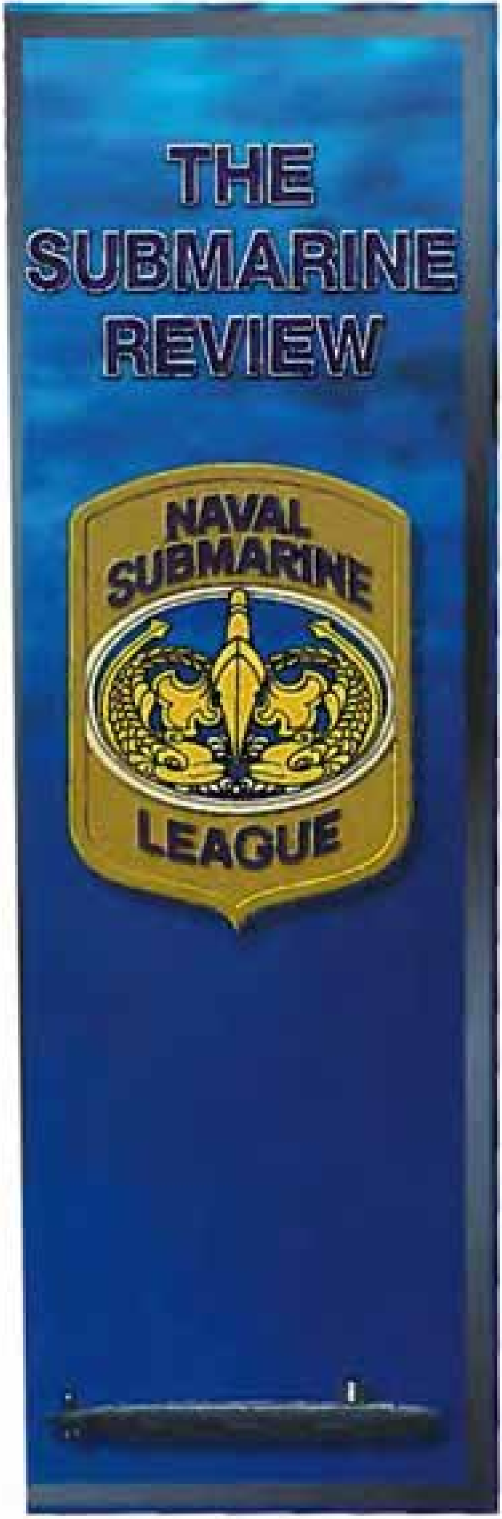

APRIL 2003

EDITOR'S COMMENTS

The submarine community lost another of our well-known veterans of the Pacific campaign of World War II this past December. Captain Edward L. Beach was also a highly effective submariner during the Cold War, both afloat and ashore, and both on active duty and while retired. He was one of the early nuclear skippers, commanding TRITON during construction and for her shakedown on the first submerged circumnavigation. He was also a prolific and successful author and an untiring advocate with the public for United States submarines. A memorial service was held for Captain Beach at the Naval Academy Chapel in January and this issue carries three of the eulogies at that service.

Our articles in this edition of the quarterly seem to span the spectrum of submarine interest from some WWII history of submarine operations to the history of submarine technology, and from a footnote to one of our Cold war disasters to an interview about the latest Russian submarine. The lead article is one of the most unusual to grace these pages in some time. Dr Anthony Wells offers a commentary on British generated special intelligence on the Japanese prior to Pearl Harbor and the use of that information by the United States. Dr Wells consulted with Captain Beach with respect to Beach's book Scapegoats about the Pearl Harbor attack and it is a coincidence of timing that his article appears in the same issue with the eulogies. Dr. Wells has dedicated his article to Ned Beach in recognition of his respect and appreciation.

As the technology for superconductivity gets closer to being a reality in future submarines it is appropriate that we all learn more it and about the potential impact it will have on submarine design and construction. Dr Norman Friedman's article provides such a commentary. In addition to all the revolutionary technology being developed for the evolution of modern submarines, there is an ongoing revolution in training aimed at keeping up with, and staying ahead of, advances in materiel. Captain Dave Marquet of ComSubPac's Tactical Readiness Evaluation Team has given us an in-depth look at the systematic approach to evaluating the effectiveness of advanced training currently being implemented. Following both those materiel and training aspects of modernizing submarine hulls and hardware Captain Jim Patton offers a view, extrapolated from recent experience, which ups the ante for operational requirements significantly. He is postulating an extension on the need for constant communications capability for submarines at depth and speed, which intimates great challenges for the entire community. It is his contention there is a real requirement for maintaining full comms with a deployed submarine during its approach to station and during its withdrawal from station, as well as while at patrol speed and depth between the to-and-from phases.

The other articles all offer information which add to the lure and lore of submarining. Captain Martin's account of the search for THRESHER and Dr. Beynon's tale of minefield penetration in WWII are both heady stuff. Dr. Sviatov's article describing an interview about the newest Russian submarine has the requisite aura of reality to go with the insight into current Russian thinking about their design objectives. Mr John Merrill's continuing series on the history of submarine sensor technology adds to what one reviewer has called "our ability to understand where we are, and have to go, by learning where we've come from".

Two items which should not be missed appear in THE SUBMARINE COMMUNITY section of this issue. The first are some words from RADM Gene Fluckey to the submariners of the Cold War and of today. This piece originally appeared in the Navy's magazine Undersea Warfare a few years ago and has reappeared on the CNO's web page. At any time, and for any group of submariners, it is always good to be reminded of who Admiral Fluckey is, what he did, and how he views successful submarining. In addition, there is a reprint piece about the dedication of the Submarine Cold War Memorial at Patriots' Point in Charleston. Having visited that site recently, I can whole-heartedly recommend it to all who had anything to do with building, sailing or supporting SSs, SSGs, SSNs and SSBNs during that half-century of confrontation.

Lastly, an important book is reviewed here as a valuable addition to our evaluation of submarine operations during WWII by the four major powers engaged. There are still lessons to be learned by those who will be setting the agenda for future operations. Having the views of an experienced observer from outside our own community can add great value to those lessons.

Jim Hay

FROM THE PRESIDENT

The Naval Submarine League completed another fiscal year on 31 March 2003. While the audit is not complete, I can report good news and bad news. The bad news is we had a fifth year of deficit operation. The good news is that we are confident that we have fixed the problem and this year the Board of Directors approved a budget with a surplus for 2004.

Last year we asked you for individual donations to support our current operations. I am pleased to report that we received over $18,000 in additional support that helped meet our operational and administrative support needs. We also initiated a program to allow our Corporate Benefactors to underwrite some expenses associated with our symposia. They have graciously underwritten several of the activities for our Corporate Benefactor Days and Annual Symposium. Several corporations donated goods and services to the League to significantly upgrade our information technology infrastructure including four new desktop computers, broadband Internet access to all of our workstations, and the capability to create DVDs to support our speakers and other exposition opportunities. The NSL moved into the 21st century with the help of our Corporate Benefactors!

These new capabilities are being used to improve our support to our members and chapters with better web page support and online registrations for the Submarine Technology Symposium and Annual Symposium. This month the NSL inaugurated the Online Membership Directory to make available current address and email information for our members.

The Corporate Benefactor Recognition Days held February 3-4, 2003 were a resounding success. The support of our active duty submarine flag officers and other guest speakers made this event noteworthy. Over 180 members of our submarine support community and individuals representing 45 corporations attended. The opportunity to interact with the active duty flag officers at a reception following Admiral Skip Bowman's remarks was one of the highlights of the event and provided a good return on the corporate investments in our League.

The Submarine Technology Symposium will be held at The Johns Hopkins Applied Physics Laboratory on May 13-15, 2003.

We have an exceptional slate of speakers including four of the Navy's 8 four-star officers, Admirals Vern Clark, Skip Bowman, Jim Ellis, and Ed Giambastiani. The entire Submarine Force Leadership will join with industry representatives. This year's theme, ***Submarine Operations and Missions: The Challenge for Technology...Sea Shield, Sea Basing, Sea Strike...FORCE Net***, focuses squarely on the CNO's Guidance for 2003 to win the war on terrorism, protect our nation, forces and people; and shape the force of the future. This classified event is limited to the first 500 attendees because of the size of the auditorium. Be sure to use the online registration early to secure your seat: www.jhuapl.edu/sts/.

Our final event for this year will be the Annual Symposium held again at the Hilton Alexandria at Mark Center in Alexandria, Virginia. This year the submarine leadership will focus on our readiness for the current operations and discuss the transformation of the SSGN submarine research programs and a report from the Commander Undersea Surveillance. We will recognize six outstanding officers and sailors and our Distinguished Civilian during our annual awards luncheon. A Distinguished Submariner will be honored at our banquet. I hope you will attend this event. Watch for the mailing of our registration package later this month.

Thanks for your support of the Naval Submarine League. Please recruit another member.

J. Guy Reynolds

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CAPTAIN EDWARD L. BEACH

EULOGY

by ADM F.L. Bowman, USN
Director, Naval Nuclear Propulsion
14 January 2003

Mrs. Beach, family, friends of Captain Ned Beach, fellow submariners, Sailors and friends of our great Navy:

I sing of arms and the man.

With this immortal opening line, the Roman poet Virgil begins his epic story of the founder of Rome, Aeneas the man on whom Rome's greatness and virtue were modeled. The man who, to this day, remains the ultimate warrior hero.

Today, in celebrating the life and works of Captain Edward Latimer Beach, Jr., we face the same challenge Virgil faced nearly 2,000 years ago: How to tell a warrior's tale in a manner worthy of the man and his achievements? How to capture the adventure and challenge? The battles won . . . and comrades lost? The terrors of the moment in combat? The loves of a lifetime, ashore and afloat?

We are luckier than Virgil, however; and our task is easier, if more poignant. For many of us knew Ned Beach personally. More of us knew of his adventures as a sailor. Best of all, Ned has often been the best teller of his own tale, through works of both fiction and history that will rank among the classics of naval literature.

It is through these tales that we get to see into the heart and soul of a Sailor of the *greatest generation*. A seasoned combat veteran who served ashore on the staff of the first Chairman of the Joint Chiefs of Staff, General Omar Bradley; who served as naval aide to President Dwight D. Eisenhower; and who, as such, was present at the creation of our modern world and contributed so much to ensure that *that* world was peaceful, prosperous, and just.

Commissioned two years before our entry into World War II, Ned Beach spent the entire war on the front patrol lines of the Pacific Submarine Force:

- From a plank-owner on the commissioning crew of the

TRIGGER,

- To service as XO under George Street in TIRANTE, where Captain Street's exploits as CO earned the Medal of Honor, Lieutenant Commander Beach's service as XO earned the Navy Cross, and the crew's heroics earned a well-deserved Presidential Unit Citation,
- To command of PIPER, whose imminent arrival (as Ned assured me on several occasions) caused the Japanese to give up in despair.

In his 12 war patrols, he served in every position from officer of the deck to commanding officer, always at the front lines of our Nation's Pacific War and always with a distinction and bravery that we can only marvel at today.

As our nation turned from victory in a war against an axis of evil unparalleled in the history of the world at that time, it soon found itself facing a new and insidious threat from its former Soviet ally. This Cold War of nuclear threat to the homeland and brushfire wars in distant lands taxed our endurance and our technology. We truly found ourselves mired in nuclear gridlock. In all of these areas, Ned Beach found himself on history's leading edge.

Handpicked by President Eisenhower to serve as his naval aide, then-Commander Beach gained a fascinating insight into national affairs at the highest level. He often described these years as the most exciting and rewarding of his career.

Mounted with the skill, cunning, daring, and planning typical of the wartime submariner he was, his campaign to have Mrs. Eisenhower sponsor our first nuclear submarine, NAUTILUS, was a diplomatic coup of the first order. (Nearly as spectacular was his success in training the First Lady in her sponsor's duties. Numerous training sessions with water-filled wine bottles resulted in a flawless christening.)

Having served ashore with distinction, he was again handpicked to command the largest nuclear submarine built to date: the unique two-reactor TRITON. In TRITON, on short notice and in nearly complete secrecy, Ned followed Magellan's path around the world submerged. Given our nuclear Submarine Force 50-year record of excellence and success, we can lose sight of what an epic achievement this was. But epic it was.

In an era when the sea floor was as unknown as the dark side of the moon, the navigational challenge alone was immense. The technical, the medical, and even the psychological unknowns combined to make the journey truly groundbreaking. As always, when the Navy called on Ned Beach, they made the right call. He brought TRITON around the world and back home again safe and sound, and provided the Soviets with more evidence of our military prowess to weigh in their ongoing Cold War calculus.

In all of these challenges and especially in his five command tours at sea, Ned Beach proved himself the exemplar not only of the *capable mariner* but also of the caring and devoted captain. His love for his Navy, whose lifeblood literally ran in his veins, and for the Sailors who served in her ships was deep and abiding. It governed all he did and served as the wellspring of the honor, courage, and commitment he displayed—years before those core values became our watchword.

I entered the Navy in the year Ned Beach retired. We never served together. Yet I consider myself extraordinarily fortunate to be counted as his friend in the twilight of his life. We shared a Sailor's love of the sea and the submariner's intense bond of loyalty and camaraderie.

During my days as Chief of Naval Personnel, I went to Ned for his thoughts and counsel several times. I always got unvarnished advice—and always what was best for the sailor. Ned and I were inducted the same night into a special fraternity: that of honorary master chief petty officers. We both were honored; we both were nearly overwhelmed. We both cried.

As I grew to know Ned Beach personally, the qualities that made him such an outstanding wartime submariner and Cold War commander also shone through in his friendships. The inherent integrity of the man—the wholeness of his commitment and the depth of his passion—are, to me, both his salient virtue and the quality that pervaded his personal as well as his professional life.

For me, the best example of this can be found in Ned's own words . . . in the dedication to his capstone book on the Navy and on his career, Salt and Steel. If I may read from that dedication:

> There is only one person to whom this story of my life could be dedicated: the lovely 18-year-old girl who became my

> partner during a hectic period of wartime leave, and has been that ever since, through the good times and the bad, sharing everything. She has been a fantastic Navy wife, supporting me in all my Navy duties, and everything else besides. We have had four children, and she's as beautiful as ever, inside and out.

There you have Ned Beach, the man in full. Ingrid, thank you for sharing Ned with us. Your gift has blessed us all.

In any memorial service, the imperative is to highlight the enduring contribution. If you seek a monument to Captain Ned Beach, simply look around:

- To Sailors he cared for, standing the watch, around the world, around the clock, trained to the standards he helped to champion.
- To an officer corps whose ideals he celebrates in novels and histories that tell us who we are, and more importantly, why we serve.
- To a nuclear Submarine Force of unparalleled accomplishment, operated with skill, daring, and efficiency.
- To a United States Navy unchallenged on the oceans, advancing freedom and justice around the world.

His monument is a living, breathing, vital institution—the United States Navy . . . the Shield of the Republic—into whose care he was born and into whose spiritual home he now returns.

Captain Edward Latimer Beach, Jr.: rest your oar. Your journey is safely home. We have the watch. Godspeed, my friend.■

NAVAL SUBMARINE LEAGUE

EULOGY

by Paul Stillwell
U.S. Naval Institute

A few years ago the U.S. Naval Institute left the headquarters building it had occupied since 1939, the year Ned Beach graduated from the Naval Academy. In its place we moved to a newly renovated wing of the old naval hospital. Jack Schiff of Cincinnati, a World War II naval officer, was the generous benefactor who facilitated the modernization of the building. And it was he who unselfishly requested that it be named Beach Hall in honor of two captains named Edward L. Beach, father and son, because they so well personified the mission of the Naval Institute. In their time, both were splendid warriors, and both were popular authors whose writings inspired legions of young Americans to join the naval service. The person who notified Ned Beach of the honor to be bestowed on him and his father was Admiral Chuck Larson, who was then superintendent of the academy and a member of the Naval Institute's board. When he later reported on his phone call, Admiral Larson said, "It's the only time I've ever known Ned to be speechless."

Indeed, communication was a hallmark of both Beaches. They were men of strongly held opinions, strongly expressed. They were eager to influence others to their way of thinking. The Naval Institute has published the memoirs of both men, and those books demonstrate how remarkably similar they were. It was as if a single spirit inhabited two bodies, two minds, two hearts. They were men of both physical courage and moral courage, willing to speak up to seniors when they felt the need, and eager to do battle against the enemies of their Navy and their nation. Ned Beach revered his father, read his books, heard his stories, and entered the Navy to emulate his example.

Ned and I became acquainted years ago when I reviewed one of his books and subsequently met him. Before too long, despite the fact that he was far senior, he said, "Call me Ned." and treated me as a friend. Do you remember his handshake? By its firmness, vigor, and duration, you felt a sense of the man's sincerity and how energetic he was. I recall a contemporary of his, Julian Burke, who was exec of the submarine DOGFISH when Ned commanded

AMBERJACK. He said Ned's boat was known as *Anglejack* because Beach brought it soaring up out of the water at such steep angles. Burke's skipper, Dave Bell, used DOGFISH to develop ideas for incorporation in the next generation of fast attack submarines, and he sent these suggestions in to the type commander, ComSubLant, one at a time. No response from New London. Finally, Bell went to SubLant to learn why DOGFISH had heard nothing. As Burke later explained, "Ned had had about 25 recommendations, which included everything that we had recommended plus about ten more, and he had beat us to the punch by about six months." Ned was indeed energetic.

It is one thing to be able to fight well; it is another to be able to write well. In addition to being a courageous warrior, Ned—like his father—was a gifted storyteller. He had the observational skills to pick up on the details that many of us see only in passing, the flair with words to describe those observations, and the imagination to make his characters come alive. We can read official reports of submarine patrols, bureaucratic battles, and the advance of technology over the years. Ned made those experiences so real that the reader was transported to the scene of the action. For reasons of security, submariners have long prided themselves on being the silent service. But that obscured their wartime deeds and the character and personality of these men who fought from beneath the sea. Ned pierced that veil of silence to tell legions of readers how it had been. Run Silent, Run Deep is justifiably considered one of the classic novels of World War II. His words put the reader on the bridge and in the control room of a World War II submarine charging in to torpedo an enemy. Ned himself was a charger, always moving forward—aggressive, sometimes impetuous, and remarkably persistent. How fortunate he was to have been married for nearly 60 years to Ingrid, a soul of graciousness and the perfect balance wheel for him.

What made Ned's books especially appealing—in addition to the realism—were the charm and humor that let readers know that he was all too human himself. He told readers, for example, about the time in 1938 when Orson Welles's famous radio drama led many people to believe the United States was under attack by Martians. Ned, the ranking midshipman, charged down to the main office in Bancroft Hall to seek action, only to be chagrined when he learned the attack was a figment of Welles's imagination. Of another event he wrote, "Once I capsized an academy sailboat during a Sunday afternoon sail with two classmates and three pretty girls; they were prettier yet when soaking wet." And there was the time he went charging through the halls of the old Main Navy building in Washington to reach Captain Hyman Rickover's office. Ned burst into a ladies' restroom by mistake, and—for one of the few times in his life—he retreated from a situation.

Ned's eagerness to right wrongs was demonstrated in his crusade on behalf of Captain Joe Rochefort, an intelligence officer whose deductions led to a crucial victory in the Battle of Midway but who was not suitably recognized for his achievement. Ned was even more involved in a campaign on behalf of Admiral Husband Kimmel and General Walter Short, whom he felt had been made scapegoats for the defeat at Pearl Harbor. These actions and many others demonstrated his great loyalty to the Navy and to the men with whom he had served. A wise destroyer sailor once observed, "Friends may come and go, but shipmates are forever." Ned is now again with hundreds of his shipmates from so many years ago. We can be confident that they are charging forward—and that Ned is leading them.■

NAVAL SUBMARINE LEAGUE

Books by Edward Latimer Beach, 1918-2002

Around the World Submerged: the Voyage of the Triton
(New York: Holt, Rinehart and Winston, 1962)

Cold is the Sea
(New York: Holt, Rinehart and Winston, 1978)

Dust on the Sea
(New York: Holt, Rinehart, and Winston, 1972)

Keepers of the Sea (photos by Fred J. Maroon)
(Annapolis: Naval Institute Press, 1983)

Naval Terms Dictionary, in collaboration with John V. Noel Jr. (third edition) (Annapolis: U. S. Naval Institute, 1971)

Naval Terms Dictionary, in collaboration with John V. Noel Jr. (fourth edition) (Annapolis: Naval Institute Press, 1978)

Naval Terms Dictionary, in collaboration with John V. Noel Jr. (fifth edition) (Annapolis: Naval Institute Press, 1988)

Run Silent, Run Deep
(New York: Holt, 1955)
This book was republished by the Naval Institute Press in 1986 as part of its series of Classics of Naval Literature.

Salt and Steel: Reflections of a Submariner
(Annapolis: Naval Institute Press, 1999)

Scapegoats: a Defense of Kimmel and Short at Pearl Harbor
(Annapolis: Naval Institute Press, 1995)

Submarine!
(New York: Holt, Rinehart and Winston, 1952)

The United States Navy: 200 Years
(New York: H. Holt, 1986)

The Wreck of the Memphis
(New York: Holt, Rinehart and Winston, 1966)
This book was republished by the Naval Institute Press in 1998 as part of its series of Classics of Naval Literature.

EULOGY

by CAPT James C. Hay USN (Ret.)
USNA January 14, 2003

Ingrid, Ned, Hugh and Ingie, I offer today a remembrance of your husband and father as I, and several hundred other U.S. sailors, saw him on a daily and continuing basis.

He was truly our *CAP'N.* No matter what rank an officer holds when he has command, which is the best job in the Navy, all his officers and men call him *CAP'N.* Ned Beach held that position while at several ranks and for a lot longer than most of us are privileged to do so. In that time he influenced a great number who went on to serve in uncounted ships, and many of us who got to be *CAP'N*s ourselves.

As the Commanding Officer of a commissioned ship there are special responsibilities and special authorities which go with that job. It is imperative that each one of us bring special talents, capabilities, and most importantly, meaningful at-sea experiences, with us when we walk aboard as *CAP'N.* I feel very fortunate to have earned a good share of my formative at-sea experience while sailing with Ned Beach.

Ned Beach was the quintessential U.S. Navy Commanding Officer; the kind of person who most rates being called *CAP'N* by all who serve the ship. But Ned was also a very special sort of Commanding Officer, he was, first and foremost, a Submarine Skipper, and one of the best, and most experienced, whoever took his ship out to **Run Silent and Run Deep**. He knew what that phrase meant in all its complexity.

All of us who served with Ned and went on to be Submarine Skippers can tell stories from which we learned our lessons. Maybe not right then, but certainly later. They were about unusual and vexing circumstances which arose and how Ned usually could come up with innovative and effective solutions which were, in turn, unusual. The point is, he knew the sea, he knew his ship, he knew his people, and most importantly, he knew what his mission was and the need to accomplish it. If I can sum up in one word that essential characteristic which underscored Ned's performance as a Submarine Skipper, I would say it is **tenacity**. And I can unreservedly recommend a clear focus on **tenacity** like Ned's as a prime requisite for all who would command US submarines on independent operations in dangerous waters.

All remembrances of sailors should contain at least one sea story and TRITON's Submerged Circumnavigation (on Shakedown) provided a lot of them. The one which probably best demonstrates Ned Beach's determination is about the day, while headed south near the Falkland Islands, when he had to face simultaneously three of those unusual and vexing circumstances which together seemed to be a mission stopper. Our fathometer suffered a fatal mishap during maintenance and we knew that soundings over most of the route we still had to travel were relatively sparse. We had some unexplained happenings in the engineering plant that had all of us searching for an answer, and on top of that the Doctor reported he had a patient with kidney stones which he could not treat onboard. All of that during one day.

Ned did what a *CAP'N* is supposed to do. He considered all the problems and their implications and all the options and then he took action. We slowed from transit speed and came to periscope depth to send a message. In his message he addressed the problem of the patient, having decided that both materiel situations could be handled. He suggested a rendezvous for a personnel transfer with a U.S. cruiser then in Montevideo. We then went deep, turned north and made flank speed to the point he had designated. We made that rendezvous, and conducted that transfer, just by planing up to decks-awash and locking out the *CAP'N* to the bridge and the Gunnery Officer, Chief of the Boat and four of the Deck Gang, with the patient, to the very wet main deck. All this was done in the dead of night and without public disclosure of our mission. All of that is in his book about the trip.

What has to be read between his published lines is that he could have done any one of several things, but he did take decisive, knowledgeable action that was unusual. In sending that message and in turning north he took a path which was bold, even presumptuous, and he knew it. It was not taken lightly, but it did indicate awareness of the greater world around him and it did protect his mission. That was **tenacity** in the face of adversity and personal risk.

Of course, there were other facets of Ned's practice of command in TRITON which showed all of us about the way it should be done. No one has figured out how to put those experience things in the instruction manual for prospective COs. One thing that impressed me was less dramatic than the tenacity example but just as important to being a good Submarine Skipper. That was Ned's skill as a ship handler. One can classify that as a physical, rather than an intellectual skill in that it is based on movement and timing. It's in the same category as torpedo shooting and as you might imagine Ned was very good at that also.

TRITON was much bigger than the submarines we were all used to driving at the time. To be known then as a competent submarine ship handler one had to be able moor at the Submarine Base in New London against a full current in the narrowest part of the Thames. One evening on returning from sea we found that our usual berth at State Pier was not available and we were sent up river to a brand new pier which was supposed to be ready for nuclear ships. There was a good current running but Ned showed us how to work the problem that night, using tugs and making a two or three bell landing. It was the mark of a real professional. And that was always Captain Ned Beach as a Submarine Skipper. Thanks for all the lessons, Ned.■

NAVAL SUBMARINE LEAGUE

ARTICLES

MISSING MAGICS MACHINE MATERIAL
New Insights on December 7, 1944
and Relevance for Today's Navy

by Dr. Anthony R. Wells

This article is dedicated to the memory of Captain Ned Beach, USN (Ret.), a great submariner, a great naval officer, a great American, and a great human being. *Tony Wells*

In the late 1960s the author was a Royal Navy Lieutenant working at one of the most sensitive UK facilities of the Cold War, Upper Lodge in Bushey Park near Teddington on the outskirts of London. Parallel to this work he was engaged on a special project in central London in conjunction with Professor Harry Hinsley (later Sir Harry Hinsley, President of St. John's College, Cambridge and Vice Chancellor of Cambridge University)[1]. Harry Hinsley was also the Chairman of the author's Ph.D. Board. As a young man Harry Hinsley was one of the lead people at Bletchley Park that cracked the Enigma Codes and managed the ULTRA source material during the Second World War.

Of special relevance is that Hinsley was sent to the United States during the war to negotiate and organize the transfer of ULTRA data and the U.S. MAGICS data from and to the UK respectively. This was the true beginning of what became known as the *Special Relationship*. Of absolutely critical note is that the British acquired a precious MAGICS machine from the U.S., long before Pearl Harbor. The prime objective from the United States' perspective was for the British at Bletchley Park to work on breaking the Japanese Naval Codes. The U.S. was successfully exploiting the Japanese Diplomatic Codes. The latter U.S. story is very well known and thoroughly documented in multiple reliable sources. However, of major importance is the fact that the British had listening posts in the Far East that could make Bletchley Park's use of the single MAGICS machine absolutely invaluable. The British could potentially fill the gaps in U.S. MAGICS data. These facts are not well known.

In his Naval Institute Press book, Scapegoats, about the attack on Pearl Harbor, Captain Edward L. Beach, USN(Ret.) makes a case for the public rehabilitation of Admiral Husband Kimmel's reputation, and restoration of his and the Kimmel family honor. The relevance of the British data from their single MAGICS machine material is critical for this reassessment.

What happened to the British MAGICS machine and the associated material? Bear in mind that at the time in the U.S. some within the *magic circle* objected to giving the British a precious MAGICS machine when it could have gone to either the Philippines for MacArthur's G2 Staff or, more important, to Admiral Kimmel's intelligence team at Pearl Harbor. What then did the Bletchley Park team produce in the critical year 1941, prior to the attack on Pearl Harbor? Of equal importance is the question, who received the data, particularly in the U.S.?

In the 1970s the British government invited Professor Hinsley to edit the official, *British Intelligence in the Second World War*. This was a wise choice. No one was better placed than Harry Hinsley. He was now one of the grand old men of British Intelligence. In the official history, which released huge amounts of Enigma derived ULTRA data, there is no mention of the British MAGICS machine and output regarding Pearl Harbor. There is only one significant reference to Pearl Harbor in Volume Two. On Page 75 Hinsley writes, "As for the Japanese attack, an analysis of the intelligence that was available about Japan's intentions after the middle of 1941 is beyond the scope of this volume". Hinsley cites the 1946 Congressional Enquiry and Roberta Wohlstetter's 1962 publication, *Pearl Harbor; Warning and Decision*. He cites British JIC (Joint Intelligence Committee) reports of June through September 1941, indicating a likely attack on, "Thailand via the Kra Isthmus so as to put her (Japan) in a position to attack Malaya should she decide to resort to force against Great Britain". (P.76, Volume Two, published 1981 by Her Majesty's Stationery Office). Hinsley makes one critical statement on page 76: "In the British archives there is no intelligence of any importance that was not available to the Americans, who, indeed, had much that was not available in Whitehall, and the British appreciations do not call for any departure from the above conclusions". The latter conclusions refer to Wohlstetter's 1962 conclusions in her book. On 18

November the British JIC issued another warning that augured an attack on Thailand (page 77). Hinsley concludes by stating, " And in a paper issued on 28 November (1941) the JIC implicitly excluded the prospect of direct Japanese attack on US possessions: it calculated that if Japan broke off the negotiations she would move against Thailand very early in 1942 in order to be ready for an attack on Malaya in the favorable spring weather" (he cites JIC (41) 449 of 28 November 1941). Finally Hinsley writes, "Except for a paper on December 5 which canvassed the advantages and disadvantages of Russia's participation in a war with Japan, there was no further JIC appreciation of the situation in the Far East before the Japanese attack" (he cites JIC(41) 460 (0) of December 5, 1941).

Twenty years later after the publication of Volume Two these words are most significant. There is no reference to the British MAGICS machine and its material. This is the missing MAGICS machine material. The Official British History does not refer to material that was published in the U.S. in the famous Clausen Report. Clausen was a JAG officer specially selected and commissioned by Secretary of War Stimson to conduct a full enquiry into the Pearl Harbor tragedy. Stimson initiated this because of the well-known belief that several key people had perjured themselves in Congressional evidence. Stimson wanted a reliable report and he trusted Clausen implicitly. Stimson was a Democrat and, although Clausen had very well known and declared Republican affiliations, he was nonetheless trusted completely by Stimson because of his well-established integrity and brilliant legal skills as a prosecuting advocate in civilian life.

What Clausen revealed was that the British Secret Intelligence Service (SIS) in South East Asia was collecting invaluable HUMINT (human intelligence collected by agents) that was passed to a secret British intelligence cell in Honolulu that was working with the U.S. On December 3, 1941 the SIS in Manila sent urgent dispatches to Hawaii, included was the statement, "Our considered opinion concludes that Japan envisages early hostilities with Britain and the U.S. Japan does not repeat not intend to attack Russia at present but will act in South.......You may inform Chiefs of American and Naval Intelligence Honolulu". This information was passed to senior Army and Naval Intelligence officers on Oahu and also to FBI agent Shivers. (Pearl Harbor. Final Judgment. Henry C. Clausen and Bruce Lee, 1992. Page 113. See also Bruce Lee's Preface to the latest edition, February, 2001.) December 3 was a key day for another reason. It was the day that Admiral Kimmel was informed that the Japanese had ordered their *Purple* (MAGICS) machine and the codes destroyed in the Washington embassy (Clausen and Lee, page 261). The British agent in Honolulu destroyed key evidence after December 7, 1941 (Clausen and Lee, page 115). After the war there was much criticism that the British SIS had paid too much attention to protecting British commercial interests and not concentrating enough on the military situation (Clausen and Lee, page 116). These criticisms were probably unfounded because the SIS in Honolulu was passing on all key British HUMINT to the U.S. via their cover organization in Honolulu, a trading company (Clausen and Lee, page 119).

The British HUMINT could not compare with the pure gold from the MAGICS, and the British had the critical machine at Bletchley Park, the machine that Admiral Turner, the head of the War Plans Division in the Office of the Chief of Naval Operations, had traded with the British for one of their ENIGMA machines (Clause and Lee, page 122). Captain Beach's book, which is a revisionist assessment, has put the whole Pearl Harbor investigation back in the dock. However, as now indicated, absolutely critical material is missing that will shift the balance of his and others interpretations. We need to make a diversion, and return to this issue.

