hold at risk the full range of assets valued most highly by the Soviets will ensure the acceptance of the TRIDENT SSBN and the D-5 SLBM as the preeminent strategic force of the future and the continuing bulwark of deterrence. Focusing the public's appreciation on the past, current and future contributions of the Navy to the protection of the nation's vital interests will do more than improve the Navy's prospects in the budget cycle contest; it will be a source of satisfaction, service and pride for all of us who serve the cause of peace.

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[The views expressed herein are the author's own and do not represent an official Navy or DOD position. Portions of this article appeared in the Navy Times (24 Mar 86) and are reprinted with its kind permission.]

SUBMARINE AUTOMATION

In the era of Star Wars technology and artificial intelligence, the subject of automation sounds pedestrian. Have not decades of submarine command-control development brought with it a highly automated, well-tuned fighting machine? Perhaps so, if one is content to compare a submarine to a battle cruiser. But any comparison between the levels of automation in the B-1 bomber and in a submarine would show the submarine to be unusually manpower intensive. Certainly there exist differences in task complexity and cost-benefit relationships between the two fighting machines, but, can we assert that our utilization of men in submarines reflects sound practice in our current technological environment?

The answer to the above question is, certainly not! There exists an important difference between submarines and aircraft that was not mentioned -- cultural differences, differences that overpower the rational analysis and the subsequent application of modern technology to ships and submarines. It will be extremely difficult to place this discussion on an objective plane, since a cultural bias is closely held and the contemplation of a cultural revolution may be seen as heresy. Yet any discussion of advances in submarine control through task automation will be a waste of time unless the cultural issues embedded in ship-centered navies are faced. In fact, the cultural foundation of our ship-centered navy is absurd! No objective system designer, starting from a clean board and working within a competitive market, would propose such an irrational employment of human skills. The performance and cost penalties would be all too obvious. These penalties have not been exposed because ship system designers neither start from a clean board nor, more importantly, work within a competitive environment. Aircraft are finely tuned fighting machines that blend the skills of man and machine because aircraft are designed and fought within an open and competitive environment.

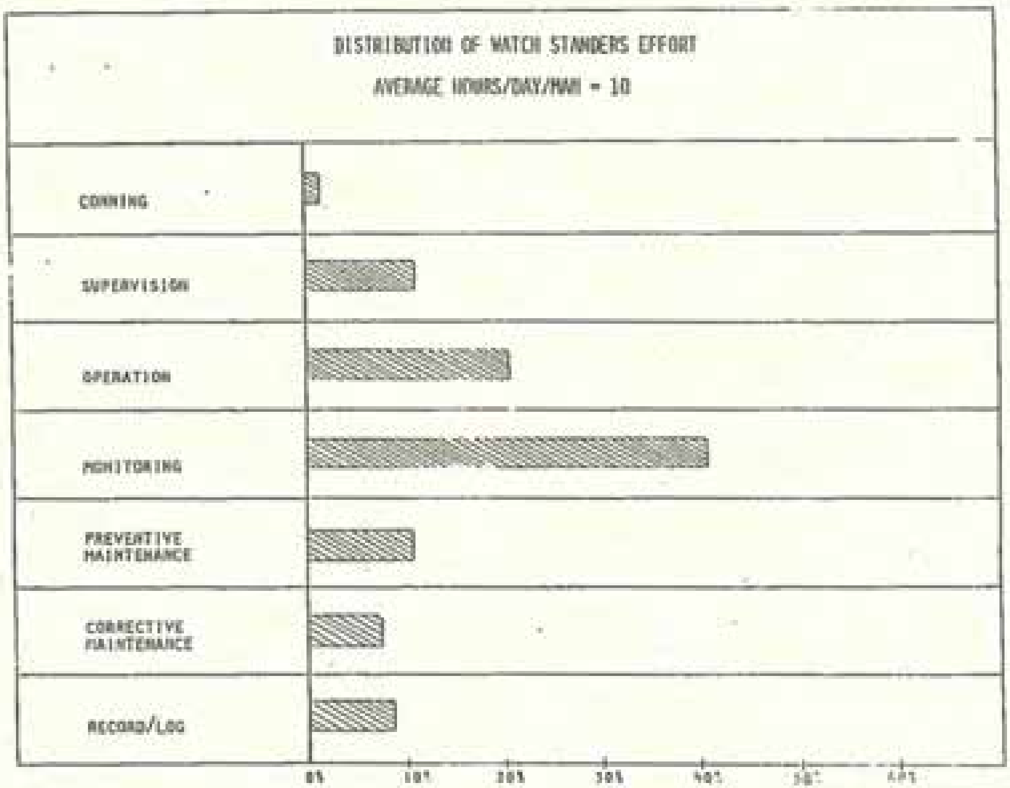
The cultural biases embedded in naval ship-centered design may be stated as follows:

1. Ship officers shall not exercise hands-on control of systems; and
2. All enlisted men shall both operate and maintain systems.

Yes, there may be some exceptions to the above, but the tradition prevails. An officer exercises control through others. His job has no meaning unless he is surrounded by men. Officer performance is judged in terms of his presence, his choice of orders, and his verbal clarity in delivering these orders. In this sense, officers are cast in the role of back-seat drivers, which would be suicidal in a race car or in an aircraft about to make a landing on an aircraft carrier. The man at the controls not only must operate under the shadow of a back-seat driver, but he must double as a qualified mechanic as well.

The origins of culture are found in history. Through a historical perspective a given practice may be found to be appropriate. Thus, in the time of sailing ships we had conditions that justified the practices which we have inadvertently continued. Then, control actions required muscle. Maneuvers were slow, man power was cheap, maintenance was unsophisticated, and the addition of quarters did not penalize ship performance. The more men the better. A heavily manned ship could rally more close-in fire power, absorb greater attrition, repair damage more quickly, and organize a greater number of prize crews. Ship-centered navies became famous for busy-work which included both watch standing and maintenance tasks. As new technologies were introduced, the old culture remained. With the introduction of steam power, engineering crews were added, each man being required to stand operational watches and to maintain the engines. The introduction of torpedoes, radios, radar, and guided missiles followed in the same pattern. The design of today's fighting ship is the result of a bottom-up process wherein the hull serves as a base upon which are assembled a collection of subsystems, each with its own operator-mechanics. The system design does not emerge until a set of printed operational manuals are prepared and distributed. These manuals cover a number of routine and emergency situations and suggest a script for the dialog between the officers and the men at the controls. For example, for a submarine ship-control system, should the man operating the stern planes find that the controls are jammed, he is to report: "STERN PLANES JAMMED ON____ DEGREES DIVE." The Officer of the Deck takes up dialog from that point. The OD announces: "BACK THE MAIN YARDS" -- no, that last order is wrong, we are in the twentieth century, aren't we?

A critical penalty associated with the belief that enlisted men should both operate and maintain systems is the requirement for watch standing: any single operational station requires three men rather than one. It is instructive to consider how a typical nuclear submarine watch stander distributes his time during an average, 10-hour work day. The figure below shows the fraction of time a watch stander spends performing each of seven classes of activities. Of these seven, the vital functions are OPERATION, PREVENTIVE MAINTENANCE, and CORRECTIVE MAINTENANCE. This data shows that only 20 percent of the


DISTRIBUTION OF WATCH STANDERS EFFORT
AVERAGE HOURS/DAY/MAN = 10
CONNING
SUPERVISION
OPERATION
MONITORING
PREVENTIVE MAINTENANCE
CORRECTIVE MAINTENANCE
RECORD/LOG
0%
10%
20%
30%
40%

watch standers' time is devoted to operating tasks and that 19 percent of their time is applied to maintenance. Thus only 39 percent of this teams's effort is allocated to the vital activities. CONNING, SUPERVISION, MONITORING, and RECORD/LOG keeping are secondary functions which can absorb man-hours substantially out of proportion to their contribution to ship performance. These activities account for 61 percent of the watch standing manpower. Perhaps these percentages are not startling, but these numbers were developed for a 36-man watch and a crew of 108 watch standers. These men contribute 1080 man-hours of work per day, a value equivalent to a one-half man-year of work in civilian life. This effect is even more spectacular in Fleet Ballistic Missile Submarines -- since these ships provide for not only three watches but two crews as well. Let us for the moment assume that the manning requirements for maintenance remain constant. From the above percentages then, we would find that a ship would require only 20 maintenance-qualified men. This leads to the question: "Do we really need 88 more watch standers on board, the majority of which are maintenance-qualified, to operate the ship?" This question can only be answered by setting aside the ship-centered, make-work culture and addressing matters of operational design from a clean board. It is through this process that the potential for automation in submarines will become clear. It does take much courage to project a reduction in manning requirements between a factor of two and four. But the central issue is not manpower reduction; that is simply the byproduct of sound system design.

If the submarine is to become a well-tuned fighting machine, it must be addressed as a system design beginning with a clean board, and within a competitive environment, devoid of any ship-centered cultural bias! This design process would start with the identification of the objectives of command, followed by an exploration of the performance parameters which serve to support the objectives. The system would be tailored operationally so that COMMAND IS IN CONTROL. Today's "command-control" systems are cover-ups for the failures of the ship-centered culture. Through operational design, decisions concerning the relationship between man and automation will come naturally. Voice communication will supplement, rather than dominate, the control functions. An operational crew devoid of back-seat drivers and off-duty mechanics will emerge. Operational effectiveness and ship safety would be enhanced. Further, with a dedicated maintenance team, the quality maintenance will be equally upgraded. This alternate manning concept parallels that of aircraft with a flight crew and a ground crew. In submarines the ground crew, of course, would be required to go along on the mission.

The proposed undertaking is objectively straight forward; subjectively it may range between the difficult and impossible. The payoff should be spectacular!

John S. Leonard

[Ed. Note: The Soviet's 43-knot ALFA -- a well automated, 3700-ton nuclear attack submarine -- was reportedly designed to be operated by 17 men - 16 officers and one rating. Jane's Fighting Ships 1986-97 however lists her complement as 40.

APPLIED RESEARCH -- the RDTE ORPHAN?

The marvels of submarine high technology do not spring full-blown from corporate production lines or from the Navy's internal long, slow process of research and development. On the other hand, operational familiarity with "high tech" systems is usually limited to contact with the equipment and the tech reps who keep it going.

Thus, though many of us have some contact with the RDTE world, few become directly involved in the R&D process by which new equipment gets initiated and developed.

Probably only a few submariners are actually aware of what it takes to get a new system concept generated so that the development process can begin.

It sounds easy -- just get some bright scientific people together, give them the right tools along with adequate guidance from R&D managers, and the job will get done. But how difficult is this process?

Bright people find management restrictions hardly conducive to creativity. Managers, at the same time, don't like "unfettered" research projects -- particularly in research applied to specific warfare areas. There is too much difficulty defending such projects at budget time. And unfortunately, sponsors of major or "fenced" programs -- those protected from budget cuts -- consider "early research" programs as a resource to help solve financial problems by sacrificing them to budget cuts. So getting "bright people" and the "right tools" to work on Navy applied research problems is not easy.

