THE SUBMARINE REVIEW
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NAVAL SUBMARINE LEAGUE • Box 1146 • Annandale, VA 22003
(703) 256-0891 Fax (703) 642-5815 E-mail: subleague@aol.com
Web Page: www.navalsubleague.com

EDITOR'S COMMENTS

The FEATURES section of this issue carries three messages for the submarine community. In his Banquet Address to the Annual Symposium in June Admiral Rich Mies, the current Commander-in-Chief of U.S. Strategic Forces and the former COMSUBLANT, not only very succinctly summarized the history and achievements of American submariners, but stressed the innovation and tenacity with which those achievements were attained. More importantly, Admiral Mies looked at the present Force and the potential of future jobs which will have to be done by U.S. submarines and concluded "....we've chartered a course,....to create a vision of the Submarine Force and undersea warfare 30–50 years hence....A vision which foresees a profound shift in the size and look of our Navy....". The second FEATURE, by Ron O'Rourke, a most credible observer from the Congressional Research Service, also focuses on the state of the Submarine Force, but in terms of what the recent past, current and projected building programs will mean for the future. In addition, Mr. O'Rourke offers some advice to the submarine community as to best approach the problems in obtaining the force levels sure to be needed for the future. Incidentally, both Admiral Mies and Mr. O'Rourke mention the recent book Blind Man's Bluff and both note that, while the book did create a sensation, it is not the definitive history of U.S. submarines in the Cold War and this community has to continue to do the hard work and face the difficulties involved in getting its point across.

As a follow-on to the article about the forthcoming submarine exhibit in the July issue of **THE SUBMARINE REVIEW**, the third FEATURE concerns the various other exhibits which will celebrate our Centennial during the year 2000. The point is made here that while the Smithsonian Exhibit may well stress the future of U.S. submarines in terms of what the nuclear subs did in the Cold War, there are other facets of the submarine story which are being told in other exhibits.

There are a number of excellent articles offered here by the authors within the community, and we take this opportunity to say thanks to all who contribute so much to the body of learning and lore which stands behind American submarining. Captain Ralph Enos continues his work on the similarities and differences between

Admirals Döenitz and Lockwood in their leadership of their respective submarine campaigns during World War II. Commander John Alden has a piece about a wartime Japanese convoy and the American POWs who were aboard. Two active duty submariners, Lieutenants Geiger and Packer, offer their views of the future with observations about the way technology is taking us that may not be apparent to all of us. There is also in this issue one article which I mentioned in July's Editor's Comments but had to postpone as the issue was at the printers. It is by a new but interested observer of submarines with a long experience in tactical aviation subjects. Mr. Lambeth of RAND gives us an interesting comparison between the ways of fighter pilots and submariners. There is also a further piece of conjecture from Mr. Joe Buff, a novelist looking at future submarine potential strictly from unclassified sources using a writer's research methods.

To comment further on the recent interest in the fate of SCORPION, Captain Tom Smith has written an analysis to put forward a theory for the cause of that loss. **THE SUBMARINE REVIEW** has no interest in stirring up debate about that tragedy, nor in the recent commentaries. Captain Smith's observations are offered here, however, more to give voice to all who have made their feelings known and to provide a credible, well reasoned analysis.

There is a warm human interest piece about one of our best known heroes, Admiral *Fearless* Freddy Warder, from his personal correspondence at the beginning of WW II. There is also a review of Captain Ned Beach's latest book Salt and Steel which I wrote myself and I ask our readers indulgence for that bit of licence but I was in TRITON with Ned for the Submerged Circumnavigation and I just could not let pass the opportunity to salute the career about which Ned offers his *Reflections*.

Jim Hay

FROM THE PRESIDENT

As we approach the Submarine Centennial year, the Defense Department, the Navy, and the Submarine Force are rapidly reaching a critical stage. Each year we see cuts in procurement, which are mind-boggling. Some of us felt reassured when funding was added to the Defense budget last year but if you look at the ongoing machinations which occur in the everyday mundane workings of DoD, you will see that the entire plus up has been dissipated since.

On C-SPAN recently, there was a program that, in fact, was the "phase one report" of the U.S. Commission on National Security. This group has not been highly publicized, although there certainly has been no attempt to keep it hidden. Some of the members of the Commission are: Senators Rudman and Hart; Representatives Gingrich and Hamilton; Admiral (Ret.) Harry Train; and former SECAF Don Rice. This is a bipartisan group that hopes to have the impact on the Defense Department which has not been seen since Mr. Forrestal's study in the mid '40s led to the National Security Act of 1947. The initial report was presented as a short general statement of the problem. There will be two more reports over the next two (+) years. The expressed desire is to use the group's recognized bipartisanship to develop a viable, acceptable, balanced report that can be used by the next President, no matter the party. The first report should be on the Web by now.

Finally, all of you should be aware that the planning for the NSL 2000 Symposium in June is making good progress. The Banquet speaker will be Admiral Bill Crowe (and he has accepted) and one of the numerous relatively well-known guests will be President Jimmy Carter. I suggest you start considering your arrangements.

As late breaking news: We have just been informed that the Post Office has approved five stamps commemorating the submarine heritage. The stamps will display USS HOLLAND, an S-boat, a fleet boat, a 688, and a Trident. That is a real success story for Hank Chiles and his Centennial Committee.

Dan Cooper

BANQUET ADDRESS
Naval Submarine League Symposium
June 4, 1999

by ADM Richard W. Mies, USN
CINCSTRATCOM

Admiral Smith, Admiral Long, Admiral Crowe, Admiral Trost, Admiral Chiles, Admiral Bowman, Admiral Clemins, fellow flags, distinguished guests, ladies and gentlemen.

Let me start by saying it's an honor to be your guest speaker tonight, here among such a distinguished group from the ninety-nine-year history of the United States Submarine Force. It's good to be back on the coast, where you almost smell and hear the sea. It's tough being an old sea dog landlocked—actually aground—on the great land that is Nebraska. The only state in our Union where the third largest city is the football stadium on a Saturday.

Seriously, as many of you know, we recently celebrated the 50th anniversary of SUBDEVGRP 2 and SUBDEVRON 12. It was a memorable celebration which allowed us to pause and pay tribute to a very unique and historic organization that has played such a critical role in the legacy of our Submarine Force.

As I reviewed the history of our tactical development, I was reminded that the history of that command is a microcosm of the history of the Submarine Force—a history of challenge and uncertainty, resourcefulness and innovation, and most important, vision and renewal.

So, tonight I would like briefly to retrace some of our heritage, to illustrate how the Submarine Force has reinvented itself over time and adapted to a changing world.

Ninety-nine years have passed since the Navy officially entered the submarine business. We have come a long way since Lieutenant H.H. Caldwell commanded USS HOLLAND on her acceptance trials in October of 1900. Since then we have commissioned over 775 submarines, the last one being USS CONNECTICUT—just think about the changes from HOLLAND to CONNECTICUT—about how far we've come. Throughout our history, one of the greatest strengths of the Submarine Force has been the innovation, initiative, and adaptability of its people.

Although the Submarine Force is nearing 100 years of age, I believe most of us trace our roots from the war in the Pacific—a war in which the Submarine Force truly achieved an identity separate from the surface Navy. Prior to World War II, submariners were used as fleet auxiliaries--coastal raiders, radar picket ships, scouts, and pilot search and rescue vessels, and elements of the battleship screen. But, following the crippling attack on Pearl Harbor, it was the Submarine Force that took the war *forward from the sea* against the Japanese, even though before Pearl Harbor, submarines had never been envisioned or trained as a striking force. Our forebearers were forced to reinvent themselves...and they did a miraculous job.

I have a copy of a famous letter which hangs in my office as a reminder. In it, Admiral Nimitz wrote, "We shall never forget that it was our submarines that held the line against the enemy while our fleets replaced losses and repaired wounds."

I don't need to remind you, but what our submarines accomplished in the years of heroism and uncertainty following Pearl Harbor is an enviable record by any standard of measurement. A mere handful of submariners, less than two percent of the Navy, with a small force of boats, sank more than 55 percent of all Japanese shipping and nearly one-third of all Japanese combatants. As the historian Theodore Roscoe later wrote: "He who lived by the Samurai sword died by the submarine torpedo...the atomic bomb was the funeral pyre of an enemy who had been drowned."

But that accomplishment was not without sacrifice—52 subs and more than 3500 men never returned from patrol. Their example of courage under fire following Pearl Harbor, of enduring fortitude, of invincible determination, of bitter sacrifice, and of ultimate, silent victory became our heritage—and they became the heroes upon whose shoulders we stand.

At the end of World War II, a second transformation took place. As the Navy downsized, the Submarine Force was in enormous turmoil. Many aviators and surface sailors thought the Submarine Force no longer had a mission. Once again, our submarine leaders had to reinvent themselves. They made an historic decision to pursue an anti-submarine warfare role. Why did they do that? What gave our predecessors the foresight and courage to undertake ASW against an emerging Soviet submarine threat? After all, there were no significant submerged sub-on-sub encounters during the war. Why not exploit the successes of the war and continue to pursue anti-shipping as their main focus? I suspect that because we are an island nation with huge dependence on our sea lanes for commerce, the threat posed by a potential enemy's submarine force was considerable. There had to be a counter to that threat and the Submarine Force was determined to develop it.

And once again they succeeded. Starting from scratch on ASW, they steadily and patiently developed into the world's preeminent ASW force and, over the next four decades, set the standard for ASW.