The British have an Official Secrets Act, and rules regarding the release of official classified information. The Official Secrets Act is transgressed at the offender's peril. It has been extremely effective. The author is a Naturalized U.S. citizen. He may be the only person who can claim to have served with both the Royal Navy and the U.S. Navy, and also worked for both the British and U.S. intelligence communities. The author believes that he has a unique perspective. There is one critical aspect of Captain Beach's thesis that needs to be explored and augmented. The British do not release all their official classified information, even after 50 years. World War II concluded 57 years ago. The British have released sensitive material after 50 years, that is material that has never appeared in any official history. For example, the British released their assessment and plan to assassinate Hitler well after fifty years. The issue centered not on any moral concerns about killing Hitler (the British were not peevish about killing the perpetrator of genocide), but more for very well thought through reasons of hard core pragmatic political expediency. Planning against the megalomaniac Hitler was more manageable than potentially dealing with the highly competent upper echelons of the extreme right of the Wehrmacht. The latter might well have organized a much more effective resistance strategy to the Allied invasion and the march on Germany than Hitler. This example reflects a political rather than a security dimension for why material may not be released, even fifty years later.

Other sensitive material may yet be released. One Canadian reviewer, John Ferris, of British Intelligence in the Second World War, made very telling comments in the April, 1993, Canadian Journal of History, "Most of the documents used in these volumes were freed before the series was complete; the remainder have been sentenced to end their natural days in the dungeons of Whitehall", and, "And even more striking than the pattern of what has been written is the nature of what has not. If Her Majesty's Government does have any secrets, the official history has not betrayed them."

This leads to a pivotal question. Where is the missing material from the British MAGICS machine from Bletchley Park? Where is the material that may relate most specifically to the final weeks and days as the Japanese carrier battle group prepared to depart, via its initial circuitous route, for Pearl Harbor and denouement on December 7, 1941? At this point we have no choice but to speculate.

If the MAGICS machine at Bletchley Park produced high grade Japanese Naval intercepts what would have happened to them? Because of the enormous sensitivity only a very limited few people would have seen the data. It is unlikely that this data would have been a subject on the agenda of the British JIC. The data would have been that sensitive. There can be little doubt that Prime Minister Churchill would have decided personally on the fate of such data, just as he did the Coventry Enigma data.

The correspondence between Winston Churchill and Franklin Roosevelt has been published. However, what has not been published, and never will, is the content of Churchill's and FDR's very private and secure calls on their personal one-to-one transatlantic telephone link. This link ran from Mr. Churchill's private room (his red phone) in his underground war bunker in Whitehall via a special switching facility in the basement of an Oxford Street store, Selfridges, to the undersea cable that went eventually to the President's private secure room in the White House. Those secure, encrypted transatlantic calls between these two great men, will remain lost forever. If only we could listen to them now? Let us go one stage further in our speculation.

There seem to be three reasonable options. First, there is no British MAGICS material. This seems most unlikely, perhaps even preposterous. The acquisition by the British of the MAGICS machine was worth more than the Crown Jewels. Second, there was material, and Mr. Churchill decided not to share this with FDR, and have the material thoroughly *buried*. This is highly unlikely. He would have been most keen to secure his half of the bargain with FDR—ENIGMA material for MAGICS material. Winston Churchill was anxious to see the U.S. enter the war while FDR was shaping U.S. public opinion that there was no likely alternative to war. Churchill knew that passing material to the U.S. would not change the United States position to enter the war once Japanese belligerent intentions were made manifest. Withholding British data from FDR of MAGICS derived data makes no sense. Third, what if Bletchley Park gave Mr. Churchill and a very small, select few in Whitehall (the Foreign Secretary and the military leadership) the unvarnished, clear and unequivocal data that the Japanese were planning on attacking the United States Pacific Fleet at 0800 Hawaii time on Sunday, December 7, 1941? This data would be derived from British intercepts and decryptions of the Japanese Naval codes from key British stations. What would Winston Churchill have done? He would undoubtedly have called President Roosevelt on his secure private line. What would the President have done? Most likely he would have done what Mr. Churchill did when the Luftwaffe took off to destroy Coventry. Would calling Admiral Kimmel have been a good idea..........? "Admiral, this is the President, I have absolutely totally reliable information that the Japanese will execute a surprise attack on the Pacific Fleet at Pearl Harbor at 0800 your time Sunday, December 7th . I instruct you to immediately........" Probably not?

It is likely therefore that the story, even in 2003, is not complete. Captain Beach may yet be right in his central thesis, though for reasons that he had neither anticipated nor about which he could have been aware when he researched his book.

There is one remaining piece of critical evidence that must be considered. The Japanese Navy's operational cipher was named JN-25-B. Within this cipher lay the keys to the attack on Pearl Harbor. However, the tragedy is that the United States prior to Pearl Harbor read no Japanese operational messages from JN-25-B. It still remains unresolved as to who prevented work being done on JN-25-B, the key to everything. It is most unlikely that the order to concentrate on the Japanese Diplomatic Codes rather than JN-25-B, or some combination, came from within the Navy. After Pearl Harbor the Navy worked on JN-25-B in earnest. The success at Midway in June 1942 was the first major result. When the war ended the JN-25-B intercepts for the three months prior to Pearl Harbor were decrypted. One reliable author has stated that, "25,581 naval messages were harvested, of which 2,413 were considered of sufficient interest for translation. And of that number 188 were discovered to contain clues to the Pearl Harbor attack plan." (Michael Gannon, Pearl Harbor Betrayed, Henry Holt, 2001, P.207). Professor Gannon has made the extremely telling point that the evidence of the post war decryptions was not presented to the Joint Congressional Committee that investigated Pearl Harbor. Professor Gannon makes this significant comment, "The cover-up prevented the JCC and the general public from knowing that, prior to Pearl Harbor, the Navy was in possession of intercepts, that if decrypted, would likely have warned the country of Japan's impending attack". (Gannon, P. 209).

One further point should be added to Professor Gannon's analysis and conclusions. JN-25-B was the very code that the British at Bletchley Park, via their stations in the Far East, would be collecting. The MAGICS machine at Bletchley that Sir Harry Hinsley had negotiated for with the U.S. was the means of decryption. The postwar U.S. decryptions reveal a small window into what the British were decrypting in enormous detail. Option one discussed above does appear therefore to have little merit, and the door is now wide open to speculate legitimately and reliably on what happened to the British pre-Pearl Harbor decryptions using their single MAGICS machine.

Let us now return to the present. Technology will permit the U.S. Navy and our forces in general, to both shape the battlespace and execute time critical strikes against all manner of targets. Whether at the Unified Command, Joint Task Force Commander, or tactical levels, we will have information that the National leadership may also possess. In fact the warfighter will have the benefit of tactical data, in addition to National and Theater data. We will all be looking at the same data. In fact the warfighter may have more complete data in the future. The United States military has learned hard lessons about remote controllers in Washington attempting to fight a front-line war. No one wants a *MacArthur syndrome* repeated. Similarly, no one wants a *MacNamara syndrome* either—The SecDef whiz kid from the Ford Motor Company, the ultimate analyst, who truly did not know the realities of a front-line war in Vietnam. The point is that we will have to work out how to use the new technology and information flow so that political control is always present but, and this is a huge but, the tactical warfighter and his/her higher echelon command authority cannot be constrained when U.S. lives are on the line in time critical events. Technology will permit shaping and planning at the Unified Command and Theater levels, but when it comes down to the *moment juste*, when the warfighter has to engage, or maybe perish, he or she must be given unambiguous and unequivocal Rules of Engagement (ROE). The actual final engagement must remain with the warfighter. Similarly, at the higher level, no Unified Commander-in-Chief or JTF Commander can be constrained in time critical planning events by a possibly wavering, slow and ponderous response from Washington. The latter must always be, ultimately, in charge, but they must never hamstring the warfighter.

Today we are able to give the warfighter data in real time. Admiral Husband Kimmel's heirs and successors at Pearl Harbor are not in the blind. However, they will need full, direct and clear National leadership direction if the new information technologies that underpin our planned C4ISRT architecture are to be exploited fully. The case has been made for letting the Fleet work out the issues and TTPs (tactics, techniques and procedures) and working the command and control issues up the chain of command to the

National leadership.

Admiral Husband Kimmel was effectively placed in the dock, though not formally court martialled, found guilty by default and not due process, reduced to his substantive rank (Rear Admiral), dismissed from his command, and summarily retired. Captain Beach has come to his defense. There is no question that Admiral Turner on the CNO's staff, and the CNO himself, Admiral Stark, were culpable in December 1941. They were both lucky men. Stark went off to a comfortable job in London, buried from the limelight in Washington and the controversy while the new CNO, Admiral King, tried to re-build the Navy and Admiral Nimitz breathed new life into a shaken Pacific Command. Captain Beach's book demands both Stark's and Turner's moral impeachment. Captain Beach did not record in his book the key fact that the Clausen Enquiry and Report to Secretary of War Stimson fully validated Beach's conclusions over 50 years ago (see Clausen and Lee, Final Judgment, pages 286-311). Clausen published all his evidentiary exhibits. However, what is missing is the crucial intercept material from the British MAGICS machine at Bletchley Park.

As a result, the very last chapter regarding Pearl Harbor has yet to be written. Maybe some day, even after the generation that was born during War World II has passed on, the British will release the material. Whatever that data may eventually reveal the author believes, without any doubt whatsoever, that Winston Churchill and Franklin Roosevelt remain the two great bulwarks of the Twentieth Century. They are on a pedestal together, beyond all others, the two men who saved civilization as we know it from an abyss into which it would have sunk under Nazi and Japanese domination.

Pearl Harbor holds critical lessons for the present because of the enormous information that technology can now provide in a secure environment. Above all, we need to examine and resolve the National leadership and C2 related issues and procedures. However, one thing will not change—as at Pearl Harbor, the ultimate and final responsibility must always rest with one person and one person alone, our Commander-in-Chief, the President of the United States.

Whether the honor of Admiral Husband Kimmel and his family should be restored is not the intent of this article. However, the author will conclude with one firmly held personal belief, that Franklin Roosevelt and Winston Churchill would want Admiral Kimmel's honor and reputation publicly restored by none other than the President of the United States.■

ENDNOTE

1. Sir Francis Harry Hinsley, 1918-1998. St. John's College, Cambridge, 1937-1939, MA 1946; British Foreign Office, war service, 1939-1946. Fellow of St. John's College, Cambridge; Cambridge professor (1969); Fellow of the British Academy (1981); Knighted by Queen Elizabeth II (1985); he retired from academic life in 1989.

ELECTRIC DRIVE AND SUPERCONDUCTIVITY

by Dr. Norman Friedman

Dr. Friedman is a longtime U.S. Naval Institute author and Proceedings columnist. He has written on a wide variety of military and maritime subjects. This article was originally prepared in 2000 under a contractual arrangement with American Superconductor, and he has updated it prior to publication at the request of the company.

The recent announcement of the DD(X) award brings the Navy another step closer to a return to what used to be seen as the inevitable future of American warships–electric drive propulsion. What is new is the possibility that more advanced technology, perhaps incorporating superconductivity, will solve the problems of the past, so that we can fully realize the advantages which have long been associated with electric drive.

There are several. The one usually associated with electric drive as part of an Integrated Propulsion System (IPS) is better survivability. Because no long shaft need connect motor to prime mover, the ship is likely to survive shock far better. Too, there is no propeller shaft to occupy the valuable space abaft the power plant. For that matter, the power plant can be located where it can best survive damage, rather than in a place dictated by the position of the propellers. None of this is new. Before World War I, the U.S. Bureau of Engineering developed turbo-electric power plants for capital ships. The turbo-generators were placed on the ship's centerline, the least vulnerable location, surrounded by boilers and then by layered torpedo protection. This type of machinery was installed on board five battleships and the carriers LEXINGTON and SARATOGA. The Bureau rightly considered electric propulsion its greatest triumph, and the U.S. Navy wanted to use it in the new battleships designed in the 1930s. Unfortunately, turbo-electric plants weighed considerably more than conventional geared ones, and the new battleships were designed under naval arms treaties which specifically limited the size of new capital ships. Every ton added for propulsion would have been subtracted from armament and armor.

In the case of the DD(X), there is further interest in integrating the prime mover with the ship's auxiliary power system. Generators for the integrated system can be distributed around the ship, so that no single hit can disable her. Integrated drive has the additional virtue that it can provide the pulses of power which future weapons, such as laser and rail guns, may need, as they need it. However, to realize that sort of advantage the ship's propelling motors must be able to accept sudden changes in power, as power is siphoned off for other purposes. This is known as transient stability.

A further advantage of an all-electric ship is controllability. If every shipboard power function is controlled by the same system, then the ship can be integrated much more effectively. For example, it may be very advantageous to unify the ship's combat and propulsion systems. As an enemy missile approaches, for example, the appropriate response is a combination of hard- and soft-kill systems and evasive maneuvers. One control system would be able to apply both, if all shipboard systems were electrical (currently, many systems are hydraulic and thus are separately controlled). Note that a distributed and unified power plant virtually implies the transition to all-electric control. The logic of the usual hydraulic shipboard power system is that power can easily be distributed by a pump in the centralized machinery space. Without such centralization, hydraulic power becomes a major dead weight in a ship.

The combination of full integration and distribution of generators requires the most compact possible generators. At least some generators will necessarily be located fairly high in a ship (to resist underwater damage). The less they weigh, the less they will affect the ship's stability.

Another virtue of electric drive was that the prime mover could be decoupled from the propeller. For example, diesel engines operate most efficiently at an optimum speed, and indeed they have resonant speeds at which they break down. Having triumphed with battleship electric drive, in the 1930s the Bureau of Engineering applied the same idea to U.S. submarines. One result was that much lighter diesels, running far faster than propellers, could be used. Another was that, for the first time, submarines did not have to avoid running at speeds equivalent to resonant diesel speeds.

This kind of diesel-electric propulsion was then unique to the U.S. Navy. It is now virtually universal for non-nuclear submarines. One advantage, realized only postwar, is that the submarine becomes much quieter, since the propellers no longer carry the noise generated by the diesel out into the water. Another is that even though the best submarine design employs only a single large propeller, the submarine can still use multiple diesels to run it, via their generators and propulsion motor. The submarine can continue to operate even if one of her diesels cannot run. By analogy, an electrically-powered surface ship might connect multiple prime movers to the same set of propellers, and run all of them on any number or combination of prime movers. Some navies currently use this sort of arrangement to run two propellers on a single gas turbine.

Adopting electric drive in a submarine would have implications beyond better silencing of the main propulsion. As in a surface ship, the after part of the submarine could be rearranged, possibly to the submarine's hydrodynamic advantage. Because the ship's power output would be entirely electrical, there would be an incentive to rethink the ship along electric lines. For example, at present the pumps used in torpedo tubes are a source of noise. For some years NAVSEA has been working on electromagnetic catapults as an alternative. Given sufficient electric power, they would become a useful alternative to the current water pulse tubes. Such electromagnetic launchers might make supercavitating and supersonic underwater projectiles (on which NUWC has been working) much more practical. Such a development would parallel the long-standing surface community interest in electric power as a prerequisite for a variety of electric weapons, such as rail guns. Too, the controls of an all-electric submarine might be easier to control electronically, and they might be more responsive. That in turn might be very important as a way of gaining maneuverability, for example to evade an incoming torpedo.

During World War II, the United States was badly short of gear-cutting capacity. Normally gearing is used to reduce the speed of a fast prime mover, such as a turbine, to the point where it can efficiently drive a propeller. It is often possible to build a slower turbine, but such a machine will be far larger and far less efficient than a fast one. Electric drive can have much the same effect as gearing. During the war, many U.S. auxiliaries, and also many destroyer escorts (frigates) had various forms of electric drive.

Electric motors are, moreover, inherently quiet. There are no gear teeth meshing into each other to make recognizable sounds. When the U.S. Navy decided, in 1955, that it wanted to build fast but very quiet nuclear submarines, the obvious solution was to replace the existing mechanically driven geared drives with turbo-electric drive.

With all of these advantages, it is surely a distinct surprise that electric drive has not taken over the naval world. It pops up here and there—recently, for example, as a component of the machinery in the British Type 23 frigate—but it is hardly the dominant force that might have been imagined in, say, 1920.

The main reason why is that the combination of generator (for the prime mover) and motor can be massive. During World War II, when many destroyer escorts were given turbo-electric power plants, the price was 26 feet more length. As it happens, a longer hull encounters less hydrodynamic resistance, so the added resistance due to the added displacement (due to the weight of the power plant) was balanced off by the added length. Even so, designers generally felt that they would prefer to use added length and space for other purposes.

As for nuclear submarines, initially the project stalled because no existing motor could produce enough power. Instead, gearing and other noise-making elements of the power plants were sound-isolated on rafts. Over forty years later, sound isolation is still the main means of silencing nuclear submarine power plants, and it is still quite expensive. One of the main advances made between the Seawolf and Virginia classes is a better and less expensive means of sound isolation, but the technique is still much less than ideal. As a veteran of earlier Bureau of Engineering electric propulsion triumphs, Admiral Hyman Rickover pressed hard for electric submarine propulsion. He managed to have a prototype, GLENARD P. LIPSCOMB, built, but the technology proved less than successful. The submarine was too large and her machinery was too unreliable. Yet Rickover's reasoning is still valid, to the point that the French adopted turbo-electric machinery for their nuclear attack submarines (the Soviet Alfa class [Project 705] appears to have been similarly powered). The main difference between the

French and Soviet submarines and their unhappy U.S. counterpart was that they used much more efficient AC power. The U.S. submarine used DC because a DC motor has an inherent ability to reverse (if the polarity of the current reverses), an ability which may be extremely valuable in an emergency or during rapid maneuvering situations. The simplest way to make a reversing AC power plant would be to combine a pair of windings (one for each direction), but with conventional motor design that would be unacceptably massive. The alternative, using controllable pitch propellers, adds additional complexity and weight.

The great barrier to electric propulsion, then, is that electric motors and generators based on today's technologies are large and heavy. For electric power to be really widely used in future warships, it must become more compact. Is that possible? In 1911 a new electrical phenomenon, superconductivity, was discovered. At very low temperatures, in some materials, it was found that electricity suddenly flowed without encountering any resistance.

Electric motors or generators based on superconductivity could be dramatically shrunk. Unfortunately, for years superconductivity was essentially a laboratory stunt. It worked only very close to the absolute zero of temperature. Indeed, much of the effort of superconductivity experimenters went into building complex and expensive cooling systems which could reach the requisite ultra low temperature (in the range of 0 to 5 degrees Kelvin – or 0 to 5 degrees above absolute zero). Physicists spent their time trying to understand why superconductivity occurred. There seemed to be little chance that it would have any very practical applications. Even so, the promise of low temperature superconductivity was such that in 1980 the Navy installed a 400 HP low temperature superconducting motor on a research craft, following it up with a 3000 HP motor in 1983. To operate, the motors had to be bathed in liquid helium at 4.2 degrees Kelvin.

In the 1980s, however, experimenters discovered that some ceramic materials could become superconducting at much higher temperatures. These were nothing like room temperature—the room temperature superconductor is still a kind of holy grail, probably unreachable—but they were within the range which quite conventional and relatively low cost refrigeration equipment could reach. Suddenly very small, inexpensive, and essentially loss-less motors could be built. Moreover, higher-temperature superconductivity emerged at about the same time that the Navy began to turn back towards electric propulsion for all the reasons which had made it attractive in the past. American Superconductor Corporation of Westborough, Massachusetts recently completed an $80 million HTS wire manufacturing plant in Devens, Massachusetts that will allow its wire manufacturing capability to grow from the present 500 Km per year to 20,000 Km per year. In 1999, the Office of Naval Research (ONR) awarded the company an initial $1.5 million contract to design a 33,000 SHP motor using a conventional AC stator and a superconducting DC rotor. In February 2002, ONR awarded an $8 million dollar contract to build and deliver a 5 MW, 230 RPM marine motor to the Navy in July 2003. Superconducting technology makes for a very compact and extremely power-dense machine. The combination, then, overcomes past problems in applying electric propulsion to, for example, nuclear submarines.

The superconducting motor is, moreover, substantially quieter than a conventional electric motor. A conventional electric motor develops a high concentration of magnetic flux, which is concentrated in iron teeth, and hence is not perfectly uniform around the motor and thus causes vibration and therefore noise. Superconducting motors can be designed as *air-core* machines without iron teeth, hence drastically reducing the concentration of flux normally associated with the high currents in motors. The magnetic field can be made far more uniform, so operation is inherently quieter. Too, in the past sheer motor size has generally been associated with motor speed: the slower the speed, the more massive the motor. Propellers are most efficient (and, incidentally, quietest) when they turn slowly. Thus designers could choose between relatively lightweight motors coupled to propellers by inherently noisy gearing, or large and very heavy direct-drive motors. Because a superconducting motor can develop high power at low speed within much more compact dimensions (it is typically a third the size of an equivalently-rated conventional motor), it should resolve this dilemma.

American Superconductor offers a wire (ceramic filaments in a silver alloy matrix) which reaches superconductivity at approximately 110 deg K. Although this is hardly what a layman might consider high temperature, it is well within the range reached by cooling systems already used in, for example, medical magnetic resonance imaging (MRI) systems—that is, in normal industrial practice.

From the Navy's point of view, perhaps the most important aspect of the new high-temperature superconductivity technology is that it has numerous commercial applications. The Defense Department is no longer so wealthy that it can afford to develop as many special technologies as it likes. It is far better to put some seed money into a technology which is likely to take off in the commercial sector, after which defense can reap some of the dividends. This is hardly a new idea. For example, in the 1930s the Navy badly wanted a new high-speed submarine diesel, but it was building so few new submarines annually that no company was likely to develop such an engine. More to the point, even if a satisfactory engine was developed, no company would invest enough to bring it to the degree of reliability the Navy needed.

The then Bureau of Engineering well understood the problem. Fortunately, in that Depression time General Motors was interested in a new potential market, diesel railroad engines. The Navy realized that the engine it wanted would also be suitable for a railroad engine. If it paid for a prototype, GM would market the engine to the railroads. Within a few years, as some bought it, GM would find itself paying for developing the sort of reliability the Navy needed, even if the Navy bought only a few engines. The idea paid off; the resulting World War II submarine engines performed brilliantly (another manufacturer, Fairbanks-Morse, developed a competing engine for the Navy and then marketed it to the railroads, too).

Conversely, when defense spending is down, it is difficult to get anyone to invest in specifically military technology. The Navy learned as much after World War II, when it tried to develop closed-cycle submarine engines, which had no obvious commercial application. At a 1948 Submarine Officers' Conference, those running the various closed-cycle programs all complained that the companies were reluctant. They preferred to put their better engineers into programs for commercial products, which had much higher payoffs. Then one officer suggested the only submarine propulsion system which did have a major civilian application. He was Captain Hyman Rickover, who was running the nuclear program at a time when civilian nuclear power seemed to be both close and extremely attractive. Reading the minutes of the meeting, one can almost hear the officers cheering.

High-temperature superconductivity seems to have very important civilian applications, because it can replace many existing electrical devices (including transmission cables) and drastically improve their efficiency. That is likely to be very attractive if energy prices continue to rise. Since July 2000, Wisconsin Public Service Corp has operated six superconducting magnetic energy storage (SMES) units built by American Superconductor in its 200 mile Northern Transmission Loop. Detroit Edison is installing superconducting cable in one of its inner city substations, to carry three times the power of their conventional predecessors. Again, they are using American Superconductor's new wire. In 2001, the company successfully completed the testing of the world's first 5000 HP, 1800 RPM commercial scale HTS motor. In effect, American Superconductor is where GM's diesel division was about 1932, on the eve of its very successful railway dieselization program. Once again, the Navy may be poised to jump aboard a commercially attractive technology, gaining large benefits from a very limited initial investment. Conversely, that investment may help develop technology the country at large will find very useful as we enter into the 21st century.■

NAVAL SUBMARINE LEAGUE

TRANSFORMING TACTICAL TRAINING

by CAPT David Marquet, USN
Senior Member
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A significant shift is occurring in the process the Submarine Force uses for tactical training. This shift was marked by decisions by both Submarine Force Type Commanders to quantitatively measure mission performance against defined standards. Although initiated through the Tactical Readiness Evaluation (TRE) process, it promises to have a profound impact not only on all aspects of submarine training but on the process for technology acquisition and determination of readiness metrics as well. The pervasiveness and significance of these impacts warrant labeling this process shift transformational.

Although developed independently, this new process is not only fully consistent with the Navy's recently announced Revolution in Training, but is a necessary step toward fulfilling the revolution.[1]

Limitations of Previous Methods

The previous methodology used for evaluation consisted of two phases. The first phase involved monitoring an event, observing the behavior and actions of the crew, and recording the environment in which they were acting. This process typically included evaluators with steno pads writing down orders given, reports made, and actions taken. Additionally, data such as distances to contacts, status of equipment, time of message receipt were recorded. Logs and records served to complete the picture.

The second phase consisted of comparing the actions taken by the crew to the prescribed procedures. For example, in piloting, if sounding data were not reported to the bridge as specified, this was noted as a deficiency. The deficiencies were then considered and a grade determined.

The primary limitation to this method is that instead of focusing on the ends—keeping the ship in the center of the channel, or putting the fire out, crews trained on the means—executing the procedures that have been designed to accomplish those ends. This diluted effort from the *main thing*. Additionally, since the focus was on following the steps of the procedure, innovative and creative methods of accomplishing the objectives were not encouraged.

A subtler disadvantage derived from the process of determining the grade based upon the relative number and significance of deficiencies. As opposed to standards-based grading, this practice pitted ships against each other.

Finally, this process was poorly suited to identify overall force weaknesses or contribute to decisions about the value of particular training or the acquisition of new technology.

A Better Way: The New Process (5-step)

The new process strives to quantitatively measure mission accomplishment against defined standards. Mechanically, this is accomplished by the development of attribute sheets that populate a database when completed. These attribute sheets have been published for the Force to use.

The 5-step process for quantitatively measuring mission accomplishment is as follows:

1. List the attributes and identify the critical attributes
2. Define the standard
3. Measure performance
4. Analyze the data
5. Determine the appropriate response

1. List the attributes and identify the critical attributes. The 5-step process begins with listing all the attributes for a particular mission or event, and identifying the ***critical attributes*** that best measure the effectiveness of the team in accomplishing its mission. For example, for a fire, the Measure of Effectiveness (MOE) is putting the fire out and the critical attributes would include the time the portable fire extinguisher arrives, the time the pressurized fire hose arrives, and the gap, if any, between application of extinguishing agents.

For approach and attack, the length of time contact is held before an attack is launched and the length of time the ship spends within a certain range of the target could measure risk of counterdetection and loss of tactical control.

We have found that the determination of these *critical attributes*, although sometimes difficult to discern, is a supremely valuable effort. For it is by identifying the critical attributes that we convey to the Force what is important for a particular event.

2. Define the standard. These standards tend to be defined as times, distances, yes/no, or number or percent of defects. For example: 2 minutes for a fire hose, 100 yards for a radar fix, report made to the operational commander made/not made, number of Interior Communication violations.

Where do the standards come from? In some cases, such as the fire example, the standard is based upon empirical studies and modeling. In this case, as reported in Naval Ship's Technical Manual (NSTM) 555, if there is longer than a 2-minute delay in attacking the fire with a fire hose, untenable conditions and significant damage become probable. Thus, the standard is defined by what is required, not by what is achievable with current methods.

In other cases, standards have been specified by higher fleet commanders. In the case of Tomahawk strike, for example, the fleet commanders have specified certain time requirements for various responses. These higher fleet requirements have been incorporated into the attribute sheets so a submarine meeting the standards of the attribute sheets is *de facto* meeting the standards demanded by the overseas fleet commander.

There are many areas where neither well-defined modeling nor specifications from the warfighters exist to help us determine the standards. Radar piloting is one. No defined standard exists. The designed capabilities of the installed radars might help us, but this is also a trap. We should ask, "how good do we need to be at radar navigation" rather than asking "how good can our currently installed equipment let us be." In these cases, consensus opinion among experts can be used to determine the standard.

Note: the currently identified standards are evolving and have been determined by a collaborative effort among the Tactical Readiness Teams, Squadron Deputies, and Training Centers on both coasts.

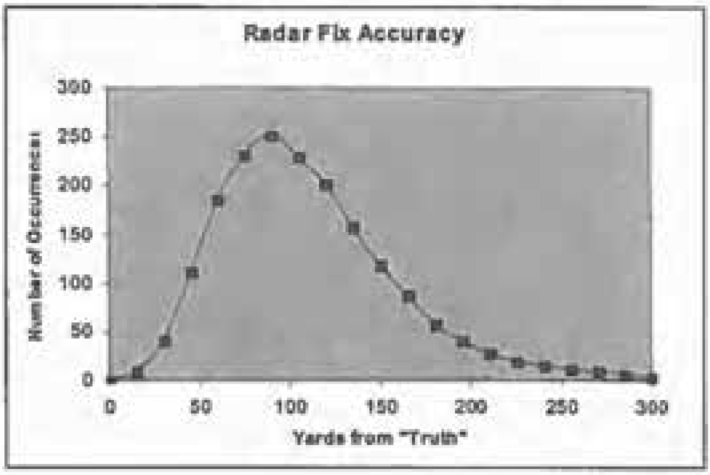
Taken together, steps 1 and 2 fill in the first quadrant, Define Requirements, of the 4-Quadrant Human Performance System Model defined by Task Force EXCEL, now the Naval Personnel

Development Command.[2]

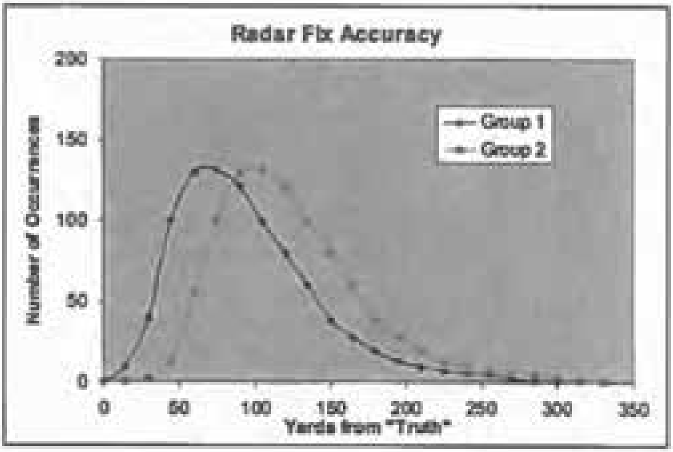
3. Measure Performance. As with the previous method, the ship/watch team is observed and performance is measured. Although measuring the accomplishment of critical attributes is key, it is not enough. The previous practice of watching the behavior of the crew and recording that as best as possible is still relevant. Why? This is because when a standard is not met, only by observation of the behavior (process) is it possible to determine why.

4. Analyze the Data. One of the strengths of the new system is its disciplined and repetitive development of quantitative data that can be analyzed. Let's assume that the figure below reflects a histogram of radar fix accuracy. Radar fixes for a large sample of the population of measured against actual ship's position. Fixes are counted in 15-yard bins—for example, how many fixes were accurate to within 15 yards, 15-30 yards, etc.

This distribution has measurable characteristics that would be useful for Submarine Force decision makers. To start with, we could determine the mean (average) error. Additionally, we could determine the proportion of fixes that fell outside a certain standard. Based on well-defined statistical principles and knowing the sample size, we could derive the corresponding parameters for the entire population.



However, let's say we could look at the data more carefully, and we find that the data actually consists of 2 groups, which I've labeled group 1 and 2, and shown in the figure below. Again, we can measure the difference in performance between these two groups, quantitatively.



Consider that group 1 consisted of ships with the BPS-15H radar, an improved radar recently installed in many ships, and that group 2 consisted of ships with the older radar. We now can determine quantitatively the benefits from this additional technology. Groups 1 and 2 could also be a comparison of operators that have had attended a certain course or not had attended the course, or Navigators with greater than 1 year experience compared to less than 1 year experience.

When one considers that through this process, data such as this will be collected on everything from firehose arrival times to range errors at time-of-fire, one can see the potential power of this process to warfighters, trainers, and acquisition decision makers.