One such project illustrates a process which should be preserved -- in order to generate the ideas and concepts on which "high tech" depends. It resulted in the sonar signal processing system known as DIMUS.

DIMUS (Digital Multibeam Steering) is a sonar technology which has grown steadily in recognition since it was conceived in the '50s. It is a key element of both submarine BQQ-5 sonars and of surface ship SQS-26/53 sonars. Invented and developed by Dr. Victor C. Anderson of the Marine Physical Laboratory, San Diego, it earned for him the Navy's Distinguished Public Service Award in 1976 and the NSIA's Martell Award for Technical Excellence in 1986. When the latter award was received, it turned out that Dr. Anderson had never seen a production model of his system -- DIMUS. Consequently, a tour and briefing of a BQQ-5 sonar trainer was arranged following the award. Dr. Anderson was apparently impressed as much by the officer instructor's enthusiasm and knowledge of the equipment, as he was by the capability that DIMUS was now providing to sonar operators. The visit, while generating feelings of pride and satisfaction in all Marine Laboratory personnel, still caused some concern for the difficulty if not the impossibility of repeating the story of the DIMUS development under today's RDT&E rules!

Dr. Anderson invented the DELTIC (delay line time compressor), which is the fore-runner of the DIMUS, at MPL, and the first analog DIMUS while at Harvard's Acoustics Research Lab for one year. This was done in 1951 with support from ONR's basic research program. The following year, he came back to the Marine Physical Laboratory in San Diego and pursued the DIMUS work as part of the Labs ONR-supported Exploratory Development Program. It took a long time to solve all the DIMUS development problems. Moreover, Dr. Anderson was a young PhD with only a brief track record and was working in a small laboratory without major organizational support. The DIMUS program thus needed a lot of faith and support from ONR to make it happen. Fortunately, submariners in ONR's Undersea Warfare Branch saw its possibilities and helped it along by defending the budget and by spreading the news of its value to the Navy.

The first reaction from BUSHIPS' Sonar Office was only lukewarm since it didn't match up with systems already planned and since available technology made it difficult to build. However, ONR's commitment to projects of "high payoff' even though risky, kept the work going through tests aboard the USS BROWN and the submarines BAYA and BLACKFIN. These tests finally led to a 3-D array installation in the bow of the USS ALBACORE. After these projects proved successful, industry participation was developed in the early '60s. A DIMUS modification to the BQR-2 submarine sonar was the first practical application. Later it was used in the BQQ-2 and the SQS-26. And finally it became an integral part of most of the new sonar systems now installed in ships and submarines.

So what's different today?

The key thing about the DIMUS development is that it did not commence in response to a requirement carefully worked out in Washington. Nor did it fit into a 5-year development plan. It was supported as true exploratory development must be -- with sufficient funds and flexibility to allow such a new concept to be tried, have mistakes noted and lessons learned, which were then used to move the project forward. ONR's job was to give the project the support it needed and to convince OPNAV and BUSHIPS of its value, where the Laboratory was responsible for initiating the development, advancing the technology, and publishing the results for the Navy's benefit.

In today's world, exploratory development is designated as the 6.2 part of the RDTE program and must be planned years in advance. Milestones and transition points are specified and must be justified in terms of a value to the Navy. Naturally, projects with low risk, near-term payoffs, and with close-coupling with stated Navy requirements, tend to be favored for funding support. Such projects, along with those which are aimed at solving problems found in 6.3 and 6.4 system developments are usually considered to be "fenced" projects free of budget cuts. Unfortunately high payoff, but also high risk, exploratory development projects rarely share the same protection.

Why is this a cause for concern?

When every new CNO states his belief that people are the most important part of the Navy, his words are not just limited to people of the operating forces. They also include the shore establishment, and particularly the RDTE part of the Navy. Research and test facilities and the engineers to use them are important, but without a flow of good new ideas, all that they can do is work on marginal improvements to existing systems. Good new ideas of value to the Navy come from innovative people with considerable technical knowledge, with interest in Navy problems and with freedom to develop new concepts. People with such talents are not satisfied with working on programmed, scheduled tests -- with constraints on technical approaches, and for which, opportunities for innovation and exploring new ideas are severely limited. The Navy's 6.2 RDTE program must be committed to support innovative people and must be designed to insure such a commitment -- else the pattern of DIMUS development will be difficult to repeat, for bringing to fruition other new technologies.

Submariners have good reason to share in such concerns. Their capabilities to perform independent missions depend heavily on keeping ahead of competitors. Standardization, redundancy and reliability may be the keystones of success for power plants, but technical and tactical innovation will determine success or failure in mission accomplishment.

A continuing interaction of scientists, engineers and naval personnel is needed to stimulate advances in technology applicable to naval problems -- while ensuring an understanding of environmental limits on system performance. In order to protect and encourage these linkages, we need to maintain a capability in the RDTE program to attract and support creative technical talent upon which it depends. Submariners can help by encouraging Navy decision makers to support a 6.2 RDTE budget which will foster innovation in research, responsive to the tactical needs of the Submarine Force.

Charles B. Bishop

[Editors Note: The Naval Submarine League membership is open to all U.S. citizens. VADM C. R. Bryan, USN(Ret.) was recently elected to be an NSL Director. Hopefully his presence and advice will encourage more members of the shore establishment and RDTE community to join. VADM Bryan has an EDO background and previously headed the Naval Ship Systems Command.]

A WEAPON SYSTEM FOR THE SUBMARINE TACTICAL LAND-ATTACK MISSION

A need to provide tactical support to U.S. air and ground forces stationed overseas gives rise to an important submarine mission. That mission is the attack of land targets far beyond the range of the submarine guns of World War II. Two types of delivery systems have emerged in the past forty years as candidates for this mission -- either long range ballistic, or air-breathing "cruise" missiles. The nature of land targets and probable enemy countermeasures to be encountered greatly favor the use of the ballistic missile over the cruise missile.

The U.S. Navy has recognized two separate types of land-attack missions. The first to become operationally deployed was the Polaris system for the strategic or deterrent mission. The first Polaris mission was conducted in late 1960. More recently, a weapon system was developed for the tactical land-attack mission -- the TOMAHAWK cruise missile. Now, a more effective submarine land-attack system needs to be defined for tactical nuclear war.

The characteristics of the missile payload selected for a land-attack mission is crucial to the design of the weapon -- its size, weight, range and speed. An early determination is therefore required of the types, characteristics and locations of potential targets, the extent of damage desired, and the yield and placement of the payload.

Of equal importance is the missile-carrying capability of the submarine. The objective of a tactical support mission is to effectively participate in a battle. To do so it must rapidly deliver payloads to one or more selected target complexes. A target complex is normally composed of both area and point targets. Typical area targets such as airfields, troop concentration areas, ports, industrial centers, and transportation hubs may cover several square miles. These are generally "soft" targets. They will normally require more than a single detonation in the target area. Point targets include specific installations such as a command center, a communication center, a dam, or a bridge. They may be either "hard" or "soft." While a single hit may be all that is required, at least two launchings may be required to attain hit assurance, and in a given battle area several point targets may be designated. Therefore, to provide tactical support in a given battle situation the submarine must carry sufficient weapons to meet the needs for coverage of both area and point targets to effectively deter enemy air and ground force employment.

Having determined the nature of likely tactical targets, missile range requirements may be determined from the geographical distribution of land masses and submarine operating areas. Figure 1 represents one possible and very important target complex -- the Bloc areas in Europe. Here lie the probable routes that Soviet land forces would take if they were to invade Europe in the future.

The cross-hatched areas shown in the figure extends approximately 1,200 n.m. from south to north -- from the Mediterranean to northern Finland. Since target coverage increases rapidly with increased missile range, submarines with 1,500 n.m. missiles could attack targets anywhere within the Bloc areas from off the Atlantic coast or from the Mediterranean and Norwegian Seas. In fact, 1,500 n.m. missiles launched from the Norwegian Sea could even reach the Leningrad and Moscow areas.

An important consideration in the design of a submarine tactical missile is to achieve the longest range and shortest flight time to target with the lightest and smallest missile capable of carrying an effective payload. Payload weight has a tremendous effect on the range and speed (time to target) performance of both cruise and ballistic missiles. As payload weight is reduced, a missile's speed and range performance improves. To illustrate the effect of payload weight on missile weight, a missile capable of carrying a payload weight of 1,000 lbs. to a range of 1,500 n.m. might weigh over 20,000 lbs, whereas it might weigh only about 3,500 to 4,000 pounds if it carried a small nuclear payload. Since missile-envelope volume is approximately linearly related to weight, the volume of the heavier missile would be about 5 times that of the lighter missile. Fortunately, light-weight nuclear warheads are available.

Figure 1.
<u>Bloc Countries as a Tactical Target Area</u>
(Bloc Countries are Cross Hatched)

Another important consideration is missile accuracy. It is determined by the nature of the target, the degree of damage desired, the characteristics of the payload detonation, and detonation placement relative to the target. There are several effects of nuclear detonation to consider -- blast, shock, heat and thermal radiation. All of these factors must be considered in determining missile-accuracy requirements.

With a missile-accuracy requirement established, the missile guidance system design must allow the missile to deliver its payload within the accuracy limits pertaining to specific types of targets. There are four basic types of guidance systems; inertial, map matching, homing and a combination of these. Inertial systems are passive. They do not subject missiles to early detection by electronic intercept means. They do tend to drift -- to gradually deviate from their initial settings. For that reason they are best used when the duration of powered flight is brief as in the case of a ballistic missile. Map-matching techniques are usable only over the land portions of cruise missile routes, but are not normally applicable to ballistic missiles. They update inertial guidance position and azimuth. Three types of map-matching may be employed -- contour matching, optical image matching and earth radiation imagery matching. In contour matching, the missile's radar altimeter measures the contour of the land over which the missile flies. The guidance system then compares the results with an earth contour map stored within the missile's guidance unit's memory to determine the missile's geographic position and heading. This is the technique used in the TOMAHAWK's "TERCOM" system. Contour matching provides fair to good accuracy if earth contours are reasonably distinctive. Since radar altimeters radiate energy there is a likelihood that the missile will be detected while still distant from the target. Optical map-matching is a passive system used with TOMAHAWK with conventional payloads to provide greater terminal accuracy against point targets. It achieves its accuracy by viewing portions of the terrain over which the missile flies with an electro-optical device. The guidance unit then compares the observed imagery with stored photo-reconnaissance imagery previously taken along a pre-planned flight path. A similar map-matching technique uses imagery obtained from measurements of earth radiation. In all types of map-matching, the missile route must be pre-planned, for it is necessary that the missile guidance unit contain within its memory the basic map data with which mid-course observations are to be compared. <u>Terminal homing systems</u> are target and flight-path dependent. The primary use of terminal homing systems is to increase delivery accuracy against selected targets or target types. Types of sensors used in such systems include radar, electro-optical/infra-red, and radio/radar intercept techniques. Homing systems have limited application to cruise missiles used in theater tactical warfare. Homing systems for tactical ballistic missiles are generally infeasible because of reentry body heating and the resultant ionization during the approach to the target. These effects appear as the missile enters the earth's atmosphere at about 400,000 feet and hamper the performance of the homing sensors. In addition, the inertia of the reentry body and the short time available for correction of reentry path tend to make ballistic missile homing systems relatively inefficient.