Because of our predecessors' foresight we can claim enormous credit for our role in helping win the Cold War. Our attack submarines went *forward from the sea* and, over many years of silent warfare, quietly drove the Soviet submarine force back into their bastions. Only this time it was a quiet, undersea war and no shots or torpedoes were fired. But it was a war nonetheless. They were a formidable opponent and an intense, sustained effort was required.

As the Soviets made their submarines quieter, we developed even quieter submarines and improved our sensors. When they went faster and deeper, we built better torpedoes. When they deployed to the Arctic, the Mediterranean, or off our coasts, we hounded them. The U.S. Submarine Force was always able to hold the edge over a much larger Soviet submarine inventory, a fact not lost on Communist leadership, which poured a substantial amount of national treasury into their submarine force.

In the early days of the Cold War, two other historic transformations occurred within the Submarine Force. First, we transitioned from diesel submarines to nuclear powered ones—from ships that were tied to the surface through battery capacity and air to those limited only by food supplies and human endurance. And second, we developed the ballistic missile submarine. When the Soviets launched Sputnik in October 1957 and our Nation was panicked over the apparent missile gap, our Submarine Force was called upon again—this time to accelerate development of a ballistic missile submarine. Many people believed ballistic missiles were too large and dangerous for submarines—a submerged ballistic submarine was pure science fiction. But a handful of visionary, innovative people thought otherwise. A little more than three years later, GEORGE WASHINGTON went to sea on its first strategic deterrent patrol—the first of almost 3500 patrols to date.

This achievement was remarkable—completed five years ahead of schedule and incorporating into a single weapon system many of the great scientific developments which have so revolutionized warfare—the nuclear warhead, the ballistic missile, nuclear propulsion, inertial guidance for navigation. We built 41 FBM submarines in 7½ years—an interesting comparison to today's construction rates and a remarkable statement about what our country can do when it sets its mind to it.

Without fanfare and recognition, our ballistic missile submarines patrolled the oceans of the Cold War in silent vigil undetected and invulnerable, ready to strike, to deter our adversaries and reassure our allies—and just as quietly they set the standard for strategic deterrence and became the preeminent leg of our strategic deterrent triad—our *ultimate insurance policy*.

As Colin Powell said,

> "...the Cold War was won especially by...America's blue and gold crews manning America's nuclear powered ballistic missile submarine fleet...no one...has done more to prevent conflict—no one has made a greater sacrifice for the cause of Peace... than...America's proud missile submarine family. You stand tall among all our heroes of the Cold War."

In the end, our Submarine Force—both attack and ballistic missile submarines—helped drive the Soviets not just into their bastions, but into bankruptcy.

There are many symbolic parallels between our submarine operations in World War II and those of the Cold War. Considering their small size, the valiant submariners of World War II were probably the most highly decorated force of that war—7 Congressional Medals of Honor, countless Silver Stars, 49 Presidential Unit Commendations, 53 Navy Unit Commendations... The list goes on. And I would venture a guess that the submariners of the Cold War years are the most highly decorated force of that peacetime era. World War II produced many submarine heroes. The Cold War produced many unsung ones. Jim Calvert certainly qualifies as both and I salute the Submarine League for recognizing him tonight.

And like their World War II predecessors, the spirit, the sacrifice, and the strength of character of our post World War II submarine families have been a hallmark. If our submariners were often alone in their confined work, they were never alone in their sacrifice. That unique set of sacrifices was shared with our families—long, difficult separations frequently without communication—no messages, no phone calls, and no letters—for months on end; missed births and birthdays, anniversaries and graduations.

It was not until well after World War II that the history of submarine operations in that war was written. For good reasons, the history of submarine operations during the Cold War must go largely untold. And from my perspective, books like Blind Man's Bluff don't come close. But it is a history that some day should be written.

Today, like the aftermath of Pearl Harbor and the end of World War II, we face a similar challenge. The world has changed dramatically since the fall of the Berlin Wall. The predictable, monolithic world we once faced has now been replaced by a world of uncertainty—uncertainty in the hills of the Balkans, the streets of Somalia, the deserts of Iraq, and the bunkers of North Korea. I recently read a parable which I think describes the situation in a world of accelerating change and uncertainty in which we, the Submarine Force, find ourselves.

Every morning in Africa, a gazelle wakes up. It knows it must run faster than the fastest lion or it will be killed...and every morning a lion wakes up. It knows it must outrun the slowest gazelle or it will starve to death. The truth is it doesn't matter whether we are a lion or a gazelle...when the sun comes up, we'd better be running.

With the demise of the Russian submarine threat, some critics say we have no role in meeting the future regional threats or crises. We have raised a whole generation of self-anointed defense experts who suffer from a false impression that submarines only exist to fight other submarines—a job no longer in great demand, though still necessary. Once again, we are the victims of our own success. We find ourselves in a struggle for relevance. As we drawdown to fewer and fewer boats, we are being stretched thin and in danger of becoming a mile wide and an inch deep. If some people are intent upon making us a leaner force, our job is to make us a meaner one.

Today we are adapting to a profoundly changed environment. We have come full circle, back to a multi-mission platform with a wide range of roles and missions—not just ASW, our core competency—but intelligence, surveillance, and reconnaissance, strike warfare, special warfare, mine warfare—both independently and as a member of our battlegroups.

And under the guidance of our great submarine team, many of whom have spoken to you during the past two days, we've charted a course, in conjunction with studies done by the National Academy of Sciences, the Defense Science Board, Andy Marshall's Office of Net Assessment, and others to create a vision of the Submarine Force and undersea warfare 30-50 years hence—a vision reflected in the design and multi-mission capability of the new attack submarine. A vision which foresees a profound shift in the size and look of our Navy of the future, with increased emphasis on stealth.

In an age of overhead surveillance and precision munitions' where if you can be detected you can be tracked, and if you can be tracked, you can be targeted, submarines are the only naval platforms that can prepare and shape the battlespace without provocation—the only naval platforms capable of waging guerrilla warfare—choosing the time, place, and method of engagement while maintaining the tactical initiative and the element of surprise.

Submarines have the potential to alter the shape of our maritime strategy and force structure by employing their intrinsic attributes in innovative and cost effective ways. The concept of converting Trident submarines to deliver special forces and strike missiles ashore—a *submerged arsenal ship*—is but one example. The attributes of stealth, agility, endurance, versatility, survivability, and lethality enable our submarines to conduct missions and tasks well beyond traditional ASW. These attributes correlate well with our national military strategy and with the four concepts of precision engagement, full-dimensional protection, dominant maneuver and focused logistics identified in Joint Vision 2010.

Today, I believe the Submarine Force is answering our Nation's call as well as it's ever been answered. We've developed our own corollary—*"Forward...From Under the Sea."* On any given day nearly 50 percent of our operational attack submarines are at sea and nearly 50 percent of those are forward deployed.

When you talk about forward presence and conventional deterrence, the Submarine Force represents nearly a third of the Navy's combatant ships with less than 10 percent of the people and 10 percent of the Navy's budget. When you talk about strategic deterrence, over half the Nation's strategic arsenal is at sea in our ballistic missile submarines, at a cost of less than 35 percent of the strategic budget. Now that's a bargain, that's leverage, and that's relevance.

In closing, innovation and adaptation have been the cornerstone of our Submarine Force over the last ninety-nine years. People like the men and women in this room are what defines the Submarine Force—not the steel hulls we operate—but the highly trained, talented, and dedicated sailors who comprise the Force—people like the Force Master Chiefs and COs you heard from in this symposium, and the sailors you recognized at lunch. We have the best trained, best prepared and most capable sailors in the world. For us, this is not only a time of great change, but a time of great opportunity. We reinvented ourselves following Pearl Harbor. We reinvented ourselves during the Cold War. And history finds us reinventing ourselves now. I'm confident that the vision, passion, innovation, and cohesiveness which have served us so well during the past ninety-nine years will help us chart a course well into the next century.

Thanks and God bless for all the great work you do in support of our Submarine Force.■

LUNCHEON ADDRESS TO SUBTECH SYMPOSIUM

by Ron O'Rourke
Congressional Research Service
May 12, 1999

Thank you for the introduction. It is a privilege to be asked to speak to this symposium for the fifth time.

As some of you know, my first presentation to you was in 1992, so my appearances at this symposium have pretty much spanned the decade of the '90s, which has been a very significant decade for the U.S. Submarine Force and the submarine industrial and technological base.

As some of you may remember, in my first appearance before you in 1992, I was a bit of an *enfant terrible*.

Now, at the end of the decade, I'm old enough that I may not qualify as an *enfant terrible* anymore, but I still want to maintain my credentials on the *terrible* part, at least in terms of offering a frank critique and, hopefully, a few constructive ideas and proposals for the years ahead, from the perspective of someone who is outside the community looking in.

In that regard, I want to talk about two things:

- First, where the submarine community is today, at the end of the '90s, and
- Second, some possible areas of focus for the submarine community as it prepares to head into the next decade.

Where Are We Today, at the End of the '90s

First, with regard to where we are today, at the end of the '90s, I want to start with a few remarks about where submarines are in the congressional debate over defense spending. I think it is fair to say that submarines today are a much less controversial item of discussion in Congress' annual review of the defense budget than they were earlier in the decade.