The ability of this process to generate data that shows how forces are meeting defined standards is a key requirement to fully embracing the Navy's Revolution in Training. Quadrant 4 of the 4-Quadrant Human Performance Model, Execute and Measure, requires a disciplined and rigorous process for measuring performance against actual standards. The previous methods of counting deviations from procedures will not be effective in supporting this model.

5. Determine the appropriate response. For the ship, the appropriate response will generally be to conduct training on identified shortfalls. This may involve an intimate look at the process used, watchbills, etc. However, more training is not always the answer. It may be that with currently installed equipment, the ship is doing the best it reasonably can. In this case, the appropriate response may be to investigate new equipment and technologies for acquisition.

Analogous to Statistical Process Control Application to Industry

In many ways, this transition directly parallels the revolutionary changes in manufacturing processes brought about by the application of statistical process control procedures over the past 3 decades. The application of rigorous statistical methods have been responsible for a revolution in quality. Monitoring for procedural compliance without measuring the objective is akin to evaluating a machine operator's behavior but not measuring the dimensions of the finished part. In the same way, mission performance will be revolutionized.

Having said that, these complex human processes, with their built in causes for variations (a course change, the onset of reduced visibility) will rarely be in statistical control. This will complicate the statistical analysis.

Benefits of the New Process

This process will provide rigorous, quantifiable information about the force's performance in assigned mission areas relative to external standards or requirements. Additionally, it will provide quantifiable comparative information about the benefits of different technologies, procedures, and training courses. When integrated with current initiatives in monitoring officer experience, this process will be able to determine the correlation between experience level and mission performance. Finally, since performance is measured against a standard, and there is no limit to the number of ships that can be evaluated as *above standards* the competition among ships is replaced by collaboration.

Role of the Training Centers

At this point, I'd like to discuss the unique role the training centers can play. In our example, I've conveniently avoided a discussion of how the *truth* was determined. How do we decide where the ship or target really were? For the TRE teams, this consists of reconstructing the track and using precise GPS or instrumented range data that may or may not have been available to the piloting or fire control tracking team.

But, in reality, this is only where the TRE team *thought* the ship or target was, and is subject to errors. Here is where the training centers play a special role because in their trainers, they actually do know the truth: the range to a contact; the actual position of the ship. Hence, data collected by training centers plays an important role in formulating the picture of force performance.

Additionally, by measuring the same attributes, the training centers reinforce a common picture of what the critical attributes of a mission are.

Current Obstacles

Having used this process for a year now, we are in a position to identify some of the problems encountered. I would advocate that we should look at these as issues to resolve rather than reasons not to continue down this path.

The first problem is how to deal with material problems. In this reality-based regime, since performance is what counts, material differences or casualties will impact mission accomplishment. Take, for example, a ship that has their high-frequency (HF) active sonar in a significantly degraded condition. This ship will be unable to detect potential mines, and has lost the capability to perform the mission area of minefield detection and avoidance. The ship may be able to demonstrate an intimate understanding of the procedures for this mission area, plan a mission, and even execute a simulated mission, but the bottom line is that they cannot perform the mission.

Assigning a score of zero here seems unjust. Accepting that each ship is primarily responsible for their material condition, there are some things that are beyond their control. While assigning a score of zero does not capture the training capability of the ship, it does reflect their ability to perform this mission. Alternatively, assigning a higher score would send a false picture of the submarine's capability to other stakeholders.

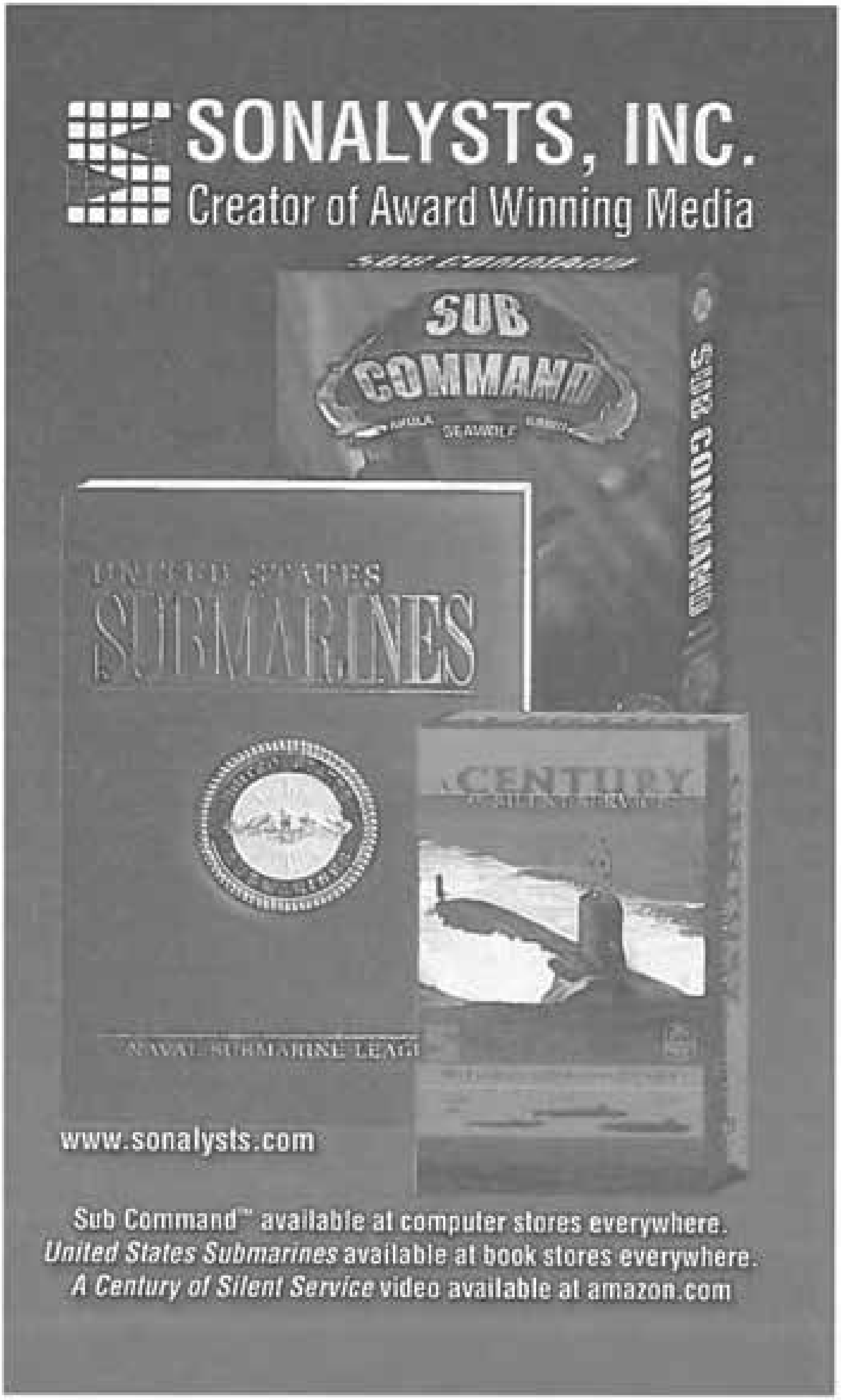
The next problem deals with accounting for differences in scenario difficulty. A ship conducting an approach and attack against an unaugmented 688 simulating a modern adversary would be expected to have a shorter detection range, engagement range, and greater chance of losing tactical control than a ship conducting an approach and attack against a less capable adversary. If range at CPA is taken as a measure of tactical control, the first ship will do worse unless there is some accounting for the degree of difficulty. How this is accomplished, in the database and in the grading, needs to be resolved.

Where Do We Go From Here?

The Submarine Force has taken a significant step through adoption of this standards-based, quantitative system of measuring mission accomplishment. This process has the potential to transform current tactical training for our Force, as well as having far-reaching impacts on training centers and acquisition processes. The next steps involve developing a common, accessible database, widespread use of the attribute sheets with healthy feedback to the sheet owners, flexibility in development of the sheets and adjustment of point values.

ENDNOTES

1. The Revolution in Training was announced by NAVADMIN 259-02, TASK FORCE EXCEL, 240035Z AUG 02.
2. TF-EXCEL publication, Human Performance Professional Working Guidelines, rev. 19 September 2002, p. 10.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THE LAST (AND FIRST) THOUSAND MILES
Extending the Search for the *Holy Grail*
by CAPT J.H. Patton, Jr., USN(Ret.)

The Submarine Force is fortunate that it has more than four decades of a common culture among operators of both attack (SSN) and strategic deterrent (SSBN) submarines. Since the very inception of SSBN patrols in 1960, assignment of most officer and enlisted personnel to each type has been need-based, and not a function of an individual's **specialty**. It has been unusual for an individual completing a full career in submarines not to have served on both. In fact, for many years into the program, all SSBN COs had first been successful SSN COs. Even today, many exceptional officers get to command both. Unlike Air Force F117 and B2 pilots, where the *fighter versus bomber* mentality still prevails, submariners have a uniform concept of what stealth is and how to best employ it. The reason that the Submarine Force is so fortunate is that many of the post Cold War missions that have evolved require that the SSN operate in a manner very reminiscent of how the SSBN has always operated—as a mobile, covert *fire base* constantly ready to strike unseen strategic targets ashore as directed.

What the SSBN mission clearly required was the establishing of a stance, as soon as the target set began coming within weapon range, where a continuous 24/7 passive (listening) connectivity assured that launch orders would begin coming aboard the ship as soon as they had begun being transmitted. Whereas some Cold War SSN missions made a similar continuous passive connectivity desirable (for ship's safety and timely intelligence updates), others such as Anti-Submarine Warfare (ASW) precluded such a stance, and operational and tactical needs were adequately satisfied by the ship passively checking for traffic once or twice a day. However, better connectivity was always desirable, and *comms from speed and depth* was the Holy Grail of SSN communications for years. Many schemes were tried and employed with some limited success, such as tape-recorded messages to nearby aircraft in sonobuoy-sized devices launched from a deep submarine or employing short and agonizingly slow Extremely Low Frequency (ELF) *bell-ringer cueing* which directed a submarine to come to periscope depth for traffic. Such schemes marginally met the SSNs' Cold War needs.

Comms at speed and depth remained an issue when post Cold War missions found on station SSNs waiting direction to quickly launch weapons against emergent targets ashore, but some key parameters had changed. No longer was the implementing and authorizing order for launch like an SSBN's. Their's was a brief set of alphanumerics that took several minutes to receive at very low data rates. This was acceptable since it took even longer to make other final shipboard preparations, so message receipt and verification still qualified as happening in *near real time,* i.e., it didn't slow down the total process). Instead, the SSN/SSGN traffic to be received could be voluminous retargeting data with Air Tasking Order (ATO) implications concerning airspace deconfliction issues. Furthermore, it is conceivable that the entire process from message transmission to weapon release be completed in a few minutes to permit engagement of a briefly vulnerable *mobile target.*

The apparent (provisional?) answer to this problem appeared to be the assumption that since the missions involved would be conducted in littoral waters, and since all littoral waters are shallow (?), the ship would be at periscope depth (and at slow speeds) and high data rate mast-mounted antennas would meet the need (which in fact they admirably do under these assumed conditions). Therefore, comms at speed and depth was a less important issue than it had been. However, conclusions drawn from assumptions are not facts, and the assumption-breaking consideration occurs when the new SSBN to SSN operational analogue is further analyzed.

As previously stated, SSBNs went *on alert,* to include establishing a 24/7 passive connectivity, as soon as weapons came in range of their targets. Some targets begin being in weapon range of SSNs (and soon SSGNs) as much as a thousand miles from the shoreline off which the ships' patrol station lies. It is likely that the ships have proceeded to that point at reasonably high speeds, but now in the absence of high data rate comms at speed and depth, the weapons they carry are either only sporadically *targetable* for the next few days or, if near real time connectivity is established at periscope depth, actual on-station arrival will be delayed by more than a week. In theory, an ELF bell-ringer can call the submarine to periscope depth to copy updated intelligence and targeting data at high data rates, but the process of getting there often takes a half-hour or so, during which the ship's speed of advance (SOA) is close to zero. It is unlikely that either the latency between bell-ringer and connectivity or the adverse impact on overall SOA would be acceptable, given the fast-paced nature of littoral warfare.

A similar situation occurs when the platform departs upon mission completion. It was very serendipitous that USS PROVIDENCE (SSN 719), having left station to head home after a long and successful deployment, chose to come shallow and copy traffic shortly after the 9/11 attack. Unilaterally deciding that its Tomahawks might be of some use, PROVIDENCE did a 180 and headed back to the northern Arabian Gulf while informing the chain of command it was ready to engage and requested water space assignments. Back in range in a timely manner, she and sister ship KEY WEST (SSN 722) were the first U.S. platforms to fire into Afghanistan. Had PROVIDENCE copied message traffic many hours later, her timely return might have been precluded. Clearly, it is just as critical that an SSN or SSGN theater asset have continuous passive connectivity for the first thousand miles leaving station as it has been discussed for the last thousand miles enroute station. If these *in and out* connectivities were to be established at slow periscope depth speeds, than actual on-station time would be reduced by as much as three weeks, with all the attendant *opportunity costs* to other missions such as Intelligence, Surveillance and Reconnaissance (ISR), Mine Warfare (MIW) and Special Operating Forces (SOF) operations.

To fully exploit the warfighting and deterrent capabilities of SSNs and SSBNs, they both need to approach and leave their assigned littoral patrol areas with full passive connectivity established while at operational speeds and depths. For intuitive reasons, the hardware and methodology employed should simultaneously provide the platform with total local optical, radio frequency (RF) and acoustic *situational awareness*. While actually on station, and if the waters are shallow and the counterdetection threat manageable, mast-mounted antenna suites would continue to satisfactorily meet connectivity requirements. In addition, although no longer number one on a rank-ordered mission list, the ASW mission still exists, and comms at speed and depth would significantly answer its connectivity shortfalls. All in all, it is conceivable that two complementary technical approaches might be required to make much more *employable* what are already highly *deployable* platforms.■

THE SEARCH FOR THRESHER

by CAPT George W. Martin, USN(Ret.)

Looking Back, 1963

In this fortieth anniversary year of the loss of USS THRESHER (SSN 593) it is incumbent on us to review the story of the loss of THRESHER, the search for the submarine, the search for the causes, and the legacy of that loss. The search by the bathyscaph TRIESTE for the submarine is summarized here. The narrative of the loss of THRESHER and the lessons learned, bought at so great a price, were examined in 1963 by the Naval Court of Inquiry[1] and the Congressional Hearings of the Joint Committee on Atomic Energy.[2] The challenge for submarine leaders is to study these documents and to reinterpret and apply them for each new generation of submarines and submariners.

Mistakes start early in the chain of events that lead to a tragedy. They can be overlooked in the euphoria of new design, the promise of technology, and the press of operational commitments. Add to this the reality of budget constraints and the loss of skilled workmen and leadership over time. Our submarine safety record is excellent. Yet, safety precepts can erode in forty years.

The Navy's challenges and technology were very different in 1963. The U.S. was in a Cold War with the Soviet Union. They were aggressively becoming a Blue Water Navy with global ambitions. President Kennedy had successfully used the Navy to foil the Soviets in the Cuban Missile Crisis just the year before. We were designing, building and training a nuclear powered submarine fleet.

At the same time, we lived in the *Davy Jones Locker* era: ships and sailors lost at sea were forever confined to the deep, and the deep guards its secrets well. The McCann Bell was the extent of submarine rescue capability. Deep submergence was a new idea demonstrated by the bathyscaph TRIESTE, which conquered the Challenger Deep in the Pacific, 35,800 feet, in 1960.[3] (I volunteered for bathyscaph duty in 1962 and in 1963 was one of the two submariners who piloted her to search for THRESHER.)

USS THRESHER (SSN 593)

THRESHER was the lead ship in a new class of attack ASW submarines whose mission was to counter the growing threat of Soviet diesel and nuclear powered submarines. THRESHER was designed to dive deeper, go faster and more quietly, and to carry a more formidable payload than any previous submarine, U.S. or foreign. THRESHER had a modified SKIPJACK hull form with a single propeller and rudder, powered by the S-5-W pressurized water reactor. She had a deeper test depth than did SKIPJACK. Both were made of HY-80 steel. The 593 boat had the new BQQ-2 sonar, positioned on the nose for better listening. She was armed with torpedoes and the developmental SUBROC weapon system. The promise of this new submarine, and the urgent need for its operational employment, were such that fourteen ships of its class were authorized in the years 1958 to 1961.

The submarine was built by the Portsmouth Naval Shipyard, (PNS), launched in 1961 and commissioned in 1962. The commissioning commanding officer was Commander Dean Axene. THRESHER went through its initial period of shakedown with sea trials and operational testing. This included a series of depth charges exploded near the hull. Residual damage from this test was continuously uncovered before and during the upcoming availability.

After shakedown, THRESHER returned to Portsmouth for Post Shakedown Availability (PSA) in August 1962. The planned six month duration was extended to nine months for both originally scheduled work and for new work. The latter included repairs of damage resulting from the shock tests. During the extended PSA key personnel were rotated to new duty stations. The assistant ship superintendent and ship superintendent transferred in November and December. In January 1963, the CO, Commander Axene was relieved by Lieutenant Commander J. Wes Harvey, and the XO, Lieutenant Commander William Cowhill, was relieved by Lieutenant Pat Garner.

THRESHER completed its in port test requirements including a *fast cruise* alongside the dock April 1, and got underway April 9, 1963 for sea. She proceeded to the operations area for the initial tests. Accompanying her was USS SKYLARK, a submarine rescue ship with a McCann Bell on board. The McCann Bell had a rescue capability to 850 feet under ideal operating conditions.

Early on April 10 the submarine and rescue ship had moved to deeper waters for the test depth phase. The known sequence of events that followed is contained in the Navy Court of Inquiry record of findings :

"That at 0747R THRESHER reported by underwater telephone that she was starting a deep dive. ...SKYLARK then maintained her approximate position. THRESHER reported course changes and depth changes, but SKYLARK did not plot THRESHER's position.

That the deep dive appeared to SKYLARK personnel to proceed satisfactorily until about 0913R when THRESHER reported to SKYLARK to the effect, 'Experiencing minor difficulties. Have positive up angle. Am attempting to blow. Will keep you informed.'

That at about 0916R SKYLARK heard a garbled transmission which was believed to contain the words '...test depth'. An additional garbed transmission was received about 0917R reported as containing the words '...nine hundred north'."[4]

SKYLARK proceeded to search the area for signs of the submarine. Finding none, she sent out a message to ComSubFlot Two in New London, saying she had lost contact with THRESHER.

Commanders sent out immediate orders for ships, submarines and aircraft to proceed to the operations area to look for the submarine. They found an oil slick, rubber gloves, and pieces of plastic. They did not find anything to give them hope. The story was carried on the evening news. The CNO, Admiral George Anderson, officially announced that THRESHER was overdue and presumed lost with all hands. The location was 270 miles east of Boston. All hands totaled 129 men: ship's company of 12 officers and 96 crew, plus one ComSubLant staff officer, and from the shipyard: 3 officers, 13 civilians, and 4 contractor representatives.

Within a few days, secret SOSUS information (later declassified), was added to the testimony before the Court of Inquiry findings of fact:

"...Commander Oceanographic Systems Atlantic obtained information that, at 0911R, the propulsion plant stopped or slowed, and that a high energy, low frequency noise disturbance of the type which could have been made by an implosion emanated from THRESHER at 0918.1R. There were also indications of two disturbances, one extending from 0909.8R to 0911.3R, the other from 0913.5R to 0914R, which could have been made by the blowing of ballast tanks."[3]

Bathyscaph TRIESTE Ordered to Boston

On the way home at 1800 West Coast time, I stopped at the Navy Electronics Laboratory waterfront gate on Point Loma. The guard came over to my car looking upset. He asked if I had heard the news: a submarine was down in the Atlantic. I was surprised, and skeptical. Submarines were known to surface with a flooded antenna cable preventing communications. When I arrived home, one look at my wife's face confirmed the news. Two media organizations had called my home to ask for information about the tragic story already on the news. As I sat down to supper Lieutenant Commander Keach, the officer-in-charge bathyscaph TRIESTE called, "Be at the TRIESTE compound by 1930."

The bathyscaph TRIESTE was the Navy's experimental deep submersible operated by the Navy Electronics Laboratory, San Diego. The bathyscaph consisted of a pressure proof sphere for the pilot and observer, stoutly bolted to a lightweight float containing 35,000 gallons of gasoline. The gasoline provided buoyancy for the five ton sphere. Two submarine officers were assigned as pilots. To conduct a dive one pilot operated the submersible and the other was the topside safety officer. We had a crew of eight enlisted and a team of civil service personnel.[4] Our mission at that time was ASW research. We took scientists into the deep to examine with their eyes and instruments the water column and sea floor.

The conference that evening was brief. All we knew was the name of the submarine and the location, 270 miles east of Boston. We studied the chart which showed the submarine was on the rugged continental slope where the depth of water was about 8,500 feet. That depth was well beyond any rescue or salvage capability.

Keach was called to the phone. It was an aide to CNO. Can you find the submarine? Keach told him that we had the depth capability but we didn't have much search capability. The aide hung up.

Captain Mason, CO of the laboratory, told us to start preparations to go to the East Coast, "in case you are called". Where, when, how was to be determined later.

The orders came the next day. We packed up the bathyscaph, replenishment stores and the eight man crew, and loaded all onto POINT DEFIANCE (LSD-31) on Easter Sunday. That afternoon we sailed for Boston via the Panama Canal. We arrived in Boston April 28 and made preparations including a test dive to 700 feet. Expecting immediate orders to sea, we were disappointed when we were ordered to "standby", pending results from the ships searching for THRESHER.

A debate took place at high levels of government and the Navy. Some wanted to call off the search and let the bereaved families find rest from the constant media attention. The Navy decided to continue the search because of the need to try to find clues to the sinking from the submarine itself.

Three more of the class were already at sea: PERMIT, PLUNGER, and BARB.

The country was shocked by the loss of 129 men at sea on a nuclear submarine. They were also worried whether there was harmful radiation escaping from the reactor. The intensity of the aroused public was reflected in the Congress. The Joint Committee on Atomic Energy opened hearings on June 26, 1963 to investigate the loss.[7]

The crucial question was: could the experimental submersible find something of value to the investigation? TRIESTE was the only capability the U.S. had that could take investigators to 8500 feet and return safely to the surface.[8] (A *round trip* we called it). TRIESTE's usefulness was not as a search vehicle but as an inspection vehicle. This understanding was not apparent to those outside our team. After months of watching our at-sea performance it became clear to all.

The bathyscaph was simple in concept and elegant in design, but the float containing the gasoline was as fragile as a raw egg. TRIESTE had to be towed to the diving point, rigged for dive topside, underwater and in the sphere. Following each dive, steel ballast and gasoline were replenished, batteries recharged and equipment repaired.[9] The bathyscaph's one foot of freeboard made these surface operations hazardous in anything but calm seas.

TRIESTE had a simple compass, two view ports, deep sea lights and cameras. Submerged, automobile batteries provided propulsion of one knot for four to six hours. The swath width for visual search purposes was fifty feet.

Searching the Deep

Captain Frank Andrews, ComSubDevGru 2, squadron commander for THRESHER, was given command of the search force.[10] Navy oceanographic ships were ordered to the area. Search plans were quickly devised and continually revised. Locating an object as small as a 278 foot submarine displacing 4300 tons is a difficult problem in a vast three dimensional ocean.

The basic plan was for the ships to search the area and locate the THRESHER. After the submarine was determined to be within an area two miles by two miles, the bathyscaph would take inspectors down to see and photograph the scene. From this visual inspection they hoped to find clues as to the cause of the sinking. A significant limitation to the search operation was navigation and underwater location relative to a known position. This combined with the narrow search width of the bathyscaph relative to the area to be surveyed, made underwater search as much a matter of luck as skill[11]. The oceanographic ships developed a bathymetric survey of the area using precision depth finders. Then with deep cameras and magnetometers they combed the bottom for clues and anomalies. After eight weeks the data, though fragmentary, fit into an area thought to be within the capability of TRIESTE. We were ordered to sea on June 19. After two months *on standby* for orders we were relieved, yet not without concerns. What we would do and how had been discussed with Captain Andrew's assistant, Lieutenant Commander Art Gilmore.[12]

TRIESTE made two series of five dives that summer of 1963, in the vicinity of the debris field established by the surface ships. We were towed the 270 miles to the area by USS PRESERVER (ARS 8), and she was our tender ship for the entire summer.[13] The first series of dives produced some photographs of debris and a plastic slipper with the letters *SSN 5* showing. The significant result for the Bathyscaph team working with PRESERVER was learning to replenish at sea instead of returning to port for that chore. After the fifth dive, TRIESTE was towed back to Boston for repairs and upgrades.[14] The work included additional battery capacity, new radiation and magnetometer sensors, and what turned out to be the most fortuitous upgrade, a mechanical arm.

On August 19, the bathyscaph returned to the search area for a second series of dives. As the weather was beginning to deteriorate the pressure to dive and *find something* increased. One rig-for-dive was aborted because sea water poured down the sphere access trunk every time the sailor or I opened the topside hatch. After an hour of bailing by hand we had admitted more sea water than we emitted.

Our luck changed on dive three when Keach came upon large pieces of crumpled steel scattered around the seafloor. (These were photographed and later determined to be the steel dome of the BQQ-2 sonar.) With little time remaining on the batteries, he selected a five foot piece of pipe and maneuvered TRIESTE into position over it. Using the newly attached mechanical arm, he captured the pipe and slowly ascended. He stopped the ascent at 100 feet and called for divers to come down and secure the pipe with lines and bring it safely to the surface.

Radiation checks had been made in the surrounding area via water samples and sea floor core samples. Nothing above normal background was found in those samples. However this was the first piece of metal from the wreckage to be brought to the surface. It was by no means certain that it would be free from dangerous radiation. On deck an anxious diver held the pipe. We relaxed when the instrument recorded normal background radiation. The pipe had etched into it the words, *593 boat*, and a drawing number that was later determined to be from the galley.

After weeks of being towed at sea and working in the seaway the bathyscaph float showed signs of wear that could not be fixed while it was full of gasoline. PRESERVER towed TRIESTE to Boston. It was September 1, and the evening sky held portent of winter approaching.

On September 5, Secretary of the Navy Frank Korth held a news conference and announced:

"The location of structural parts of THRESHER on the ocean floor having been positively confirmed by the bathyscaph TRIESTE during her latest series of successful dives, I have today directed that the associated operational aspects of the search for the nuclear submarine THRESHER be terminated."[15]

Secretary Korth went on to state that the Navy planned to continue the search as a research project and not an operational one.

The Search Continues, 1963-1964

The continued search was conducted under the Office of Naval Research. Captain Andrews retired from the Navy and took over as the director of the search. The USNS MIZAR was operated by the Naval Research Laboratory and headed by Chester Buchanan, chief scientist. He installed improved surface navigation equipment, an experimental underwater tracking system and an improved towed sled. MIZAR located her position relative to a bottom datum and to the position of the sled she towed. The sled was upgraded with a side scan sonar in addition to the lights, cameras, and magnetometers previously used. Over the winter of 1963-1964, Buchanan used this new capability to make a comprehensive survey of the THRESHER area and produced a photo mosaic of visible portions of the submarine.

Substantial improvements were made to the bathyscaph. A new float was designed, built and mated to the sphere, and renamed TRIESTE II.

The officer watch was relieved during the spring, Lieutenant Commander Brad Mooney became officer-in-charge. Lieutenant Larry Shumaker returned to the project and a third officer came aboard, Lieutenant John Howland.[16] Trial and training dives followed near San Diego. TRIESTE II was transported by ship to Boston for another dive series. In May, Mooney and his team arrived, set up base at the Boston Navy Yard, and made preparations to return to sea.

TRIESTE II's first dive in the THRESHER area turned into the only dive of the series. The propulsion motors quit shortly after being turned on. Mooney, the pilot, drifted with the current and came upon the debris field. He chose to surface rather than risk drifting into a piece of wreckage. After they surfaced, they found that the battery had shorted burning a hole into the gasoline filled float. Back to Boston they went where further inspection showed that the electric motors and most of the external electrical system had to be replaced. The work was completed in time for a second dive series to begin before the weather prevented safe operations at sea.[17]

A second series of dives was begun in August with dramatic results. On dive four Mooney was the pilot and Howland and Andrews (search commander) were observers. Shumaker was topside safety officer. The bathyscaph landed on what they thought was the sea floor. After letting the customary cloud of silt settle, Mooney realized that he was sitting on top of something because he could see the sea floor below. He rotated the craft 90 degrees horizontally. As his eyes became accustomed to the eerie light from the external lamps he made out the silhouette of part of the submarine hull. He had landed TRIESTE right on top of the elusive submarine. Further examination showed they had found the main section of the hull. As the lights dimmed from the diminishing batteries they lifted off and rose to the surface and daylight.[18]

Results

The search results can be summarized as follows:

- Mizar, a specially equipped ship, used deep towed cameras and instruments to locate and photograph the submarine debris and shrink the search area.
- The bathyscaph TRIESTE took inspectors to examine and photograph the wreckage, and retrieve the pipe.
- Tangible evidence obtained by the search team proved that the wreckage was indeed the sunken submarine THRESHER. The Navy used this evidence to publicly state the search results in positive terms and bring a measure of closure to the tragedy.
- This success, however limited and with whatever problems yet to be overcome, made an important beginning in the field

of deep submergence search and inspection. That team was used again to find SCORPION in 1968-1969.■

ENDNOTES

1. Department of the Navy, Loss of the USS THRESHER, Findings of Fact: Court of Inquiry findings of fact, opinion and recommendations, as to the loss of the USS THRESHER SSN-593 on April 10, 1963. Held April-June 1963. Declassified November 1993.
2. Hearings before the Joint Committee on Atomic Energy, Congress of the United States, EIGHTY-EIGHTH CONGRESS, First and Second Sessions on The Loss of the U.S.S. THRESHER. June 26, 27, July 23, 1963, and July 1, 1964.
3. LT Don Walsh, USN, and Jacques Piccard piloted the bathyscaph to the deepest known trench in the ocean. The Navy had bought TRIESTE from the Piccards in 1958. Jacques was the son of the inventor, August Piccard.
4. Department of the Navy, Loss.
5. Department of the Navy, Loss.
6. Enlisted crew: J.A. Devoe, J. Norman, R.D. Legg, F.D. Barnett, C.N. Adams, F.J. Brandenburg, N.D. Smith, F. Adams. Chief scientist was K.V. Mackenzie and the topside engineer, G. Buono.
7. Hearings before the Joint Committee.
8. The only other bathyscaph in the world was the French Navy's ARCHIMEDE. She was engaged in experiments in the Puerto Rican Trench in 1963.
9. A typical replenishment involved loading eight tons of desposable steel shot ballast, 1000 gallons of gasoline, charging the batteries, and repairing electrical equipment, instruments and wiring.
10. Frank A. Andrews, "Searching for THRESHER", U.S. Naval Institute Proceedings, (May 1964). Captain Andrews had a Ph.D. in physics and could work with scientists on their professional level. This was key to his obtaining their cooperation in this *ad hoc* experiment, finding a submarine in 8500 feet of water.
11. Navigation is discussed in Andrews' and other technical

papers from the search. By the end of the 1964 search an experimental system was in place.

12. Frank A. Andrews, "Searching for THRESHER", describes the THRESHER Analysis Team which collected results from the many research ships and laboratories. Gilmore was our contact with the analysis team and made two dives with us in TRIESTE.
13. Our at sea contingent including USS FORT SNELLING (LSD 30) and USS PRESERVER (ARS 8). FORT SNELLING was the task group commander's command post and used her size to discourage Soviet trawlers from coming too close. PRESERVER was our seagoing home and communications center. She towed TRIESTE, housed and fed us, helped our crew replenish the bathyscaph, and performed the myriad tasks enabling TRIESTE to operate at sea for three weeks.
14. TRIESTE was designed as a proof of concept instrument. The float was 2 mm thick mild steel. The electrical system—batteries, underwater motors, wiring, and instruments—were exposed to the wash of waves working in the seaway. The delicate float and exposed electrical system created most of th our operational readiness problems.
15. Fred Korth, Secretary of the Navy, press release dated September 5, 1963, "Statement of the Secretary of the Navy Fred Korth on the 5-month long search for the submarine THRESHER".
16. LT Shumaker was a TRIESTE plank owner and assistant officer-in-charge with LT Don Walsh, officer-in-charge, during Project Nekton, the series of dives to the Challenger Deep.
17. J. Brad Mooney, personal letter to author, September 1964.
18. Frank A. Andrews, THRESHER Debris Field, The Submarine Review, April 1987.