An important characteristic of tactical warfare is "movement." Therefore, payload delivery systems designed for tactical combat must be time-sensitive, possess rapid targeting flexibility, short delivery time-to-target, and adequate accuracy to negate specific targets. With regard to targeting, each missile should be capable of being targeted (or retargeted) within, for example, a minute to any target within range. Map-matching guidance systems applicable to land-attack cruise missiles such as TOMAHAWK do not permit this. Map-matching requires that at launch the guidance memory unit contain stored over-land route data (whether contour or imagery) to which observed data can be compared. This stored data is provided launch ships for selected over-land routes on computer media tapes or disks. Each route is prepared weeks or months ahead of time for a specific route to a pre-selected target. This stored data is inserted into the missile guidance unit just prior to launch. In addition, the ship must plan the over-water route to a designated sea-land boundary, and this route information must also be input to the guidance system and married to the over-land route data.

An outstanding feature of inertially guided ballistic missiles is complete flexibility with regard to last-minute target assignments or changes. Solution of the pure inertial guidance problem for ballistic missiles is mainly dependent upon inertial reference inputs, launch point and target geographical coordinates, and stored missile guidance system equations. Modern computer mass-memory storage units are very small in size but large in memory capacity. This now permits most of the traditional "fire control" functions to become part of the missile guidance and control system. As a result, the only manual inputs required are target geographical coordinates. Inertial system delivery accuracies to ranges of about 300 to 1,500 n.m. are of the order of 1/8 to 1/2 mile.

Missile attack reaction time -- the sum of launch preparation time and missile flight time -- greatly favors the ballistic missile over the cruise missile. Launch preparation time for modern ballistic missiles is measured in seconds, whereas, launch preparation time for a TOMAHAWK is of the order of 10 to 20 minutes because of required on-board pre-flight activities. The time of flight for a ballistic missile to a target at 1,000 n.m. is of the order of 10 minutes as compared to 2 1/2 to 3 hours for the cruise missile. Thus, the attack reaction times compare as 10 minutes for the ballistic to 200 minutes for the cruise missile. The significance of this is that aircraft at an enemy air base, for example, may be long gone before the cruise missile gets there.

As to vulnerability, cruise missiles are subject to anti-aircraft defenses. These include electronic counter measures and weapons ranging from shoulder launched homing missiles to more elaborate SAM defensive systems. On the other hand, it is nearly impossible to provide defenses against ballistic missiles in the battlefield.

The "Sherwood Forest" arrangement of vertical launch tubes for ballistic missiles was first developed for POLARIS. The POLARIS submarine was readily achieved by cutting a SKIPJACK hull in half and inserting the launch tube section. The same concept is viable for providing a new tactical ballistic missile land-attack capability. Missile design should not be compromised by requiring that it be enclosed in a capsule and made capable of torpedo tube launch as is the case of TOMAHAWK. A vertical launch system will readily allow for growth including greater range and payload, and features such as stellar guidance mid-course update, if and when greater performance is required.

Now is the time to initiate design studies leading to an advanced submarine tactical ballistic missile, land-attack weapon system with immediate launch and fast attack-reaction-time capabilities, complete targeting flexibility, small nuclear payload, inertial guidance, at least 1,500 n.m. range, multiple vertical launch/storage tubes, and provision for missile growth. Such a system will reduce the need for TOMAHAWK missile over-land route reconnaissance and preplanning, and over-water route planning prior to launch. Further, ballistic missiles will present no conflict/deconflict problems in a task force environment.

An additional consideration: the matter of payload delivery accuracy may come up. The answer is that ballistic missile inertial guidance accuracy appears to be adequate. Considering only blast effect, "The Effects of Nuclear Weapons, Edition 3, 1977," gives the following data:

For Max. overpressure of 5 psi.*

10 KT	0.95 n.m. radius
20	1.18
30	1.35
40	1.49
50	1.60
100	2.00

For Max. overpressure of 10 psi.

10 KT	0.60 n.m. radius
20	0.75
30	0.87
40	0.95
50	1.10
100	1.30

* psi will take care of any tactical force and its equipment. Thermal and radiation effects will finish them off!

William P. Gruner

<u>REMARKS BY ADMIRAL KINNAIRD McKEE</u>
at the funeral service of
Rear Admiral JACK DARBY
who died of a heart attack on 1 January, 1987
while COMMANDER SUBMARINES PACIFIC

I'm here to talk for a few minutes about our good friend and shipmate Jack Darby.

I have to say that I had a tough time collecting my thoughts for this day. My mind became a kaleidoscope -- filled with multiple images of our association and shared experiences. I found it difficult to put some order to the matter.

I first met Lieutenant Jack Darby when he was Weapons Officer in USS DACE. I was a new commanding officer looking for a way to get off to a good start. Jack helped make that possible -- he had a big part in establishing the reputation that the submarine already enjoyed, and he helped set the tone for later, because of what he did, and what he left behind.

The next time he was Commander Jack Darby. I had just set up shop in the Mediterranean when who appeared but Jack, in command of THOMAS JEFFERSON. Jack spent five years in command of two missile submarines -- with over four years of submerged operations! And, most of us heard him say that he'd really like to do it all again.

To put that in perspective, think about the fact that submarines represent well over a third of our Navy's combatant strength, but are manned by only a handful of young officers like Jack Darby -- less than 10% of the Navy's Officer Corps. Few outside of our community recognize the contribution made by these men, and nobody else fully understands the terrible personal responsibility borne by those who command the missile submarines. Jack knew -- and he sought it.

One SSBN command is far more time in the tiger's mouth than most officers can handle -- yet Jack went for two.

A few years later it was Captain Jack Darby -- Commandant of Midshipmen, USNA. Not unexpectedly, Jack showed his midshipmen a remarkable blend of professional competence, integrity, toughness and sensitivity. He had each of those fundamental characteristics of leadership in full measure, but there was more. He had a unique sense of the worth of an individual, and the ability to see not only what he was, but also what he or she could become.

Jack had a tough act to follow as Commandant -- coming in behind Jim Winnefeld. But he was up to it. He quickly became an eloquent example of the right guy in the right place at the right time.

Then it was Admiral Jack Darby -- a highly regarded member of the Joint Staff; then COMMANDER, SUBMARINES PACIFIC. Again, the right guy in the right place at a critical time in the lives of our young submarine officers and enlisted men.

Throughout his career, Jack Darby demonstrated great skill as an operator, a diplomat, and as a military commander. And he commanded. He did not manage, he did not petition or manipulate. He commanded.

He did many things well, but most of all, he was a submarine officer -- the kind of guy who revels in the challenge of the deep ocean and in the company of brave and skillful men who would share it. He sought the direct personal responsibility of command -- what he called the "inescapable responsibility" -- and he encouraged others to do the same. In fact, his principal legacy is the young people whose lives he touched and who still serve in the same tradition of commitment -- officers, enlisted men, and midshipmen who experienced his special sense of the right thing to do, and his singular ability to handle the toughest job with balance and lots of good humor. He made each of them reach deep inside for their own personal understanding of their chosen profession.

Jack also left us a legacy of commitment. I don't think he ever had a job that wasn't the most important thing in his professional life. Jack Darby never saw a job he couldn't do or didn't like. Even so, he was somewhat taken aback at the prospect of being the Commandant of Midshipmen without any undergraduate experience at the Naval Academy. But in the long run, it strengthened his commitment -- and the Academy was better for it.

John Adams is supposed to have said; "There are only two creatures of value on the face of this earth, those who have a commitment, and those who demand the commitment of others." Jack did both. He was, he is, truly a "creature of value."

I shall not forget Jack Darby. He touched my life in many ways -- just as he touched many of yours. There are a thousand ways to think of him. I like to remember that keg of beer he won from Commodore Mike Moore when DACE hit five of five in our first fleet exercise. But one of my best recollections comes from a submarine birthday ball several years ago. Jack and a bunch of former submarine CO's got together to put on the floor show. I'm not sure whether they thought of themselves as a rock group or a country band -- that's not important -- what's to remember is how they brought down the house with a raucous rendition of Willie Nelson's "On the Road Again." But this time the name of the song was "On Patrol Again." Jack sang "Oh how I wish I was on patrol again.... making music with my friends....."

There was a big crowd, and we all laughed a lot, but we also knew he meant it. So as we leave this chapel today, let's think about him as he would have it. Jack's not really gone -- he's just on patrol again.

Now it's time for his decoration. Jack liked to say "that the rewards of real service come in the knowledge that one's work represents a lasting contribution to the welfare of individuals and the mission of the Navy." We recognize such service with a medal and a citation to express the nation's thanks for service that is at once beyond the simple call of duty, yet absolutely vital to our survival as a free people.

So now for the American people and on behalf of the President, it is my great pleasure to award the Distinguished Service Medal to Rear Admiral Jack Darby.

DISCUSSIONS

POLARIS SURVIVAL AND TRIDENT RELIABILITY

In the January 1987 issue of SUBMARINE REVIEW, Lieutenants Breux, Horn and Foster made some interesting comments on a POLARIS survivability war game, played in SAC Headquarters in 1961, almost 27 years ago. Four of us who participated in that game had described it in an earlier issue of the REVIEW. I was delighted to see some younger officers respond to the description of an interesting game wherein the POLARIS system was under a "real world" attack by some leaders in the Strategic Air Command. Although I am at that wonderful age where the more I know the less I understand, I strongly suspect that the Lieutenants were giving me the needle, inferring that those of us involved in the 1961 Game were naive, amateurish in our knowledge of analysis, and of the wrong "professional background." And they may be right in their views. A few more comments might be of interest -- and maybe even valuable to the Lieutenants.

The analysis of the 1961 Game, probably conducted by the Lieutenants somewhere in the vicinity of a good computer installation, was very interesting and representative of the considerable improvements that have been made in the war gaming process in the last 27 years. In 1961, although digital computers were beginning to make in-roads in the war gaming function, their use was extremely limited. Although the Strategic Air Command (SAC) was a leader in computer usage at the time, capabilities of the degree necessary to play a series of war games envisioned by the Lieutenants did not exist. We played a hand game -- laborious and time consuming -- and we examined only one set of conditions. The Game never should have been attempted in the first place -- but the issue was real. POLARIS was a considerable threat to the manned bomber and ICBM for many reasons -- and its credibility had a tremendous impact on the budgets of the individual services as well as on the effectiveness of the deterrent posture in the world. So we were ordered by the authorities in power to "play a game" -- and we did so, without benefit of much more than some good maps, a few adding machines, a book of probability tables, plus the talent available in the Joint Strategic Planning Staff and SAC Headquarters. We succeeded in fending off a direct attack on POLARIS. Had we had the analysis and war gaming capabilities available today, we could have undoubtedly come to better and more positive conclusions in a more definitive manner -- in far less time. But the end result would have been the same -- the survival of POLARIS -- a reinforcement of its credibility as a dominant deterrent force. So much for the past.