The period of maximum controversy, as many of you may remember, was in 1995, 1996, and 1997 when the acquisition strategy for the Virginia class was a major item of debate and disagreement both within Congress and between Congress and the Executive Branch.

That debate was pretty much resolved in 1997, and since then, the Virginia class acquisition program has receded in prominence as a topic of discussion and is now being treated more as an established and routine element of the Navy's shipbuilding plan.

For those involved in the Virginia class program, and for the submarine community, that sounds like good news—and to some extent that may be true. Uncontroversial programs are less likely to be suddenly altered by congressional action. As a consequence, they are more likely to achieve year-to-year stability, which is highly desirable in terms of program execution.

The fact, however, that submarines are no longer at the center of congressional attention the way they were a few years ago is perhaps not good news for the submarine community, in two ways.

First, achieving the higher submarine procurement rate that is scheduled to begin in a few years is going to require a substantial increase in procurement funding, and the fact that submarines are no longer in the spotlight may make it more difficult for the submarine community to lay the groundwork in Congress for supporting that increase when it appears in the budget.

The bill for that increase is going to be presented to Congress in fiscal 2006, which is just about the worse time imaginable—it's right in the early stages of the long-predicted defense procurement bow wave, when the procurement bills for a lot of other major DoD acquisition programs are going to start coming due. The submarine community will be asking for substantially increased funding at the very time that DoD and the Congress will be struggling to find ways to fund procurement of aircraft programs like the F-22, the Joint Strike Fighter, the Super Hornet, the V-22, land- and sea-based missile defense programs, and various C^4ISR (command, control, communications, computer, intelligence surveillance, and reconnaissance) programs, not to mention other shipbuilding programs, such as the DD-21, which is scheduled to achieve its full rate of procurement starting in fiscal 2005.

Many of these other programs, because they are currently in the research and development (R&D) phase, will be topics of annual or near-annual discussions in Congress for the next several years; so when the time comes to move these programs into procurement, and up their procurement ramps, Members and committees will have had several years of recent exposure to the services' rationales and justifications for them.

In the case of the Virginia class, in contrast, the submarine community will be seeking to double the procurement rate of a program that members or committees may have not focused on for the better part of a decade, if they were even on the defense oversight committees back then. By then, familiarity with the details of the program may have faded, and that may make it difficult to generate the sense of priority or urgency for the program that may be needed to secure the required increase in procurement funding in a competition against the other major procurement programs that will be seeking funding at that time.

The second way in which being uncontroversial may not be the best news for submarine acquisition concerns funding for R&D. As I stated at this symposium before, the mid-'90s debate over submarine acquisition was a debate essentially among supporters of submarines; and as a consequence, the debate resulted in, among other things, increases to the amount of funding available for advanced submarine technology development. For the submarine community, that was a welcome development, because it helped to fund a lot of potentially valuable submarine technology development projects that lacked resources.

Those new technologies, if brought to maturity, could help make submarines more capable or less expensive than they are today, which would make submarines more able to compete for potentially scarce DoD procurement dollars in the next decade. With submarines no longer at the center of congressional attention, however, increases in submarine technology development funding are likely to be smaller. As a result, fewer development projects will be brought to maturity, and the submarine community will have fewer new things to offer in competition with DoD procurement programs that may represent entirely new capabilities, like ballistic missile defense, or quantum improvements over older-generation platforms, like the F-22.

In short, for the submarine community, being out from under the congressional spotlight is not necessarily a completely good thing. The submarine community needs to be aware of the potential downside of being out of the limelight, given the scheduled need to increase funding during the coming defense bow wave.

All this suggests that the submarine community will need to maintain its effort over the next several years to explain to others the current and potential value of submarines—of getting the message out, so to speak. This is something I have talked to you about on several occasions over the years, and there certainly has been a lot of change in this area over this period.

For example, at my first appearance in 1992, I was asked the following: "Do you perceive that submarines are considered to be good intelligence gathering platforms by the Congress?"

And I answered as follows--and you can find this on page 27 of the published Proceedings of the 1992 Symposium: "I don't think there's much of a consciousness one way or the other about the relationship between the intelligence community and submarines except perhaps among members or staffers on the intelligence committees, which is a fairly limited group. I think submariners can talk more in general about the fact that attack submarines collect important intelligence. You don't have to say what it is, where you're getting it, or how you're getting it. But I do think it would be very useful to the debate if submariners--and some non-submariners--said, 'Yes, they make a valuable contribution.' You can make certain kinds of statements in public without getting into classified matters such as, 'When clouds cover an area, satellites can't see everything, therefore, we need an alternative.' That kind of statement can be made in public debate."

That was 1992. As a measure of how far things have come since then, you only need consult the book, Blind Man's Bluff, which most of you have probably read and perhaps talked about at this symposium

I recently read it myself, and to quote Bart Simpson, "Hey Karumba!" Compared to what you can read in here, what I said in 1992 seems hopelessly quaint. Talk about getting the message out! This book will certainly do a lot of that.

This book will go a long way toward educating Members of Congress, congressional staffers, and the public at large, about the tremendous value of submarines as intelligence-gathering platforms, and about the courage and resourcefulness of the people aboard submarines performing that mission.

Even so, it should also be pointed out that, while the stories recounted in this book are by and large very supportive of the submarine fleet, in a couple of ways, there are things in this book which are not so supportive. First, the book recounts a number of instances in which people who were engaged in these intelligence-gathering operations withheld negative or potentially negative information in reporting their activities to higher authorities or circumvented normal channels of approval when seeking permission to conduct these operations.

Now this sort of withholding of information happens all the time in government. But in these instances, it happened in connection with activities of national-level importance and high diplomatic sensitivity.

I can see how someone in a position of authority might read this book and develop a strong appreciation and respect for the submarine community—but at the same time something else. Not a distrust—that would be too strong a word—but rather a skepticism or wariness toward the submarine community. This is something that might come back and bite the submarine community at some unexpected time.

Second, although the book refers at a couple of points to the fact that intelligence gathering is done by many subs, the focus throughout most of the book is on the operations of a small number of highly specialized boats. As a result, the reader might easily come away with the impression that intelligence gathering, though an important mission to national leaders and theater military commanders, is not a major drive of attack submarine force-level requirements, when it apparently is.

Indeed, Navy testimony a few weeks ago to the Seapower Subcommittee of the Senate Armed Services Committee suggested that the number of submarines required for intelligence, surveillance, and reconnaissance missions is a central issue in the current debate over the sufficiency of the 50 boat, force-level goal set forth in the Quadrennial Defense Review (QDR). The book, however, can give the reader the impression that this mission can be satisfied with a force of two or three or four specialized craft, and that these boats needn't even be modern or particularly capable units.

Blind Man's Bluff, though, is only one contributor to the understanding that policymakers and opinion leaders have of the capabilities and value of submarines, and of the number of submarines needed to perform a given set of missions or tasks.

The Navy's own effort to get the message out in recent years has come to involve several elements, including testimony and briefings to Congress, brochures and white papers, interviews with the press, and press access to the fleet. Over the course of the last several years, these efforts have had a fair amount of success in overcoming the old, simplified stereotype of submarines as nothing more than anti-submarine warfare assets, and the closely allied idea that submarines don't have all that much to do in the post Cold War era.

At the same time, though, these efforts have also confirmed two things. First, the effort to explain the capabilities and value of submarines will need to continue indefinitely due to the constant turnover in elected and appointed officials and their staff.

Second, skepticism about the value of and need for submarines in the post Cold War era persists, and can be difficult to overcome, particularly in the presence of counter arguments from other quarters. A case in point is the article from Time magazine, entitled *That Sinking Feeling*. This article is similar to numerous press reports written in the early '90s, at the start of the post Cold War era, that voiced skepticism about the potential value of submarines in the post Cold War era. Except this article was written not in the early '90s, but in February of this year. Some of you may remember reading it when it came out.

In painting a picture of where the submarine community is today, at the end of the '90s, one can also note, among other things, the significant shrinkage of the Force, the shift in operational emphasis to non-Russian-oriented operations in littoral waters (including land-attack operations), the transition from the Seawolf program to the Virginia class, significant restructuring of the submarine construction industrial base and the shift to a timed production arrangement, and the reorganization of the Navy's submarine technology development plan and oversight apparatus.

These were all huge changes. Together, they underscore just how important the '90s have been as a transitional decade for the submarine community.

But for me, the '90s were notable for at least one more thing—something that passed by with relatively little comment, perhaps because its consequences will not become fully apparent for another 20 or 30 years. For the submarine community, the '90s were not just a transitional decade. In terms of attack submarine procurement, the '90s were also, to a large degree, a lost decade.

During the entire decade of the '90s, the United States procured a total of five attack submarines. This includes the final Los Angeles class submarine in fiscal 1990, the second Seawolf submarine in fiscal 1991, the third Seawolf in fiscal 1996, and the first two Virginia class boats in fiscal '98 and '99.

That's an average of one-half of a submarine per year for an entire decade. As I have noted in testimony to Congress and elsewhere, an average procurement rate like that is a pretty good rate for a country like Great Britain, but not for the United States.

Assuming a service life of 33 years for newly procured submarines, maintaining a 50-boat Force over the long run would require an average procurement rate of 1.5 boats per year.

If we had procured attack submarine at this steady-stage replacement rate during the '90s, we would have procured a total of 15 boats, rather than 5. The 10 boats that were not procured can be thought of as the submarine procurement backlog or deficit of the '90s.