The search for the causes of the loss of THRESHER and legacy will be discussed in a follow on article.

ASDS, SSGN, AND WIAs

by Mr. Joe Buff

Mr. Buff is a novelist working in the national security field with a specialty in submarine-related subjects. He has contributed several articles to THE SUBMARINE REVIEW. His first was requested by the Editor to illustrate the "Jules Verne" method of requirement definition, and appeared in the June and October issues in 1998, titled Looking Forward-Submarines in 2050. He has published several novels about submarines including Crush Depth which made the Military Book Club top 20 bestseller list.

Two technological developments, well known in the submariner community and both of them significant force multipliers, are together revolutionizing Navy capabilities to project power onto land. The modification of several Ohio class SSBNs into an SSGN configuration presents a new order of mission-flexible, forward deployed, and stealthy land-attack cruise missile launch platforms blended with Special Warfare commando transport. The Advanced SEAL Delivery System minisub (ASDS) enhances that forward deployed transport and staging even further, by being able to enter the littorals as a very low signature vehicle. Because of its small size, the ASDS can penetrate shallow waters and yet serve as an undersea base of operations for a SEAL team or other combat swimmers, with an autonomous endurance of several days. Each new SSGN is projected to be able to carry two ASDSs as dorsal loads, plus a complement of as many as 66 Special Warfare personnel (close to twice that in an emergency).

At a luncheon during 2002 of the Nautilus Chapter of the Naval Submarine League (Groton/New London, CT), a status report on the SSGN project was presented. One attendee asked a question which the present writer also wished to ask: "What provision is being made for commandos wounded in action?" The response given was that WIAs would be transported directly to a shore facility or surface ship for immediate medical treatment. This makes eminent sense in many possible Special Warfare mission scenarios.

The purpose of this article is to address the matter of situations where the concept of operations does not permit such rapid, high signature evacuation of WIAs to a hospital or vessel other than the SSGN itself. A suggestion will be offered that in certain circumstances it might be appropriate, even necessary, to deploy on the SSGN a medical doctor with experience in combat trauma surgery. In addition, a suggestion will be offered of an *undersea Stokes litter* that might be used to transport a wounded person from the atmosphere into the ASDS as stealthily as possible, yet with minimum added stress and trauma to the patient in the process of this transfer.

No specific bibliographical references are offered with this article, because the discussion derives from a combination of open-source materials and general reasoning. Also, this discussion applies equally well to an SSN deploying commandos via an ASDS, or older SDV, or even via inflatable rubber boat.

Concept of Operations

To be concise, let us refer to Navy SEALs when we mean to include any personnel who might stage ashore from an ASDS and go in harm's way, including for instance Marine Recon troops or CIA espionage operatives. Those personnel in fact need not be American; they could come from our allies or coalition partners.

There are, clearly, many different mission scenarios and tasks to which Navy SEALs can be assigned in war and in peacetime. There are at least two dimensions to the parameters of any specific mission: level of secrecy, and level of nearby support from less-stealthy friendly forces.

Secrecy can apply on at least three levels:

1. Direct Action—destruction of enemy assets, capture of prisoners or of international fugitives from justice, or other tasks where the SEAL team's presence might be instantly detected.

2. Clandestine Action—tasks such as delayed demolitions, or certain forms of enemy facility penetration and intelligence gathering, which are meant to remain undetected in the near-term but which may be detected after some delay.

3. Covert Action—tasks, such as certain forms of espionage or psychological warfare, which are intended to remain undetected forever.

Friendly support is always a significant but potentially difficult issue in Special Warfare operations. In real world tactical situations, the danger is always present that the mission may become compromised while in progress. Retaliation by armed enemy forces may occur. SEAL team members might become wounded in combat. In fact, for a mission to produce a WIA almost by definition means the action has been compromised, and enemy troops could be in hot pursuit of the withdrawing Special Warfare team. Heavy enemy weapons might be brought to bear, either on the team, or to repel friendly rescue/extraction platforms, or both. It is conceivable that the team may be operating in a certain place under certain circumstances such that the only conceivable sanctuary and casualty aid station available is the ASDS and the SSGN on which the SEAL team arrived.

Medical Personnel

Special Warfare commandos, like many military personnel, certainly receive training in combat first aid. A member of the team will ordinarily be designated as the primary care giver, i.e., the battle corpsman or *medic*.

Nuclear submarine crews, as a matter of normal routine, include a hospital corpsman and assistants; medical instruments and supplies are embarked on the submarine for every deployment; the wardroom with its dining table can be rapidly transformed into a surgical operating theater if necessary.

However, as skilled as such personnel are, there will be limitations to their abilities to save the life of a seriously wounded comrade. Combat medics, working in the field and possibly under enemy fire, can only hope to stabilize the patient for urgent transfer to better facilities, by taking basic steps to hold back blood loss and treat symptoms of shock. Submariner corpsman are trained and equipped, for the most part, to handle wounds and injuries generally less severe and life threatening than those which might be inflicted on SEALs in contact with enemy troops.

As an example, there is a famous case in Silent Service history in which a corpsman on a submarine on patrol during World War II performed a successful emergency appendectomy on a member of the crew. In general, to the extent that a submarine has been rightfully compared in some ways to an industrial site, serious cuts or crush injuries to body extremities can occur which call upon the corpsman's maximum skill. For instance, a crewman might drop an extremely heavy filled garbage container onto his foot. Or, a crewman might accidentally place his hand too close to the hydraulic mechanism which controls the ship's rudder.

However, in all these cases there are potentially significant differences between the extent of the wounds and the degree to which the wounds are life-threatening (or even permanently disabling), and the wounds a SEAL might receive from enemy fire. To perform an appendectomy is to follow established procedures which intentionally avoid lasting damage to muscles, organs, nerves, and major blood vessels. Conventional weapons of all sorts, however, including firearms, mortars and artillery shells, bayonets, and anti-personnel mines, inflict trauma which is far more chaotic within the human body, far more dangerous to the victim's survival, and vastly more challenging to treat medically. Similarly, to suture and splint a crushed finger or toe, while of vital importance and demanding of excellent training, skill, and, yes, courage and dedication, is nowhere near as difficult as treating a limb maimed by shrapnel, an abdomen pierced by a twisting bayonet, or a chest cavity hit by multiple small- or large-caliber firearm rounds.

To save the lives of WIAs, additional medical devices and materials, as well as additional and more highly trained medical personnel, would appear to be essential. And their availability to the wounded man is time-sensitive indeed, because adequate care not rendered soon enough might come too late. A WIA might tragically become a KIA: an immediately available *medical doctor combat trauma surgeon* might mean the difference between life and death. Since some of the adapted Ohios' former SLBM launch tubes are intended as SEAL equipment lockers, for certain missions part of this space might hold the surgeon's instruments and supplies.

Atmosphere/Ocean Transfer Capsule

Having established above that in some military concepts of operations, the only recourse for effective treatment of combat wounds may have to be available on the SSGN, the problem then arises of transporting the patient from the scene of combat to the host submarine. The combat, presumably, occurred on land or in the surf zone along the shore. The ASDS, the SEAL team's *taxi*, is the obvious means of bringing wounded persons to the SSGN.

The ASDS can permit people to enter and exit in one of two ways. The ASDS has a *top hatch*. However, freeboard is extremely low, and flotation collars may not be available to either increase freeboard or to protect the open top hatch from being swamped by seas. In addition, use of the top hatch requires the ASDS to surface, and if the SEAL team has been compromised and is under enemy fire, surfacing the high-value and vulnerable ASDS in order to evacuate a wounded man might not be an acceptable option.

The other way in which to enter and exit an ASDS is through the *bottom hatch in the hyperbaric lock-in/lock-out chamber*. To do so requires either free diving, i.e., holding one's breath while swimming down underwater, or using scuba equipment, such as the Draeger rebreather.

A wounded man may have extreme difficulty in surviving a free dive, and, especially if unconscious or going into shock, may be unable to properly use a Draeger. These concerns apply even if the man is carefully helped by teammate dive buddies. Recall that a serious risk while using the Draeger is that to lose the mouthpiece without first sealing it closed admits seawater into the rig, creating a *caustic cocktail* which makes the Draeger useless and may cause severe respiratory injury to the diver. Furthermore, any form of movement down the water column from the surface to below the ASDS, and then into the lock-in chamber whose atmospheric pressure has been equalized to the minisub's depth at the keel, will inflict considerable stress on the wounded man's body—subsequent decompression will add further stress. Blood clots or embolisms, or even a drop in body temperature due to sudden immersion in frigid seawater, may prove fatal. There is also the problem of blood entering the water from the man's wounds, if sea creatures such as sharks or barracudas frequent the area of operations.

A potential solution to this atmosphere/ocean transfer conundrum is to develop a waterproof, pressure-proof capsule to temporarily contain the wounded man. The capsule might be completely effective while only needing to withstand sea pressure down to a depth of 20 or 30 feet—the depth limitation of the pure oxygen Draeger is ordinarily about 30 feet in any case. The capsule would require externally operated buoyancy compensator equipment, monitored and controlled by unwounded team members, to assure the capsule neither refused to submerge nor sank to dangerous depths. The capsule could be either carried inside the ASDS, or borne as an external load, but would need to be sized to fit inside the lock-in chamber. (For SEALs being recovered by the host sub from an inflatable boat or other small craft, the transfer capsule could be held until needed inside the submerged SSN's or SSGN's escape trunk.)

Inherent in these stated design parameters is that the victim's body fluids—and also body temperature —would be isolated from the surrounding water, which might hold not only sharks but also toxic pollutants and virulent infectious germs. (These latter threats might be indigenous to the local environment, or might result from chemical or biological weapons being used against the team.) By making the transfer capsule pressure proof, the victim can remain at a safe, low-trauma one atmosphere absolute pressure during the entire transfer process, until the ASDS bottom hatch is shut and the hyperbaric sphere is equalized to normal. (Once inside the ASDS transport compartment, a corpsman can continue care until docking with the host SSGN.)

Furthermore, the interior of the capsule might be equipped with certain first aid and life support gear:

- An integral back board with straps, to immobilize the patient's body during the transfer and also protect head, neck, and spine from aggravation of existing trauma.
- An oxygen bottle and breather mask, to help support the WIA's vital signs.
- A blood plasma (or properly matched whole blood) intravenous supply mechanism, not dependent on gravity-drip feed, again to minimize shock and support vital signs during the undersea transfer.

None of these devices and technologies seem beyond the reach of present paramedic and diver-medicine equipment and procedures, although some special development and adaptation work might be required, with inherent additional financial cost. A feasibility study of the entire basic concept, and systems integration into existing and ongoing SSGN design and construction efforts, would also create expense and possible delay.

Conclusion

This article has sought to point out that, part and parcel with deployment of Special Warfare forces through the SSGN/ASDS transportation system, comes the need for adequate provision to treat combat casualties, integral to the transport system itself—at least in certain types of missions and in certain types of operating environments. A friendly hospital ashore might not exist for hundreds or thousands of miles. The nearest supporting surface ship—with its sickbay—may also lie far beyond a distant horizon. Actual or imminent enemy fire may prevent survivable air or ground movement to such alternative facilities, even when the facilities do exist. A SEAL's best refuge, just like a submariner's, has always been underwater.

It is a long-standing tradition of the U.S. Navy SEALs, as in other special forces, to never leave a man behind. Knowledge that a medevac infrastructure, perhaps as proposed above, was actually in place would heighten morale. It would also potentially aid national security and defense preparedness in a larger sense, because the ready availability of outstanding trauma care might facilitate planning of missions that can afford to take risk more aggressively, and thereby increase strategic and tactical value of those missions.

As submariners and SEALs work more and more closely together, and a partial *fusion* of their cultures does occur, steps should be taken for the maximum possible support of everyone our nation asks to risk their lives protecting freedom around the globe. When the very nature of war is evolving in unpredictable ways in the twenty-first century, nothing should be taken for granted about absolute air superiority and total sea control at all times everywhere, or about the ability of even the most superb armed forces in the world to achieve all conceivable Special Warfare missions without sometimes suffering serious combat wounds. If the horrific events of September 11, 2001—and the prolonged, volatile aftermath of that day—have taught us and our Allies any one thing, it is that we don't need more dead heroes. The general public's expectation for low casualty rates in future conflicts, and our genuine craving for heroes who are very much alive, argue strongly in favor of a casualty clearing process integral to the SEAL-submariner partnership and the SSGN/ASDS warfighting revolution.■

A LEADERSHIP LINK

by CAPT Neil E. Rondorf, USN(Ret.)

One of the dilemmas that face the Submarine Force (and all naval units) from time to time is a unit that is mysteriously difficult to make successful. They get help, advice, time, guidance and many other aids but still find it difficult to create a positive atmosphere of success. In this article it is my purpose to share an experience to illuminate one of the often-overlooked keys to success—the Chiefs' Quarters.

During my tour as Executive Officer of an SSN, I came face to face with this phenomenon in submarine leadership, which I came to recognize several times over. The current skipper had taken command of the submarine in the wake of several unpleasant events and was given the task of *righting the ship* so to speak. He had the complete support of the Force Commander and the Squadron Staff. Every effort and asset was provided to assist.

The ship was at La Madelena in the Mediterranean when I reported aboard during the mid-deployment upkeep. I was immediately impressed with the quality of the officers in the wardroom. One day a few weeks later while we were underway following a very successful ASW operation (no one I have ever served with could do open ocean ASW like our skipper), the COB came into my stateroom in a state of total frustration. He was dealing with some crew issues and was having a devil of a time getting the CPO's on board with his effort. Although they agreed and there was no obvious opposition, it just was not happening. My impression of the COB was one of aggressive attention to detail often seen in successful auxiliarymen. (I can fix anything).

We began an analysis of the situation and our symptoms but could not explain our overall situation. We then gathered up all the records of the LPO/CPO records and began a detailed review. The COB felt he didn't have any quality help so I set out to prove him wrong and challenge him on his leadership. To my amazement there was a strangely consistent lack of *top performer* evaluations. As a group they seemed numb, uninspired and lacking in spirit. The analysis revealed a significant number were crew fills from other units, *get well tour* assignments and numerous indications of *near failure* elsewhere being given a second chance. The distinct impression created was that the COB was on his own. This is not to slight the abilities or careers of those Chiefs but there was not balance usually found in any cross section of a group.

The ship could certainly perform the mission as demonstrated by the SIXTH Fleet ASW *Hook Em* award for ASW and an above average on the ORSE. However, this success required an extreme participation level by the CO, XO and Department Heads. Many may feel that is appropriate and a necessary requirement for success (and they are right to a degree). The difference is that each time a deficiency was corrected we ended up fixing the same problem again a short time later. One could then argue that the corrective action was obviously not effective. The problem was far too consistent for this explanation.

Upon return to homeport, after a very successful deployment, the COB arranged to have the Force Command Master Chief (CMC), who had been Engineering Department Enlisted Advisor (EDEA) on a previous ship with me, and the Force CCC visit the ship for lunch one day. After lunch we went through the records for our enlisted leadership and they were equally amazed by the consistent lack of strong leadership across the board. They asked what we thought we needed and the COB requested their assistance in finding one *Top Performer* LPO/CPO to put in each department.

With that kind of support it was fairly easy to recruit several top performers. Within several months we had a totally different attitude aboard and it was being driven by the Chiefs' Quarters. It was at this point the Captain confided in me that he was finally beginning to enjoy his command tour. The differential between the wardroom and Chiefs' quarters was extreme until the infusion of talent. Although not as uniformly talented as the wardroom one strong leader in each department for the Department Head to rely on, the junior officers to learn from and the enlisted crewmembers to emulate made all the difference in the world. By the end of the year the ship was runner up in the Battle "E" competition.

Pers 42 and NavSea 08 do an outstanding job of providing the quality of officer's required to balance the talent in each wardroom. Our ship had come off of several difficult events and in turn was given the talent needed to get the ship to where it needed to be. It was evident and the subsequent success rate of these officers verifies the talent and motivation of the officers detailed to this ship.

On the other hand the enlisted detailers stay focused on the rate and there is little opportunity for an *across the board* assessment of talent at the CPO/LPO level. My supposition is that the phenomenon experienced on that SSN was driven by the ship's reputation. The waterfront sailor knows which ships are successful and which are having difficulty. If a successful LPO/CPO candidate is asked where he would like to go and given the choice between the "E" boat and the bottom of the pile—he chooses excellence. The result is that those who go the *bottom boat* are often only the average performer. As a result the downward spiral can continue unabated until drastic measures are required. I am not advocating a change in the detailing process. We need to allow our sailors the choice of where to go for myriad positive personal reasons. On the other hand there is a strong need for some intervention on behalf of the submarine that is having some difficulty. I think the key to that is an overall level of awareness of the quality of the CPO quarters on each of the units. An over abundance of mediocrity will perpetuate the present level of performance rather than a drive for excellence.

The second aspect of this phenomenon is the cross-deck process. It would appear that this process is used much less today than several years ago. This is a valuable and necessary element of continuing to keep the boats manned and is used very sparingly to ensure the minimum of personal upheaval. However, if one unit needs a fill (and those units that struggle often seem to need more) the providing unit seldom gives up the top performer. Thus the unit in trouble seldom gets the *first round draft choice*.

In my encounter with this issue on our ship, I thought this was my own special problem to solve as XO. Several years later, while serving as Deputy at a squadron on the West Coast, I became reacquainted with this phenomenon. From this position, I had the opportunity to look across the squadron and noted a startling similarity on one of our SSNs. The ship had a reputation of being an *unhappy* ship. The Commanding Officer was brilliant with a uniformly outstanding wardroom. The ship performed the mission very effectively and had a lot to be proud of, yet there was not an atmosphere of success. It was a struggle to achieve a consistent level of performance and the CO was frustrated. He was focused on the COB and felt he was not being supported and that the COB was ineffective.

On a hunch the CO and I pulled all the CPO records and I did a comprehensive comparison. There were few strong leaders and again there was an overwhelming majority of average performers among the enlisted leadership. The standard was set by the wardroom but was not being transmitted by the CPO Quarters and the COB was unable to initiate change. The sheer will power of the CO and the talent of the wardroom were running the ship but things were not improving. A captain for the submarine detail desk in BuPers was in town on a waterfront tour and listened intently to the situation. Upon return to DC he did a similar analysis and agreed in principle. With his support the squadron staff specifically *recruited* several new talents for the ship in question, being careful to distribute them in all departments. The change in the ship was near instantaneous. The wardroom could make the ship perform but without the CPOs, long-term improvements were extremely difficult.

In these same months another SSN was in the midst of a long, frustrating and difficult WESTPAC tour. Eventually, CTF-74 and the Squadron Commander lost confidence in the CO and as the Deputy I was sent to Japan to assume command. The ship had had enough riders and *help* but essential elements of safe submarine principles were not improving. The ship had a reputation for having a run of *bad luck* and it was my impression that the ship was making a portion of her own luck.

The Squadron Torpedoman (TMCS (SS)) had been sent to the ship several months earlier as the new COB. The staff knew the ship needed some help and he wanted the challenge. He was the right man for the job. He was an aggressive, knowledgeable and intensely determined individual and it was felt that he would be part of the solution. He was extremely talented, but he may have been too little too late.

I met with CTF-74 upon my arrival in Yokosuka and he assured me I had his support to do what was required to get the ship underway and operating safely. Upon reporting aboard I had a long chat with the XO and COB. The COB's perspective was that the officers were talented but not working up to their potential and the CPOs were not involved in solving the problem. The COB and I reviewed the CPO quarters' service records and found that there was a preponderance of *average* among the Chiefs. We decided to divide and conquer. He would focus on the CPOs and I would concentrate on the wardroom. The ship had a rough reputation and the CPOs were generally weak performers backing up a uniformly above average wardroom.

A unique example jumped out at me. One Chief was TAD to CTF-74 because each time the ship got underway he was medivaced for medical reasons but no long-term solution could be determined. I felt strongly that the CPOs were needed on board and if they could not sail they couldn't be assigned to this ship. I asked CTF-74 to return him to San Diego and directed the senior E-6 to assume leadership in the division. Within several days the entire division had a new attitude and took on the task of preparing the ship to get underway. They knew who they were working for and that they were all going to sea as a team.

The COB and I had a personal discussion with each CPO/LPO. They were all given a choice: they could return to their homeport, no questions asked, or they could stay on board and do their jobs. If they stayed, they were going to do it the COB's way. If the COB didn't get what he needed that individual was going home from the nearest port at which I could get him off. The message was clear.

Within several days I decided to send an additional CPO back home and assigned the senior E-6 to duty as LPO and recovery began. The remaining LPOs were offered a choice: perform as CPO or go home. The COB and I took several of the newer LPOs who had potential but were mired in the overall attitude of mediocrity, behind closed doors. When strong CPO leadership was demonstrated (or excessive weak leadership eliminated) change began to take place.

In all these cases the impact of strong CPO leadership from at least one man in each department led to an overall positive impact. In all cases CPOs exhibiting strong enlisted leadership challenged their peers and inspired the crew. The CO was allowed to focus on the tactical and operational training of the wardroom and crew while the CPOs maintained the day-to-day management details of the divisions and watch sections. The COB and EDAA enforced leadership and accountability and the crew *got the message*. The training of the JOs quickly returned to normal with *tactics from above* and divisional *management, training and maintenance* from below.

These examples indicate that when a unit begins to falter and develops a negative reputation, many good LPO/CPO candidates have already plotted an avoidance course. It is appropriate for the Squadron staff and the Force N-1 to monitor these situations. They will need the support of the placement and detailer offices to affect some changes, but the difficulty is that the farther away from the water front the more difficult it is to see the problem. Whatever the mechanism, the bottom line is that when a unit is struggling, **strong leadership in the CPO quarters is a key to recovery.** The waterfront reputation is what controls much of the detailing requests and it is up to the waterfront leadership to detect a migration of talent away from certain units. Keeping the talent balanced will give all the units a better opportunity to perform to expectations and create positive on board environments for professional growth and career development throughout the Submarine Force.■

HEAD OF THE MALACHITE DESIGN BUREAU ABOUT THE NEWEST RUSSIAN SUBMARINE GEPPARD

by Dr. George Sviatov
Captain 1st Rank Russian Navy(Ret.)

After commissioning in Severodvinsk on December 4, 2001 of the Russian Navy's first nuclear powered attack submarine of the 21st century, GEPARD (Project 971, Bars or Acula class), sailed from the White to the Barents Sea. She arrived at the North Fleet's Submarine Base in Gadjievo on December 21, 2001, and is now in operational status.

A couple of months before her commissioning, on October 9, 2001, a correspondent of the Saint-Petersburg Vedomosti, newspaper, Igor Lisotchkin, took an interview from Vladimir Nikolaevitch Pyalov about that submarine. He is the Head and General Designer of the Saint-Petersburg Sea Bureau of Machine Building (SPSBMB) Malachite. He is also Laureate of the Russian Federation State Prize.

Q - It is impossible to say that Malachite gleams on pages of the press. On the one hand, in your bureau worked Peregudov, Isanin, Tchernishov and other great shipbuilders, and many projects of underwater ships were born in it. On the other hand, I am afraid that the name of your bureau would be unknown for many of our readers.

A - We, former Special Design Bureau-143 (SDB-143), are a half century old. During those decades our business has been the same—to create the base of the contemporary Navy. Our nuclear submarines, which combine stealth, mobility and strike power, are capable of operating in any area of the World's Ocean, without the necessity to provide even a regional domination on sea and in the air. It is difficult for me to say what your readers know about our Bureau. But its projects and deeds are represented sufficiently in scientific, historical and memoir literature. And Malachite uses its own series of books Underwater Shipbuilding: Past, Present, Future. We published 15 of them.

We have a lot to speak about. The first native nuclear submarine (Project 627) was built by our project. Ballistic missiles were launched for the first time from our submarines: in 1955 from sea surface, in 1960 from underwater. And in 1962 our submarine

LENINSKY KOMSOMOL for the first time in the USSR twice sailed under ice of the Arctic Ocean above the North Pole and later three times surfaced on that point.

Q - The bureau is specializing in the design of so called multipurpose submarines. Vladimir Nikolaevitch, please, explain for our readers, what does that term mean?

A - The submarine ships are divided in the two categories. One of them is strategic missile carriers. Their task is to take positions in the World Ocean clandestinely and to be ready to strike an aggressor by a crucial retaliatory nuclear blow. The other category are such submarines which are capable to search in the ocean and destroy any underwater and surface ships of an enemy, to strike land targets with high precision weapons, to provide intelligence, mine laying and a number of other functions. They are called multipurpose submarines. By the way, these submarines are escorting the underwater strategic missile carriers to battle patrols to safeguard them from possible dangers.

Q - It is known that Malachite realized the projects of the third generation nuclear submarines: Bars class (by NATO classification Akula) is one of the third generation. Is it true that these submarines are the best in the World in comparison with other submarines?

A - That's true. And it is not a bragging of the bureau's general designer and head. It is generally accepted. The foreign scientific and technological literature devoted a number of good words in the most superlative degree to the Bars. Fourteen such submarines have been built: seven in Komsomolsk on Amur and seven in Severodvinsk. GEPARD is the last launched submarine of that class.

Q - What is her difference from an ordinary Bars?

A - Ordinary Bars do not exist. As a matter of fact, any submarine is built over a long time—several years. During that time the situation in the World Ocean changes, new scientific ideas, kinds of weapons and means of their use appear. So, we need to improve a building submarine. There are government documents, which order us, designers, to do it. And each new submarine is not a simple repetition of her predecessor. Approximately same practice exists abroad. For example, Americans from the beginning of 1970s were building a very big series of Los Angeles class attack submarines (we call them Leses). Class is one but ships are different, because of the fact that their project was modernized significantly five times. To speak about GEPARD, she accumulated all the experience of underwater shipbuilding, last achievements of military science and technology.

Q - In NATO your SSN is called Akula-2…

A - I don't know what to answer… Probably it would be correct to say Akula-3. But it is business of NATO specialists, let them do it.

Q - Some people say that GEPARD is the fastest and noiseless submarine… The Chief Ministry of Defense supervisor on the Sevmash Captain 1 Rank Pavel Nitchko said: "Now we can say with pride—there is no such second submarine in the world, which has such tactical-technological characteristics as GEPARD. But there were times when Americans called our nuclear submarines *roaring cows* and were convinced that they could detect their movements with sufficient accuracy. By the way, it is clear that it is very important *who follows whom in the ocean*. And in one nice time Americans discovered with amusement that they did not follow somebody, but somebody followed them? When did that happen?

A - In 1980s with appearance of Bars. Till that time we could not solve the problem of stealthness. But all of our submarines always had high speed.

Q - Problem of low noise propellers? There were a lot of talks…

A - Many people thinks so, but it is not quite correct. Certainly the role of a propeller is significant. But its noise appears only on high speeds. The turbine and hundred of submarine's mechanisms produce noise. And not because of designers' mistakes. American submarines had less noise levels because of more perfect culture of production in comparison with our culture. We quarreled a long time with our producers demanding absence in all mechanisms of unbalances and eccentricities, which generate not only noise but also resonance of adjacent parts of a submarine. The same task was put to industry by the country's government bodies. Not immediately, and not fast, but we managed to solve that problem completely. Our first Bars was a low noise submarine, but during building of all the series the noise level of GEPARD was reduced by 3.5 times. And the picture had been changed. Do you remember the case when our submariners transferred a sailor with peritonitis to the British sailors. English military sailors were impressed not by the fact of such a contact. They were shocked for another reason: our submarine had surfaced just in their exercise area and they did not know about her presence there. GEPARD at the working speed, which allows her to scan a sufficiently large area, cannot be detected by existing sonar means. And even when she is increasing speed, she is able to see and hear any potential enemy before he will be able to detect her.

Q - The submarine has a Veveerovsky reactor. One. Why?

A - Use of two reactors on submarines was directed to increase of reliability. But the modernized nuclear power plant OK-650 with one water-water reactor has such power, reliability and safety that there is no necessity for doubling. We go for a long time by that way, it is checked. That is not an innovation.

Q - There were messages that GEPARD successfully passed two stages of the state sea trials, including weapons firings and approbation of all battle systems?

A - I would like to say more exactly: she passed all stages of the sea trials. And with amazing success, practically without deficiencies. Such happens not often.

Q - Now the KURSK tragedy is connected with all discussions about nuclear submarines. What could you tell in that respect?

A - Almost nothing. Malachite did not participate in the investigation of that accident and our designers have not been asked anything. We use the same information of press and television as you. But, if you like to know my private opinion as specialist, I will say: in the death of that ship, there couldn't be guilt of Rubin designers nor her crew. KURSK was an excellent submarine. And the most probable reason of an accident was an improbable, unexpected combination of a number of circumstances, which could happen in a life time of several generations. It is necessary to understand that now nuclear submarines, in our country and abroad, are on such a high level of development that they can be considered as unsinkable. In essence they are such. Many scientists and designers are convinced in that. I would like to say that our submarines of the third generation had no devices which let a diver to speak with the crew, to give the air into a submarine from a surface ship. Because it was considered that there was no necessity for that. The tragedy of KURSK demanded a correction of many views in the shipbuilding area...

Q - Journalists tried to get the answer for a long time in Severodvinsk to the question: "What kind of changes have been implemented in rescue means of a submarine in a case of a heavy accident?" They were assured that these means made on the highest technological level, but the specialists did not go to details referring to impossibility to say about design details of a submarine. One can suppose that because all on GEPARD was built on *the highest technological levels*, you had no need to implement any changes. Is it so?

A - First of all, I think that sailors' rescue means can not and must not be secret. And second, your supposition is not correct. After well known tragic events we made thorough revisions of all the system of collective and individual submarine rescue means and had implemented noticeable changes. I'll give only one example. In the process of GEPARD building, remembering about difficulties, which the crew of KOMSOMOLETS had experienced with launching into the water of escape rafts, we suggested to equip the submarine by principally new devices. We had gotten objections on our scientific-technological councils. A year ago the objections had been dropped. Now it is sufficient to push a button by a crew member, and powder charges cut out the covers and throw out an escape raft which will be opened automatically. GEPARD has four of such devices. I am sure that the crew never will use them. But it is known that God saves those who save themselves. By the way, even before the death of KURSK we presented proposals about unification of submariners' rescue means on the World Fleets. It would provide a possibility in peace time for one submarine to provide help to another submarine independent of her national identity. Our proposal was not rejected and consideration of it is continuing.

Q - But you work in such an area where contacts between designers are hardly welcomed?

A - Why not? Such contacts exist. For example, we met with American colleagues. They chuckled for a long time on super secrecy, which surrounded our activity. Then our military sailors invited Americans on our submarines and showed them in *alive* shape.

Q - But isn't it fraught with serious consequences?

A - It is not. Design of a submarine, her arrangements are made according to well known laws of shipbuilding. Secrets are in many know-hows, which concentrate in her mechanisms, aggregates and devices. But they are impossible to watch. And designers are tactful people, they do not put improper questions. Americans promised to show us their submarines. But until now they did not find resoluteness. So now we are chuckling.

Q - Some people are saying firmly that the Russian President will participate in commissioning GEPARD...

A - That decision is up only for the President. But there are such hopes on the North Fleet, on Sevmash and on Malachite. The more so, that Vladimir Vladimirovitch was acquainted with GEPARD. In October of 1999, when he was yet the Prime Minister, he sent her out from # 55 assembly shop to sea trials.

Q - I visited Malachite three years ago. The Bureau was then in such difficult financial situation that it seemed it could not be worse. Now, as I understand, the situation is better?

A - Yes, we think that the most heavy times are behind us. Our industry began to *breathe* and our clients were able to return to us their not small debts. In addition, our Bureau participated successfully in some tenders of conversion projects. One plant of our design was bought by Belorussia. Iran expressed interest in it... Certainly, we would like to live better, but it is a sin to complain today.

Q - During the last years you created a number of interesting projects: from underwater icebreakers to a theater on water. Without any hope for financing. What is it? Stubbornness of professionals?

A - Let us consider a well known phenomenon in today industry. With its reviving a little bit, there immediately appeared the deficit of professionals. Qualified turner, welder, fitter—on gold weight. Enterprises entice them...