Today, it seems that TRIDENT is under attack -- in a somewhat different manner than POLARIS in 1961 -- and from different antagonists. There are wishful anti-submarine warfare theorists who claim the seas will be transparent in ten or fifteen years, thereby casting doubt on the survivability of TRIDENT. And there are others who would welcome a flaw in the reliability of TRIDENT -- for a variety of reasons. The more successful the system, the more it will contribute to deterrence -- and thereby as an incidental result, receive a larger share of the available deterrence defense dollars.

Some of the more sensible opposition to TRIDENT comes from those who are genuinely concerned about the dangers of nuclear war, started by mistake or contrivance. They don't like the idea that the actual launch of the missiles in a TRIDENT submarine is under the direct control of military personnel on board. They want positive control of all nuclear weapons in the hands of civil authority. They invent scenarios wherein the skipper of a TRIDENT submarine blows up the world of his own volition or with the contrivance of his crew. They don't understand the term "special trust and confidence" and they don't give it much credibility. In some extreme cases, they even cast aspersions on the sanity of people who would serve with such weapons systems in the first place. (Naval aviators often have the same feelings about the submarine service). They want all missiles in all Navy units, particularly those in the TRIDENT, to be equipped with the Permissive Action Link -- the PAL -- with the control vested in the hands of civil authority. And they have mounted an organized effort to bring about such a condition.

For example, the John F. Kennedy School of Government at Harvard held a conference on the subject in February 1986. A draft version of the minutes of that meeting can leave no doubt as to the seriousness of the action that is being mounted to place further constraints on the TRIDENT system. The impact of the installation of PALs in TRIDENT could stand some good analysis. If such installation decreases the reliability factor of the system considerably, the emphasis on its role in deterrence will be decreased accordingly, which many of us believe would not be in the best interests of peace -- or the Navy's role in the events of the future.

Possibly for their next exercise in war gaming analysis, the Lieutenants could put together a model that explores the impact of Permissive Action Link on TRIDENT effectiveness. In 1961 the survivability of POLARIS was a key issue. In 1991 it can well be the reliability of TRIDENT, in addition to the survivability of the launch platform itself. Some bright young Lieutenants may have to fight that battle and now may be a good time to get ready.

Jerry Miller

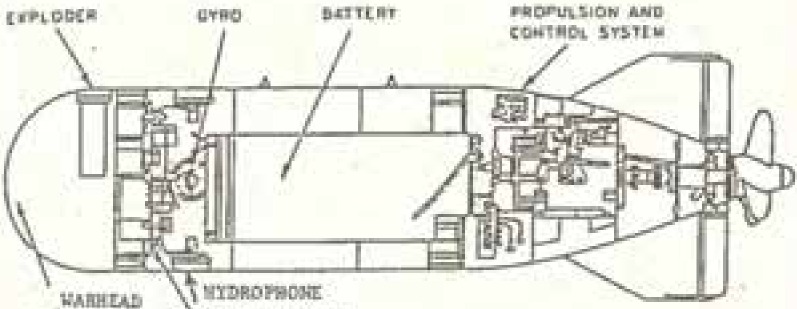
THE PASSIVE ACOUSTIC CUTIE

In the January Submarine Review, Phoenix discussed the World War II U.S. experience with steam-driven torpedoes, the Mk 14s and 23s, and with the electric-powered Mk 18s. But, one other type of submarine-launched electric torpedo, the Mk 27 "CUTIE" should have also been discussed to understand WW II experience with "electrics."

Although only a few CUTIEs were used by U.S. submarines in WW II, their success was so exceptional that they should not be forgotten. They were a small torpedo with a small warhead, slow, and with passive acoustic homing. Understandably with today's very fast, big warhead torpedoes -- and consequent high, self noise -- a passive acoustic homing capability in a torpedo is pretty much ruled out. Further, the U.S. has placed primary emphasis on having submarine torpedoes for anti-submarine use, and against enemy submarines which are relatively quiet compared to the loud, surface ship targets of WW II, and against which a passive acoustic torpedo could be truly effective. Thus the lessons learned from the use of the CUTIE against Japanese warships are rarely appreciated.

The history of the U.S. Mk 27 torpedo began with a recognition in 1943 that the Germans were using a terminal homing torpedo called the GNAT -- the German Naval Acoustical Torpedo. It was a torpedo that guided itself to contact with the target by the noise generated by a ship's propellers. Earlier, the U.S. Intelligence community became aware of German work on passive acoustic torpedoes. Hence, a torpedo project was initiated in 1940 with the passive homing system work centered at Bell Labs and the Harvard Underwater Sound Laboratory. With engineering development then assigned to Western Electric and G.E., a so-called "Mine Mk 24" with the code name of "FIDO" was put in production and 10,000 units were ordered. But this number of units was radically reduced when it became evident that it would be a highly effective weapon. The Mine Mk 24 ("mine" being a misnomer for security reasons, to not alert the enemy to this new torpedo) made its debut in 1943 for use primarily with air craft. FIDO accounted for 31 U-boats sunk and 15 damaged from the 142 attacks made against U-boats during World War II.

In approximately the same time frame, Westinghouse adapted the Mine Mk 24 for submarine use and called this anti-escort torpedo the Mk 27 or "CUTIE." (See illustration.) This passive acoustic small torpedo, weighed 120 pounds, was 19 inches in diameter and 90 inches long, had a 95 pound warhead of HBX, made 12 knots and ran 5000 yards. It didn't see service in U.S. submarines until late in 1944 in the Pacific theater. Whereas only seven CUTIEs were fired by a total of three submarines, there were 4 hits recorded -- an impressive record of success. Actually there were 106 Mk 27 Mod 0 torpedoes fired by other platforms as well as submarines during WW II with 33 hits resulting in 24 ships being sunk and 9 ships damaged. A single torpedo thus tended to achieve the same results against escorts as a salvo of larger non-homing torpedoes.



Torpedo Mk 27

Significantly, the Mk 27 CUTIE was quietly launched from a torpedo tube by starting it while still in the tube and letting it swim out -- taking 8 to 10 seconds to clear the tube. The noisy ejection of the conventional torpedo was thus eliminated.

One other passive acoustic torpedo, the Mk 28, appeared in the Fleet before the end of WW II. It was a full-size, 21-inch diameter, 21-foot long electric torpedo of 20 knots speed, 4,000 yards range and with a 600 pound warhead -- and could be submarine launched. There were 14 of these Mk 28s fired during the War with only 4 hits resulting. This was probably due to inadequate training in its tactical use.

As for the firing of CUTIEs by the three submarines, as noted in Clay Blair's Silent Victory, their use was initiated by Carter Bennet in SEA OWL.

On the first patrol of SEA OWL in November of 1944, in the shallow waters of the Yellow Sea, Bennet gave a CUTIE its first submarine test. A small patrol craft was the target. SEA OWL was taken down to 150 feet -- a safe depth which would prevent the CUTIE from homing on SEA OWL -- and one Mk 27 torpedo was fired. A hit resulted and SEA OWL was surfaced to check the effectiveness of the torpedo. Bennet found the patrol craft in a sinking condition -- making this attack, in Bennet's judgement, "an unqualified success." On his second firing of a CUTIE, again from 150 feet deep and again at a small patrol craft, there was again a convincing explosion and SEA OWL was surfaced, to find the vessel not badly damaged but dead in the water. The patrol craft was then finished off with a Mk 18 torpedo. Soon afterward, Bennet tried two more CUTIEs against what he believed to be a destroyer coming out of Nagasaki. Nothing happened -- perhaps because the destroyer was making too much speed or because the destroyer spotted the torpedoes. But the latter reason was less likely than the former since the early models of the Mk 27 appeared useless against a target going more than 8 1/2 knots.

On April 9, 1945, George Street in TIRANTE, after attacking a small convoy and sinking a 5,500 ton transport loaded with troops, was put under depth charge attack by several escorts. Street then fired one CUTIE, heard a loud explosion overhead with breaking up noises, but never knew the ultimate result of this attack. Nor was this escort listed as sunk -- but perhaps it was too small for the official records.

On July 1, 1945, Frank Lynch in HADDO attacked a 4-ship convoy off Inchon, Korea -- in a dense fog and in only 65 feet of water. Two freighters were sunk and two damaged in Lynch's 8-torpedo attack. The fog lifted and an escort, a frigate, was sighted charging at HADDO. At flank speed, HADDO fled for deeper water being chased by two escorts. Staying on the surface seemed fatal so HADDO was dived in 80 feet of water. Two CUTIEs were released -- hoping that they wouldn't hook back on HADDO. One torpedo hit Coastal Defense Vessel No. 72, an 800-ton frigate, which blew up and sank. The other escort broke off his attack to rescue survivors.

In effect, the CUTIE with its passive acoustic homing feature proved to be a useful anti-escort torpedo, particularly for submarine use in shallow waters. Its swim-out feature was non-alerting to searching surface escorts. And its successful use in extreme situations, as a last-ditch submarine defensive measure, might have encouraged greater emphasis on this kind of weapon for future submarine operations.

R. C. Gillette

THE BASTION STRATEGY

I agree with Mr. Breemer in his REVIEW article, July 1985, that in the relevant Soviet literature, there is little direct mention of what in the West we have come to call a "bastion" concept or strategy. As to literature on the "strategic witholding posture" to which the author alludes, it is prolific, giving good reason to infer and deduce such thinking on the part of the Soviets.

In the difference in size between DELTA and TYPHOON, one should keep in mind that the original design of TYPHOON may have called for a 24-tube ship rather than a 20-tube ship.

It is quite true that since the early 1970's there has occurred a noticeable increase in the per unit size and therefore the endurance of Soviet ships. Newer Soviet submarines taking advantage of this increased size and endurance to be overseas during wartime would still, in Mr. Breemer's words, have to be "guarded" by forces other than themselves.

In theory, were the Soviets to concentrate their SSBNs in relatively small areas, such as the northern "bastions", this would ease the Western search and localization problem, though it might or might not ease the detection problem.

Contemporary Soviet military thought does not necessarily hold that any nuclear exchange will be preceded by a period of crisis and increased tension -- sufficient to constitute reliable warning. Often this is wishful thinking on the parts of both the U.S. and U.S.S.R. The fact is that the Soviets, more than the West, are constantly augered by a "realistic" perception that war may begin precipitously, without much warning, fed by accidental misinterpretations. The Soviets wish this were not possible because, for them, wars are begun on purpose and by careful calculation. Nevertheless, in recent years, the Soviets show an increasing appreciation for spasmodic war start.

Keeping most of their submarines in and near home ports most of the time is a long-standing Soviet preference owing to a philosophy and a necessity of readiness which is very different from that of the U.S. Navy. It has a lot to do with endemic and systemic limitations on Soviet naval readiness, as Mr. Breemer and others have suggested. But, it is also the manifestation of the Soviet understanding of how wars start and of how they can best react to the start of a war in both the very near term and in the longer course of calculated events. The Soviets repeatedly say that it is incorrect and dangerous to impute Western preferences and motives to them.