This sustained period of below-steady-state procurement will continue through fiscal year 2005, by which time the cumulative procurement backlog will grow to 14 boats, or more than one-quarter of the Force-level goal.

As a result of this sustained period of below-steady-state procurement, the Submarine Force is going to face a significant Force-structure challenge in the 2020s and 2030s.

That challenge is summarized in picture form in the graph of projected national force levels. (Figure 1). It shows how the deficit in submarine procurement during this period will be unmasked after about 2015, when the large number of 688s procured in the 1980s begins to retire at a rapid rate, producing a bathtub in the attack Submarine Force level goal that will last for many years.

Submarines, of course, are not the only type of ship whose procurement rate has been reduced over the last several years; Navy shipbuilding in general, like many kinds of defense procurement, was reduced significantly in the years following the end of the Cold War. As a result of this downturn in Navy shipbuilding, a ship procurement backlog for various types of ships has accumulated over the last decade, and the Navy as a whole will face a challenge in maintaining its planned total force level of about 300 ships over the long run.

Within this overall situation, however, the Force structure situation for attack submarines is perhaps the most acute, because the downturn in submarine procurement has been deeper and longer lasting than for other types of ships.

Until very recently, this longer term Force structure challenge looked even more daunting than what you see on that graph. Within the last few weeks, the situation has been eased by the Navy's determination that it can safely extend the service life of selected 688Is to 33 years.

As a result of this selected service life extension, the Navy will now to be able to maintain a Force of about 50 boats with a post-Future Year Defense Program (FYDP) procurement rate of two boats per year. Without the service life extension, avoiding a significant drop below 50 boats would have required a procurement rate of 2-2/3 to 3 boats per year starting in FY08.

Reducing the downstream required procurement rate from 2-2/3 to 3 boats per year down to 2 boats per year is a significant help in my view, and not just because it will save the government something like $1.3 to $1.9 billion per year in avoided submarine procurement costs, but also because it makes the goal of maintaining a 50 boat Force plausibly achievable.

Going from today's planned procurement rate of about 1 boat per year to a rate about 3 times as high looked so challenging financially that I think it would have encouraged officials to throw up their hands in frustration and say, "Forget it. If that's what it will take to maintain a 50 boat Force, we can't afford it. Let's just keep the procurement rate at about 1 boat per year, let the Force drop below 50, and either reduce mission requirements or find other ways to perform them."

In contrast, increasing the procurement rate from 1 boat per year to 2 per year is at least plausible enought that officials might be more likely to continue supporting the maintenance of a 50 boat Force.

In this sense—in terms of potentially changing the psychology of regarding the downstream required submarine procurement rate—the decision to extend the service lives of selected 688Is is of enormous potential value to the longer term future of the Submarine Force.

But saying that a goal is plausible is not the same as saying that it will be easy to achieve. To the contrary, as I mentioned earlier, increasing procurement from the FYDP rate of about 1 boat per year to the required rate of 2 boats per year is going to require about $1.9 billion per year in additional procurement funding, at a time when many other major DoD programs will be competing for limited procurement dollars.

Indeed, although the submarine community's long range plans show 2 submarines per year, the Navy's long range resource allocation plans appear to budget for a procurement rate of about 1.5 boats per year—the long term steady-state replacement rate. If you look at the graph, you can see that this missing half boat per year adds up over time. At 1.5 boats per year, the attack Submarine Force will be around 40 boats at the bottom of the bathtub in the last 2020s and won't get back up to 50 boats until about 2045.

Finally, in discussing the status of the Submarine Force at the end of the 1990s, it is worth noting the rather curious evolution of the Submarine Force-level goal in recent years.

As I have noted in a recent report to Congress, for more than 15 years the attack Submarine Force-level goal has appeared to be a less precise and more generalized figure than the force-level goals for other major components of the Navy's force structure. In contrast to the goal for other kinds of ships and aircraft, which have been defined in terms of precise total numbers of ships, or air wings, or lift capacity, the Force level-goal for SSNs has been expressed in rounded off numbers or ranges of numbers, such as 80 or 55 boats under the Bush Administration Base Force plan, 45 to 55 boats under the Clinton Administration's Bottom-Up Review (BUR), and most recently the figure of 50 boats under the QDR.

In addition, the explanations offered by the Navy for its attack Submarine Force-level goals have tended to be less extensive and less specific than the explanations it has offered in support of force-level goals for other categories of ships.

An exception to this pattern of rounded-off attack Submarine Force-level requirements was the 1992-93 Joint Chiefs of Staff study that established a Force-level goal of 51 to 67 SSNs, including 10 to 12 with Seawolf-level quieting by 2012.

It might have been expected that this ambiguity and tension regarding the attack Submarine Force-level goal would have been settled by the QDR, but it hasn't. The QDR goal of 50 is "contingent on a reevaluation of peacetime overseas presence requirements."

That reevaluation has been underway in the Joint Staff for some time now and is expected to be completed soon. The Navy has suggested in its testimony to the Seapower Subcommittee this year that the study will show a need for significantly more than 50 boats. In the meantime, DoD officials have testified since last year that "Commander-in-Chief requirements for SSN deployments...would dictate a Force of 72 attack submarines".

So it appears that the issue of the attack Submarine Force-level goals will continue to be characterized by ambiguity and tension. I don't know of another part of the Navy, or of the military, whose force-structure goals have been as persistently ambiguous, tentative, and volatile.

In spite of this ambiguity, and the potential for the goal to be increased as a result of the JCS study, the plan to reduce the Force with early retirements to 50 boats by fiscal 2003 continues to be implemented. This is significant, because unlike the case of the non-nuclear powered ships or many other kinds of equipment, retirement of a nuclear powered submarine is effectively a non-reversible event. Once they are deactivated, they are gone for good.

Look again at Figure 1. It doesn't include any early retirements beyond these that have already taken place. But as a result of those that have already occurred, the Navy is already locked into having a Force of no more than about 50 or 60 boats for the next 20 or 25 years, no matter what the post FYDP submarine procurement rate turns out to be.

So if the JCS study supports a substantial increase in the attack Submarine Force-level goal, that goal will in all likelihood not be attainable for many years to come. For example, if the JCS study were to support a Force-level goal of 70 to 80 boats, we could procure submarines at a rate of 2.5 to 3 boats per year—which is about as high a rate as you can imagine, under current circumstances—and still not get there until about 2035.

This suggests that the value in the near term of a JCS finding in support of an attack Submarine Force-level goal of more than 50 boats will be primarily rhetorical—as a counter to proposals to reduce the Force-level goal to less than 50 boats, such as the recent Cato Institute study that argued in favor of reducing the goal to 25 boats.

Some Possible Areas of Focus for the Future

I want to turn now to the second and final part of my address, which concerns possible areas of focus for the submarine community for the future, as it prepares to head into the next decade.

Identifying areas of focus is important not just because of the change in the calendar, but because of the approaching change in administration. No matter who is elected president, there will be a change in personnel, a review of U.S. defense programs, and a critical window of opportunity for the submarine community to put forward a compelling case for its programs.

In that connection, I want to present three potential areas of focus for the future.

The first concerns the submarine technology development plan. As I discussed earlier, funding this plan as fully as possible will be important to maintaining the future cost-effectiveness of submarines as they compete during the procurement bow wave against other DoD programs for limited procurement dollars.

This technology plan itself, however, must compete against other R&D programs for limited research and development funding.

The submarine technology development plan contains many worthy programs, but the ability of the submarine community to secure maximum funding for this plan is arguably hampered by its lack of a clearly identifiable and compelling overall goal. The plan, in short, is too much of a laundry list to inspire others and win their continuing support.

The various projects in the plan are organized into a few broad categories, and it is clear that developing and inserting these technologies into future submarines will improve the cost effectiveness of those boats. But how much cost effectiveness will be improved, and by when, its not immediately apparent, and there is no clear picture of what the submarine could look like at a certain date, or at a certain sets of dates, in the future.

This lack of a clear goal or set of goals, to be achieved by a certain date or set of dates, puts the submarine community at a disadvantage relative to other program areas, such as surface combatants, aircraft carriers, or tactical aircraft, which, because they are shifting from older generation designs to newer ones, are able to show a picture of a new and different platform that will enter service in a certain year.

This is not only a matter of marketing, however, it is a matter of substance as well. Establishing an overall goal or set of goals, and a date or set of dates by which goals are to be achieved, has the potential to focus people's energies more effectively and thereby possibly enhance the creation, acceptance, and implementation of new and innovative ideas.

As a possible model, one might consider the Air Force's Integrated High-Performance Turbine Engine Technology Program (IHPTET)—a 15 year effort, divided into 3 phases of 5 years each, that is aimed at achieving specific and challenging improvements in engine performance and efficiency by the end of each phase. At the time this program was started, the goals were considered by many to be very ambitious, particularly since turbine engine technology was considered by many to be a mature technology area. Years later, this program has achieved many of its goals on schedule or almost on schedule, in spite of the fact that it wasn't certain, at the outset of the program, exactly how those goals were going to be achieved.

If such an approach were to be applied to the submarine technology development plan, what goals might it include?

Some goals, pertaining to improvements in payload and sensors, were set forth by the Defense Science Board's report on the future submarine, which in turn were in effect implemented in the form of the Navy-DARPA (Defense Advanced Research Projects Agency) Memorandum of Understanding.

Other goals have been suggested by Admiral Bowman, who has spoken very simply and clearly about the need for submarines to get connected, get modular, and so on.