And a more critical situation, if not to think about it, could appear in science and designing. So, we tried not only to preserve a collective of highly qualified specialists (that we had done) but also to work on the projects (in particular for development of the sea shelf) and scientific ideas related with long range prospects. I am sure that Russian economy will raise from its knees and it is necessary to be ready to do it.[1]

In his interview Vladimir Pyalov also presented general tactical and technical characteristics of his new submarine:

- Nuclear submarine GEPARD
- (K-335, Project 971 Saint-Petersburg's Sea Bureau of Machine Building Malachite)
- Chief designer: Georgy Nikolaevitch Tchernishov (since 1977: Yury Ivanovitch Farafontov)
- Category: multipurpose
- Class: Bars
- Laid down: 1991
- Length: 113 m
- Beam: 13.8 m
- Draft: 9.6 m
- Surfaced displacement: 8,470 tons
- Submerged displacement: 13,800 tons
- Number of compartments: 6
- Crew: about 80 men
- Maximum speed: more than 30 knots
- Time of autonomous sailing: more than 3 months
- Weapons: torpedoes and missiles with warheads of various types, high accuracy weapons, mines.[1]

Commentary to the Interview

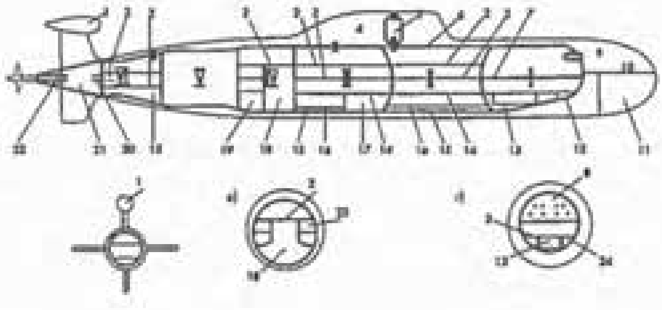
The interview of Vladimir Pyalov is the honest and high quality product of a distinguished professional. He is also Chief Designer of the fourth generation Russian SSN or SSGN SEVERODVINSK, which is being built in Severodvinsk for several years. It is possible to agree with him that GEPARD (Project 971 submarine) is the best in that class of SSNs of the Russian Fleet. As a responsible high official he did not give GEPARD's diving depth and full speed. They are known in professional literature: test depth-600 m and maximum speed-up to 33 knots. He also did not give a number of her torpedo tubes (4-650 mm and 4-533 mm) and number of torpedoes and torpedo size missiles (40) 12-650mm and 28-533mm and type of her sonar (modernized Scat-3).[2,3]

So, it is probably correct that GEPARD is more effective in comparison with an American serial SSN, even of 688I flight. But she is probably a little bit inferior in comparison with the U.S. Seawolf class submarines (the same number of torpedo tubes, number of weapons 40 and 50, speed 33 and 37 knots (hp-50,000 and 60,000) with approximately the same test diving depth, some 600m. The advantage of GEPARD is her 6 compartment architecture, up to 30 percent reserve buoyancy and surface unsinkability with any one flooded compartment. Minus: bigger underwater displacement (13,800t compared with 9,150t) and less speed.[2-3]

The assumption of Vladimir Pyalov about participation of the Russian President in commissioning of GEPARD had been fulfilled. On the 4th of December, 2001 Vladimir Putin christened GEPARD in Severodvinsk.

It seems that in only one aspect about the cause of the KURSK's tragedy he showed himself more as a diplomat but not an independently thinking chief designer. It is understandable. On GEPARD the control room is also in the second compartment, although in principle it could be the third compartment. And his remarks about liquidation on the Russian third generation submarines devices to provide air into a damage submarine, which is laying on the bottom, and communicate with her and a diver as unnecessary, are very questionable. He also did not tell a word about danger of using 650mm 65-76 torpedoes with kerosene and hydrogen peroxide as fuel and oxidizer (one of which was the established cause of the KURSK death), because GEPARD will carry other similar and, might be, the same torpedoes.

The architectural scheme of a Project 971 submarine is shown below.[4]



1) towing sonar antenna; 2) first deck; 3) second deck; 4) sail; 5) conning tower- surfacing escape chamber; 6) pressure hull; 7) deck of the torpedo room; 8) torpedo room; 9) flooding part of bow; 10) bow part; 11) place for Scat-3 sonar antenna; 12) bow different tank; 13) electric storage battery; 14) third deck; 15) hold; 16) fourth deck; 17) internal tanks; 18) reactor room; 19) pumps room; 20) deadwood tube; 21) helm compartment; 22) stern different tank; 23) non-passing corridors; 24) tanks of torpedo complex.[5]

The figure shows a six compartment naval architecture of the submarine, which with about 30 percent reserve of buoyancy provides one compartment surface unsinkability and two spherical bulkhead and the surfacing chamber, which give all her crew a possibility to surface from the depth 200 m.

Pictures show the absence of the stern gondola (1 on the figure) for the towing sonar antenna. In its place is a small device, through which the towing antenna is directed from space between pressure and outer hulls.

In conclusion it should be mentioned that Vladimir Pyalov did not say a word about the Project 885 Severodvinsk class newest Russian SSN or SSGN submarine, on which he is Chief Designer. The submarine had been laid down in Severodvinsk in December of 1993 and had to be commissioned in 2000.

She had to have several new conceptual and naval architectural decisions: first in the Soviet and Russian submarine history spherical bow sonar antenna, eight again only 533mm side torpedo tubes with 40 torpedoes and torpedo size tactical missiles and eight vertical, some 2m diameter, tubes in a separate compartment for strategic long range cruise and possible ballistic missiles.[6-7]

But probable difficulties with implementation of such decisions and competition from Projects 971 attack and 941 and other project ballistic missile strategic nuclear submarines, did not allow fulfilling or postponed the plans of 1993 about SEVERODVINSK.■

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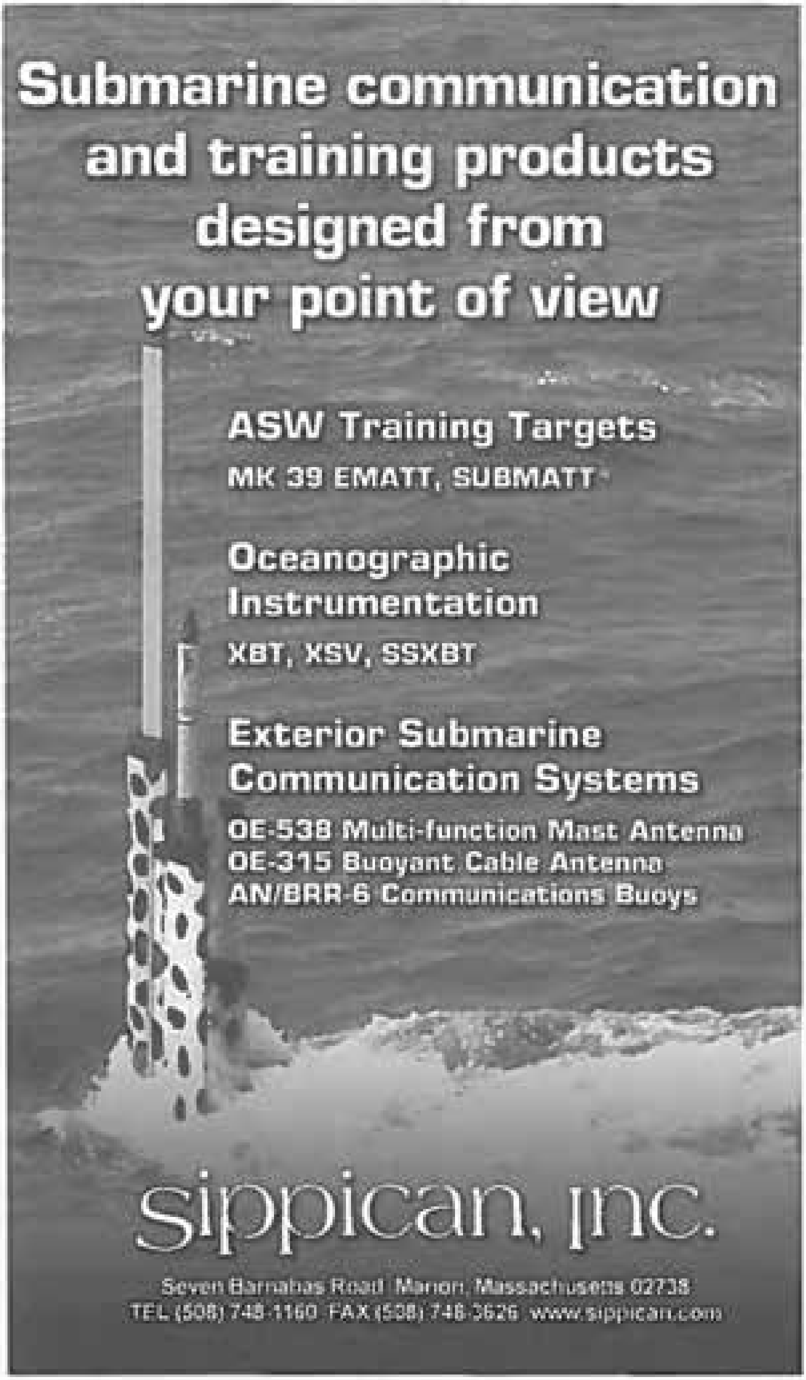

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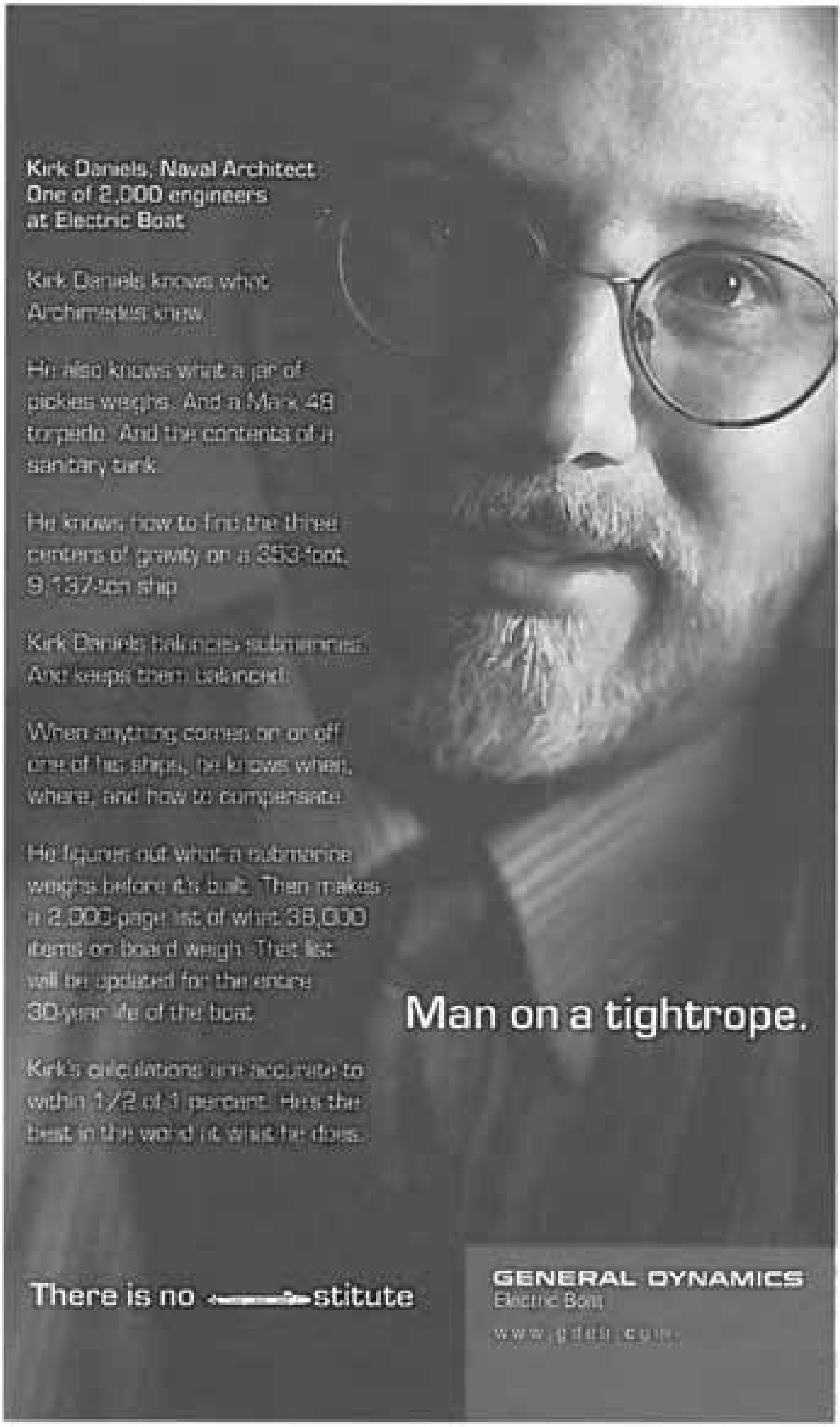

Kirk Daniels, Naval Architect
One of 2,000 engineers
at Electric Boat
Kirk Daniels knows what Archimedes knew.
He also knows what a jar of pickles weighs. And a Mark 48 torpedo. And the contents of a sanitary tank.
He knows how to find the three centers of gravity on a 353-foot, 9,137-ton ship.
Kirk Daniels balances submarines. And keeps them balanced.
When anything comes on or off one of his ships, he knows what, where, and how to compensate.
He figures out what a submarine weighs before it's built. Then makes a 2,000-page list of what 38,000 items on board weigh. That list will be updated for the entire 30-year life of the boat.
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Man on a tightrope.
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SUBMARINE BELLS TO SONAR & RADAR
SUBMARINE SIGNAL COMPANY
(1901-1946)
Part II

by John Merrill

Part I of Mr. Merrill's article appeared in the October 2002 issue of ***THE SUBMARINE REVIEW.***

In the years immediately following the Armistice, many of the various detecting equipments developed during the war years saw continued and broadened use for the next decade. Devices included the previously discussed SC-tubes, Y-tubes, Fessenden 510 Hz oscillators, and the MV-tube. The MV was one of the better multiple carbon button type microphone receiver listening devices developed at the New London Experimental Station. Proposed by Max Mason 3 July 1917, this set permitted the reception of sound waves from a distant source and essentially eliminated the need of using towed devices. By 1929, detectors with improved performance developed by the Sound Division of the Navy Research Laboratory were replacing the SC-tubes with improved performance.

Submarine Signal Company 1920

It was natural that Submarine Signal should continue work related to the detection of sound in the sea. Company assets included 20 years of experience with the submarine bells on a worldwide basis and the extensive WWI manufacture of detection equipment. The Boston-based (Atlantic Avenue) research and manufacturing facilities, 250 employees, and a national and international reputation were further resources of note. The Company also benefitted from the experience gained from the Nahant war related detection research.

Synchronous Radio and Underwater Sound Signaling

The research staff in 1920 at Submarine Signal developed a radio/underwater sound synchronous system to allow the navigator to determine quickly his distance from an underwater warning bell. With the transmission of a radio signal simultaneously with the bell, the delay time in reception of the bell made it possible to calculate the distance of the ship from the bell. Two years later, a device for receiving returning sound echoes, amplifying them and computing the time interval and distance automatically, appeared.[40]

It should be noted that by 1921 interest in radio beacon warning systems, independent of underwater sound, increased. By 1928, the U.S. Lighthouse Service placed an automatic radio beacon in service.

Sound Division of the Naval Research Laboratory (NRL)

The primary mission of NRL, established in 1923, was to perform applied research to support naval operations. Through the inter-war years, the Sound Division directed by Harvey C. Hayes provided the Navy's technical leadership in the development of underwater detection systems. The Division primary staff consisted of five engineers and scientists. In addition there were about fifteen NRL support personnel and non-government consultants. This constituted Navy's sole in-house capability to perform research and development in underwater acoustics until the vast expansion during WWII.[41]

Early in 1922, prior to the move from Annapolis, Dr. Hayes developed a sonic depth finder (SDF). The components consisted of a MV tube (the wartime development by Max Mason at the New London center) as a receiver and a Fessenden oscillator as a signal source and a timing device. This effort initiated by Hayes in developing the first practical sounding instrument was a significant step forward in effectively plotting the ocean depths.

Submarine Signal Company's Fathometer Depth Sounder

In 1923, Submarine Signal Company introduced the world's first commercial Fathometer Depth Sounder. It was the first echo sounder to provide accurate, detailed permanent recordings of underwater topography. Based on successful horizontal and vertical sounding experience with the Fessenden oscillator prior to WWI, a successful depth-sounding instrument called Fathometer (registered trademark) was engineered by Submarine Signal Company.

The system included an improved oscillator and other modifications from earlier approaches to depth sounding. Sound waves were transmitted from the oscillator mounted in the ship's skin. The returning echoes were picked up; and the time interval between each outgoing signal and its returned echo was measured, and converted into distance-depth, and displayed on a calibrated clock-like dial by neon flashes so rapid as to appear essentially continuous. System characteristics accommodated measurement of shallow and deep soundings.

In the decades following WWI, depth sounding and echo ranging evolved side by side. The frequencies used for echo ranging and for depth sounding are distinct and both equipments may operate simultaneously. One notable technical difference is the minimum distance requirements. Echo ranging specifies a 50-yard minimum; depth sounding, 4 yards.

Fathometer specifications of the U.S. Hydrographic Office and the Coast and Geodetic Survey required depth measurements to within 5 feet. With sound traveling about 5000 ft/second, time measurement of the order of 1/1000 of a second was essential.

In that era that preceded electronic devices, Submarine Signal Company engineers accomplished precision measurement with accurately-timed electromechanical instrumentation.

Fathometer Users

In 1924, the first commercial Fathometer was installed and tested on Merchants and Miners Transportation Company (M&M) 440 foot liner S.S. BERKSHIRE. A well-witnessed test run of the Fathometer was made from Baltimore, Maryland, to Cape Charles, Virginia. Contours of the ocean floor from 5 to 1500 fathoms were successfully observed with the liner running at full speed. "This Fathometer was demonstrated to the U.S. Navy, U.S. Coast and Geodetic Survey, and U.S. Shipping Board and received their approval for its accuracy and reliability."[42] Installation on some of the ships of the mentioned government activities followed.

The following year, United States Coast and Geodetic Survey (C&GS) obtained a Fathometer designed and built by Submarine

Signal Company. C&GS used the model 312 Fathometer primarily for deep-water soundings. With this system, depths were read by noting the position of a continuously rotating white light at the instant the echo was heard in the operator's headphone. Later, this method was replaced by the red-light method, which utilized a rotating neon tube that flashed adjacent to the depth scale at the arrival time of the echo.

Deep water Fathometer installations were made on the cable-laying ships of All American Cable Incorporated, Mackay, Western Union Cable Telegraph System companies. A May 1925 test of the 1925 Fathometer installation aboard the Western Union Telegraph System cable ship the S.S. CYRUS FIELD prompted its captain, H. H. Bloomer, to write his home office:

> "The Fathometer was left running from 6:40 A.M. to 8:00 P.M. Tuesday and gave most accurate results…The distance covered in dense fog was 630 miles and time taken was 62 hours. This was due entirely to the added confidence that the Fathometer gave me and never before have I proceeded with such little anxiety."[43]

The U.S. Coast and Geodetic Survey installed Fathometers on its oceanographic ships such as the former yacht LYDONIA. With the Fathometers, certain then known and never-before-discovered deeps were sounded. Subsequently, recorded depths ranging from 25,000 to 44,000 feet were found in forty-five locations.[44]

S.S. COLUMBUS[1]

Transoceanic liners were quick to install the Fathometer, often even more than one. German Lloyd's 2000 passenger liner COLUMBUS the biggest ship in the German merchant fleet made its maiden voyage on April 22, 1924. The liner was to serve the North Atlantic crossing from New York to Bremerhaven. Equipment included the Submarine Signal Fathometer echo sounder.

At that time, because of a suspected depression in the ocean

[1] COLUMBUS was sunk voluntarily on April 30, 1939 off Cape Hatteras, in order to escape being captured by an enemy British ship.

bottom in the vicinity of the Nantucket lightship, there was considerable interest in the topography of the ocean there. Captain Johnson regularly set the Fathometer in operation as the area of interest was approached and took a particularly large number of soundings across this area. With his soundings, Captain Johnson could tell his position accurately in approaching the Nantucket Lightship. In the June 1928 *Marine Review*, some of his soundings are plotted on a chart and curves drawn to show the topography. The Captain was also the first to adopt the practice on his "westward" course and "eastward" return path (30 miles south) of checking the deep water Fathometer readings with those indicated on the official North Atlantic hydrographic chart.[45] In both clement and inclement weather, the Fathometer soundings provided navigational assistance.

V-Class Submarine

The first three submarines of this class were launched in 1924-25 with an additional six more by 1933. A new device installed on V-3 was the electro-acoustic Fathometer developed by the Submarine Signal Company. For the first time, it gave the submarine the capability of measuring the depth of water under the keel accurately and instantaneously.[46]

1927

By 1927, a Fathometer recorder was developed that used a stylus to plot and preserve the Fathometer depth readings on charts.[47] A new model Fathometer was introduced to meet the needs of small pleasure and commercial boats. In addition to visual depth readings, recorders adapted for four depth-ranges were available for:

- normal needs (in feet and fathoms)
- meeting deep-ocean survey measuring (in fathoms)
- shallow-depth harbor and river precision requirements (some versions in inches and others in feet)
- small boat simple inexpensive needs (visual in feet, recording in feet and fathoms)

The famous racing schooner ATLANTIC, equipped with a

Submarine Signal Fathometer used the device successfully during a New York-to-Bermuda competition event. It was found that even under a 30-40 degree angle of the hull when careening under full sail, visual and recording Fathometer signals were not impaired.

Naval Institute Proceedings February 1943 article "Sonic Sounding" noted "...by 1929 the U.S. Hydrographic Office was receiving reports of deep-sea sounding daily. At that time, practically all ships had been equipped with sound depth apparatus of the Fessenden type, developed by the Submarine Signal Corporation."

The Woods Hole Oceanographic Institution (WHOI) Fourth Annual Report of the Director for the year 1933 cited the Submarine Signal Company. "Selecting a fathometer for the research vessel ATLANTIS, after investigating the merits of different types, the "Fathometer" manufactured by the Submarine Signal Company was selected and installed May 1932 on *Atlantis*...This machine has given satisfaction for soundings as deep as 3000 fathoms."

A July 25, 1935 accounting of Submarine Signal Company's Fathometer implementation emphasizes the widespread acceptance of the instrument. At that time, the Fathometer was operating on 649 vessels of various sizes and speeds, and 133 equipments were on order. In the table below, 393 American vessels were equipped and 91 equipments on order for American ships.[48]

Vessels Equipped with the Fathometer

Class of Service	Number Equipped	Number on Order	Total
Merchant Marine	202	25	227
Trawlers	217	16	233
Yachts	49	-	49
Cableships	4	1	5
Government Vessels	140	86	226
Survey Vessels	37	5	42

Listening Installation

Late in 1927 Submarine Signal made and installed for the War

Department a passive submarine warning system at the approach to New York harbor via the Long Island Sound route. The system was implanted at the east end of Fishers Island off Fort Michie, an outpost of Fort H. G. Wright. Equipment consisted of a 36-spot (microphone) passive listening arrangement. Submarine underwater characteristic hull swishes were detected and the location and moving direction identified.

Echo-Ranging in Post War Period

Developing echo-ranging equipment at this time had the benefit of the hurried WWI submarine detection research as well as real wartime antisubmarine implementation of techniques and strategies. Foremost among the wartime efforts was the application of piezoelectric materials as suitable transducer material and in the use of ultrasonic frequencies for detection. These concepts were investigated and demonstrated but not brought to the equipment level during the war years.

Immediately after the war, quartz and Rochelle salt continued to receive attention. Magnetostriction for use as a transducer followed later. However, the level of support and interest in submarine detection research and development lessened. In the mid-1920s, the Navy was specifying ultrasonic frequencies for accurate short-range detection. System designs stemming from Langevin's work operated at frequencies of the order of 40 kHz. Earlier Langevin demonstrations witnessed by U.S. Navy ASW officers in October 1918 of equipment aboard a ship at Toulon detecting a submarine created further interest in ultrasonic detection. The demonstration included submarine detection at 1000 and 2000 yards and communication out to 800 yards.[49] Additional advantages of working with higher frequencies included avoidance of ocean noise and improved amplification of echoes.

In 1926, a Langevin quartz steel projector was tested in Boston with Langevin in attendance. During the next three years, Submarine Signal Company designed; built and tested improved types with quartz steel and magnetostriction projectors. Magnetostriction projectors offered the ability to handle high power without fracturing. Attention during these years was also directed toward developing Rochelle salts transducers.

NRL Sound Division Echo-Ranging Equipment.

In the inter-war period regarding equipment, "The Navy equipment was designed by the Bureau of Ships and the Naval Research Laboratory (NRL) and was manufactured by the Submarine Signal Co. at an approximate annual rate of 14."[50]

NRL designed and developed a variety of echo-ranging equipments, nearly all operating in the ultrasonic range between 10 and 50 kHz. With bearing and range capability these were an improvement over the earlier acoustic detectors. These experimental systems installed on naval vessels during 1927 had ship speed and range limitations. Later, a series of active sonars involving quartz, Rochelle salt, and magnetostriction transducers evolved from the work at NRL. The principal contractors supporting the Navy Laboratory prior to the WWII years were:

Submarine Signal Co.[2]	Equipment manufacture
Brush Development Co.	Rochelle salt crystals
B.F. Goodrich Rubber Co.	Watertight transducer housings

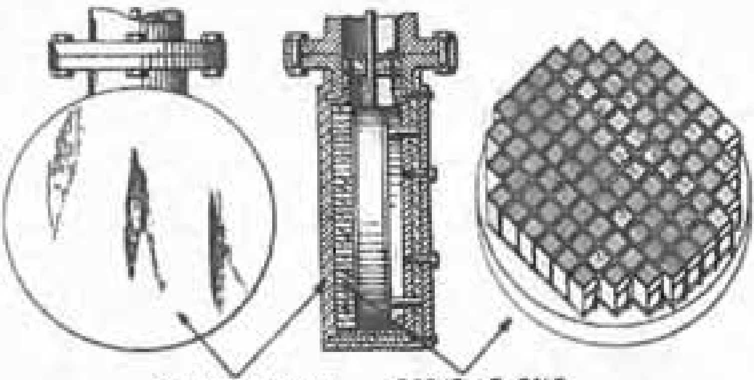
Submarine Signal Echo-Ranging Production

With the Navy building 97 destroyers and 45 submarines during the 1930s, commercial production of some of the Navy-designed detection equipment was assigned to Submarine Signal Company. The Company soon became a significant manufacturer of the Navy's detection equipment prior to and during WWII. Through 1943, Submarine Signal Company was the dominant supplier of echo sounding and echo ranging to U. S. Navy. Competent naval authority stated that over 90 percent of WWII submarine sinkings involved Submarine Signal Company apparatus.[51]

During the late 1920s and early 1930s NRL developed a series of echo-ranging devices, some of which were in production at Submarine Signal Company by 1933. With continued improvements such as streamlined domes, operation at speeds of the order

[2] A pertinent comment is made in *Seek & Strike*, "The relationship between this commercial firm, specializing in underwater acoustics, and NRL was particularly close."

of 15 knots were achieved. These equipments and their variants with suitable adjustments were installed on destroyers and submarines.



E. Klein, ONR Report ACR-135
Sept. 1967, p. 25

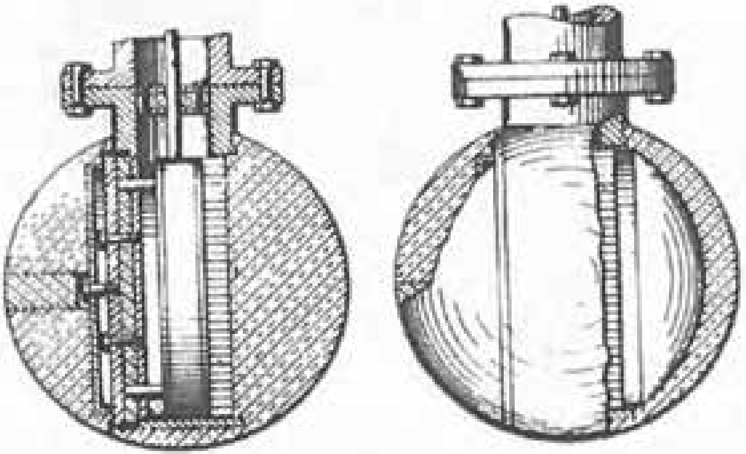
Rochelle salt crystal array (JK)
End and side views, diameter – 15 inches

QA, the first NRL echo ranging system was completed in 1927. One-mile submarine detection was achieved off Key West, Florida. Eight QA systems were installed on destroyers.[32] QB echo-ranging device, Production for submarines of the QB echo-ranging device included 20 at the Washington Navy Yard and 33 at Submarine Signal Company beginning in 1933. Starting in 1934, Submarine Signal QC production was set at six for submarines and six for destroyers each year.

Range, frequency and speed are approximate in the table.

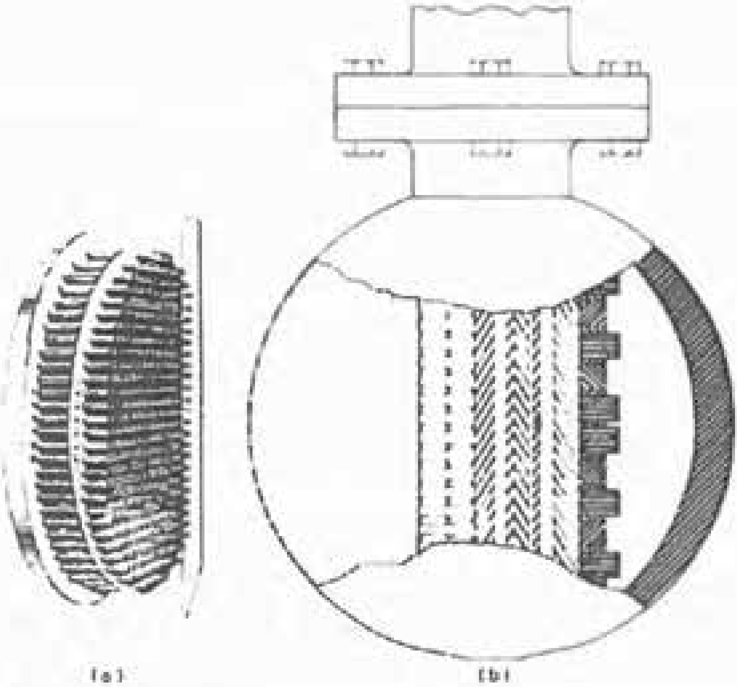
Type	Piezoelectric Material	Range Yards	Frequency kHz	Speed Knots
QA	quartz	4000	20-40	3 to 4
QB	Rochelle salt	5000	13-32	up to 15
QC	Magnetostriction	10000	18-24	up to 15

The QC magnetostriction system accompanied with Submarine Signal Company NM magnetostriction depth finder was installed in 1933 on the destroyers DEWEY and FARRAGUT. QC systems became the standard on U.S. destroyers during WWII. QB systems with Submarine Signal's NG depth equipment were installed on submarines CUTTLEFISH and CACHALOT the same year. QC, with a power output of 400 watts, surpassed the lower power capability (20 watts) of the QA and QB systems.



E. Klein ONR Report ACR-135, p. 25

Rochelle Salt crystal echo-ranging device (QB)



E. Klein, ONR Report ACR-125
Sept. 1967, p. 26

Two transducers in one housing
(a) Magnetostriction tube array (QC)
(b) On the right Rochelle salt (JK)
Assembly built by Submarine Signal Company

About fifty different WWII sonar systems were derived primarily from the QB and QC configurations. QC derivatives appeared in as many as 40 systems. Through 1943, Submarine Signal Company was the only supplier of echo sounding and echo ranging equipment to the United States Navy.[33]

Bathythermograph–Sound Instrumentation

Understanding how the ocean moves and mixes heat requires accurate and continuous measurements of temperature as it changes with depth. Whether sound waves in the water will be bent upwards or downward is a function of the ambient temperatures. In 1936 at MIT, Carl Gustave Rossby and Athelstan Spillhaus developed prototype instrumentation to make temperature depth profiles. Sea tests of the new instrument took place under the aegis of WHOI.