Moreover, it would not be a good idea to be in the area where any SSBN attempted to launch SLBMs from "inside their home ports." Additionally, a sizeable depth of water and navigable sea room is required to launch SLBMs -- properties usually not found inside home ports.

James T. Westwood

LETTERS

HOW MANY SOVIET NUCLEAR ATTACK SUBMARINES?

Just for general information and to clarify box scores of Soviet submarines, the following numbers of nuclear attack submarines are derived from unclassified sources:

- From Jane's Fighting Ships, 1986-87, the Soviets apparently have 84 nuclear attack submarines in commission today. These submarines carry 20 or more torpedoes and probably the SS-N-16 as well -- a missile with an ASW torpedo warhead. (13 of these are converted YANKEE SSBNs)
- additionally, the Soviets have 52 missile-carrying nuclear submarines (cruise missiles) which also carry a big load of torpedoes and <u>are</u> nuclear attack submarines by any definition. (Would anyone reclassify the 688s which have twelve cruise missiles, in vertical tubes up forward, as SSGNs, instead of nuclear attack submarines?)
- in addition to the 136 nuclear attack submarines listed above, there are possibly a few more Soviet nuclear submarines which are not clearly identified, which might be nuclear attack submarines.

The uninitiated (into submarine matters) tend to believe that only SSNs are nuclear attack submarines. This is because of the vague way in which submarine box scores are frequently presented -- in unclassified documents. Don't be fooled. Refer to the above figures and order your thinking about the Soviet submarine threat accordingly.

RRRF

ON THE "SILENT SERVICE"

I can't tell you how impressed I was with the ideas W. P. Gruner brought up in his article "Enough of This Silent Service Bunk" in the October 1986 SUBMARINE REVIEW. Or what delicate memories it touched in me, reaching back to my service in World War II. I too resented being "shut out" of information I really deserved to have. I know it impaired my effectiveness as an enlisted man and always felt I could have done a much better job if I had only known what was going on.

I was one of those early SD radar men Mr. Gruner mentioned. I went aboard GATO in mid '42, and was given a ten-minute "course" in radar -- which I had never even heard about before. I never could understand why I didn't get a single contact on that patrol until we were just outside Dutch Harbor. Somebody hit the control room deck from the conning tower just as I saw a blip on the radar. When I reported it, I was informed that it was "friendly" planes strafing us. Great morale builder, right?

Before the war we were told that SSs were the "eyes of the fleet" -- the fleet's scouting force. We were supposed to duck under the enemy's screen, locate their big ships and radio back the information. But we understood that if a DD spotted us or even our periscope, or if an aircraft reported our silhouette we were as good as dead. I'm sure that this brain-washed lots of our SS officers and men -- even while the Germans were at the same time proving that theory was false. But such information learned in the Atlantic War wasn't getting to the Pacific.

I especially liked Mr. Gruner's statement, "Secrecy is counter-productive in this age of rapid technological advance." How difficult it must be for people to work cooperatively in a "silent service."

Frank Sennello

VADM DeMARS SPEECH AT THE SUBMARINE SYMPOSIUM, LIMA

VADM DeMars' fine speech in Lima mentioned the "tight fraternity" of submariners. It brought on fond memories of the 50's when our wardroom hosted competent and charming submarine officers from Argentina, Brazil, Peru, and the Netherlands. It could well be that some of these men, as senior officers, heard his speech.

Among the important points he made were:

- the USSR has many Non-NUCS as well as many NUCS.
- the USSR is building greater variety and numbers of NUC's than NATO.
- the USN concentrates on NUCs relying on Allies for Non-NUCs.
- By maintaining technical and personnel superiority, the USN can, with its Allies, maintain adequate submarine strength with about 100 SSNs.

It seems clear that in the years since the introduction of SSNs there has been great progress in improving not only SSNs but also in the improvement of SSs. Areas of improvement include: silencing, shock-proofing, sensors, hull strength, submerged endurance, etc. Further, producibility of SSs may have held up better than that of SSNs.

Thus, estimating a future "correlation" of submarine forces is a very complex function of exchange rates between SSNs, SSs, and SSNs vs SSs, (including multiple SSs and enemy subs in coordinated ops with other ASW forces -- all in appropriate geographic settings. It is assumed that SSBN safety on both sides will depend largely on the above correlation.)

The adequacy of 100 USN SSNs will depend, perhaps critically, on the complex correlations above. Yet, most of the discussion I've heard has involved estimates only of the SSN vs SSN exchange.

It seems important, then, to conduct exercises within the various submarine types in NATO -- particularly for SSNs vs SSs -- to more accurately estimate the complex correlation above and to respond realistically in future force plans.

The design of exercises from which improved estimates of exchange rates can be made will obviously require the most subtle analysis and planning. The conduct of exercises and analysis of results will be equally subtle to include the necessary submarine-class and geographic diversity and statistical significance. And, it may prove difficult to exclude participation by the unwanted.

Further difficulty in design and analysis of exercises arises when one considers the contributions made by non-submarine forces such as air, surface, mine, and C^3I forces.

Finally, the resolution to win in any set of exercises short of war may be the most important factor of all in a dynamically changing technological world. Propaganda effect and political subversion are definitely influences affecting resolution.

The ceiling of 100 SSNs, long embedded in political stone, could be the formula for defeat.

RBL

FIGHTING IN DEFENDED WATERS

How great to hear from Henry Young again! -- in his most thought provoking article, in the January issue.

At risk of over simplification, Henry explores certain aspects of a submarine campaign in defended waters in consideration of planning implications. He brilliantly shows that in a campaign focused on destroying SSBNs while facing a constantly acting defense, the exchange rate of SSBNs for SSNs will be degraded as successful attacks reduce desired engagement opportunities with the defensive forces remaining strong.

Some of his conclusions:

- SSNs should avoid the SSBNs defenses.
- increasing the number of SSNs committed to the campaign will not overcome the effect of a modest defense.
- a fast start of the SSN campaign will not materially increase effectiveness.

I would conclude that: making the destruction of SSBNs the objective of the campaign seems to be a distorted strategy. The objective is to win the war as soon as possible. The way to do that is to attack as vigorously as possible any thing that may get in the way of U.S. objectives. Attacking SSBNs early in a war may be a mistake from other directions. It could destabilize the deterrence, put off the destruction of more accessible targets leading to loss of the sea war to forces which attack SLOCs; and as Henry points out, failure to attack what he defines as submarine defenses even reduces the chance of destroying the SSBNs.

I agree with his last paragraph:

"Fighting an undersea campaign in defended waters is shrouded in uncertainties that should challenge SSN force planning at the levels of strategy, operations and tactics for a long time to come. Sound insight into the nature of such operations is a prerequisite for effective force development and employment plans."

Dick Laning

<u>IN THE NEWS</u>

o <u>The Post</u> of January 13 explains the last-minute "secret" change made to the U.S. yacht, Stars and Stripes, for its final round of races off Fremantle, Australia to pick a challenger for the America's Cup. Dennis Conner's boat had gotten a new plastic hull coating designed to reduce drag. The coating was "applied in 30 three feet by one foot panels of about .007 inches thickness and with V-shaped micro grooves -- like an LP record." The coating was designed by 3 M to cut drag on space vehicles and "will boost boat speed." (The subsequent 4-1 victory of Stars and Stripes over the seemingly invincible New Zealand boat and later the 4-0 win over KOOKABURRA III was apparently conclusive evidence that Stars and Stripes had gained a good deal of speed by adding this coating. The SUBMARINE

REVIEW article "Slippery Skins for Speedier Subs" in the July 1984 edition, notes that "thin grooves running lengthwise along the outer skin of a sub, reduce boundary-layer turbulence" -- and "seem to reduce drag better than perfectly smooth finishes.")

o <u>Defense Week</u> of 22 December, 1986 reports that inaccurate design drawings for the installation of the BSY-1 combat and weapons launch system (formerly the SUBACS) in the SSN-751, an SSN-688 Los Angeles class submarine, will delay the delivery of the SAN JUAN seven months. SAN JUAN, SSN-751, was christened at Electric Boat's Shipyard on Dec. 6th. Vice Admiral Hernandez, Commander of the U.S. Third Fleet said, at the christening, "When commissioned, she will be the most capable submarine in the world." And, launching this submarine on the eve of the anniversary of Pearl Harbor was a fitting reminder of the "consequences of being ill-prepared for war in a time of peace." San Juan Mayor Baltasa Corrada hoped that the SAN JUAN's hull number was a prophesy of things to come, i.e. San Juan as the capital city of the 51st state of the union.

o An <u>ALNAV</u> of January 1987 lists five unrestricted submarine line officers who were selected for promotion to the grade of Rear Admiral (Lower Half):

Douglas Volgenau, CO, NUSC Newport, RI.
Thomas A. Meinicke, Chief of Staff COMSUBLANT
Raymond G. Jones, Jr., OPNAV (OP-90B)
William P. Houley, OPNAV (OP-11)
William A. Owens, Exec. Asst. to VCNO (OP-90A)

This selection lists 29 unrestricted line officers who made flag rank with this selection. Eleven were aviators and 13 were surface officers.

o <u>The Post</u> of 27 January tells of the use of STINGER missiles by Afghan guerrillas to shoot down Soviet helicopters and fixed wing aircraft. One guerrilla commander said they were shooting down aircraft in about 70% of their attempts with this heat-seeking weapon. This shoulder-launched missile when used by the commander's unit had downed two helos and 3 transport planes with the seven missiles the unit had fired. The commander further noted that he believed 90 to 100 Soviet or Afghan government aircraft had been brought down by the STINGERs so far. This is the first wholesale use of the STINGER in actual battles. Six were reportedly fired in the Falkland Islands War with one aircraft claimed destroyed. But this first test of this weapon in a war environment was with little training of the men who fired the missile. [Ed. Note: Some British submarines have a battery of Blowpipe missiles (similar to the STINGER but far less sophisticated) installed in their shears for anti-aircraft use.) The STINGER, as identified from The World's Missile Systems is a U.S. missile of 3 miles range, 60 inches long, weighs 22.3 #s, is supersonic in speed, is fired from a 7.7# shoulder launcher, has dual thrust solid propellant propulsion, and has counter-countermeasures circuitry to give it immunity to any known IR threat. It can engage aircraft of up to mach 1 speed, at all aspects, and is a fire-and-forget weapon. Its diameter is 2.75 inches and it is a replacement for REDEYE.

o On Dec. 13th, the TENNESSEE (SSBN 734) was christened at Electric Boat by Mrs. Landess Kelso, the wife of Admiral Frank B. Kelso II, Commander in Chief of the Atlantic Fleet. This 9th submarine of the TRIDENT class is the first of her class designed from the keel up to carry the TRIDENT II (D-5) ballistic missile, which has significantly greater range and payload than the TRIDENT I (C-4) and an accuracy which in effect makes it a good counterforce weapon. ADM Kelso said, "So today we witness, with the launch of the TENNESSEE, the final step in the modernization of the submarine leg of our nation's strategic triad." Adm. Kelso added...."Today the TENNESSEE begins its historic journey to add a new capability to maintain world peace." Senator Gore of Tennessee called the christening "truly significant" because it "marked the era of the new missiles" and "will deter Russians around the world."