I don't think you'd be surprised, however, if I suggested that there also be an explicit goal relating to reduction in submarine procurement cost. Procurement affordability is often spoken about in general terms, but specifics are harder to find. The Defense Science Board report, for example, noted that we need to build more submarines, not fewer, but didn't elaborate on how that might be achieved within given funding constraints.

The submarine community needs to begin procuring boats at a rate of 2 per year to avoid falling below 50, but programmed funding may be sufficient for no more than 1.5 boats per year, and possibly less, if budget projections prove optimistic.

This suggests that an overarching goal might be established to find new technologies that can help reduce submarine procurement costs 25 percent by a certain date, so that 4 boats can be procured for the price of 3 without reducing unit capability.

If you think that goal can't possibly be achieved, you may be right. I don't know if it can. But I believe that establishing such a goal will promote a more sustained and extensive focus on this issue than there is at present, and thus create more of a chance that at least substantial progress toward this goal might be achieved. Some of the goals for the Turbine Engine Technology Program may have looked equally unachievable when they were first announced.

And what makes more sense—working to achieve as much of this goal as you can, or sitting around hoping that budget circumstances will change enough to permit a procurement rate of 2 boats per year at current prices? I don't think the submarine community can afford to bet on being rescued in that way, particularly in light of the coming defense procurement bow wave.

Procurement affordability, however, is not something that can be achieved just through changes in technology, but in other ways as well, such as changes in acquisition strategy or in the production environment.

In that connection, a second potential area of focus for the next decade would be to explore opportunities for regaining lost economies of scale in submarine production. Economies of scale have declined for most areas of Navy shipbuilding, but perhaps for submarines more than any other kind of ship, both because the reduction in the procurement rate for submarines was so great—on the order of 75 percent or more from Cold War levels—and because submarines were isolated from and less able to tap into the economies of scale or materials and components used in the civilian economy or on military surface ships.

Anything that can be done to tap into civilian or military surface ship economies of scale has the potential for reducing procurement costs. Increased use of commercial-off-the-shelf computer technology is one well established example: technologies for electric drive propulsion and integrated power systems are another, and potentially a very significant one.

My third and final proposal for the future has to do with reexamining the bounds of what the submarine, in the end, is trying to improve and optimize.

With the development and deployment of new underwater systems, including unmanned undersea vehicles of various kinds, advanced bottom-based sensors, and smart, mobile mines, the undersea arena in the years ahead will come to include a more complex, heterogenous mix of systems, and the submarine, though still capable of independent operations, will more and more be best understood as part of a larger underwater force architecture.

This suggests that, in the future, the goal increasingly will not be to optimize the submarine itself, but the entire underwater force architecture, of which the submarine is a major part. If so, this could have numerous implications for what the submarine will be asked to do, what capabilities it should have, and how its cost effectiveness is measured.

For the submarine community, the question will no longer be, "How can I improve the submarine?" But rather, "How can I improve the underwater force structure?" That's not the same question.

Similarly, as submarines get connected to the rest of the fleet, and as the fleet moves toward a network centric environment, the bounds of analysis might no longer be, "How can I improve the underwater force architecture?" But rather, "How can the underwater force architecture be changed to improve the effectiveness of the total fleet force architecture?" Again, that's not the same question.

This all may sound terribly abstract and far in the future, but I don't think it is, for three reasons.

First, we already have an example in the Coast Guard's Integrated Deepwater System program of a maritime service that is asking competing industry teams not for proposals to replace specific classes of aging ships and aircraft, but for proposals to acquire an integrated force architecture—a system of systems—capable of performing an array of Coast Guard missions in the deepwater environment effectively and at the lowest cost. This system of systems will include surface ships; aircraft, command, control, communications, and computer systems; and logistic support. But the Coast Guard is not telling the industry teams what the ships or aircraft should look like, or how many of them there should be. The Coast Guard is simply interested in acquiring the most cost effective force architecture.

Second, limits on Navy acquisition funds will encourage Navy officials to explore options for reducing costs by optimizing the larger system of systems.

And third, limits on defense procurement dollars will encourage manufacturers of naval equipment other than submarines to see if their equipment can perform certain missions now performed by submarines. Thus, if to optimize the undersea force architecture, other technology communities may, directly or indirectly, consciously or not, begin to address this issue themselves.

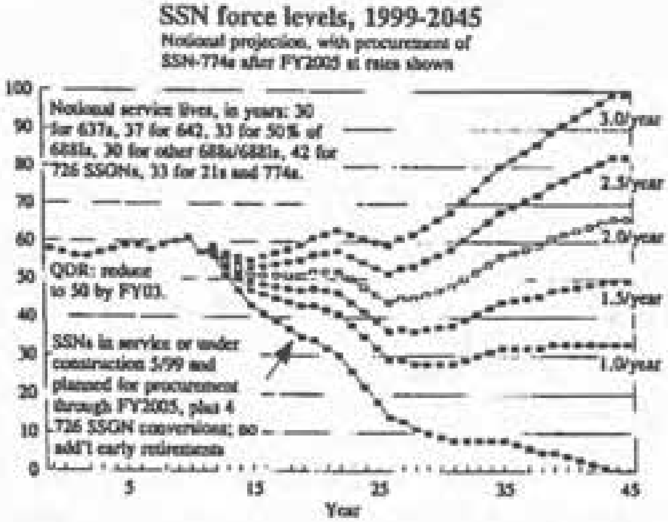
Conclusion

In conclusion, I want to reiterate my concern, in light of the coming Submarine Force-structure challenge and the DoD procurement bow wave, about the ability of the submarine community and the Navy to achieve a sustained submarine procurement rate of two boats per year and to secure robust funding for the submarine technology development plan that underpins the procurement effort.

With a new decade—and a new administration—fast approaching, these are key issues for the Submarine Force and the submarine technology community. I've thrown out a few ideas for addressing these issues; they are certainly not the only ones that should be considered.

But as always, I hope that I have, at a minimum, left you with something to think about. Thank you.■

Figure 1



Prepared by Ronald O'Rourke, May 1999.

CENTENNIAL MUSEUMS AND MEMORIALS

A combination of four Capitol area exhibits and memorials will provide a comprehensive perspective on the first hundred years of the U.S. Submarine Force. The four projects will serve as lasting memorials to submarines and submariners past and present, while the capability of the submarine and its promise for the future will be presented for all to see. No single exhibit or memorial could possibly cover in detail all of the accomplishments and potential of the Submarine Force. However, this carefully coordinated combination goes a long way toward recognizing the achievements of all submariners of the 20th century and commemorating all aspects of the first hundred years of the U.S. Submarine Force. These National Committee activities will be complemented by numerous other commemorative projects at submarine museums and other locations throughout the country. Centennial projects at some of these other locations will be featured in the next issue of the **REVIEW**. *Editor's Note: In the January Issue we will feature other museum and memorial initiatives from around the country. Please provide candidate input for this article to Rick Dau at NSL Headquarters.*

The four national activities include a major exhibit at the Smithsonian, a submarine heroes exhibit and a stained glass and bronze memorial window at the Navy Memorial, an expanded submarine exhibit at the Navy Museum in the Washington Navy Yard, and a submarine sculpture to be prominently located at the U.S. Naval Academy.

The Smithsonian exhibit, *Fast Attacks and Boomers: Submarines in the Cold War*, was described in detail in the July issue of **THE SUBMARINE REVIEW**. This exhibit will focus on the modern submarine technology that won the Cold War and that has paved the way for the multi-mission submarines such as SEAWOLF and VIRGINIA, which will lead us into the 21st century. The location of this three year exhibit will provide exposure to millions of visitors and will help spread our message throughout the country while providing an introduction to the submarine Navy for hundreds of thousands of young people.

The heroes exhibit at the Navy Memorial will highlight those individuals who have distinguished themselves in submarines as well as the *everyday submariner*. The memorial window will recognize, in permanent memorial, the sacrifice of all submariners who have given their lives in the line of duty.

The exhibit at the Navy Museum, located in the historic Washington Navy Yard, will highlight submarines in the first half of the 20^{th} century including the exceptional achievements and sacrifices of submariners in helping to win World War II. It will be expanded by 800 square feet to cover the transition of the Submarine Force from World War II to the Cold War.

Finally, the sculpture at the Naval Academy will serve as a lasting reminder of the importance of submarines to Naval Warfare. The sculpture will be viewed on a daily basis by the many visitors who frequent the academy grounds as well as the Midshipmen who will be future Submarine Force leaders.

The Centennial's National Commemorative Committee, including representatives from the Naval Submarine League, U.S. Submarine Veterans Incorporated, and U.S. Submarine Veterans of World War II, is supporting the Submarine Force in the development and funding of these important centennial projects. Each project is unique and the themes and content are the result of extensive negotiation with the hosting activities. We are truly fortunate to have the Submarine Story displayed for all to see in four premier locations.■

ONKEL KARL AND UNCLE CHARLIE
Dönitz and Lockwood: A Comparison of Style
Part II

by CAPT Ralph Enos, USN(Ret.)

Part I appeared in the July 1999 issue of THE SUBMARINE REVIEW.

Well, Dönitz lost and Lockwood won. It's easy to identify characteristics of the loser that contributed to his losing, and characteristics of the winner that contributed to his winning. But this doesn't level the playing field. Would Dönitz, given Lockwood's hand have played it as well; or conversely, would Lockwood as FdU (Flag Officer, U-Boats) have done better than Dönitz?