The following year, the device then called bathythermograph (BT) was taken to sea for tests on the WHOI's research oceanographic vessel ATLANTIS with Spillhaus aboard. Initially, a potential user list for the new device consisted of biologists, oceanographers and the fishing industry. Columbus Iselin a scientist at WHOI discerned a role for the BT in connection with the underwater detection of submarines.

In late August 1937, the WHOI oceanographic cruise in addition to BT data collection made sound-BT detection tests in conjunction with a U.S. Navy submarine and the destroyer USS SEMMES, a Navy experimental sound vessel attached to the Navy Research Laboratory (NRL). During this cruise, south of Guantanamo Bay, Iselin and L. Batchelder of Submarine Signal Company investigated a continuing problem of deterioration of sonar range in the afternoon.

Suspicion that the detection equipment operators were at fault was examined. Managing the noontime diets of the operators to maintain peak-operator performance did not prove fruitful, nor did measurements of other ambient parameters and their examination. Extensive collection and examination of sea temperature data[34] led to the realization that temperature gradients in the water where the sound was travelling were responsible. The gradients were either bending the sound wave downward, reducing range, or upward, producing skip. The results were confirmed by data collected the following summer. Correlation of "afternoon effect" range reduction and thermoclines became clearer.

The BT provided a practical instrument for quickly gathering this essential ambient information related to sound propagation in seawater and demonstrated the potential importance of the BT in underwater sound detection of submarines and for submarines to avoid detection. The relationship between the thermal layers of seawater and the propagation of sound waves was perceived.

With oceanographic and Navy uses of the BT established, WHOI oceanographer Columbus Iselin consulted Submarine Signal Company's vice president H. J. W. Fay concerning the manufacture of BTs. Iselin commented on the meeting.

> "Mr. Fay is terribly interested in the whole scheme (sic) and has turned over to us the full facilities of their shops and engineering experience."[55]
>
> "Fay agreed to develop the bathythermograph because his company wished to maintain its long-standing reputation in the ocean instrument field."[56]

On August 10, 1938, Submarine Signal Company filed for a patent on the BT and began production. The patent was in Spilhaus's name but Submarine Signal Company received the rights to the design. On May 29, 1941, the U.S. Patent Office applied a secrecy order on the original patent of the bathythermograph because of its importance to the Navy.[57]

War Years

In mid-1940, World War II was nearing the end of its first year. U-boat shipping losses were about 8 ships per month and rapidly increasing to an eventual 143 per month in 1942. Vannevar Bush's National Defense Research Committee (NDRC) came into being June 27, 1940 with President Franklin D. Roosevelt's concurrence. This made it possible to broadly pursue efforts to conduct scientific research to create new tools to prosecute the national defense. In regard to the current status of tools for antisubmarine warfare (ASW), it was recognized that they were limited. Supersonic submarine detection equipment worked out to several thousand yards only under favorable conditions.[58]

Coinciding with the start of the NDRC, the Secretary of the Navy asked the National Academy of Sciences (NAS) to advise him on the scientific aspects of the defense against submarines and the adequacy of the Navy's preparations. E. H. Colpitts, recently retired as vice-president of Bell Telephone Laboratories and World War I submarine detection investigator, led a committee to develop recommendations. For two months, the committee visited Navy ships, shore activities, and the Submarine Signal Company.[59]

Washington Navy Yard and Submarine Signal were the important builders of the Navy's submarine detection equipment in 1940.

On January 28, 1941, Colpitt's recommendations included the need for immediate broad scientific and engineering investigations for the development of equipment and methods involved in submarine and subsurface warfare. Under the auspices of NDRC, three dominant laboratories were established to enhance the ability to improve the underwater sound aspect of ASW. NDRC contracts with Columbia, Harvard and the University of California resulted in new research laboratories in New London, Connecticut; Cambridge, Massachusetts; and San Diego, California. Further, "Production facilities of the Submarine Signal Co. and Radio Corp. of America were greatly expanded. Other companies such as the Bell Laboratories, the Western Electric Co., and the Bludworth Co., established additional facilities and began supplying sonar's equipments and accessories."[60]

<u>Radar at Submarine Signal</u>

A 1946 book "*<u>Radar</u>*"[61] in the chapter titled "Who Invented Radar?" lists some American companies active in radar research and development during WWII. The list includes Submarine Signal Company as well as Sperry Gyroscope Company, Bendix Aviation Company, Federal Telephone & Radio Corporation, and others. At Submarine Signal Company, interest in and research for new applications for radio began in 1920 and grew during the 1930s,as shown below by the radio related patents of some of the engineers during this period.

Starting in the 1920s, Submarine Signal research interests moved to radio applications. Initially the research involved paralleling radio use in ways similar to the Company's applications of underwater sound. An example is the previously-mentioned 1920 synchronizing radio and underwater sound signaling research. Certainly, radar was not anticipated at this early date. By the time of the advent of radar in late 1930s, the acquired competence of the Company's engineers was a unique asset.

Some Significant Submarine Signal Company Radar Related Patents[62]

Patent No.	Subject Indication	Issue Date	Engineer
1,923,976	Portable distance finder	8/23/33	H.V. Hayes
1,924,156	Pulse-echo radio distance finding system	8/29/33	R.W. Hart
1,194,174	Radio altimeter	8/29/33	E. Wolf
1,979,225	Cathode ray tube distance indicator	10/30/34	R.W. Hart
1,982,271	Intensity modulated cathode ray tube radio altimeter[3]	11/27/34	E.E. Turner
1,993,326	Frequency modulated radio altimeter	3/5/35	R.W. Hart
2,010,968	Radio course and distance indicator	8/13/35	E.W. Smith
2,143,035	"A" scan distance indicator	1/10/39	E.W. Smith
2,407,272	Thyratron modulator	9/10/46	M.M. Hart
2,407,273	Radio altimeter, grid keyed	9/10/46	R.W. Hart
2,407,663	Radio altimeter, double cathode ray tube	9/17/45	R.W. Hart
2,426,501	Multiple range indicator	8/26/47	H.M. Hart
2,448,025	Antenna train control	8/31/48	W.C. Grabau

R. W. Hart's pulse-echo radio distance finding system was disclosed to the Navy in 1929 and a patent application submitted. The following year, NRL's interest in this field increased after a plane flying over Washington, D. C., was detected by radio waves. Submarine Signal, cooperating with NRL, conducted further study of this area of work. In 1933 when Hart's patent was granted in

[3] Using the cathode ray tube in which normally electron beam is suppressed except at the time of the receipt of the incoming signal, at which instant an indication is produced, a feature which is now used in all Plan Position Indicator Radar.

1933, the Company was requested by the U.S. Navy to keep the invention "secret as well as all related future research."[63] The Company complied and transferred to the U.S. Government while a number of patent applications were pending. At the same time, the Company refrained from filing relevant foreign applications.

Granting of some of the patents took interesting paths. For example, on June 26, 1942, Submarine Signal Company Engineer B. M. Harrison invented a sonar device and filed for a patent under Public Law 700. It was kept secret for many years. By March 16, 1955, the patent was ready for issue but by that time the patent for an Attack Plotter was allowed for radar as well as sonar.

By the 1939, Submarine Signal radar related advances included:

- Using shorter wavelengths
- Modifying radiating and receiving antennas
- Improving radio beam directivity
- Facilitating the design of keying impulse amplifier
- Developing waveguide phase displacement along acoustic compensator lines

Microwave antenna research by Wilmer L. Barrow and Frank Lewis at MIT by 1939 discussed using directed horns to obtain predictable beam patterns. Further, when two horns were used, isolation between transmitter and receiver was improved. At Submarine Signal, Harold Hart, physicist, was asked to take over the radio echo ranging research and to try to use the new MIT developments.

Hart constructed a radio echo ranging system using a circular sweep cathode ray indicator, a Thyratron modulator and a triode transmitter operating at 50 centimeters. The antenna was a pair of sectored horns manually rotated. These horns were mounted on the roof of the Submarine Signal building on Atlantic Avenue, Boston, and a favorite demonstration was to track the New York boat out of Boston Harbor, after it left its berth across the street.[64]

With the establishment by NDRC of the Radiation Laboratory at MIT November 1940 some members of the new laboratory's staff visited Submarine Signal for demonstrations of an operating radio echo ranging system. The group included Lee DuBridge, Kenneth Bainbridge, and Louis Turner, all of whom subsequently were to become well known in the radar field through their work at the Radiation Laboratory.

Early in 1942, following the suggestion of BuShips, Submarine Signal began the development order to make ten microwave sets (3000 Meg Hz 10-centimeter S-band) for the Navy. The purpose was the redesign and modification of a Radiation Laboratory experimental radar for manufacture and production. The radar was intended for submarine chasers and motor torpedo boats. Later in the year, Submarine Signal was requested to begin quantity production of the system now designated as the SF radar (in continued cooperation with the Radiation Laboratory). This radar effort was in addition to Submarine Signal's main sonar production for BuShips.

To comply with the production of radar apparatus, a separate "Engineering-Manufacturing Division for Radar" was set up, headed by Harold Hart, holder of several radar-related patents. A production of 1200 SF equipments followed which found installation on naval coast patrol vessels and mine sweepers. Another radar system, the SU, was manufactured at Submarine Signal. The SU was the first 3 cm 10000 Meg Hz X-band system. This X-band radar was installed on almost 2000 destroyers, LSTs (tank landing ships), scout cruisers, Coast Guard cutters, Maritime Commission vessels, and others.

Some Navy vessels were equipped with Submarine Signal's three development groups **sonar depth, sonar ranging and radar equipment**. As of 1955, certain of these systems were still in use by U.S. and Canadian navies.

In the later years of the war, various techniques and devices were secretly developed to counter enemy radar. The area of investigation was referred to as Radar Countermeasures (RCM). Submarine Signal's contribution was a ship-borne radar direction finder. It was developed in close association with the NRDC Radio Research Laboratory at Harvard. At the time it was the only device capable of intercepting the highest radar frequencies and determining range and bearing of the target radar.

A Company facility was set up in Fall River, Massachusetts to make Mark 15 and 33 fuse time and ballistic computers for naval radar gunfire control along with Fathometers for sonar depth sounding on the Maritime Commission vessels.[63]

Submarine Signal Division (Raytheon)

In 1946, the year after the end of World War II, Submarine Signal Company completed 45 years of important participation in the evolving field of underwater detection. It was known in the commercial world for its Fathometer and the wartime manufacture of sonar and radar systems was substantial. "Its wartime sales had grown to over $50 million dollars a year; its profits hit a peak of $1.7 million."[44]

As mentioned above, the Company's work in the preceding decade and during WWII was classified and consequently not in the purview of the commercial world. The U.S. Navy was its largest and most important customer. Other developmental projects involved Carnegie Institution and other selected screened and discrete groups. This limited customer base did not enhance Submarine Signal's position in the commercial world. With the war's end and reduced spending by government agencies, this position was not a totally favorable one.

From 1925, in parallel with Submarine Signal's growth in Boston's emerging electronics industries, Raytheon grew and expanded at a greater rate. During the late 1920s and 30s, Raytheon inserted itself in an important role in the development and manufacture of radio tubes, an essential part of the expansion of commercial radio and radio receivers. Raytheon, with commercial products, was nationally known. The war years' radio tubes, radar, and other defense systems provided opportunities for growth and 1945 saw a fiscal wartime high for Raytheon of more than $174 million in sales. Through the years, Submarine Signal bought millions of dollars of Raytheon's radio tubes and components. The two companies one large and one small shared advanced research projects and were well known to each other in the Boston community.

Through its first twenty years, Raytheon grew in part by careful acquisition of industrial activities engaged in making products that related to or directly supported Raytheon's product line. Further, Harvard, MIT, and Tufts science and engineering staffs and students had a presence in Raytheon as consultants and graduates as engineers. These same schools and their staffs were known to Submarine Signal.

It may be assumed that with materially reduced defense spending in 1946 and Submarine Signal's modest commercial base, acquisition of Submarine Signal by Raytheon could have advantages for each company. From the Raytheon viewpoint, significant sonar and underwater sound capability would be added. Submarine Signal's radar R&D and manufacturing experience would also augment Raytheon's. On May 26, 1946, Submarine Signal became a division of Raytheon.

2002—Heritage of Submarine Signal

Submarine Signal's underwater acoustics scientists and engineers retained their own organization at Raytheon's Newton and Wayland, Massachusetts laboratories. New submarine and destroyer sonar systems evolved, as well as active ASW helicopter equipment.

By 1960, the Submarine Signal group then a division of Raytheon was located in a new advanced industrial ASW center at Portsmouth, Rhode Island. This action was in response to the changes in ASW precipitated with the advent of the nuclear submarine and submarine-launched missiles.

The continuing research and system development tradition stemming from Submarine Signal in the new century carries the Raytheon designation Integrated Defense Systems. U.S. Navy systems include surface ship self defense, submarine combat control for current attack submarines, system integration for amphibious assault craft and Marine command and control needs. Military vessels of Turkey, United Kingdom, and Italy are also users of the Raytheon Integrated Defense Systems group.[47]

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HELL'S BELLS—A SUBMARINER'S VERSION

by Dr. Robert Beynon

Dr. Beynon sailed USS BOWFIN during WWII at the sound of Hells' Bells. He is the author of The Pearl Harbor Avenger.

The following quotation comes from an article in the Smithsonian Magazine, May 2002 issue, page 28:

> "and the feeling that comes over us...when we hear the bell calling us...the feeling that we are obliged to go.?"

The use of the bell in the early 1800s to call persons to meal times, to start and end work shifts, and time to retire from the busy day was a method to keep people on a strict schedule. The culture created by the ringing of the bell was a new phenomenon for the people who left the farm for employment in the factories of America. This newness regulated the lives of the workers as lamented in the story the Spirit of Discontent. One character in the story complained

> "I am going home, where I shall not be obliged to rise so early in the morning, nor be dragged about by the ringing of the bell...I object to the constant hurrying of everything. We cannot have time to eat, drink, or sleep...Up before day at the clang of the bell...and out of the mill by the clang of the bell...into the mill, and at work, in obedience to that ding-dong of a bell—just as though we were so many living machines."

During World War II, the ringing of the bell took on an entirely new meaning. Instead of the use of the regulation of the factory worker, the bell was a *toll of danger*. The United States Navy Submarine Service used the bell to detect the minefields within the Japanese sea lanes which were laid to disrupt the effectiveness of the efficiency of the undersea vessel.

The vast Pacific Ocean was dominated during the early years by the Japanese Navy. The almost 70,000,000 square miles of seawater were the domain of the Japanese warlords. A strong merchant marine was used to create the war-making potential of the Japanese economy. Ships containing war materials supplied the manufacturing power through the importing of oil, iron ore, coal, rubber, and foodstuffs from the neighboring islands. These materials were converted into arms, ammunition, and aircraft that the army and navy needed. It became a virtual necessity for the American armed services to stem the tide. America answered the call after December 7, 1941. Most important to this cause was the American submarine, which slowly began to stop the flow of Japanese goods.

As the 70 million square miles of the Pacific Ocean grew smaller and smaller, the submarine offensive was looking for new areas of penetration. About the only remaining area was the body of water lying between Japan and the mainland of Asia. This area was heavily protected, it was an in-land sea, and only approachable by three entrances. After much study seeking possible entries, only two were considered feasible. Russia was using the northernmost passage for passageway to the Port of Vladivostok. The logic and reasoning detailed that a submarine could *tail gate* a Russian vessel into the area. Such a decision was risky, but considering the possibility of available Japanese shipping the decision was made to give it a try. Before a final decision was made, the question was what would happen if an American submarine were detected while patrolling the waters. It was projected that all entrances would be blocked and the trapped boat would be sealed inside and hunted down until all food and fuel was exhausted. In light of all the scenarios, the decision to go forward was given by Admiral Lockwood.

It was into these waters a wolfpack of nine submarines commanded by E.T. Hyderman entered the Sea of Japan, known as the *Emperor's Bath Tub*. The task force was coded *Operation Barney* and the nine boats nicknamed the *Hell Cats*. Entrance into the sea was effected by three boats entering on three separate days. Each boat was assigned an area for patrolling and seeking out the enemy.

Intelligence reports indicated the scheduled path into the Sea of Japan was protected by four lines of mines. These explosives were set at 13 meters to interrupt periscope depth entry. A second line was set at 23 meters and the third and fourth lines were at depths of three and four meters to intercept boats entering on the surface.

To prepare for the invasion of the Emperor's sacred waters, a new field detection instrument, the FM sonar, was installed on the selected submarines. USS BOWFIN had tested an earlier version on its seventh patrol. The new system was capable of detecting individual mines at a distance of one-third of a mile—1760 feet. When a mine was detected the sonar gave off a clear bell tone. This sound became known as *Hell's Bells*. The sound and the distance allowed the submarine skipper time to evade *the inevitable*.

The author was aboard USS BOWFIN (SS 287) as she began her venture. On June 6, 1945 at 0318 the boat dove to 150 feet and slowly progressed on her journey. The time elapsed into a trip of 17 hours and 24 minutes. BOWFIN was assigned an area near the Port of Konan. The area proved of little value as only fishing boats became possible targets. Succeeding days proved more successful. The second day on station, the submarine spotted a freighter. Battle stations were ordered and four bow torpedoes were fired. The bridge station witnessed one hit at midships. Six minutes later the ship's bow pointed skyward and 30 seconds later she was gone.

While patrolling the Gensan-Konan traffic lane another freighter became a target. Three forward torpedoes proved the death of another enemy vessel. A periscope look only revealed one life boat upside down and one sailor holding on for dear life. What was had disappeared. Eleven days into the patrol run, BOWFIN headed for a rendezvous with two other boats. Transmitted messages were unheeded. Not being able to interpret the silence, Captain Tyree returned to his original assigned station. Luck was not the skipper's escort. The only target available was a clearly identified Russian freighter.

June 23, 1945 was gathering day for the nine boats which had entered the *private lake*. Eight boats reported; one was missing. USS BONEFISH was last reported in the Bay of Toyama Wan off the North coast of Honshu. With the loss of BONEFISH the Silent Service cannot consider any foray into enemy territory a success. With deep regrets for loss shipmates, the remaining boats returned to Pearl Harbor. After the war the accomplishments of the nine boats was best described as:

What they had done was remarkable in anyone's book.

They had sailed up through the East China Sea, and then through Tsushima Strait that runs between Tsushima Island and Kysuhu and had gotten into the innermost of Japanese waters. This was a protected area where shipping moved freely. The Japanese had believed that no enemy could ever penetrate the minefields of this region. The Sea of Japan was the area most used by the war machine of Japan. Escorts and destroyers were protecting vessels transporting war materials and personnel between Korea and Manchuria where most of the materials were manufactured. Foodstuffs had been cut off from Indochina, Thailand, and Manila and were now being shipped out of South Korea. These commodities were vital to Japan and were now eager targets for the nine American submarines.

So go the stories of *The Ringing of the Bells*. In one instance a call to work, in another, a warning of imminent danger.■

NAVINT NEWS

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From the 15th July 2002 issue

The Franco-Spanish Scorpene Submarine Design

The French submarine-building yard DCN Cherbourg has achieved a remarkable resurgence of activity. Although the French submarine industry at one time held a commanding position with the Daphné design it has in recent years come to concentrate largely on nuclear powered strategic submarines (SSBNs) and attack submarine (SSNs) for the Marine Nationale. The industry was a result rationalized and centred on DCN Cherbourg, relying on the official design bureau Direction Constructions Navales (DCN) for design resources.

All this changed dramatically, following a joint venture with Spanish state-owned yard IZAR (formerly EN Bazán), whose Caragena yard also builds conventional diesel-electric submarines (SSKs) for the Spanish Navy. In fact the Spanish connection goes back to the 1970s, when four Daphné class SSKs were built at Cartagena with technical support from DCN and the independent Dubigeon yard. This programme was followed by another four SSKs, the more modern Agosta design, with support from DCN Cherbourg.

By mere chance the two submarine yards had adopted the same computer-aided design (CAD) system, making collaboration between Cherbourg and Cartagena even simpler than it might have been. The design chosen for the export market was the Scorpène, a 1990s design enamating originally from DCN. The commercial arm, DCN International (DCNI) was quick to see a gap in the SSK market opening up. Laurent Barthelemy, Director of DCN Cherbourg, says that the next ten years will see a proliferation of SSKs as expending minor navies branch out at SSK-owners or replace ageing tonnage. As many small operators have found, submarines have a finite hull life if they are used operationally. Eventually they become unsafe to dive, unless they are maintained for pure prestige, in which case they become non-effective any way. Barthelemy sees DCN Cherbourg as remaining profitable if it achieves only one order a year. The IZAR connection brings with an added advantage in selling SSKs to Latin American navies. The yard currently employs just under 3000 workers, as compared with 10,000 ten years ago.

The first fruits of the new collaborative arrangement were the sale of two Scorpènes to Chile. Later named O"HIGGINS and CARRERA, they are under construction at Cherbourg, with some steelwork supplied from Cartagena. The Scorpène is a single-hulled design, benefitting from advanced technologies developed for French Navy SSBNs. They include an Albacore type *teardrop* hullform, use of glass-reinforced plastic (GRP) structures in the casing and fin, and improved piping and power systems.

<u>Particulars</u>

Displacement:	1564t (surfaced/1711t (submerged)
Dimensions:	66.4m X 6.2m x 5.4m (surfaced
Propulsion:	3.5 MW EPM Margtronic Jeumont electric motor; Hagen batteries; 4 MTU 16V 396 SE84 diesels
Speed:	12kn (surfaced)/20kn (submerged)
Armament:	18 Black Shark heavyweight 533mm torpedoes + option for anti-ship missiles
Electronics:	active/passive bow sonar, Argo AR-900 ESM; Sagem I-band navigation radar, SUBTICS command system
Range:	550nm @ 4kn (submerged)/6500nm @ 8 kn (surfaced)
Diving depth:	300m+
Complement:	6 officers, 25 ratings

Work is well in hand on the Chilean boats, with a Chilean technical mission of 22 officers at Cherbourg. Sea acceptance trials (SATS) for O"HIGGINS are planned to begin in October next year, with commissioning *pencilled in* for April 2004. CARRERA will follow her sister into service a year later. The two afte pressure hull sections were shipped from Cherbourg to Cartagena in July

2000 and July last year, respectively. The sections are welded together at Cartagena, and in September or October this year the fully outfitted after section of O"HIGGINS will be returned to Cherbourg. The forward section of CARRERA will be shipped to Cartagena in August 2004.

An important design feature is silencing by means of a number of sections, including the machinery compartments and the operations room, mounted as *uncoupled* blocks. The operations room is installed as a single 60t module, and all these sections are isolated from the pressure hull by rubberized mountings to reduce low-frequency radiated noise. Although not all the sections are isolated in this way, they play a major part in reducing the acoustic signature. DCN claims that the Jeumont permanent-magnet EPM Magrtonic 3.5Kw electric motor is competitive with the German Siemens Permasyn motor developed for the new Type 212 and Type 214 submarines.

The cruciform rudders aft have a shortened lower rudder to limit damage when resting on the seabed.

The steering console is provided by Alstom and DCN Ruelle. It has two ruggedized PCs, joysticks and flat panel displays. DCN Ruelle supplies the Shipmaster Integrated Platform Management System (IPMS). The Chilean boats have two PCs, four 18in displays and a single 21in large display to give the supervising officer an overview of the IPMS status, and if necessary, a damage control assessment. The Shipmaster IPMS is linked to a management network of control and management sensors via a fibre-optic 10MBs Ethernet databus. The version offered to Malaysia will integrate the IPMS and steering consoles, allowing one-man operation.

From the 1st September 2002 issue

UK Government Rejects Navy Plan for SSBNs

According to report in the London *Times* on 12 August, the UK Government and Ministry of Defence (MoD) have rejected a Royal Navy (RN) proposal to re-arm its four Vanguard class strategic missile submarines (SSBNs) to improve their flexibility. The reason given is that the force of four SSBNs operates on a very tight schedule of refits and post-refit trials to ensure at least one boat on patrol at all times.

The proposed alteration would be to modify the launch-tubes for the D5 Trident II nuclear-armed ballistic missiles to accommodate an unspecified number of Tomahawk land-attack cruise missiles. This would give greater flexibility and provide a massive increase in firepower against land targets.

The idea is clearly inspired by the U.S. Navy's (USN) plan to convert its four oldest Ohio (SSBN 728) class SSBNs to deploy both Tomahawk and Special Forces. The Trident launch-tubes will be modified to launch seven Tomahawks or Tactical Tomahawks, giving each boat a total of 154 land-attack missiles. But the USN has the luxury of 18 Ohio class SSBNs, and has to reduce the numbers to comply with the START Treaty, which came into effect in December last year.

Design-Philosophy for French *Barracuda* SSN Project

The French Marine Nationale has for some years been studying operations for a new generation of six nuclear attack submarines (SSNs) to replace the Rubis and Améthyste classes between 2012 and 2022. The project goes back some years, to the long-forgotten Sousmarin Nucleaire Attaque Futur (SNAF), but has changed dramatically as a result of technical advances in all areas of design.

The Délégation Générale pour l'Armement (DGA), the Armed forces' procurement agency, formed an integrated project team in October 1998, in collaboration with the Naveal Staff, DCN, Technicatome and the Commissariat a l'Energie Atomique (CEA), the regulatory body for nuclear powerplants. DCN will be the platform design authority and builder, while Technicatome will be the design authority and builder of the nuclear plant. These two organizations will form a team to act as a single prime contractor, responsible for performance, costs and schedules, and sharing the industrial risk. The cost-target for the whole programme is below €5 billion (US$4.9bn) at today's prices.

For the first time competition at sub-contractor level will be open to foreign competition, according to the DGA. If this intention becomes reality it will be a remarkable *volte face*, but there are such things as level playing fields, and it will be very surprising if a foreign sub-contractor wines any significant work from DGA's Service des Programmes Navales or DCN.

The *Barracuda* design will have a surface displacement of 4100t, recognition that the 2400t displacement of the Rubis class was incompatible with adequate silencing or internal volume for advanced sensors and combat systems. Speed will exceed 25kn and a maximum diving depth of 350m is required. Increased automation will cut the crew to 60, as compared with 75 in the Rubis class. Armament will be 18 weapons, using a water-ram discharge system for the four launch-tubes. The weapons will include an advanced variant of the F17 heavyweight torpedo, the SM-39 Exocet anti-ship missile and possibly a tube-launched version of the SCALP cruise missile. Mines will be an alternative payload, and the boat's layout will permit the deployment of special forces.

The command system will integrate combat management functions with the sensor suite. Known as the *Système de Combat pour Barracuda et SNLE* (SYCOBS), it will be designed and manufactured by Thales Underwater Systems (TUS); the sensor suite will include a bow sonar, wide-aperture flank arrays and reelable thin-line towed arrays. The new SSNG TERRIBLE will also have SYCOBS, and in effect, will allow TUS to eliminate technical risk before it goes into the first *Barracuda*.

The powerplant will use a derivative of the K15 pressurized water reactor (PWR) plant adopted for the Triomphant class SSBNs and the carrier CHARLES DE GAULLE. A hybrid drive system will use electric propulsion for cruising and *turbo-mechanic* for high speed.

The current timetable is for purchase of critical long-lead items to start in 2004, with production work starting the following years. Sea trials for the first SSN are scheduled for 2011, and entry into service is envisaged for the end of 2012. The remaining five boats will follow at two year intervals.

From the 15th September 2002 issue

Singapore Commissions Second Submarine

The Republic of Singapore Navy (RSN) accepted a second refurbished ex-Royal Swedish Navy submarine at a ceremony held at Changi on 24 August. RSS CHIEFTAIN (ex-SJÖHUNDEN) has joined her sister RSS CONQUEROR in 171 Squadron, and two more will be in service by 2004. They remain in Swedish waters to provide training for the Singaporean personnel (Project *Riken*). A fifth hull was also acquired for *cannibalization* for spares.

CHIEFTAIN has undergone refurbishment by Kockums AB, including the provision of air conditioning for operations in tropical waters. She was ordered in July 1997, and renamed and relaunched at Karkskrona on 22 May last year. She arrived at Singapore in March this year. She is armed with Tp 613 533mm heavyweight torpedoes and Tp 431 400mm anti-submarine torpedoes launched from separate tubes. Apart from refurbishment the original outfit of weapons and sensors is unchanged: Ericsson IPS-12 combat system, Terma I-band navigation radar, Hydra medium-frequency sonar, etc.

The RSN finally reversed a policy of not investing in submarines in the 1990s, when it became clear that they would provide a deterrent to powerful neighbours who might choose to infringe territorial waters. In that sense the Chieftain class will act as *mobile minefields* to enforce the country's neutrality.

From the 15th October 2002 issue

New SSN Sonar Completes Sea Trials

The UK Royal Navy's latest submarine sonar and its integrated combat system has completed the first sea trials in the nuclear attack submarine (SSN) HMS TORBAY. The SSN is now undergoing a Long Assisted Maintenance Period at Devonport, in effect a post-trials *shakedown* before undertaking more trials later in the year. Factory acceptance took place at Thales Underwater Systems' Cheadle Heath site, and the sea trials were conducted off the West Coast of Scotland, including the British Undersea Trials and Evaluation Centre (BUTEC) range between the mainland and Skye.

The second of four Trafalgar class SSNs, HMS TRENCHANT, to receive the Sonar 2076 upgrade is nearing completion of her refit at Devonport. According to the Programme Director of the S&T

upgrade programme, Jon Sayer, says that the update involves the whole of the combat system, reductions of noise-signatures, and some specific improvements to the trim and buoyancy and depth control. "It is a complete rip-out and replacement of the eyes, ears and brain of the boat, and a re-layout of the command deck".

Development of 2076 is halfway through an eight-year programme, with installation f outboard improvements, the sonar arrays, already completed. The next stage is development of the inboard software precessing capacity of the SMCS command system. The post-refit sea trials of HMS TORBAY afforded the first opportunity to test both inboard and outboard installations *in water*, as opposed to inboard installation trials at the new Shore Integration facility at Ash Vale in Hampshire (formerly located at Frimley). A complete S&T updated command system is now in place at Ash Vale. Elements of the New Astute class command system, derived from the 2076/SMCS combination, are also being delivered to Ash Vale, ensuring that the operational installation will go as smoothly as possible.

From the 1st/15th November 2002 issue

Lively Euronaval 2002—Report from Paris (excerpted)

The French and Spanish submarine industries are not as well placed as might be expected, following sales of the Scorpène design to India (which is likely to build its ships at Mazagon Dockyard in Mumbai), Malaysia and Chile. Two versions of Scorpène are being marketed: Scorpène Basic for *blue water* operations and Scorpène Compact for *green water* missions. The former is 66.4m long with a submerged displacement of 1700t, a submerged speed of 20kn+ and a diving depth of 300m+. It has a crew of 32, through the introduction of extensive automation, and an endurance of 50 days. An Air Independent Propulsion (AIP) version with the MESMA system involves a 9.8m *plug* which increases submerged displacement to 2000t. The Compact version includes a MESMA AIP (to reduce the danger of snorting in coastal waters) and features major revisions to the weapon compartment, with six tubes reduced to four. The boat is 59.4m long with a submerged displacement of 1450t, a submerged speed of 14kn+, a diving depth of 200m, an endurance of 40 days, and a crew of 22.

The recent success of Scorpène Basic sales in Asia, up to six hulls, has led DCN International and the Spanish yard IZAR to examine further prospects, although these seem more distant. Singapore is certain to require boats to replace the four former Swedish Centurion class but these have been recently updated with the UDS SUBTICS combat system and requirements seem unlikely before 2010 although some reports suggest a replacement requirement seem unlikely before 2010 although some reports suggest a replacement requirement might be issued in 2005. Curiously, it is in Europe where sales prospects, at first sight so certain seem in reality more of a mirage. Portugal requires replacements for the three Albacora class with a requirement for two or three ships from 2005 but the Lisbon Government is having problems meeting its commitments for the Euro and no funding is currently available. It is uncertain when, or if, money will be available for this project for the Portuguese Government may opt to strengthen its surface fleet instead. Spain also has a requirement to replace its four Delfin (s 60) class and four Galerna (S 70) class boats but Madrid is reported to be seeking something slightly larger than Scorpène and IZAR has been offering its own design to meet the S 80 requirement. This is 70m long, and project-definition was completed in October 2000; the Spanish Navy has provided funds to IZAR's Cartagena yard for research and development of the design.