o <u>General Dynamics World</u> of January 1987, reports that on Nov. 21st at the Naval Weapons Center China Lake, California, the TOMAHAWK cruise missile demonstrated a new land attack capability. The test was the first flight of the production configured submunitions-dispensing variant. Launched by the USS ARKANSAS at sea, the missile flew a 500-mile mission to the China Lake Range and successfully engaged multiple targets with its 24 packs containing seven inert "combined effects bomblets (CEBs)." This TOMAHAWK warhead enables a single missile to attack multiple targets such as revetted aircraft or air defense installations. "Approximately 30 percent of Navy TOMAHAWK cruise missiles will be the submunitions variant." (This submarine-launched weapon is considered to be usable prior to strikes by a U.S. attack carrier's manned aircraft on land objectives -- it is a means to soften up enemy air defenses and reduce attrition of follow-on U.S. manned aircraft.) On Nov. 26th a TOMAHAWK was vertically launched for the first time from a submerged submarine. This anti-ship variant flew 250 miles and passed within a lethal distance of a target hulk. This first of seven flights will give submarines a vertical launch capability for TOMAHAWK in addition to a torpedo tube launch capability. (In mid-January there were two more submerged launchings with cruise flights to Eglin Air Force Base about 700 miles away.)

o <u>Jane's Naval Review</u> of 1986 has an article by Commander Roy Corlett, RN, which poses the question of what is inside the very large pod, mounted on the rudder structure of the VICTOR

IIIs. (In previous SUBMARINE REVIEWs the functions of this pod have been guessed at.) CDR Corlett notes that, "What has been described as a magnetohydrodynamic (MHD) propulsion pod on the VICTOR IIIs is now fitted to SIERRA and AKULA-class submarines -- a sure sign that whatever it is, it works." He notes that "the way an icing coat forms on the superstructures of some Soviet submarines within minutes of surfacing seems to indicate cryogenics in some form or other," in use by the Soviets in their submarines. As to the pod itself, his guess, he feels -- as to how the pod as a propulsion system works -- is backed by some good published Soviet evidence. He describes the pod as having a tube with a venturi entrance and which runs down the center of the pod. A streamlined cover at the forward end of the tube opens when the submarine is submerged. This cover protects the tube when the submarine is on the surface. Around the tube is a flexible sheath partitioned into segments each of which is filled with a magnetic fluid. Around the sheath, and separated from it by partitioned cavities, are inductor coils which match the resilient sheath segments. Around the propulsion tube are liquid helium cooling coils to provide superconductivity of the inductor coils. In operation, a static converter converts direct current into a voltage variation in the inductor coils and generates a pulsed magnetic field. This field, acting on the magnetic fluid, sets up a traveling wave in the fluid and thence in the flexible sheath. The resulting motion draws water into the tube's venturi entrance and expels it aft, creating a thrust. For the size of the pod and the method of propulsion described, a cruising speed of 7 knots seems possible.

o *The Washington Times* of 6 January reports on an article by Desmond Wettern of London's *Sunday Telegraph.* Wettern wrote that "plans for big surface warships for the Soviet Navy have been curbed in favor of the new submarines." He said that Soviet submarines could circumvent the U.S. SDI system by flying their cruise missiles close to the earth's surface -- skimming the surface of the sea before striking targets far inland. The article also notes that according to _Jane's Fighting Ships_ 1986-87, at least one Soviet nuclear submarine (a Yankee ballistic missile submarine) has been rebuilt to carry the SS-NX-24 land attack cruise missile which has a range of up to 4800 miles and is being tested. "The missile is thought to be capable of striking any targets in the continental United States from a submarine lying hidden off either seaboard. The report also said that Admiral Vladimir Chernavin, successor to Admiral Gorshkov as Head of the Soviet Navy, "is a leading exponent of submarine warfare."

o YNCM(SS) Henry Buermeyer writes about the National Submarine Memorial located in a park in Groton, CT, and consisting of the conning tower of the USS FLASHER along with a set of bronze plates showing the names of the 52 submarines lost in World War II. There, at the Memorial, the sacrifices of the 3,505 officers and men and their lost submarines are to be remembered during formal memorial services on Memorial Day and Veteran's Day. FLASHER sank more tonnage than any other U.S. submarine during World War II. The Memorial still needs $47,000 to complete this project -- still, the goal is to dedicate this National Submarine Memorial on Memorial Day, 1987. Contributions can be mailed to: National Submarine Memorial Preservation Fund, P.O. Box 57, Gales Ferry, CT 06335. It is also noted that the City of Groton is looking at the feasibility of acquiring land for a walkway from the National Memorial to the Thames River and to erect along this walkway memorials for the THRESHER and SCORPION.

o _Aerospace Daily_ of December 15, 1986, quotes VADM Bruce DeMars, Deputy Chief of Naval

Operations for Submarine Warfare, as telling the House Armed Services seapower subcommittee that the improved 688 class submarines will be twice as effective as the current 688 class boats and would have a wartime kill ratio over Soviet attack subs of more than five to one. The first of the upgraded 688s, the SSN-751, "will be able to counter the seven new types of Soviet attack submarines that have become operational since 1976." Admiral Kinnaird McKee in later testimony noted that some say the Soviet Union has a three-to-one advantage in submarine numbers, but this really isn't so. "If you match their first-line attack boats against our first-line attack submarines, the ratio is about one-to-one. If you sprinkle in the Soviet diesel boats, that runs the ratio up. But diesel boats are really minefields, in my judgement. And again, to get the three-to-one ratio, you also have to throw in the SSBNs which aren't going to go hunting for trouble."

o An <u>AP</u> story on January 13, 1987, announces the imminent first flight test of the TRIDENT II (D-5) intercontinental ballistic missile -- submarine launched. "When the first TRIDENT II rises from a launch pad at Cape Kennedy, FL on January 15th, the Navy will be testing a weapon said to be so accurate it can match the targeting ability of land-based missiles, even though it's fired from a submerged, moving submarine." Critics claim that this weapon will turn the nation's strategic submarines into "first strike" weapons systems, undermining the deterrent balance with the Soviet Union. The first test involved a launch from a ground pad instead of a submarine, but following the flat pad tests, firing the missile 5-10 times from a submarine will be needed before it is declared operational.

o A Navy release of 24 December, 1986, names the USS PLUNGER (SSN-595) as the Pacific Fleet winner and USS FINBACK (SSN-670) as Atlantic

Fleet winner of the Marjorie Sterrett Battleship Fund award. "The award is given annually to the submarine judged to have the highest level of combat readiness."

o Air Force Magazine of December 1986 in an article by Edgar Ulsamer says, "we are witnessing a modernization and upgrading of their (Soviet) forces that spans the spectrum from strategic to conventional conflict... this stem-to-stern overhaul of the Soviet Armed Forces has transformed them from garrison forces to global forces that routinely test and probe this nation's perimeters." The article mentions that three TYPHOON-class submarines are operational with a fourth and fifth nearing operational status. They carry twenty solid-propellant SS-N-20 SLBMs with a range of more than 8,000 kilometers. Four new ballistic missile submarines of the DELTA IV-class are at sea and will carry the SS-NX-23 which is completing its flight testing. This liquid-propelled SLBM carries ten mirved warheads over a range of more than 8,000 kilometers. It is also noted that the YANKEE SSBNs -- being decommissioned to keep Soviet ballistic missile launchers within the 950 SALT II limits, as new Soviet SSBNs enter the force -- are being converted to a "wide-hipped" configuration in order to accommodate the launch tubes for their new, large submarine-launched cruise missiles.

o The San Diego Navy Dispatch of October 30, 1986, tells about the Submarine Escape Tank at Pearl Harbor and the hopes that it will be preserved as an historical landmark. Decommissioned, along with its sister tank at Groton, CT, in 1982 on its Fiftieth Anniversary, the Pearl Harbor tank had its plumbing removed but still stands, semi-occupied, while the Groton tank is planned for demolition this year. Submarine escape training was initiated at both tanks in 1932 following a "disturbing increase" in submarine accidents after World War I. All submariners, except those with waivers, trained in these unusual tanks, making ascents -- with "lung" or "free" -- from various depths (up to 100 feet) to prepare them for escape from a stricken submarine. Two instructors usually accompanied the trainees on their ascents and if problems arose, an air lock was less than five seconds away. But today, these tanks have outlived their usefulness, as advanced methods of submarine escape and rescue have rendered the tanks obsolete.

o Defense Week of 26 January tells of delays in the Navy's SEA LANCE anti-submarine standoff weapon -- of about 80-mile range. Two versions have been planned, one with a nuclear depth charge type of warhead (a replacement for SUBROC) and the other a conventional version which combines the missile body with the Mk 50 advanced lightweight torpedo. Technical difficulties with the nuclear version which was first to be operational in the original program, have caused the Navy to now opt for the first development of the conventional version. Program delays due to this shift have evidently delayed the development of the SEA LANCE missile up to one year.

o A flyer distributed around the Chicago area tells of the battle by WW II submarine veterans to find a permanent home for SILVERSIDES -- which accounted for 23 enemy ships in her 4-year Pacific campaign. Presently anchored at the foot of Chicago's Navy Pier and open to visitors, SILVERSIDES has been offered a permanent home in Muskegon, Michigan, but the Chicago Park District has also promised a lakefront docking site and adjacent land for a Great Lakes Naval and Maritime Museum. The latter proposal is certainly a more favorable one but inaction by the Park District has kept SILVERSIDES's siting in limbo -- and her potential as a lakefront monument to Chicago war veterans not being realized. The help of submariners to increase interest in this project, generate political pressures and increase financing is needed. The contact in Chicago is through Great Lakes Naval and Maritime Museum, Box A-3785, Chicago, Illinois, 60690.