It is doubtful that either would have succeeded in the place of the other because the service traditions and styles of their respective navies and nations were so different. Lockwood was an amiable gentleman who was part of a cohort of similar naval officers, people who knew and respected each other and their near contemporaries throughout the Navy, and who learned to mask their ambition behind casual bonhomie. He knew that success in the Washington bureaucratic maze depended on contacts, on lobbying, on *working the room* so to speak, as much as it depended on your own credibility and the merits of your project. Lockwood's semi-informal correspondence with his classmate W.H.P. Blandy, Chief of BuOrd, for example, may have been worth hundreds of official complaints coming up through the chain of command in getting the bureau to attend to the torpedo problem. His incessant interest in, and nagging of University of California's Division of War Research (UCWRD) about the fm sonar development undoubtedly had its effect in bringing that technology on line.

By contrast, it is difficult to conceive of Dönitz sending off amiable notes to anyone, or gently but firmly pressing a bunch of academics into rushing a technical development. Had he been inclined to, or had his navy and war establishment been open to that kind of pressure, say in pushing the Walter air-independent development faster, perhaps Germany might have had their high-submerged speed submarine much sooner.

Dönitz and Lockwood were both revered by the sailors in their boats. They took great care to meet as many boats returning from patrol as possible, and in personally debriefing commanding officers. Both had to relieve COs for lack of aggressiveness, and they did this with a high degree of humanity; they were *surfaced* without humiliation or lasting discredit. Both provided beach facilities for returning crews that were unprecedented. Dönitz requisitioned French hotels and chateaux for his troops, ran a special train back to Germany for sailors on leave, provided luxuries not available elsewhere for sale in the U-bootfahrers' canteens, saw to it that their messes served the best food, and, in short, treated his crews like the elite sailors he saw them as. Lockwood—who had had an opportunity to hear of this treatment in his year in London (May '41-April '42)—was determined to do the same. As ComSubSoWesPac and as ComSubPac, his first concern was providing recreational facilities ashore for returning submariners.

Dönitz knew that your first duty was to look out for your troops, but his boats' situation, from late 1942 onward, got worse and worse. As losses mounted and vast numbers of new construction boats had to be manned, experienced hands grew scarce. Inevitably, morale declined, volunteers dried up, and impressed seamen grumbled. To his great credit, after losing 42 boats in May 1943, Dönitz withdrew his boats from the dangerous North Atlantic convoy routes, awaiting, he thought, the arrival of new and better weapons. Alas, without any significant improvement in equipment, he threw the boats at the enemy once again in August 1943. The slaughter of the U-boats continued; their tonnage results continued to decline.

In recent years, Dönitz's policies of throwing the U-boats at the enemy regardless of losses, results achieved, or prospect of success, has come in for heavy criticism. The claim is that these policies were foolish, at best, and callously murderous at worst. Many old comrades defended Dönitz, who died in 1982. They pointed out that morale in the U-bootwaffe remained high until the end, that discipline and efficiency were maintained, and survival to a great extent depended on experience.[1] And they argued it would

[1]The U-bootwaffen suffered a 70 percent casualty rate, the highest of any arm of any nation in the war. An astonishing 33 percent of all boats lost, 215, were sunk on their first patrol.

have been impossible for any military leader to have done differently, considering how Hitler's Reich seemed bent on self-immolation as its enemies tightened the ring around it.

When, in January 1943, Dönitz took over from Raeder as navy commander-in-chief and had to move to Berlin and put another 500 miles between him and his beloved U-boat men, he became even more remote from the waterfront. In contrast, Lockwood was anxious to move his command closer to the forward deployment sites, and did move it to Guam late in 1944.

Both Lockwood and Dönitz wrote their war memoirs after the war. Dönitz's Ten Years and Twenty Days was written while he was imprisoned in Spandau, and it suffered by not having access to many allied sources, particularly information about Ultra code breaking. The book, not surprisingly, is a great *apologia*. He had much to excuse and explain, not the least being his status as Hitler's hand-picked successor as Führer. His explanations are disingenuous: He was just a soldier doing his duty. If soldiers who do their duty to the state, and the state happens to lose the war, can be put on trial for waging "aggressive war"—which is, after all, what all soldiers in all wars are encouraged to do—what is our honorable profession coming to?[2] He was at pains to distance himself from Naziism and the Party. He was silent on his own anti-semitic and pro-Hitler speeches.

Dönitz reserved most of his memoir to rationalizing his conduct of the U-boat war. He repeatedly stated that if only he had been given enough U-boats at the beginning of the war, he would have prevailed in the tonnage war. And who does he blame for not having enough boats at the beginning? Why, Hitler and Raeder of course. He defends his wolfpack tactic and ignores all evidence that shows it didn't work. He regrets not having better Luftwaffe cooperation, but doesn't appear to recognize that long-range air reconnaissance was a vital, and missing, element in a successful U-

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[2]Dönitz was convicted at Nuremburg on the charge of waging aggressive war. He was found not guilty of two other counts: plotting to wage aggressive war, and war crimes (e.g., ordering U-boats not aid survivors). In the latter case, a telling defense came from a deposition from Fleet Admiral Chester Nimitz, who said that U.S. submarines conducted unrestricted submarine operations against Japanese merchant ships from the outset and that normally U.S. submarines ignored survivors. Dönitz's sentence, 10 years, was the lightest levied at Nuremburg.

boat strategy; nor does he fault himself for not working harder to get it.

He says nothing about the Type VII's shortcomings, particularly its inadequacy without radar in the rotten North Atlantic weather. He fails to mention any initiative to put radar on U-boats even though his Japanese allies could have attested to the murderous efficiency of American subs using it. As for the rotten North Atlantic weather, I believe he dismissed it as a factor, perhaps rationalizing that weather affects both friend and foe alike. I don't think Dönitz had much familiarity with North Atlantic weather. He really was a warm water sailor.[3] I believe that if he'd ever experienced a winter North Atlantic storm in a small vessel, he would have appreciated the Type VII sailor's problems.

Lockwood penned his WWII memoirs, Sink 'em All, in 1951, after several other successful works centered on his submarine experiences. In 1967, the year he died, his autobiography Down to the Sea in Subs came out. Sink 'em All was his first literary work and it shows. It too is an *apologia* for his wartime stewardship of the submarine forces; it isn't stylish and is laced with clichés and colloquialisms in common use during the era. The only problem American submarines faced during the war was a shortage of reliable torpedoes. America won, so Lockwood wasn't faced with rationalizing defeat. Down to the Sea in Subs shows his maturity as a writer; it is much more interesting and shows his human side much more than Sink 'em All.

Both Lockwood and Dönitz served on foreign stations, and this had to affect their worldviews. Lockwood's experience was much broader, however. He spent much of his junior officer years in the Asiatic Fleet or in China, including a brief sojourn in Japan. As a staff officer he visited Europe during WWI and later he brought a surrendered German U-boat back to the U.S. Later as a commander he headed the U.S. Naval Mission to Brazil, and as a captain he was naval attaché in London.

Dönitz's first duty was in the cruiser SMS BRESLAU which, together with the battlecruiser GOEBEN, was given to Turkey, and with its crew, commissioned in the Ottoman Navy at the beginning

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[3]His WWI duty as a junior officer was all in the Mediterranean or Black Seas. Later service in the Reichsmarine was in the Baltic or North Seas; his round the world cruise as CO of EMDEN was mostly in tropical waters.

of WWI. He was a POW in England, and also spent several weeks in England on independent study during the early 1930s. Also, he had an opportunity to see other parts of the world as CO of EMDEN. He had no experience with the United States.

Lockwood benefitted from his Asiatic duty in appreciating the need for a large, long range submarine for distant Pacific patrols to be equipped with air conditioning to mitigate torrid tropical waters. All of which he pushed for as a member of the submarine conference. Again, there is no evidence that Dönitz drew any positive benefit from his foreign experiences; on the contrary, his warm water experience may have led him to discount North Atlantic weather as an operational factor. Perhaps his very limited seagoing experience, when compared to Lockwood's, narrowed the range of his judgement. Clay Blair believed that Dönitz's experience with ineffectual airborne ASW during WWI caused him to discount the aircraft threat 20 years later.[4]

Dönitz's ignorance of the United States may have led him to repeatedly dismiss intelligence estimates of American shipbuilding output as fantasies. Had he credited these estimates, it would have destroyed his rationale for a tonnage war. Perhaps he shut his mind to it.

Perhaps Dönitz's greatest flaw was his inability to consider possible enemy countermeasures to his tactics and equipment. He started the war with too few boats. He felt that if he had 300 rather than 57, and using his beloved wolfpack tactic to destroy convoys, he would be able to defeat England. It was a case of winning the last war all over again. In WWI the U-boats' big problem was finding convoys. Had they been able to do so, there was little the convoy's escorts could do to attack a submerged submarine. Of course, asdic/sonar had been developed between the wars. He would get around that problem by attacking on the surface at night.