A failure here would certainly ot upset the German Submarine Consortium, which was conspicuously absent from Euronaval after having been present at Defendory in Greece. The consortium was underlining its success in the Greek and Turkish markets, but it has lost out in several major contracts. The failure is not just the loss of building contracts but often ancillary equipment as well, although the Scorpènes do have MTU16V 396 SE84 diesels (rated at 2.2 MW). Sensors, combat systems, communications and control equipment are often driven by the winners. Both Chile and Malaysia have opted for the DCN International/Whitehead IF-21 Black Shark electrically-driven heavyweight torpedo and negotiations are under way with India. Yet in this respect it was interesting to note that American companies present at Euronaval were underlining their commitment to S 80. Lockheed Martin Naval Electronics & Surveillance are offering their Submarine Integrated

Combat System (SUBICS) while Kollmorgen Electro-Optical has offered its Type 76 and Type 86 periscopes and optronic masts.

Pride of place on the central DCN International stand was a model of a concept for a radical future export submarine SMX 21, a twin-hull AIP diesel electric design of 64.5m length with a surface displacement of 2700t, a submerged speed of 18kn+ and the ability to operate down to 250m. No indication of crew sizes was provided but the designers confidently expected major reductions through the incorporation of automated combat and platform management systems. The overall size is similar to two Agosta diesel electric submarines similar to those being buil by Pakistan but the endurance would be 60 days with a range of 9000nm. SMX 21 is designed as a multi-role vessel for land attack, AsuW and special missions with mission modules in two water-filled spaces between the pressure hulls on either side of the fin which have pump-jet propulsors.

Within each pressure hull were two torpedo tubes and a mine chute with 15 weapons carried in each hull, but mission packs installed in the space between the pressure hulls would be the backbone for mission requirements. The packs consist of inter-changeable weapon launchers, each with ten cells, installed between the pressure hulls forward of, and abaft the fin. Whereas U.S. Navy submarines have vertical missile modules, the French have decided to reduce hull height to 5.5m by having the cells inclined. The weapon packs could include heavyweight torpedoes, mines, land-attack missiles, anti-ship missiles or anti-air missiles in dedicated or mixed loads. For special operations a dry dock shelter pack could also be included.

From the 1st December 2002 issue

Pakistan's Naval Plans Mature (excerpted)

Although the threat of a nuclear exchange with India has receded tension between the two neighbours makes tension endemic. Hugely outnumbered by the Indian Navy, with only 27 ships, the Pakistan navy (PN) accounts for about 25 percent of the nation's US$2.3 billion annual defence budget. According to the PN's Chief of Naval Staff, Admiral Abdul Azziz Mirza, the PN follows a policy of "selective deterrence", and its major need is more small to medium sized surface warships.

The modernization of the ageing submarine force is well advanced. The French-built KHALID is in service and SAAD will join the fleet soon. When HAMZA is commissioned, she will be the first submarine with the French MESMA Air Independent Propulsion (AIP) system in service. The MESMA will then be retrofitted to her two sisters. According to Admiral Mirza, when the re-equipment of the surface fleet is completed, the PN will be able to contemplate building mores submarines.

The upgrading of the PC-3 Orion maritime patrol aircraft continues to cause problems. An embargo was lifted to allow work to be restarted in 1996-97, but more have been requested as part f the price for Pakistan's support for the War on Terror. New weapons in the inventory include the French SM-39 submarine-launched anti-ship missile, the Chinese C-802, and the AGM-84 Harpoon.

Pakistan Navy Order of Battle

2 Khalid class submarines + 1 fitting out

2 Hasmat class submarines

4 Hangor class submarines

Royal Navy Accepts 200th Spearfish Torpedo

The UK Royal Navy (RN) recently took delivery of the 200th Spearfish heavyweight torpedo from BAE Systems' Underwater Systems Division. Spearfish is the main heavyweight underwater weapon in the RN's inventory, and the first deliveries were made in 1999.

In 1976 the Rn began the process of finding a replacement for the Mk24 Tigerfish, which was considered too slow and lacked the running depth to cope with the next generation of Soviet submarines. By 1980 Naval Staff Requirement (SNR) 7525 emerged, calling for a dual purpose (anti-surface and anti-submarine) variable speed torpedo. A fierce challenge was mounted by Gould Inc. to persuade the Ministry of Defence (MoD) to buy the Mk48 Mod 5 ADCAP, but in 1981 the MoD decided to adopt a national solution, and in 1982 a development and initial production contract was placed.

The in-service date (ISD) of 1987 could not be met, and it was not possible to issue warshot torpedoes until 1994. The first full load was embarked in HMS TIRELESS in May 1999. In part this delay was due to political interference, but also by a National Audit Office report identified problems of reliability. It was finally decided to incorporate improvements in Spearfish Mod 1, and to make Mod 1 the operational version.

The main electronics section has seven 1412L microprocessors using Coral 66. Spearfish contains a number of homing and tactical computers to control the torpedo. They enable it to select search, detection, and attack modes autonomously.

Advanced Spearfish is under development, with more advanced processing and other improvements.

<u>Spearfish Mod 1</u>

Length:	7m
Diameter:	533mm
Weight:	1850kg (in air)
Speed:	ca65kn

From the 15th December 2002 issue

<u>U.S. Aids Australian Submarine Yard to Win Support Work</u>

The Australian Submarine Corporation (ASC) has signed a US$20 million contract with its American counterpart Electric Boat Division of General Dynamics to help it switch from being a builder of submarines to supporting the Australia flotilla.

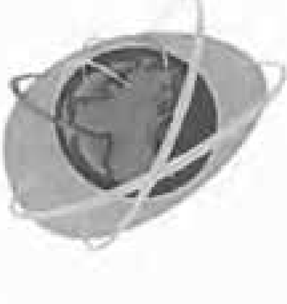
The Adelaide-based shipyard is currently completing the last of six Collins class diesel electric submarines for the Royal Australian Navy (RAN) under a U.S. $2.8 billion (A$5.1bn) contract. HMAS RANKIN was launched in November last year and will be completed next year. A year ago Prime Minister Mr. John Howard announced that ASC would be responsible for all refits of the Collins class and this could be worth US$570 million (A$1 billion) over the boats' 25 year life. Full cycle refits, which will include changing batteries, will be required every six years at a cost of US$57 million (A$100m) but the ships will also require upgrading including the installation of the Raytheon CCS Mark 2 replacement combat system from about 2006. Intermediate refits will be conducted at Fleet Base West, Fremantle WA.

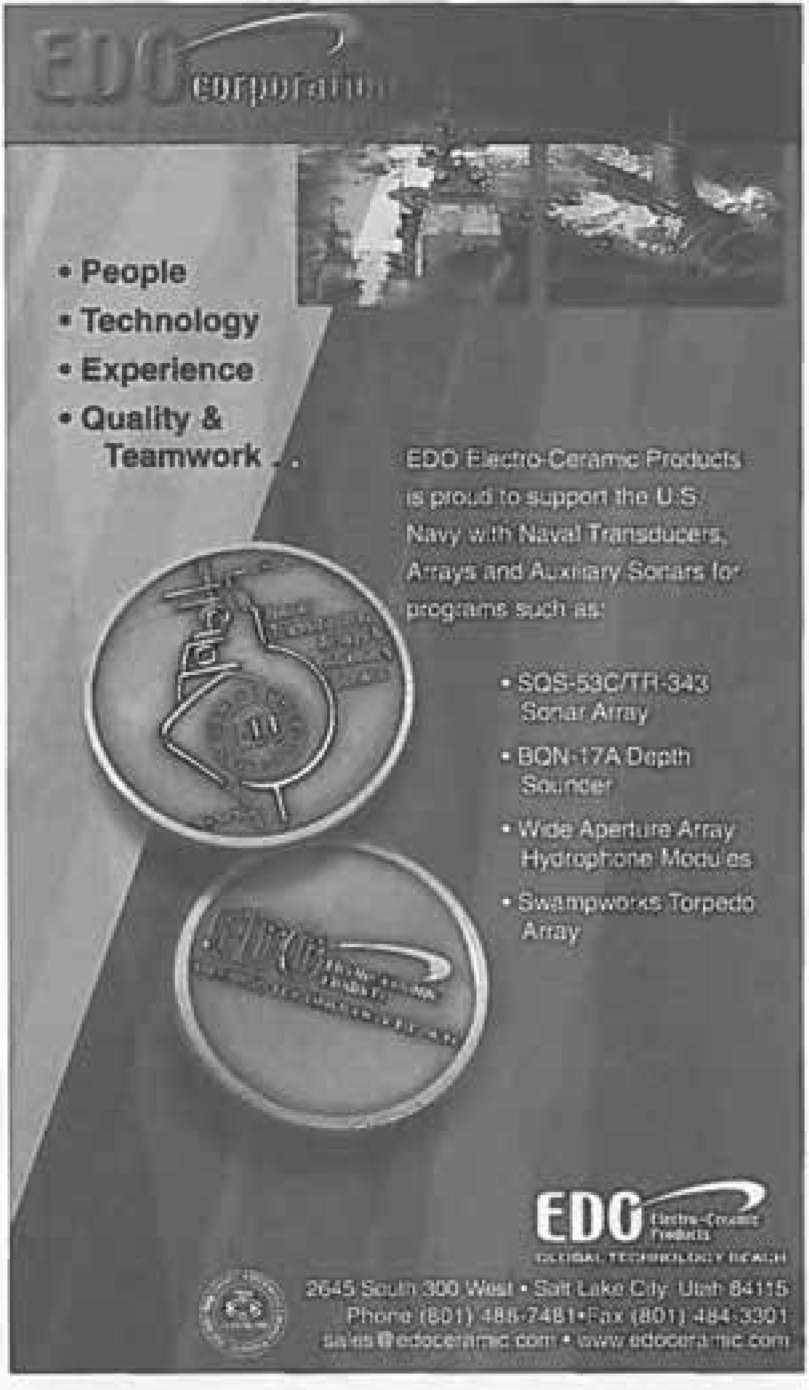
The refit agreements will be negotiated with performance incentives, with the first likely to be signed in 2003. The three year agreement signed with Electric Boat on 3 October will see the U.S. company provide technical advice on the maintenance of the hull and machinery, although it might be extended later. A tem of advisors will be based at Port Adelaide and the agreement has provision for annual extensions up to 2009.

Spent Fuel Removed from Russian Nuclear Submarines

The Interfax Military News Agency has reported that on 2 November the state-owned company Zvyozdochka began to unload spent nuclear fuel from a decommissioned Project 941 Typhoon class ballistic missile submarine (SSBN) in Severodvinsk.

A complex has been built specifically to unload spent fuel from decommissioned submarines with US$15 million in assistance from the United States under the Cooperative Threat Reduction Program. The complex can unload fuel from two Typhoon class or four Delta class SSBNs each year with only a single daily shift of workers. The importance of the complex was underlined by an incident a few days later at the Russian Pacific Fleet base of Pavlovsky Bay, when defective wiring caused a fire in a decommissioned nuclear submarine; it was quickly brought under control, however.■





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DISCUSSIONS

SINGLE CREW SSBN FORCE

by LCDR Craig Andrew Preston, Jr., USN
Navigator
USS LOUISIANA (SSBN 743)(Gold)

Today's SSBN force can be dramatically improved by eliminating the current two crew concept and shifting to a single crew for manning. In the past decade, changes to SSBN force requirements, maintenance practices, force protection, and most significantly crew training and inspections has made the current two crew system obsolete and inefficient. The shift to a single crew SSBN force could greatly improve ship performance, crew training, manning, and quality of life while freeing up resources and personnel to address badly needed shortages ashore.

The need for a dual crew SSBN was established during the Cold War under the premise that a second crew could take control of the ship once it returned from patrol and go back to sea to patrol status after a 30 day refit. This system was needed in order to meet Strategic War requirements and maintain the ship at sea to carry out its strategic mission. However, the end of the Cold War and the restructuring of Nuclear Posturing has meant less SSBNs are required at sea at any one time. Less SSBNs at sea means that each SSBN can go longer periods between patrols and eliminates the need for rapid refits and crew exchange of commands. A shift to single crew could be put into effect with no impact on the current strategic commitment and readiness requirements. In fact patrol periods could be carefully planned and orchestrated to better prepare the ship and the crew for extended patrols, allowing additional ships to carry out local operations and conduct sea critical maintenance deferred due to a limitations previously imposed by a 30 day refit period.

The current two crew SSBN force spends a minimum of 66 percent of its training attempting to stay proficient for at sea operations. A single crew SSBN force could cut this number in half enabling the single SSBN crew to train and be more efficient at its at-sea mission and tasking. This is a huge return in training hours and efficiency which could provide the improvement and consistency in performance badly needed. Trident Training Facility could be used exclusively by boats in extended Refit periods to maintain their proficiency. Each crew would not be forced into a non-proficient period every seven months from which to rebuild. Additionally, a single crew SSBN would reduce formal ship inspections by half greatly freeing up SUBLANT training commands and allowing the ship to do more independent at-sea training than being forced into numerous inspections with each underway.

The elimination of the second SSBN crew would eliminate the inefficiencies in the Exchange of Command. Any homeowner understands the difference between renting and owning a household. A shift to single crew SSBN force would better empower the SSBN crew to take ownership of the ship's problems and give them the opportunity (more than 7 months) to establish a lasting and consistent solution and performance out of the ship and crew. No more *Blue/Gold Crew Problems*. Early Refresher Training Periods at sea would be eliminated since the crew would always know the full status of the material condition of the ship going into refit.

Personnel have long been the Navy's largest expenditure in the Defense Budget. The elimination of a single crew to each SSBN could free up thousands of personnel and resources or millions of dollars which could be plugged back into the SSBN force for improvements. These additional personnel could be used to better staff our training facilities, better improve our Refit facilities, and provide a highly trained and consistent Force Protection Unit currently being provided part time by SSBN crew members during much needed training periods. A huge political obstacle to this proposal would be the elimination of commanding officer, executive officer, wardroom, and Chief of the Boat billets which would greatly reduce the depth of the Submarine Force and eliminate the job opportunities to the personnel striving to fill these billets. Wouldn't the elimination of these jobs make these jobs more competitive and more likely to be filled by the most qualified person with correct attitude and talent? We already have huge depth at these positions in the COSS/XOSS programs. The need to hang onto these jobs only comes from our need for job security where their elimination from the naval structure is clearly in the best interest of the Navy due to the tremendous savings and reduction in duplicate chains of command.

The shift to a single SSBN crew provides opportunities to greatly improve the SSBN force by eliminating redundancy and waste. One proposal might be to eliminate most of the second crew but leave approximately 50-60 men assigned as a augmentation force in port under the training direction of an XO screened individual to train, attend formal schools, coordinate maintenance, setup training opportunities, and support the ship with mesage traffic and operations. Being augmented might be a reward for a sailor who performs well or an opportunity to take a stand-down period after several patrols and refits in succession. Upon return to port this augmentation force rejoins the crew and can immediately assist loading missiles/torpedoes, performing maintenance, and standing the watch. Team Refit under one chain of command with a single vision and scope. The English employ this type of system with great success.

A longer on crew period could be offset by the idea of augmentation and longer inport and maintenance periods enabling sailors to take leave, attend formal schools, and take care of personal problems. A single crew would have no team refit personnel in the form of another crew to paint and assist in refit. However with potentially longer and more effective refit periods, a small augmentation force mentioned above, could handle the work load. Additionally, more sailors at Trident Refit Facility could greatly reduce Ship Force maintenance requirements assisting the issue of a smaller Team Refit workforce.

The idea of single crew SSBNs has numerous advantages in cost savings and efficiency improvements which cannot be ignored. The idea of an augmentation force would allow the SSBN to function normally without suffering the pains and inefficiencies of Exchange of Command. However, most importantly, the SSBN would be able to continue her mission utilizing more effective training periods and enabling the crew to establish more consistent and effective performance at sea. The ship would be more prepared and outfitted from a longer refit period and the crew would take greater ownership of the ship. The time has clearly come to revamp the way we man SSBNs to meet our needs at sea and inport. The advantages and windfalls from a single crew SSBN will require a huge change in the philosophy and principles that the SSBN has operated under for years. A well thought out and researched plan could make this transition and the savings that come with it a reality. The promises and commitments under which the SSBN force was established no longer exist and new measures must be implemented to make the most of our invaluable personnel, equipment, and resources. In a changing time, let us move forward.■

TOWARD AN UNMANNED ATTACK SUBMARINE?

by Nader Elhefnawy

Nader Elhefnawy has a degree in International Relations from Florida International University and has previously published in several journals on maritime and military affairs. This is his fourth article for The Submarine Review.

Unmanned aircraft have gained growing attention in recent years with the apparent success of systems like the Predator and the Global Hawk. Along with the X-45 *Strikestar*, they are pointing the way toward a future where unmanned combat aircraft dominate the skies, and some projections suggest they will constitute a third of the combat aircraft flying by 2020. Robotic vehicles are becoming important in land warfare, as with those which explored the caves of Tora Bora in Afghanistan, and may play a crucial role in the next generation of tanks represented by the Future Combat System. Unmanned systems are already set to perform a variety of roles at sea, such as aiding with coastal surveillance and demining. And just as unmanned systems on land and in the air are leading in the direction of unmanned tanks and bombers, they may even be pointing the way toward an unmanned submarine.

An unmanned submarine would possess a number of significant advantages, broadly analogous to those that unmanned aircraft enjoy. One is that its size and weight could be reduced, since it would not have to accommodate human beings, over a hundred officers and enlisted personnel in the case of American nuclear submarines. Another is that a submarine's service life could be extended; one does not need to train crews to operate unmanned submarines, thus saving them much hard usage. It would also mean the possibility of longer missions, as submarine cruises would not be limited by the endurance of their crews—potentially critical given the importance of reducing the number of subs required to maintain one submarine on station.[1] Keeping hulls continuously deployed and rotating the crews of ships while they are in forward-deployed positions will be simplified when the crew is reduced in size. (If there is no crew, the task gets eliminated entirely.)

For the time being, however, the goals are likely to be much more modest. UUVs capable of theater-level reconaissance within a decade's time appear feasible, assuming that the effort is made to develop vehicles with greater endurance and to overcome the control issues.[2] As with aircraft, large UUVs could conceivably go from performing reconnaissance to mine-laying, and then combat, likely beginning with anti-ship and land-attack functions and eventually proceeding toward taking over the attack sub mission. As is implied by the fact that even the simplest of these missions remains at least a decade away, the process would be a much slower one for submarines than for humans. Warships are larger and more complex than any other weapons system, and none perhaps more so than submarines. Another major caveat exists: an unmanned, combat-capable submarine can not be effectively directed by remote control, at least not with any technology existing or on the horizon, despite steady improvement in areas like digital acoustic communication. This means that submarines will require that much more advanced a level of artificial intelligence, pushing the date at which they become viable still further into the future, if at all.

In the meantime the likelihood is that submarine crews will shrink over the long haul, rather than abruptly giving way to totally unmanned systems, just as has been the case with merchant vessels.[3] Ships which had a crew of fifty are today routinely operated by less than half that number, and some designs have only ten crew. Of course, warships are not merchant vessels, least of all submarines. The greater complexity of their task aside, the small crew sizes of today's commercial vessels was attained by their adopting an *airline* model where crews take ships from port to port, while maintenance and cargo-handling functions are shifted to shore-based personnel. By contrast, navy planners are looking forward to more logistically independent submarines, but even here automation has made its impact felt in the Virginia class, which has a crew of 113 compared with 129 for the Los Angeles class and 133 for the Seawolf class boats. Fifteen watchstanders were eliminated through reengineering, and greater reductions are anticipated as new technologies are incorporated into the boat's modular design.[4]

The follow-on to the Virginia class expected to enter into service in the 2020s will almost surely be crewed, but a real chance exists that a crewless submarine may actually be an option for the generation of submarines to follow in the 2040s. Such a claim may seem spectacular, but appears less so when one considers the state-of-the-art in fields like artificial intelligence and nanotechnology.

Artificial Intelligence

The quantum leap in computer processing power seems bound to continue for the foreseeable future, with chip speed doubling and chip price halving annually. Many artificial intelligence and robotics experts, including Rodney Allen Brooks, Bill Joy, Ray Kurzweil and Hans Moravec anticipate that this will result in the commercial, practical availability of computers with intelligence equal to a human being's in the 2020-2040 time frame. Whether or not computers will actually demonstrate consciousness, inuition and volition as these authors predict is surely an important question, but even without this happening they will find a growing range of roles. This increased computing power can, for instance, be used to integrate data from a wider number and variety of sensors, acoustic and non-acoustic, or to interpret that data, particularly as neural-net computers with human-like pattern-recognition capabilities are developed.

Moreover, the growth in computer processing power is thought highly unlikely to halt at this point. This may make them crucial in keeping up with the accelerating pace of modern warfare, gradually taking over a larger portion of the decisionmaking.[5] While the pace of undersea warfare has historically been slower, supercavitating weapons, dispersed sensors like those exemplified by the Advanced Deployed System (ADS) and high-capacity, high-speed communications links seem likely to bring submarine warfare in line with the speed of information-age combat on land and in the air.[6]

Nanotechnology

The requisite advances in artificial intelligence will in part be facilitated by nanotechnology, particularly where it can contribute to faster, smaller computers, though this would not by any means be the limit of its contribution in this area. Condition-Based Maintenance (CBM), which is being facilitated by microtechnology, can reduce the consumption of spare parts, and maintenance demands more broadly. The same goes for the low-friction moving parts which molecular technology can manufacture, because of the possibility of producing components with ultrasmooth surfaces, will be slow to clog or wear out. This will simplify logistics and necessitate fewer part replacements, reducing the complexity of the maintenance task that an unmanned submarine's systems would have to perform.

Additionally, nanotechnology can reduce the weight of a submarine of any given size. The creation of light, superstrong materials through nanoscale assembly will reduce the weight of its hull (and increase its strength, making it deeper-diving, swifter and more resistant to attacks). Consisting of *buckyball* arrangements of carbon atoms, they have a tensile strength a hundred times greater than that of steel yet only a sixth the weight. According to one estimate, a car made of them would weigh about fifty pounds. Should it become practical to build submarines out of them, the steel vs. titanium hull debate would become instantly irrelevant.

Assuming such miniaturization and new materials, and substantially smaller, lighter submarines as a result, a less powerful and smaller power plant could become practical, opening up alternatives to the present fission power plant standard on U.S. subs. By the 2040s fusion energy may have progressed to the point that a fusion-powered submarine may be feasible. New life, however, may be breathed into non-nuclear plants, presently of new interest because of the advent of air-independent propulsion. (Already, hydrogen fuel cells are becoming viable.[7])

Of course, even more so than artificial intelligence, nanotechnology remains nascent, and even its simplest products are exorbitantly priced. Carbon nanotubes have until recently been several times more expensive than gold, and so enjoy only narrow applications, principally in small quantities in expensive consumer items like tennis racquets and designer clothing. The price could be coming down as new production methods are introduced, however, with high-volume plants projected to cut the price by a factor of a hundred within the next few years. Moreover, given their extraordinary strength, much smaller quantities of them would be required for a particular project than if other materials were being used.

Proceeding along these lines, the submarine may come to be crewed by a very small number of personnel, operating a highly automated vehicle considerably smaller than present-day submarines. In size, weight and internal design it may come to resemble a long-range bomber more than a traditional ship adapted to operate underwater, the capabilities of attack submarines packed into a mini-sub. Turning back to the aircraft analogy, strategic bomber crew sizes have been steadily cut down in recent decades, from six in the B-52 to four in the B-1 to two in the B-2, even as the systems grew increasingly expensive, complex and capable. The time when that figure comes down to zero is in sight, and the same could happen for submarines.

Understandably, even when such submarines become technically feasible, designers may not wish to take human beings out of the decisionmaking loop to that extent, particularly where attack submarines or vessels equipped with nuclear weapons or power plants are concerned. Nonetheless, doing away with nuclear propulsion may increase the comfort level with reducing or eliminating human crews. A breakthrough in underwater communications, likewise, might increase the comfort level with comletely unmanned systems because of the increased human control it would permit. In any event, just as the pace of underwater conflict is likely to accelerate in the coming decades, so is automation certain to be the crucial way in which navies in the future cope with that pace.■

ENDNOTES

1. Defense Science Board, *Report of the Defense Science Board on the Submarine of the Future* (Washington DC: Office of the Under Secretary of Defense for Acquisition and Technology) July 1998.
2. Edward C. Whitman, "Unmanned Underwater Vehicles: Beneath the Wave of the Future", *Undersea Warfare*, Spring 2002.
3. Committee on the Effect of Smaller Crews on Maritime Safety et al, *Crew Size and Maritime Safety* (Washington DC: National Academy Press, 1991).

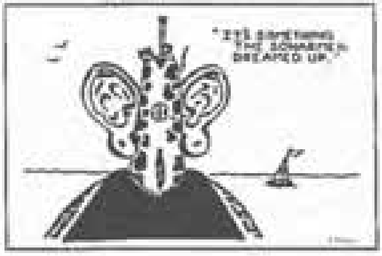
4. Barbara Graves and Edward Whitman, "The Virginia Class: America's Next Submarine", *Undersea Warfare*, Spring 1999.
5. Thomas K. Adams, "Future Warfare and the Decline of Human Decisionmaking", *Parameters*, Winter 2001-02.
6. Nader Elhefnawy, "Undersea Future Shock", *The Submarine Review*, July 2002.
7. "First Fuel-Cell Submarine is Christened at HDW", *The Submarine Review*, July 2002.

THE MAGAZINE'S TWENTIETH BIRTHDAY

THE SUBMARINE REVIEW published its first issue in April of 1983; therefore, with this April 2003 issue we mark our twentieth birthday. Captain Bill Ruhe started the magazine and ably piloted it through the first seven years. Those years saw the tone set for a magazine of high special interest. Articles of current importance shared the pages of the new publication with objective treatments of submarine historical importance. The stated objective was to establish a forum for professional discussion of any and all topics relating to submarining. Wartime actions were examined and peacetime preparations were described, both with a view toward illustrating lessons to be learned. Captain Ruhe met that objective, won a dedicated readership for the quarterly and set the standard for exemplary submarine-related exposition. He retired from day-to-day direction of the magazine in 1990 and went on to concentrate on authoring his books. Of particular interest is his personal memoir of many patrols in War in the Boats, published by Brassey's, Inc. in 1994.

The magazine has continued his focus on the entire submarine community and its interests. The League's Board of Directors has a commitment to remain an independent, knowledgeable commentator on submarine issues and discussions, be they of the past, present or future. This policy has guided the publication over the past twenty years and will continue to be our charted course as we strive to provide an objective forum for all who can add to the body of submarine achievements, rationale and potential.

Dolphin Scholarship Foundation Cartoon Calendar Contest



A total of thirteen (13) drawings will be selected for the **2004** calendars (the extra cartoon is for the cover of our small calendar). A $25.00 cash award and a complimentary copy of the large and small calendars will be awarded to each winning artist.

Drawings are to be of a humorous nature depicting life in the Submarine Service.

All drawings must be originals in **black ink on white paper** (8 ½" X 11") in **Landscape Format. Copies will not be accepted**.

All drawings become the property of the Dolphin Scholarship Foundation and are non-returnable.

All drawings must be accompanied by the following information printed on the back of your entry: Artist's name, Rank/Rate, Duty Station, Mailing address and telephone number.

Dependents should also include the name, rank, and duty station of their sponsor.

Children should include their age.

Send drawings to the following address:

Dolphin Calendar Cartoon Contest
Dolphin Scholarship Foundation
5040 Virginia beach Blvd., Suite 104-A
Virginia Beach, VA 23462

Entries Must Be Received on Premises by May 31, 2003

For more information contact your local Dolphin Calendar Chairperson or Ann Maliniak at (757) 671-3200 or annmalin@exis.net.

THE SUBMARINE COMMUNITY

MESSAGE TO TODAY'S SUBMARINERS

by RADM Eugene B. Fluckey, USN(Ret.)

The following article appeared in the Winter 99 issue of Undersea Warfare Magazine published by N77. It is reprinted with permission.

As a young ten year old lad in 1923, I was tickling the crystal of my radio and picked up a station in Pittsburgh, Pennsylvania, just as our President, Calvin Coolidge, was starting a famous speech. *Silent Cal* did not speak often, but when he did, people listened. This is what he said.

> "Press on. Nothing in the word can take the place of persistence. Talent will not: Nothing is more common than unsuccessful men with talent. Genius will not: Unrewarded genius is almost a proverb. Education alone will not: The World is full of educated derelicts. Persistence and determination alone are omnipotent."

I was so impressed that I named my first mongrel dog Calvin Coolidge!

Adopting this philosophy, my studies picked up. Why not excel? I graduated from high school at age 15. My Dad said I was too young to go to college, so he parked me at Mercersburg Academy, working my way slinging hash. Here I learned to be humble. They had an annual prize, open to all students, in *Original Math* including all the disciplines. My prof wanted me to enter the eight hour exam. I refused. He said that he had bet another prof $50 that I would win. Somebody believed in me. I couldn't let him down, so I entered. It was the toughest and most complex exam of my life. After eight hours I had only finished one and a half problems. I told my prof of my failure. He said what was more important was that you did your best. The results came out. I won. No one else had finished one problem.

Serve your country well. Put more into life than you expect to get out of it. Drive yourself and lead others. Make others feel good about themselves, they will outperform your expectations, and you will never lack for friends. In USS BARB, our philosophy was, "we don't have problems—just solutions."

At age 85, I envy the exciting future you have ahead, in war or peace, being the ultimate guard for Old Glory. You nuke submariners, with your capability to eliminate enemy boomers, and your inevitable, irresistible, devastating response, won the most important war since man first stood up on his hind legs—The Cold War! So be proud. I salute you—Unsung Heroes!

Final World War II Battle Flag of USS BARB

USS BARB's final battle flag at the end of World War II presents a symbolic record of the boat's many wartime accomplishments and significant awards won by its crew.

Across the top are represented the six Navy Crosses, 23 Silver Stars, and 23 Bronze Stars bestowed on individual crew members during the war, as well as the Presidential Unit Citation and the Congressional Medal of Honor awarded to then-Commander Fluckey. The 34 merchant ships sunk or damaged by BARB are denoted by white flags with either solid or hollow red suns in the center—or in one case by a German Nazi flag emblematic of a tanker sunk in the Atlantic. Rising sun flags represent the five Japanese warships sunk or damaged by the ship, and the largest of these (top center) symbolizes the UNYO, a 22,500-ton escort carrier. The small merchant flags with the superimposed numeral 7 each represent seven smaller victims of less than 500 tons each.

The gun and rocket symbols record significant shore bombardments of Japanese targets, such as factories, canneries, building yards, and a large air base. Most unusual is the representation of a train at the middle bottom, which commemorates the occasion when a landing party from BARB went ashore to destroy a 16-car train by putting scuttling charges under the tracks. This was the sole landing by U.S. military forces on Japanese homeland during the World War II hostilities.

Rear Admiral Eugene Fluckey was born in the District of Columbia and graduated from the U.S. Naval Academy in June 1935. He entered Submarine School in 1938, and at the beginning of World War II was serving on USS BONITA (SS 165). Aboard BONITA from June 1941 until August 1942, he participated in five war patrols against the Japanese in the Pacific. After one war patrol as prospective commanding officer of the Gato class submarine USS BARB (SS 220), he assumed command on 27 April 1944. For heroism during the ship's eighth, ninth, tenth, eleventh, and twelfth war patrols, he was awarded four Navy Crosses and the Congressional Medal of Honor, unequaled by any living American. He is also entitled to wear the ribbons of the Presidential Unit Citation and Navy Unit Commendation awarded to BARB for those actions.

Many of the Submarine Force's littoral missions today were prefigured by Admiral Fluckey's exploits in World War II. Against the Japanese, he pioneered a role for submarines in both land attack and sabotage. He took BARB into heavily defended coastal waters to launch torpedo, rocket, and gun bombardments, many of which inflicted severe damage on Japanese coastal installations.