o <u>The Washington Post</u> of March 3, 1987, has a story on Navy Secretary Lehman's demands to have three nuclear submarine commanders who were recommended for promotion to captain by a selection board convened in January, be "deselected" to make room for three others. According to "Navy officials," Secy. Lehman "did not feel that the promotions of almost 300 commanders to captains were fairly distributed among the submarine, surface and aviation branches," and directed that the board be reconvened. But VADM DeMars objected on the basis that the Secretary's deselection process "was not legal." However, when on February 27th, VADM DeMars, Deputy Chief of Naval Operations for Submarine Warfare, was ordered by Lehman to reconvene the board to select three other officers in specified warfare communities, DeMars reminded the Secretary that he had previously declined to carry out such an order. At which, Lehman directed DeMars' resignation as President of the FY 88 Active Duty Line Captain Selection Board. DeMars letter of resignation was then submitted. According to George Wilson, author of the <u>Post</u> article, a Navy officer in the Pentagon circulated a memorandum which said that the Secretary "could not manipulate the current Chief of Naval Operations to bend the legal rules governing the completed board results." In a follow-on article in the <u>Post</u> of 4 March, George Wilson noted that Secy. Lehman, at a Pentagon news conference, denied breaking any laws by ordering VADM DeMars to "deselect" three commanders already recommended for promotion to captain. And, that DeMars action in resigning as head of the selection board -- rather than carry out his direction which DeMars considered to be "illegal" -- was, in Lehman's words "in more than six years as Navy Secretary this was the first time an admiral had refused to obey an order." The Secretary attributed this defiance to his "lame duck" status, since he has announced he will leave his job in about a month, being relieved by James Webb. The Secretary also said he "had rejected five previous promotion lists because they favored nuclear submarine officers disproportionately." George Wilson also reported that "The Senate Armed Services Committee sent a letter to Defense Secretary Caspar Weinberger yesterday demanding a 'complete and thorough' investigation of Lehman's role in all promotion board deliberations," and suggested that no more Navy promotion boards be convened by Lehman until after the investigation. In the selection made by DeMars' board, "253 commanders were recommended for promotion to captain. Of that total, there were 30 nuclear submariners, 73 surface warfare officers, 122 pilots and 28 naval flight officers." The nuclear submariners had 30 of 38 selected -- 79% of the eligible officers, whereas other specialties had about 50%. And, according to the Secretary, DeMars board had not complied with the Secretary's guidance "and indeed exceeded by 150 percent" the number of submariners to be selected for captain. A Navy Times article on the same subject says that nuclear submarine officer retention is projected to fall to 40% in 1987.

o The groundwork for establishing a new Submarine League chapter in the mid-Atlantic region (New Jersey, Pennsylvania and Delaware) from members of the Naval Submarine League is being spearheaded by Henry Palmer and Dick Tauber. Those who want to participate should write Palmer at Computer Sciences Corporation, Rt 38 Box N, Moorestown, NJ 08057, with home phone number (609) 953-1143; or write to Tauber at RCA Corp., (Bldg 127-294) Borton Landing Road, Moorestown, NJ, home phone (609) 654-1165.

o Rear Admiral Jim Blanchard, who died March 5, 1987, is well remembered for his sinking of the Japanese aircraft carrier TAIHO of 31,000 tons. It was the newest and largest carrier in the Japanese fleet at that time and was Admiral Ozawa's flagship at the Battle of the Philippine Sea. But the story of Blanchard's sinking of TAIHO is not a simple one. On June 19, 1944, Blanchard in ALBACORE found himself in the path of Ozawa's main carrier group. Blanchard, after avoiding a destroyer, took a quick periscope look at the second carrier in line. Hearing that his TDC was not functioning properly, he shot six torpedoes by "seaman's eye." As 3 Jap destroyers charged ALBACORE, Blanchard took her deep. One solid hit was heard, plus what sounded like a possible second hit but which was a heroic sacrifice of a Japanese pilot who spotted the wake of an ALBACORE torpedo and dove on it -- destroying the torpedo and himself. The one hit by ALBACORE seemed so inconsequential that TAIHO's flight operations were continued for the next seven hours. But, spreading gasoline fumes then caused a severe explosion -- the sides of TAIHO being blown out. At this, Ozawa transferred his flag to the cruiser HAGURO -- just in time, as a second explosion caused TAIHO to sink stern first. For many months, the U.S. was unaware of this sinking and consequently Admiral Lockwood awarded only a Commendation Ribbon to Blanchard "for damaging an aircraft carrier." Eventually a Japanese prisoner of war said that TAIHO had been sunk in the Battle of the Philippine Sea by a submarine's torpedo. When this was confirmed, Admiral Lockwood changed Blanchard's Commendation Ribbon to a Navy Cross.

o USS JACK (SSN 605) is planning a 20th Anniversary reunion along with a reunion of the JACK's (SS 259) crew members. The reunion is scheduled for May 8 to 10, 1987, in the Groton area. For information contact Ensign Mike Metzger, (203) 449-3329, or Senior Chief David Ellis, (203) 889-4740.

FLEET TACTICS

By Captain Wayne Hughes, USN(Ret.)
U.S. Naval Institute Press, 1986

This book is a study of fleet tactics which approaches the subject from an historical perspective and proceeds to develop chapters on the "Great Trends," the "Great Constants," the "Great Variables," and the "Trends and Constants of Technology."

From this massive overview of the elements of tactics there is a chapter on "Modern Fleet Tactics." This would appear to be an authoritative statement of the current thinking in the U.S. Navy on how to operate a Fleet in combat. In the Forward, Admiral Thomas Hayward states that our Navy has "a need, unrivaled by that of any time in our history, for the study and mastery of tactics," and that this book "is a treasure house of commonsensical guidelines and stimulating ideas."

Admiral Hayward also comments that he is often asked "How much longer will the Carriers be the centerpiece of the U.S. Navy's tactics?" And, according to Admiral Hayward, "A responsible answer must revolve around technology and tactics, -- and the pages that follow are relevant to the whole issue."

This book may indeed mark a turning point in the understanding of tactics by the U.S. Navy. Since WW II the literature on naval tactics has been practically non-existent. Whenever tactics are considered they are usually presented axiomatically to support an analysis whose conclusions advocate the adoption of a new technology or the need for more of certain classes of ships and aircraft.

The author admits that "this book says little about the submarine wars .... That is because fleet actions offer the best chance of controlling the seas." But unexplained by the author is why he never includes submarines as an element of the Fleet. He always presents the carrier battle group as the centerpiece of his tactical force.

Admiral Hayward admitted to being a Naval Aviator "harboring all the biases that term connotes." And your reviewer admits being a WW II submariner with all the technological ignorance and biases attributed to that breed by many in the modern Navy. But, does that imply that tactical skills are the exclusive privilege of the technologically informed? Indeed, does the skill of a boxer demand a knowledge of physics and physiology, and has the tactical successes of past heroes been based on their technological skills?

The best book on tactics was written some two-thousand years ago by Sun Tzu and is frequently quoted by Captain Hughes. Sun Tzu called his treatise "The Art of War" and has, over these two-thousand years, been the best analysis of the skills needed by that outdated notion of the "Warrior."

Sun Tzu says "Do not repeat the tactics which have gained you one victory, but let your methods be regulated by the infinite variety of circumstances." This is a truth well known to anyone experienced in battle; the essence of successful tactics is that of catching the enemy "off guard" or, if you will, by surprise. Tactical doctrine and tactics by formula may result in optimum solutions in analysis, but are fatal against an alert enemy.

The essence of tactical genius as best exemplified by Admiral Nelson is to do those things which the enemy does not consider reasonable or logical. All of which says that an understanding of the analysis of Fleet Tactics presented by Captain Hughes is not likely to produce a future warrior of the caliber of Horatio Nelson, John Paul Jones, or Chester Nimitz. Battles are won by the best warriors, not the best mathematicians or technologists, or even analysts.

But still, Fleet Tactics is an important book. If it is widely read and discussed by Naval Officers it will become apparent that something more is needed to produce future victories of the importance we attach to those of Nelson and Nimitz.

Admiral Hayward's feeling that the "need (for the study and mastery of tactics) was unrivaled by that of any time in our history" was a feeling expressed by Winston Churchill when he wrote of WW I,

> "We had brilliant experts of every description... fine sea officers and devoted hearts: but at the outset of the conflict we had more captains of ships than captains of war. In this will be found the explanation of many untoward events."

Fleet Tactics may well be the first step toward developing these "Captains of War." If so, it deserves analysis and criticism.

Frank C. Lynch, Jr.

SUB DUTY

By Grover S. McLeod. Copyright 1986. Published by: Manchester Press, P.O. Box 550102, Birmingham, AL 35205. Illustrations by Vince Zerone. Price $19.95

Prior books that have been written about submarine participation in the Pacific during WW

II have been written by naval officers or naval historians.

This book presents a forthright view of the submarine war from the eyes of an eighteen year old seaman and later torpedoman. Highly personal, with much name dropping, there are still design, tactical, and operational lessons that shine through the five hundred and forty-eight pages.

The author, now a practicing attorney in Birmingham, Alabama, in his introduction states that the success of the fleet type submarine was more due to the courage of the officers and men that sailed it than the submarine, for many nations had submarines that had as many capabilities as the Americans. He makes the point that U.S. submarines were standard, which not only permitted interchangeability of parts, but enabled personnel to be shifted easily from boat to boat. An underlying thesis of Attorney McLeod is that the American sailor was unique, superior to his weaponry and in many ways to the Navy to which he belonged. In his eyes, the Navy was burdened with unnecessary classes, secrecy, and often was guilty of bungling.

There is an interesting discussion in the early pages, of the chasm between officers and enlisted men. In most cases the chasm would not close during the war. In visiting Australia later during the war, Sam finds that the Australian Army worked in the opposite way. Officers walked the streets with their soldiers, they drank together socially in pubs and it was never "Mister" or "Sir." It was "Lieutenant" or "Captain" or "Sergeant" or "Bluie" or "Snow." They also maintained discipline when necessary. This association had much to do with making the best fighting unit in the war. He further states "The German submarine officers were of like mind. On their first night in port, the officers and men had a grand drinking session. There was much camaraderie between officers and enlisted men on the U-boats. This was possible because their submarine officers came from the Merchant Marine, rather than the Academy, and so they had a feel for life on the lower echelon." How grand it would have been "if the officers of the FINBACK then had shed their whites for khakis and doffed their hats and ties. It would even have been nicer if they had shelved their whiskey and their fancy officers' club and joined us on the hill. It would have done much for the crew if they had drank beer with us and shared our stories."

Not all readers subscribe to the author's perceived submarine liabilities. Yet there are valid lessons to be learned. FINBACK, ordered to the Aleutians immediately after Midway, was woefully short of accurate navigation charts. Fishermen who had been charting the northern waters for ten years, gave the opponents an edge. In July 1942, when USS GRUNION (SS 216) did not respond to a command communication, FINBACK was directed to search a twenty-five mile quadrant east of Kiska, and transmit on 450 kilohertz. The susceptibility of these transmissions to the opponents' shore-based RDF system seems to have escaped the notice of the command at Dutch Harbor. Charts were improvised and our seaman author gives the Navigator credit for charting a "dozen" new Aleutian Islands.

Much has been written about the Mk VI Magnetic Exploder and the Mk XIV torpedoes errant depth running ability. A chapter is devoted to bad torpedoes. The lesson learned involved excess secrecy and insufficient proof testing.

In HALIBUT, Attorney McLeod's second boat, operation and maintenance of the surface SJ radar is dealt with. Remembering the lack of a radar technician in FINBACK, and the remembered uselessness of the SD (air warning) radar in that boat, the Navy is criticized in being late in training men in radar maintenance. The schools were too brief.