His first boats were manned by sharp COs and well trained crews. They were more than a match for the inexperienced British escorts and aircraft of 1939. But the enemy improved his ASW force's training, equipped the escorts and aircraft with centimetric

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[4]Clay Blair, *Hitler's U-boat War: Volume I The Hunters*. (New York: 1996). 38.

radar, huff duff, improved depth charges and bombs, and developed ahead-thrown weapons, acoustic torpedoes, Leigh lights, jeep carriers, sonobuoys, and much else, while the U-boats remained with essentially the same equipment they started the war with.[5] The one intangible which the U-boats had an advantage in—training and experience—by 1943 had been reversed. Escorts became experienced and well-trained; U-boats, their crews diluted by losses and expansion were suffering horribly from inexperience. Dönitz had to be aware of these problems with U-boat crews; he does not admit to being aware that the enemy was getting much better at the game.

There is not evidence that Lockwood ever underestimated his Japanese enemy. On the contrary, by the time he arrived on the scene, the Japanese had aptly demonstrated their naval capabilities by wiping the Western Allies from their seas. If anything, U.S. submariners were suffering from too much caution. It became Lockwood's job to buck up or remove timid COs, and this was no easy task for either him or Dönitz, since the shore commander has no way of directly observing a CO's performance. One has to listen very carefully to the talk in the mess decks to discern what's really happening in a boat. The shore commander has to be a shrewd judge of men. Lockwood certainly was, and so was Dönitz.

Despite both being affectionately called Uncle Charlie by their respective submarine forces, Dönitz and Lockwood were as different personalities as their navies were different. Dönitz was a lean, austere, prussianized naval officer who found it difficult to unbend. Although he did unbend in the U-boat officer's mess, he gave the impression that this was always a strain, that it was foreign to his basic nature. A telling detail is that his one vanity seemed to be his pride in being able to fit into his naval cadet's uniform as a Grossadmiral.

Lockwood was avuncular, a hearty mid American type who loved playing poker with his buddies. Although Lockwood had run track at the Naval Academy, by WWII his body had settled into

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[5]U-boats eventually did get a metric wavelength intercept device Metox, an anti-escort acoustic torpedo, a pattern-running torpedo, and snorkels. But all these improvements were more than matched by Allied improvements or countermeasures by the time they were introduced.

comfortable middle age. He loved vigorous outdoor activity, hunting, hiking, mountain climbing, preferably with amiable companions. Dönitz was a loner; his idea of outdoor recreation was taking long walks alone with his dog.

As near as we can discern both Lockwood and Dönitz enjoyed healthy marriages to strong women. Dönitz married young (he was only 26, an age that raised eyebrows in the Imperial Navy) and apparently his courtship and marriage was a romantic affair. He even showed a flair for the poetic as a young officer. Lockwood was 40 when he married; he apparently had put duty before the ladies. Consequently his children were still young when WWII came around. Both Dönitz's sons were killed in action, one of them in a U-boat; his daughter married a U-boat ace who survived the war. No one can fathom how the loss of his sons affected him; typically his outward demeanor was stoic. He never betrayed how it may have touched his heart.

It is doubtful if either Lockwood or Dönitz would have enjoyed the kind of success they did without Richard Voge and Eberhard Godt, their respective operations officers. Voge and Godt were tuned to their boss's wavelength, and functioned with them like a hand in a glove. What is more they were trusted. Lockwood could travel to the mainland, or Guam, or Midway, knowing that SubPac Ops were in good hands. Similarly, when Dönitz fleeted up to Navy C-in-C, Godt continued to run daily operations as he had for the previous three years.

Had Dönitz been in Lockwood's shoes it is doubtful he would have screwed up a winning hand. He may have had his blind spots, but he was a shrewd naval officer with a strategic appreciation of submarine warfare's importance in a war against Britain. This strategic insight may have led him to focus on critical Japanese choke points much earlier than U.S. commanders did. He may have argued the case for continuing his commerce war when his superiors wanted submarines diverted to other operations, and may have gained some more boats for empire waters and East China Sea as a result (although his actual success in arguing against diversion of precious U-boats to non-productive sectors was not particularly great). His single-minded focus and advocacy of submarine commerce warfare might have rubbed Nimitz and King the wrong way, although there is considerable evidence that Dönitz was astute enough to know when to lay off pushing a superior. His handling of the torpedo problem would probably not have been as deft as Lockwood's although he just might have listened more carefully to early CO's complaints and raised an alarm with Nimitz and King long before U.S. commanders did.

Would Lockwood have done better than Dönitz? Assuming Lockwood was as tuned in to the Nazi system as he was the American system, he would certainly have settled on a better sea-control submarine than the Type VII and he probably would have worked the system to get it into production faster than Dönitz did. He would have foresworn the daily maneuvering of submarines and would have immersed himself in progressing technical developments that would give U-boats an edge. He probably would have seen that the Walter boat wasn't going to make it and worked the system to get the Type XXI built in quantity for the earliest deployment. He would have insisted that his boats have radar. He would have swallowed his pride and romanced Göring to get Luftwaffe to provide long range air reconnaissance and protection for boats transiting the Bay of Biscay.

All this seems to suggest that he could have made the Battle of the Atlantic a closer contest than it was. But the thing that defeated Germany was not U-boat failure, but failure of the entire German military-industrial structure. It just wasn't up to the strain of serving military forces fighting on as many fronts as Germany had opened and contending with Allied forces served by seemingly endless amounts of men and materiel. Lockwood couldn't have changed that.■

WHY SUBMARINERS SHOULD TALK TO FIGHTER PILOTS

by Benjamin S. Lambeth

The author is a senior staff member at the RAND Corporation. A civil-rated pilot and longtime specialist in air power, he has flown in more than 35 different fighter, attack, and jet trainer aircraft types worldwide. He also has attended portions of Navy Fighter Weapons School (TOPGUN) and has trapped twice in USS KITTY HAWK (CV 63) in an F-14 with VF-1. While preparing this article, he spent four days in USS ATLANTA (SSN 712) observing prospective commanding officer training in sub-on-sub operations.

The sky above and oceans below share a lot more in common than being blue. Despite sharp contrasts in character, they represent operating mediums for remarkably similar forms of high technology combat.

At first glance, few would even remotely consider the sub-on-sub and air-to-air arenas as having any significant unifying features. Among the many differences between the two, the most obvious is the vast dissimilarity in relative speed of operations. Fighter pilots routinely engage at closure rates of 1,000 kts or more. Commitment decisions and initial moves typically occur only minutes, sometimes even seconds, apart. In contrast, the commander and crew of a nuclear fast attack submarine (SSN) operate at a far slower pace. For them, a speed of 30 kts or more is attained only when making noise is not an operational concern.

In yet another key difference, SSNs typically hunt and engage as singles, whereas the basic fighting unit in aerial combat is a two plane section of fighters. Four or more four plane divisions will often be committed in major offense sweeps, and fighting without the support of a wingman is uniformly shunned as an invitation to disaster.

There are also differences in the human demands that figure in the two contrasting arenas of combat. Although both entail high task loading, often to a point of mental and even physical saturation, fighter pilots work alone in the cockpit or, at most, with a single weapons officer in the back seat. For their part, SSN commanders take into combat a crew of up to ten officers and 100 or more enlisted men. That, in conjunction with the longer engagement times typically involved, makes for significant dissimilarities in task management, crew coordination, and needed stamina going into a fight.

By the same token, thanks to secure radio, fighter pilots can talk freely among themselves and share tactical information via data link, even in a heavy jamming environment. For them, communication is instantaneous and generally unobstructed. In contrast, submariners fight an unseen, unheard, and very private fight beneath the ocean's surface, in which contact with the outside world is out of the question.

Furthermore, there is a considerable difference in the relative comprehensiveness of the awareness picture enjoyed by the two combatants. Fighter pilots usually command a rich, if not definitive, visualization of what they are facing going into a fight. SSN commanders, on the other hand, while not totally blind by any means, tend at best to have a more ambiguous grasp of their tactical situation throughout most of an engagement.

Finally, there is an asymmetry in stakes between the sub-on-sub and air-to-air missions. A fighter pilot who absorbs a surface-to-air or air-to-air missile shot *may* be lucky enough to have the option of ejecting and saving his life. For the submariner, taking a lethal torpedo hit is generally a lose-all proposition. Neither individual typically broods about these possibilities. But an SSN commander knows at some level that he has more to lose going in a fight.

Yet with all due allowance for these and other differences, there are enough areas of comparability between the sub-on-sub and air-to-air mission areas to suggest that the two classes of high technology warriors share more of a kinship than either may be prepared to acknowledge. Without exhausting the many examples, they include:

Operating in a three dimensional arena. There is a big difference between maneuvering on a flat plane and in free space. Submariners and fighter pilots both face the complexities of a third dimension that do not routinely figure in the planning of those who fight in the surface warfare world. In each medium, it is difficult to hide, given the capabilities of sensors on both sides. Fighters and SSNs can remain elusive up to a point, the former by terrain-masking and the latter by exploiting thermoclines and other ocean anomalies and generally operating a quiet and stealthy ship. But as a rule, unobstructed line of sight means detectability. The big difference between the two lies in detection range. An air intercept radar can acquire a fighter-sized target at a distance of 40 nautical miles or more in the forward sector. Modern attack submarines, by contrast, are now so quiet that in the most challenging cases, one must be in very close proximity to an enemy vessel before it can be detected by passive sonar.

Of course, the SSN commander also has the option of using active sonar. However, like initiating a radar search in air-to-air combat, that has the effect of pinpointing the illuminator's location and marking him as hostile. It is the equivalent of someone turning on a beacon in a darkened room full of armed opponents. For that reason, it is advisable only when a firing solution and disengagement option are at hand.