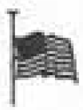
In 1945, Admiral Fluckey was ordered to new construction in Groton, Connecticut, but was soon transferred to the Office of the Secretary of the Navy to work under Secretary James Forrestal on unifying the Armed Services. In December 1945, Admiral Chester Nimitz, the in-coming Chief of Naval Operations, selected him to be his Personal Aide. Later in his distinguished career, Admiral Fluckey served as Commanding Officer of Submarine Division 52, of Submarine Squadron Five, and of the submarine tender USS SPERRY (AS-12). He was selected for Flag Rank in 1960 and reported as Commander, Amphibious Group Four, and later as COMSUBPAC. He also had successful tours as the Head of the

Electrical Engineering Department at the U.S. Naval Academy and as the U.S.N. Flag Officer in Lisbon, Portugal. He retired in 1972.

In 1992, Admiral Fluckey recounted his WWII patrols on BARB in the book, Thunder Below!, which won the prestigious Samuel Eliot Morison prize for Best Naval Literature in 1993. Stephen Spielberg's DreamWorks Films recently picked up the film option. Healthy and active at age 85, Admiral Fluckey works on the behalf of more than 80 charitable and non-profit organizations. Just this past September, he gave an inspiring speech at the annual United States Submarine Veterans, Inc (USSVI) convention in Hagerstown, Maryland. He and his wife Margaret reside in Annapolis, Maryland.

IN MEMORIAM

CAPT Keith M. Bunting, USN(Ret.)
CAPT John B. David, USN(Ret.)
LCDR Ned E. Dixon, USN(Ret.)
CAPT Walter M. Douglass, USN(Ret.)
Ms. Katherine Ousey
LCDR H. Richard Williams, USN(Ret.)



FITTING MEMORIAL TO SILENT SERVICE

Reprinted with permission, Charleston Post and Courier, December 14, 2003.

At the recent dedication of the Cold War Submarine Memorial at Patriot's Point in Mount Pleasant, retired Vice Admiral Albert Baciocco, Jr. recalled: "We never advertised what we were doing. We were the Silent Service."

What the silent service was doing, without advertising the fact, was helping to save the world by deterring nuclear war while, at the same time, winning the Cold War.

And, of course, the submariners were making history through their enduring courage. So it is fitting that their silent service is at last memorialized. And no place could be more appropriate than Patriot's Point.

The memorial, incorporating the sail of an actual nuclear submarine, LEWIS AND CLARK, stands guard over Charleston Harbor, where the sleek black-hulled nuclear-powered ballistic-missile submarines were a familiar sight as they sailed to their long deep underwater patrols for more than three decades.

The imposing memorial is a reminder that another major chapter in the history of Charleston was written by the submariners and their families, and the people of the area, who were on the front line of the Cold War.

The memorial honoring the silent, unadvertised achievement of the submariners who played a major role in winning the Cold War was an achievement in itself. Admiral Baciocco, who chaired the foundation that planned the memorial, found the money, more than $1 million, and supervised its construction, told our reporter David Quick on December 6, the day of the dedication: "It's been a long time coming. Once or twice in the last five years, I didn't know if we were going to see this day."

The dedication brought history to life. Among those present was retired Admiral James B. Osborn, who commanded the first ballistic missile submarine patrol when he and his crew sailed out of Charleston on the submarine GEORGE WASHINGTON on November 5, 1960.

Also taking part in the ceremony was Admiral Frank *Skip*

Bowman, who has served in nuclear-powered ballistic-missile submarines for 36 years. Admiral Bowman declared the Charleston area *Submarine Country* because of its role in submarine warfare and because so many submariners have made their homes here. He honored veteran submariners from near and far who attended the dedication, including 30 veterans who served aboard LEWIS AND CLARK. They posed for a photograph with their land-bound submarine, a silent but visible symbol of the dogged victory of submariners in the 40 year long Cold War.■

INFORMATION REQUEST

Author Glenn A. Knoblock is working on a unique book about the history of the African American men who served in the Submarine Force during World War II and beyond (up to 1960) as Stewards, Steward's Mates, Officer's Cooks, and Mess Attendants. Mr. Knoblock states "that these men have never received their due for the fine service they gave, while the Submarine Force has never received the recognition due to it for the way in which such men were treated. The Submarine Force was years ahead of the surface Navy in regards to the way minorities were treated."

He is asking **THE SUBMARINE REVIEW** readers who remember such men, even those who later changed their rating, to contact him with their remembrances. While crew lists have provided him with many names of such men, it would be helpful if fellow shipmates can provide further insight as to their personality, character, and service.

Please contact him at: Glenn A Knoblock, 31 Forest Street, Dover, NH 08320; (603) 749-0676; e-mail: glennknob@aol.com

A SHORT HISTORY OF THE U.S. SUBMARINE VETERANS FRATERNAL ASSOCIATION

by Patrick F. Householder

The United States Submarine Veterans was started by a group of United States Submarine Veterans of World War II led by Dominic *Joe* Negri and others who shared a belief in the need of an organization open to **all** submariners from the very beginning of the Submarine Service through to the present and into the future—not limited to just those who served so ably in the Second World War.

They took this action following two unsuccessful votes to open up regular membership in SVWW II to U.S. submariners of all eras and their determination was made stronger with the loss of USS THRESHER in 1963.

In Groton, Connecticut, the *Submarine Capitol of the World*, these men started contacting past shipmates. They hit a responsive chord and favorable response came from Massachusetts, New York, New Jersey, Pennsylvania and many more from Connecticut.

After holding preliminary meetings in the above states, a final meeting was held October 12, 1963 in Orange, New Jersey and the United States Submarine Veterans organization was born. The following officers were appointed to serve in an acting capacity until regular elections could be held in the summer of 1964. Robert Link, President; Ken O. Walkington, Vice President; Joe Burges, Secretary; Mike Drucker, Treasurer.

Several months later, on May 24, 1964, the organization was officially chartered in New London (Signers: Joe Negri, Ken O. Walkington and Joe Marion) and Incorporated in the State of Connecticut, with additional plank owners being Warren *Ed* Gannon, Angelo La Pelosa, Robert Link, Thomas Rowan, and Hugh Trimble. Joe Negri was elected the first State commander and Dick Higham was elected the first Base Commander of Connecticut Base #1 (later known as Groton Base). This charter gave USSVI the license to operate and conduct business in all fifty states.

The *Clubhouse* at 40 School Street became a reality in 1966. Due to the fact that the Groton Base was incorporated within the state of Connecticut and they had their own building, it was voted that Groton become the National Headquarters of USSVI.

The purposes of USSVI can be defined as Remembrance of our departed submarine shipmates and the sacrifices they made in the name of freedom; Comradeship and good times with our USSVI Subvet brothers at meetings and conventions, and Benevolence, by doing charitable works in support of our creed for all submariners and our offspring.

To better establish communication and rapport, an organization magazine, *Submarine National Review*, came into existence in May, 1966, later to become the *American Submariner*.

In the intervening nearly 40 years, USSVI has grown to 10,000 members, with 97 Bases located throughout the U.S. and an active charitable foundation established to support the good works Subvets wishes to carry out. Groton Base has grown to nearly 2,000 members, far outstripping all other Bases, and the National Office has moved to Silverdale, Washington, reflecting the National nature of USSVI.

Joe Negri and the other founders of USSVI would be proud and we honor our finest with the annual prestigious *Joe Negri* award in honor of this farseeing WW II Subvet who wanted to create a organization for all submariners, no matter when they served.

For more information about U.S. Submarine Veterans please visit http://USSVI.ORG, call 1-877-542-DIVE or email: ussvi@telebyte.net.■

SEA STORIES

THERE I WAS

by LT Ted Curtin, USN(Ret.)

We were headed Southwest, somewhere off Newfoundland, homeward bound after a Cold War adventure off the Faeroes, where we had patrolled submerged for about six weeks, listening for the passage of Russian subs possibly bent on mischief in the open Atlantic. It was the time of the Suez Crisis, and we had been part of the execution of a long-standing operation order that flung a cordon of submarines and patrol planes across the *Gap*, the various straits that separate Greenland, Iceland and the United Kingdom. We had been called from our homes under secret orders, our plans for scheduled deployment to the Mediterranean canceled in the furor over the Egyptian takeover of the Suez Canal and the ensuing fighting. Our task had been to lie still beneath the surface, listening for the sounds of submarine engines and calling in the planes to locate, identify and track the intruder. Now we had been relieved by another sub, and were on the surface, speeding our way back home to New London.

Our boat was USS ATULE (SS 403) a World War II Fleet submarine converted to what we called a Guppy, streamlined, and with better batteries and equipment. I was the new Chief Engineer, recently reported aboard from the older GROUPER, on which I had qualified in submarines. Our skipper was Willy Knull, a mild-mannered, soft-spoken man of considerable experience, and the crew, officers and men alike, were a good and generally well-seasoned lot. Our recent patrol had served to bind us into a smoothly working team.

I had just been called for the night watch, eight to midnight. It was winter, and as the cliché goes, "a dark and stormy night"; so, as I was assembling a nearly-dry set of foul-weather gear, I was happy to get word that the Captain had decided to submerge for the rest of the night, because of poor visibility and the rough ride we were getting. We were near the regular shipping routes, and submarines are hard to see even in good weather, so he felt we had rather be both safe and comfortable, even if it delayed our return home.

So, there I was, leaning against the plotting table in the Control Room, braced against the constant violent rolling and pitching, the boat shuddering every so often as a particularly big or erratic wave slammed into our low-lying superstructure. I felt even more grateful not to have to suit up and climb into that dark maelstrom. We reported up to the captain in the Conning Tower that the oncoming watch was assembled and ready, and we heard him shout up to the bridge, "Take her down!" The diving alarm blasted its familiar "Oooga-oooga", the P.A. system carried the Officer of the Deck's shouted, "Dive, Dive!", with a background noise of shrieking wind, and the watch on deck came tumbling down the ladders into the Control Room, streaming water from the foul-weather gear that encased them all but their eyes.

Then the bottom fell out of our world!

Normally, when a submarine dives, at least the diesel-powered fleet boats, the sound of the diving alarm is followed by a well-ordered, coordinated sequence of events. The engines are shut down and propulsion is shifted to the electric motors and battery at full speed. All the outside openings are shut, while the vents are opened, allowing the huge ballast tanks to flood and give the boat negative buoyancy. Large steel hydraulic planes extend from the boat's sides, one pair forward and one aft, like stubby airplane wings, to control the angle of the boat as she goes up or down. As she submerges, usually at a down-angle of 5 degrees, the OOD becomes the Diving Officer, and he and his crew make adjustments to drive the boat down to the ordered depth and level her off on an even keel.

That is what is supposed to happen—normally. As I stood there waiting for the wet crew to complete their dive, things suddenly went awry. Just as the Chief Petty Officer of the Watch scanned the *Christmas Tree*, a lighted board that showed whether outside openings were open or shut, and reported "Green board, pressure in the boat", signifying that all was well and safe for diving, the boat lurched into an alarming down angle, throwing us all off-balance. She seemed to be heading for the bottom, pointing her bow more than 45 degrees down, and things began to fall out of their stowage spaces with a tumult of thumps and bangs, accompanied by a shower of dust and debris long hidden in out of the way places, while we all hung on and wedged ourselves in place as best we could. As Engineering Officer, I was the ship's senior diving officer, so I got right behind the Diving Officer, to give what assistance I could, as he urged his planesmen to get the angle off and pull her up.

The Skipper took over from the Conning Tower, as submarine doctrine provides, and took the classic action called for, Stop, Back and Blow. He ordered, "All stop, All back full, Blow all main ballast". On a dive, the stern planes, situated right behind the propellers, have the greatest effect on the angle of the boat; and ours weren't having any effect in leveling us. The Captain's orders stopped the full speed force of water over those planes , began to pull the boat backward, (toward the surface), and immediately began to lighten the boat by blowing the water out of the recently flooded ballast tanks, making the boat buoyant again.

Soon we were wallowing on the surface, breathing our various sighs of relief while we tried to figure out what had happened. I recalculated the figures in the diving book, a log of the distribution of all the liquid weight in various tanks, which affects the trim, or angle of the boat when submerged. We checked out all our control mechanisms, and all seemed normal. So, we tried it again.

And the same thing happened! Again we plunged rock-like toward the bottom, a couple of miles down. Again we stopped, backed and blew, and once more we reached the surface, where we rolled about much like a log in the surf while we double-checked all of our equipment, procedures and calculations. Nothing seemed to indicate an answer, until finally, one of the young lookouts who was, on the dive, the stern planesman, said, "Mr. Curtin, these planes aren't working right. See, I can spin the wheel in manual with one finger, and it should take all my might!" Back I went to the After Torpedo Room, where the stern planes had a pointer attached directly to the control arm, and it was moving properly. Yet something was radically wrong when no resistance could be felt in moving the planes by hand. All our heads were together, yet all that collected experience found no explanation, and we decided we had no choice but to go home all the way on the surface.

I climbed into damp, salt-crusted foul-weather gear and took my watch on the bridge, an hour or so late, immediately cold and wet, but still alive. Though quite drained by the harrowing experience, my mind was still pondering the whys and wherefores of the event, since it was in my bailiwick as Engineer. Through it all there had been no panic, not even among the newest, unqualified hands, and I don't recall being afraid, though we had been in great danger. My reaction had been one of anger and frustration over the malfunction; but the more I reflected on it the greater was my gratitude and pride in the behavior of the crew, who worked calmly together, a smoothly operating team of professionals, secure in their knowledge of what they and their boat could do together.

All our thought on the problem was to no avail, as we pounded our way slowly down past Nova Scotia, through snow and ice that coated our superstructure, and more storms that battered holes in the aluminum plating of our *sail*, the streamlined structure around the bridge. It was not until we were alongside the floating dry-dock in New London that the answer came. A diver came to inspect the sternplanes, and as was their method, jumped off the deck to land down on the planes themselves—only he kept on going—there were no planes there at all! Somehow, sometime during that first storm, the planes had taken such a forceful blow from the sea that the shaft had broken in two, and the planes had fallen right off! At last we knew just how precarious our position had been. And now we had our own *sea story* to match countless others we'd heard, most of which began with the words made famous by the wartime novel, Shore Leave, "and there I was..."■

PRACTICE MAKES PERFECT

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

During 1957 I served in USS CAIMAN (SS 323) with Lieutenant Commander Jack Hawkins as CO. Jack was a wonderful man to work for if you didn't mind being held to very high professional standards. We had a very good boat, and as I recall we won the *E* that year. However, Jack became concerned about the fire control party's lack of precision at the firing point. So we retired to the conning tower one afternoon during the final week of upkeep before a week of type training and we practiced and practiced and practiced. We responded to a dummy target introduced from sonar, solved for target motion and honed our skills at the firing point procedures. "Set, Shoot, Fire!" rang out time after time as we simulated firing torpedoes. This seemed to go on for hours. Jack never yelled at us but he was adept at Chinese water torture methods and he never let up for a minute. "Set, Shoot, Fire!" again and again, ad nauseam. Finally we quit, having honed ourselves to a very fine edge, with Jack confident that he had the best firing point fire control team in the Pacific Submarine Force.

On Monday we went to sea and started an approach on the target. I was fire control coordinator and Ray Heimbach, our XO, was assistant approach officer. John Shilling manned the TDC and Joe Smith was ATDC officer. We did a nice job of target motion analysis as I recall and were getting close to the point where we could fire a Mk 14-5 steam torpedo with a high hit probability. Ray checked on all the details: torpedo ready, tube flooded, and muzzle door open, as the range closed.

Then he made a fatal mistake. He turned to John Shilling at the TDC and asked John "Are you set?" Immediately Joe Smith, having heard the magic word "Set" and having already computed the spread, yelled "Shoot", the fire controlman on the firing key hit the button and yelled "Fire" and away went the exercise torpedo with poor Ray yelling "Noooooo" and trying to pull it back into tube with body English.

I can still remember Jack Hawkins' look of disgust at his highly trained and finely tuned fire control party as the torpedo went out and missed the target.■

NOW YOU SEE THEM, NOW YOU DON'T

by CAPT John Shilling, USN(Ret.)

The setting for this story is aboard USS CAIMAN (SS 323) operating off a foreign coast on a "mission of great importance to the government of the United States" in the winter of 1958. Commander Jack Hawkins, CO, at the conn, was conducting surveillance ops at periscope depth with about 60 feet under the keel. An ASW training exercise is in progress with several DDs and one diesel sub target.

CAIMAN, operating with the Fire Control Tracking party, was making visual observations and correlating sonar information to maintain the picture of fast moving DDs at ranges of less than 4000 yards. Tension ran high in the Conning Tower, but Captain Hawkins displaying a calm demeanor and a confident manner, conned the ship with great tactical skill. #2 Attack Scope which broke the surface at keel depth of 64 feet, was being used for a round of observations for the tracking team, when one of the targets turned toward us and the Captain ordered, "Down scope". The scope dipped promptly as the FC party began to hear screw noises through the hull. Sonar reported that a high bearing rate DD was passing down the starboard side at a range of 1000 yards.

We all were acutely aware that *going deep* was not an evasive option in our situation. No one said a word, but all of us showed our concern by the wide-eyed expressions on our faces, which clearly indicated that this was a hairy spot to be in. In the meantime, the *Hawk* had positioned himself in front of #1 periscope, and ordered "up scope". The tracking party returned to reality and readied for a round of bearings and observations. The Captain placed his eye to the scope as it rose from the well, then immediately ordered, "down scope", with not a word about target bearing or angle on the bow. Puzzlement was added to the tension permeating the Conning Tower.

The Captain, his face showing deep concern and surprise, announced, "Men, they are closer than I thought! It seems they have put a bag over the periscope!" Suddenly, the Diving Officer shouted up that his depth was 64 feet, and we all realized that #1 scope which the Captain had inadvertently used was at least two feet underwater when he made the observation. Laughter replaced fear and tension in an instant. The Captain had made a mistake and rather than kick butt and blame others, had instead turned the error into a humorous situation. The tracking party, now relaxed and focused was ready to roll when Captain Hawkins ordered, "Raise #2 periscope."■

NAVAL SUBMARINE LEAGUE
HONOR ROLL

BENEFACTORS FOR MORE THAN FIFTEEN YEARS

AMERICAN SYSTEMS CORPORATION
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ELIZABETH S. HOOPER FOUNDATION
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HYDROACOUSTICS, INC.
L-3 COMMUNICATIONS OCEAN SYSTEMS
MARINE MECHANICAL CORPORATION
NORTHROP GRUMMAN CORPORATION-MARINE SYSTEMS
NORTHROP GRUMMAN INFORMATION TECHNOLOGY
PEROT SYSTEMS GOVERNMENT SERVICES
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LETTERS

ONE ORIGIN OF THE INTERNATIONAL EFFORTS IN SUBMARINE ESCAPE AND RESCUE

1 November 2002

Upon reading the article in the October 2002 issue of **THE SUBMARINE REVIEW** about *Submarine Escape and Rescue Liaison Office (SMERLO)*, I thought that I might make a contribution to the origin of the international cooperation in submarine escape and rescue.

To set the stage I was the Special Assistant to the Assistant Secretary of the Navy for Research and Development, Dr. Robert A. Frosch, from 1967 to 1970. As a result of the USS THRESHER tragedy in April 1963, a Deep Submergence Systems Project (DSSP) office had been established. One of its ongoing projects was the design and construction of six Deep Submergence Rescue Vehicles (DSRV) (later reduced to two). These vehicles were a great improvement over the traditional means of submarine rescue in depth, speed and capacity. These vehicles were carefully designed to be able to mate with all current and proposed United States Navy submarines.

The DSSP proposed a new initiative designed to permit the DSRVs to be able to effect a rescue of personnel from any submarine—not just U.S. types. This initiative proposed that the U.S. Navy would provide enough detail of the mating surface in the immediate area of the submarine hatch so as to be compatible with the DSRVs. The drawings would provide any submarine designer with adequate information so as to ensure compatibility. This policy initiative was presented to Dr. Frosch for approval. After some discussion he approved the policy.

Thereafter I pursued the clearance process and after a few days I had an approved press release. At about that time, Captain Bill Thompson, the Assistant to the Secretary for Public Relations, came into my office. He explained that the Secretary, Mr. Paul Ignatius, was then in Honolulu preparing to make a major speech. He, the Secretary, would like to make some kind of an announcement and did he, Captain Thompson, have any ideas. Naturally, I explained that I had just what the Secretary was looking for. After quizzing me about the approval procedure, Captain Thompson took the press release and went off to contact the Secretary.

About two days later, Captain Thompson came into my office. He explained that initially the Secretary was most appreciative. Shortly before the banquet, however, the Secretary called Bill with some concerns. He was having misgivings about the whole thing and was about to give up on the announcement. Bill replied that he might as well make the announcement—the Secretary's speech was even then being carried on all the major wire services!

Later I was told that the appropriate drawings and explanations were provided to all of the United States naval attaches.

It may well be that the origin of the international cooperation in submarine escape and rescue started with Secretary Ignatius' speech in Honolulu in 1968.

Yours truly,
C.A.K. McDonald
Captain, USN

ABOUT RADCON MATH AND FORCE LEVEL

February 25, 2003

CDR Mark Gorenflo's article, *Submarine Force Structure: An Exercise in Applied Radcon Math*, published in the October 2002 edition of **THE SUBMARINE REVIEW** points out the difficulties in funding two Virginia class SSNs per year. CDR Gorenflo makes a number of excellent observations and recommendations on issues associated with increasing the build rate to that level. He also is critical of the defense industry's performance on Virginia, saying industry is "producing less with more" and industry "should deliver a product on time and within budget."

As designer and prime contractor for the Virginia class, Electric Boat Corporation is on track to deliver the lead ship not only on time, but ahead of schedule. The primary reasons for this success are the: (1) design build process developed by Electric Boat and the Navy; (2) development and use of the world's best shipbuilding Computer Aided Design (CAD) tools, and (3) increasing refinement of modular construction techniques used at Electric Boat and Newport News.

Increased cost for Virginia is more a function of the unprecedented low building rates for nuclear submarines and Navy contracting constraints than shipyard performance. The low building rates (6 submarines authorized in the 12 years from 1992 through 2003) have driven costs for material higher as many suppliers have left the submarine industry, and those that remain incur high unit cost. The active supplier base has been reduced by 40 percent over the last ten years. Shipbuilders and suppliers are aggressively working to control material costs, but the long-term solution is dependent on increased volume and procurement strategies that provide a stable and predictable market for suppliers. Additionally, the use of unrealistic annual escalation factors, not shipbuilding performance, have caused overruns. At the time of the construction contract award, the government budget forecasts were using less than 2 percent as an annual escalation factor when Bureau of Labor Statistics historical data for the shipbuilding industry index reflected 4.5 percent. The historical shipbuilding inflation indices have proven valid, and significant additional funding has been required to achieve proper funding.

Shipbuilder controllable costs on the other hand have incurred far smaller overruns. Electric Boat and Newport News current estimate reflects an overrun of less than 3 percent of the total contract for costs directly controlled by the shipbuilders: shipyard labor and overhead. Overall, the construction estimate at completion indicates a total cost growth of 16 percent, of which 84 percent is not controllable by the shipbuilder.

Although at times the Defense Industry probably deserves criticism due to poor cost performance, the Industry performance on Virginia has been on schedule and very close to budget. This level of performance for the lead ship of a class is unparalleled.

/S/
F. J. Harris
Vice President Programs
Electric Boat Corporation

THE SUBMARINE REVIEW

THE SUBMARINE REVIEW is a quarterly publication of the Naval Submarine League. It is a forum for discussion of submarine matters, be they of past, present or future aspects of the ships, weapons and men who train and carry out undersea warfare. It is the intention of the **REVIEW** to reflect not only the views of Naval Submarine League members but of all who are interested in submarining.

Articles for this magazine will be accepted on any subject closely related to submarine matters. Article length should be no longer than 2500 to 3000 words. Subjects requiring longer treatment should be prepared in parts for sequential publication. Electronic submission is preferred with either MS Word or Word Perfect as acceptable systems. If paper copy is submitted, an accompanying 3.5"diskette will be of significant assistance. Content, timing and originality of thought are of first importance in the selection of articles for the **REVIEW**.

A stipend of up to $200.00 will be paid for each major article published. For shorter Reflections, Sea Stories, etc., $100.00 is usual. Book reviewers are awarded $52.00, which is that special figure to honor the U.S. submarines lost during World War II. Annually, three articles are selected for special recognition and an additional honorarium of up to $400.00 will be awarded to the authors. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League.** The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League. In those instances where the NSL has taken and published an official position or view, specific reference to that fact will accompany the article.

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

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

BOOK REVIEW

WAR BENEATH THE SEA
by Peter Padfield
John Wiley & Sons, New York 1998
ISBN 0-471-24945-9, paperback, 560 pages
Reviewed by CAPT James C. Hay, USN(Ret.)

This book was recommended to me as "the best single overall book on submarine operations in World War II". Naturally, I had to follow up on such words and when my copy arrived in the mail I saw John Keegan quoted on the front cover as "The standard work on the subject". High praise indeed; and I found Peter Padfield's book to live up to both billings. It is, therefore, recommended to all with either general or specific interest in submarining, World War II, higher tactical leadership or the making of strategy. The most interesting of all, of course, is examining the anatomy of that particular brand of heroism which leads to successful independent operations against the enemy's strength.

In his Prelude and in his first Chapter, Padfield sets the stage, respectively, for the submarine campaigns of World War II and for submarines and submariners of the era. The Prelude describes the first attack of the War on the 13,500 ton ATHENIA, by Ober Leutnant Lemp of U-30, with the sinking and its attendant repercussions. Chapter One very well captures both the advantages and disadvantages of service in submarines of the War's major combatants. He succinctly explains the mechanics of submerged shiphandling and torpedo attack in the 1940s and introduces his question about the type of person who volunteered to do these things. A major thread to his account of the War's submarine campaigns is the development of his answer to that question. Woven through his accounts of individual action, and higher level decision, are his descriptions of character traits and practices of submarine skippers and their commanders.

The run up to the Second World War as it pertained to submarines is treated fully enough to describe the main types of boats built for each of the major powers; and to address the common problem facing each of those forces. Padfield's introduction to that section shows both his understanding of the scope of the question "Why submarines?" and his somewhat understandable bias to the British situation.

> "The submarine did not change between the wars; it simply developed in small ways from its forerunners in the first war, yet there were distinct differences between the national fleets. These had less to do with differing national requirements than with a shared misunderstanding of the role and strategic potential of the weapon by the gunnery admirals at the top, aggravated by the distorting effects on design of naval limitation treaties."

Padfield's general words intimate an overall repression of submarine innovation between the wars, as experienced by the Royal Navy. However, he does treat the United States situation a bit more generously about hardware in his specific description of the American workup to the undersea war of the '40s. That is, he does give full credit to the 1920s and '30s U.S. Submarine Officers Conference for coming up with the design of the WW II Fleet Boat, as opposed to the less innovative designs of the other navies. The U.S. Navy as an entity, however, is criticized heavily for insensitivity during the same period. He blames the Navy for its lack of pre-war insightful planning, its rigid training practices which stifled tactical growth, its overly close and stingy torpedo development and its bureaucratic approach to solution of the weapon problems.

The Submarine War itself is treated both chronologically and by the three main theaters. The Atlantic features the German U-Boats and their struggle against growing Allied strength, the Mediterranean pits the British against the Axis efforts to cut off the Middle East, and his account of the Pacific War addresses both the American and Japanese submarine campaigns. In describing the *The End* of the war, Padfield sums up the won-loss records of the four Submarine Forces and provides his own evaluation of the best and worst of the force commanders. It would be interesting to hear the views of American veterans and students of the WWII *War Beneath the Sea* concerning Padfield's opinions about the commanders.

During the early Atlantic submarine war the Royal Navy submariners had a particularly hard patrol area just off the low countries, keeping watch for an invasion fleet in the shallow waters and rough seas of the North Sea and English Channel. The author holds that period as preparation for the coming trials of RN submarines in the Med. The story told of the early U-Boat war features the exploits of the "aces", young officers in command who ran up very impressive totals of tonnage sunk. The tales of Prien at Scapa Flow, and the wolfpack attacks with Kretschmer and Schepke scoring big victories for Doenitz are all told. The turning of the tide, however, is foretold in the German disasters of the Spring of 1941, even before America's entry into the war. All three of those U-Boat aces were lost within one week in March of 1941. More importantly, Ober Leutnant Lemp, who had U-30 at the beginning of the war, was then in command of U-110 and in May of '41 was counter attacked in a convoy battle and had to scuttle his boat. Unfortunately for him, and for Doenitz, the boat did not sink immediately and the British escort commander was able to order a boarding and capture of their Enigma machine and code books. Lemp did not survive that action, although most of his crew did. Padfield treats the irony of those several weeks with typical understatement.

The tale of the U-Boat campaign of '42 and '43 involves the U.S. with its ASW efforts and developments. The *Paukenschlag* operation off the east coast of America was a wake-up call for the U.S. Navy and Padfield revisits the British points about Admiral King not adopting the Royal Navy's procedures and command structure for convoy protection. In describing King's formation of the TENTH Fleet in May of 1943, he does give him credit for fully integrating U.S. ASW efforts. He seems to regret, however, that it was done by geographically separating USN and RN/RCN areas of operations, rather than at the outset giving supreme command of the Atlantic to the British. There are many lessons yet to be learned from the combined naval discussions of that period, and Padfield is to be thanked for raising the issues again.

The Mediterranean War is largely the story of the RN's TENTH Submarine Flotilla of 540 ton U class submarines based in Malta. The larger (1090 ton), but still not big, T class from Egypt did some great work in the Aegean and the eastern Med, but the tiny Us carried the brunt of the battle to stop Axis resupply and reinforcement of Rommel's Afrika Korps. The saga told of Malta with continuous air bombardments and the TENTH Flotilla continuing to refit and rearm its boats is one of tenacity, innovation, collective bravery and amazing focus on the important objectives. The Med had its share of submarine heroes as well. Wanklyn in UPHOLDER, Tomkinson in URGE and Miers in TORBAY all made impressive records in tonnage sunk and German plans upset, displaying professional skill and personal bravery in uncommon amounts. Padfield offers an interesting parallel between the characters of Miers and Mush Morton for them both having machine gunned enemy soldiers in the water after sinking their troop ships.

The submarine campaigns of the Pacific War probably hold more interest for American readers, and it is instructive to read of that war from a British perspective. The author characterizes the first year or so of US submarine action as "an inauspicious start". He again blames King for not recognizing the new realities of the requirements for submarines, and particularly for separating command and control of Pacific submarines between two theaters. His point is that an integrated, focused *tonnage* war on Japanese shipping might well have brought the war to a close a lot earlier. Single command of submarines as a *strategic* asset is an interesting point, both from the extent of its pertinence to the WWII case and its applicability to future planning.

All the submarine aces of our pantheon are mentioned by Padfield and given due credit for extraordinary accomplishments. WAHOO's exploits in sinking a destroyer at Wewak in New Guinea and on the same patrol the sinking of two frieghters, one transport and one tanker by the team of Mush Morton and Killer O'Kane are covered in detail. Those details also include Morton preventing the Japanese troops who survived the sinking from reaching the nearby shore to fight again. Red Ramage in PARCHE and his convoy melee, Sam Dealey in HARDER and his five destroyer destruction derby, and O'Kane on his own in TANG are all covered adequately enough to give the general reader a good feeling for the skill, daring and tenacity of those skippers. The late-war incursions to the Chinese and Korean coasts by Gene Fluckey in BARB and George Steele in TIRANTE in their actions against covert convoys are well covered. It is apparent, however, that space did not permit a full treatment of the work and knowledge involved in finding those convoys nor of the skill and fortitude displayed by each in going into shallow water in an enemy harbor to wreck havoc on what was left of Japanese shipping.

At the end of the book Padfield gives his evaluation of the force commanders. Doenitz is given an outstanding place for "his clear focus on the tonnage war". Padfield does say that toward the end he sent his U-Boat men out to die in obsolete boats, but does not score him for not starting a parallel path of technical improvement at the outset and waiting until too late in the war to push the Type XXI. At the same time he counts Christie in SW Pac as "the most disastrous failure" for his actions in command regarding the magnetic exploder affair. There seems to be a cross in the author's reasoning about the material responsibilities of operational submarine commanders. On the British side, Captain Simpson, Commodore of the TENTH Flotilla in Malta, is ranked among the highest while Admiral Pound and the British Naval Staff "lacked clarity or sufficient force in argument with Churchill" which allowed the U-Boats "to bring Great Britain within an ace of defeat".

Oddly enough, neither Lockwood nor Nimitz were named among his list of the best.■