Some of the hither-to unchronicled adventures are described in detail through the author's eyes. Two incidents stand out as written by our seaman first class author. There was the self or auto ignition -- of a British type aircraft recognition flare in its storage box in the conning tower, while submerged at two hundred feet. This occurred after repeated exposure to the hostile environment of salt water and heat. One officer and the fire controlman donned lungs with smoke canisters and promptly discovered that the canister did not filter out the acid smoke. With its self-contained magnesium oxide, immersing the flare in a bucket of water did no good. The boat was forced to surface.

In another operational incident described in detail, the conning tower hatch is not properly dogged shut by the nineteen year old quartermaster. Grover McLeod, a lookout, and now manning the bow planes, recalls the scene as the boat plunged to forty-two feet with a twenty-six inch hatch dogged open. With reflex action, the many drills paid off. The boat surfaced and lived to fight another day. If either of these two incidents had occurred while in contact with enemy forces, FINBACK would have joined the fifty-two submarines on eternal patrol.

In a sense, it is an "after battle critique" written forty-four years later. The book is, of course, a sailors story. It is non-technical and very readable. To the serious student of submarine warfare, certain fundamental truths stand out as weaknesses in what was a highly successful submarine campaign which provided the cutting edge in stopping the advance of the opposing naval forces and then strangling the sea supply routes to a vulnerable island fortress. On the verge of the high technology era, the U.S.

submarines suffered from inefficient weapons, lack of secure communications, underwater and surface, and technicians to maintain complex new surveillance systems.

It is possible that the eighteen year old seaman, and torpedo man, in 1942 and '43, perceived voids and weaknesses that took months and years to get up to higher echelons. The operational foul-ups, which happened to every submarine and usually glossed over or omitted in official patrol reports, give the book its honest and authentic flavor. Although some shipmates disagree with "Sam" McLeod on details, this book is a good sea story, in which all WW II submariners can relive their own experiences. Additionally, there may be lessons learned for the present generation.

Captain H. I. Mandel

THE MIKADO'S GUESTS
by A. Bancroft and R.G. Roberts, Print Image Pty. LTD., 31 Angove Street, North Perth, Western Australia.

On Australia Day, January 26, 1987, one of the authors, Arthur Bancroft gave a dinner party for U.S. submariners who were in Perth for the America's Cup races, plus other American submariners who had married Australian girls and retired to live in Perth. Specifically, Bancroft was honoring Jack Bennett, who was on the Queenfish which picked Bancroft out of the water five days after Bancroft's prison ship went down. Jack Bennett, Charlie Rush and Charlie Bishop can attest to the great bond of friendship which had been established with the Australian military people through U.S. submarine operations in the Western Pacific.

The book reviewed here is an account of two of these survivors from H.M.A.S. PERTH, which was sunk in February 1942. For the most part it deals with their prison camp tribulations but the dramatic end to their captivity needs to be retold to our submarine community -- for the importance of this special facet of submarine warfare. Thus the last several chapters are condensed here to give some flavor to how it all ended.

Enroute to Tokyo: "Further cholera tests were taken by Japanese doctors and the prisoners were prepared for the unpleasant journey. Previously we'd been told that there was little chance of getting to Tokyo, so the prisoners visualized the prospects of being sunk by American submarines.

"On September 6, 1944, after fond farewells to comrades staying behind, over 700 Australians were moved to the Singapore docks where they were joined by a party of 1300 Englishmen who would sail with us in the same convoy.

"The Australians plus 600 Englishmen were herded onto a Japanese transport, the "ROKUYO MARU" of 9,100 tons. With the help of rifle butts the men were crowded down below in No.2 hold, but it was found impossible to find anything but standing room. Two square feet were allowed for each man. The accommodation was meant for 187 steerage passengers and the Japanese were trying to cram 1300 into this space. The remainder of the English, about 700, boarded another ex-American transport. Our convoy consisted of two tankers, four transports and four destroyer escorts. Off the Philippines, the convoy was joined by more transports and two more escorts.

"At 2:30 a.m. on the morning of the 12th of September, an Allied submarine sank one of the escorts. (This was Ben Oakley's GROWLER which had earlier sunk a 900-ton frigate and then in a surface attack sank a Japanese destroyer with a down-the-throat shot. Admiral Ralph Christie called it "one of the most daring attacks on record.") For half an hour the convoy zig-zagged furiously and depth charges were dropped by the dozen. All men were herded down below but there was no panic among the prisoners.

"At 5:30 a.m. two tankers blew up within a few hundred yards -- off our port bow. The pitch black night was immediately turned into day. Our ship was silhouetted beautifully against the two burning tankers. Shortly there were screams from the bridge heralding the approach of torpedoes from the starboard side. One hit abaft of mid-ships and shook the ship from stem to stern. A minute later another explosion rocked the ROKUYO MARU. Luckily the second torpedo hit up in the bow and did very little damage. With our ship drifting toward the burning tankers and with flames all over the waters, the Japs left the ship taking all the life boats while the Australian officers ordered an orderly abandoning of the ship. (This attack was by Eli Reich's SEALION. He fired six torpedoes at a tanker and a big transport, the ROKUYO MARU, and hit both plus another transport which he saw go down. Looking through his periscope he saw "a large vessel burning well down in the water -- the ROKUYO MARU." SEALION withdrew from the area, unaware of the Allied prisoners who were taking to the water on make-shift rafts. The burning tanker sank, shortly.)

"The ROKUYO MARU took 12 hours to sink. Many of us attempted to return to the ship with no success. Two Jap escort vessels picked up Japanese survivors but kept the prisoners off with revolvers. Late in the evening a merchant ship hove-to on the horizon but was turned away by the destroyer escorts.

"After one day and night in water the men were very cheerful and hopeful, but many were ill from drinking salt water and the fuel oil from the sunken tanker was very uncomfortable and many were blinded by it. That night more ships were attacked and the transport with 750 Englishmen aboard was torpedoed -- no survivors. (This attack by Paul Summers' PAMPANITO produced hits in a large transport and a freighter which were seen to disappear beneath the sea. Another attack saw hits in a freighter which sank and damage inflicted on a fourth freighter "could not be observed because of the haze and smoke." Two days later PAMPANITO and SEALION observed the ROKUYO MARU still aflame but neither submarine considered it a worthy target since it was only a matter of time until it would also go to the bottom. The afternoon of the 15th PAMPANITO sighted men on a raft covered with oil and filth but some with black curly hair didn't look like Japs. Then we made out the words "pick up please" -- there were 15 men on the raft. PAMPANITO eventually found more rafts and more prisoners of war, until 73 men were taken aboard. Meanwhile SEALION was combing the ocean for survivors and rescued 54 men, but four later died on the way to Saipan. When PAMPANITO told of his rescue operation, Gene Fluckey in BARB and Elliot Loughlin in QUEENFISH were ordered at top speed to close the area to help recover any other survivors. But enroute, both submarines encountered another enemy convoy and Ed Swinburne, the pack commander, decided to take a crack at the convoy first. BARB put some torpedoes into a large tanker which blew up. Then a little later a 22,500 ton aircraft carrier was spotted and UNYO, an escort carrier, went to the bottom. Loughlin's QUEENFISH with its last four torpedoes damaged a large tanker. Then the two submarines hurried on to find survivors.)

"Late on the 15th we saw a submarine picking up survivors but she didn't see us. Our hearts sank very low as we heard her engines fading in the distance. At night we paired off on the rafts for warmth. The sun in the daytime was a curse and we wished for the cool of night. But at night it was vice versa, we wished for the sun. On the 17th by midday the waves were from 10 to 15 feet high. It was advisable to lash one's self to the rafts as the sea was continually breaking over the rafts. At about 1500 hours a submarine came directly to us, though the sea was tossing her about like a cork. Getting us off the raft and onto the submarine was a dangerous job for the crew as well as us. Quickly we were lowered down the forward escape hatch into the forward torpedo room and placed on mattresses and snow white blankets. After being used to the small Japs for two and a half years these fine husky American sailors were a sight for sore eyes. From then on until we left the submarine, nine days later -- in Saipan -- their kindness, sympathy and consideration left us with a debt we can never repay. After eating nothing but rice for two and a half years, civilized food was marvelous and the zest with which we tackled it amused the submarine's crew greatly.

"It was with regret that we said goodbye to the crew of the QUEENFISH for we had struck up everlasting friendships with these boys, most of them only 20 years of age but already well-seasoned in the horrors of war.

Later Bancroft and Roberts learned that there were only three other survivors from the cruiser PERTH -- "and one of them, Bob Collins, was a friend of ours."

This is another one of the accounts from World War II which are beginning to appear in considerable numbers and which offer the opportunity to tie some of one's own war experiences together. The America's Cup races did more than renew a yachting rivalry. It also proved a good excuse for many reunions with Australian friends, more than forty years after the war's end.

Charles Rush

We have had several people call the office or write to request information on how to purchase the book "Fresh Water Submarines - The Manitowoc Story", reviewed in the January edition of THE SUBMARINE REVIEW. The book, by Rear Admiral William T. Nelson, USN(Ret.) is available through the Manitowoc Maritime Museum, 809 South 8th Street, Manitowoc, WI 54220. Price $8.50. ($8.85 for Wisconsin residents.)

IN REMEMBRANCE

RADM JACK N. DARBY, USN

RADM F. WARREN KELLEY, USN(Ret.)

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SPEAKER PACKAGE

A new speaker package titled U.S. Fleet -- Submarine Navy has been distributed to the Naval Submarine League chapters for member use. It consists of a set of 35mm slides and a script which combined with ones own personal experience will be an interesting review of the submarine service. Also loan copies are available from NSL Headquarters. Call Pat Lewis at (703) 256-0891.

Dear members,

In addition to our regular 16 MM films and the BBC mini-series "SUBMARINE" on VHS tape, we now have available for loan to our members another VHS tape called "HELL AT FORTY FATHOMS." This tape includes "THE GROWLER STORY" and "SILENT SERVICE. They will be available through your local Chapters, as well as through the National Headquarters.

We are continuing to have a demand for the back issues of the SUBMARINE REVIEW, so I am once again offering this order form for those of you who want to complete your library.

Sincerely,

Pat

Pat Lewis

BACK ISSUE ORDER FORM

Many of our members have requested copies of earlier issues of THE SUBMARINE REVIEW. We have made arrangements with our publisher to reprint back issues, with a minimum run of 50 copies per issue. Unfortunately, the cost is high -- $10.00 per copy -- but these books are unique, and very much in demand. The first run of back issues has been delivered to our office, and a few are still available for purchase. If you are interested in completing your library with all issues of THE SUBMARINE REVIEW to date, please indicate the issues desired, and remit $10.00 for each copy.

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THE SUBMARINE REVIEW is a quarterly publication of the 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 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 $50.00 stipend will be paid for each major article published. Although this is not a large amount, it will help offset the authors cost for paper, pen and typing. Annually, three articles are selected for special recognition and an honorarium of up to $400.00 will be awarded to the authors.

Articles should be submitted to the Editor, W. J. Ruhe, 1310 MacBeth Street, McLean, VA 22102. Discussion of ideas for articles are encouraged, phone: (703) 356-3503, after office hours.

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.

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