A high premium on initiative and stealth. In both undersea and air-to-air combat, the winner will be the one who can enter the fight unobserved, take the first shot with impunity, and disengage at will. Since the SSN, in a manner of speaking, was the original *stealth fighter*, submariners have known this for years. Only with the advent of low observable technology and extended range missile capability has it emerged as the dominant tactical advantage in aerial combat.

Overlaps in tactics and tactical repertoires. Likewise in both undersea and air-to-air combat, employment concepts begin with getting the most out of one's platform and systems against enemy equipment of comparable capability. From that, they progress to dynamic one-on-one maneuvering as the foundation for more complex scenarios. In both undersea and air-to-air combat, the tactics package proceeds from one-on-one to one-on-one-or-more (or one-versus-unknown). Where the point of comparison breaks down is that fighter engagements will usually be many-versus-many--an unlikely scenario in SSN combat.

More to the point, the winning edge in both cases involves an amalgam of good situation awareness going into a fight, plus the ability to analyze and sort quickly, make crisp commitment decisions inside the enemy's information processing loop, get off a valid shot, and then reengage from a position of strength or exit the fight to safety. The big difference lies in the way in which the time factor plays in the two cases. In aerial combat, elapsed time from initial vector to weapon impact and disengagement will be minutes at most. In the SSN world, things generally proceed more slowly at first, with the premium going to perseverance and steel nerves. But in both cases, events begin unfolding quickly as the endgame approaches. Also in both cases, the side with the better situation awareness will invariably command the tactical advantage.

Overlap in mission character. There is at least an indirect resemblance between the offensive sweep missions in the air-to-air and undersea warfare worlds. In both cases, the classic injunction *lose sight, lose fight* applies, although in air-to-air, *sight* may include a radar paint, and in undersea warfare it obviously refers to sensor contact. Likewise in both cases, there is a premium on making the most of guile and deception. There are points of comparison as well in the use of passive defenses, such as decoys, chaff and flares, and other countermeasures. With respect to cueing, there are analogs in the uses of offboard support by radar surveillance platforms like the E-2 in the case of the fighter pilot and the combination of the P-3, S-3, and ASW destroyer for the submariner.

A clean fight. In theory at least, fighter pilots die alone, while submarine commanders go with a lot of company. But in both cases, moves and countermoves are distant, impersonal, and antiseptic. And in both cases, the tactical problem is generally couched in terms of the attacker against the opponent's *platform*, with the priorities typically being to survive first and then win.

Maximum weapons range is a pivotal consideration. Likewise in both cases, if the attacker's reach is greater than the defender's , the attacker can control the fight from initial moves to resolution and disengagement. Contrariwise, fighter pilots and SSN commanders can both use angles and speed to negate or defeat an opponent's shot—*if* they have the requisite performance margin in their own platform.

Smart last-ditch maneuvers can be a lifesaver when energy and ideas have been exhausted. By throttling back and releasing flares, fighter pilots can defeat all but the most sophisticated infrared missiles. Similarly, SSN commanders can employ countermeasures or go to all stop to reduce noise and negate an enemy's targeting solution. That said, a world class guns defense in close air combat, or a *Red October* last chance break turn during the crucial endgame of an SSN engagement (the movie depiction of the latter no doubt a considerable exaggeration of real world SSN maneuvering), depends critically on good situation awareness and timing. Anyone attempting such a tactic had best have a viable disengagement option. Otherwise, he may simply be helping to solve his attacker's problem.

Fair fights are a losing proposition. Both submariners and their air-to-air compatriots will seek to avoid, at all reasonable cost, the sort of close-in engagements that fighter pilots have aptly characterized as "knife fights in a phone booth". In each case, in the terminal phase in which the opponents are eyeball-to-eyeball (figuratively speaking, in the submariner's case) and committed to the fight, it is often very difficult for either side to disengage cleanly. That means a high probability of a kill by the luckier or more aggressive and tactically astute combatant. Accordingly, the preferred game plan in both mediums is to conduct standoff combat, in which stealth and surprise are the pivotal factors. Ideally, the first indication that a fight is on should be a fire light in the enemy's cockpit--or the sound of an incoming torpedo in the enemy sonarman's headset.

Knowledge warfare is the name of the game. This applies especially if there are major asymmetries in the opposed weapons at play. An example in air-to-air combat would be a situation in which one side had launch-and-leave radar missiles and the other did not. Knowing one's own and the enemy's platform and weapons performance parameters and limitations, plus the tactics and operational proclivities of the other side, is crucial to success in both mediums.

The human factor will usually be the swing variable. The Israeli Air Force's chief of training opined some years ago that "the three most important ingredients in air-to-air combat are aggressiveness, aggressiveness, and aggressiveness". He meant disciplined aggressiveness, to be sure, not the headstrong combativeness of a bull in the ring. But aerial and undersea warfare are closely akin in not being forgiving places for the indecisive. Baron von Richtofen in World War I well described an irreducible trait of the winning air warrior as "the spirit of attack born in a brave heart".

This has commonly been taken for granted in the case of the fighter pilot. It has not, however, been a part of the stereotypical image of the submariner. Yet Norman Friedman has offered a useful corrective in the latter regard: "When we went to nuclear subs, Admiral Rickover, who ran the program, was an engineer, not really a combat type. To this end, every officer commanding a nuclear ship is a nuclear engineer. But what you really want in a submarine commander is a pirate."

Just as basic flying ability is an insufficient precondition for the successful fighter pilot, so is nuclear engineering training for the SSN commander. Flying skills are but a means of putting fire and steel on target. Likewise for the SSN commander, the submarine is but an instrument for getting a job done. When all the polite language is pared away, the winning fighter pilot and the winning SSN commander are, at bottom, winning personality types. The airplane and submarine are only extensions of their competitive instinct and prowess.

To take the point of comparison further, the accomplished nuclear engineer is not, by the qualification alone, automatically suited to the tactically demanding hunter-killer mission in undersea warfare. There remains a core element of initiative and unwavering commitment to prevailing in combat that is key to success in that mission, without which any SSN commander will suffer an inherent liability going into harm's way.

For the same reason, in an ideal selection approach, fighter pilots are screened first for personality traits deemed essential for success in air warfare, including emotional maturity, calmness under pressure, the ability to absorb information quickly, controlled self-confidence, adaptability under stress, and a deeply rooted will to win. Then, and only then, does it become important to determine whether candidates also have the aptitude to fly an airplane. The latter is important but secondary to mission performance. Almost anyone with basic intelligence and good motor skills can be taught to fly a fighter. A different ingredient comes into play when it comes to wielding it effectively as a weapons platform. It is that added factor derivative of attitude and will which largely accounts for the difference between mediocrity and mastery. Likewise in undersea warfare, tactical cunning and boldness in execution will frequently be the deciding factors in determining an engagement's outcome.

If these points have any validity in principle, what do they mean for the submarine community in practice? In years past, submariners and fighter pilots remained seemingly light years apart professionally because they lived and operated in arenas with no functional overlap whatever. Yet with the Cold War now over, the classic high end challenges for each community have largely gone away. For fighter pilots, these were topped by massed offensive sweeps into enemy airspace, initiated by head-on missile shots from beyond visual range and devolving into swirling dogfights against the enemy's superior numbers. For fast attack submariners, they were headed by the epic hunter-killer campaign against Soviet SSNs and SSBNs, from the open ocean to the Barents Sea and other Soviet sub bastions.

Today, with the SSN community's once dominant focus on blue water sub-on-sub warfare now displaced by more littoral concerns, the combat aircraft analog for submariners has become more the Joint Strike Fighter than the F-14. That said, the rich experience of the SSN community at planning and training for sub-on-sub warfare has made for a corporate memory of great relevance to the emerging world of air combat. Low observability to enemy sensors will be the dominant design feature of the next generation of fighters. In light of that, it seems more and more that submariners and fighter pilots have much in common to talk about. As the seams between force elements in all services continue to give way to the need for more rational force integration and joint employment, there are manifold reasons for combatants of all types to get to know one another's mission responsibilities better. Toward that end, submariners and fighter pilots would appear almost perfectly positioned to set the example.

Of course, some might object that this is an artificial matchup in the end, since much the same could be said for officers in *any* combat arm, whether undersea warfare, fighter aviation, or, for that matter, infantry, artillery, armor, surface naval warfare, or special operations. Up to a point, there is merit to such a view. The warrior ethic is generic and should inhere indivisibly in *all* military professionals, regardless of their mission tasking.

Yet to insist on such a leveling rule to a fault would be to ignore a special tie between submariners and fighter pilots that sets them apart from most, if not all, of their fellow combatants from other walks of service life. Both are literally at the sharp end of the lance when it comes to contact with the enemy. Both have full control over their tactics execution. In each case, their platforms and weapons are direct extensions of themselves. And their personalities and situation assessments figure centrally in the course and outcome of the fights they win or lose. In light of that, a gathering of attack submariners and fighter pilots aimed at exchanging operational insights on points of force employment where the two communities have features in common might make for an eye opening professional experiment for all concerned. It is a fair bet that the overlapping practices that would be unveiled through such an exchange would be as revealing as they were surprising to most participants on both sides.

To be sure, it would be a stretch in the extreme to suggest that just because of the surface similarities between the two modes of warfare, attack submariners and fighter pilots would stand to learn much of *direct* applicability to their respective missions by talking to one another. Short of that, however, the two communities could profit greatly by paying closer attention to how each goes about such common *processes* as prospective commanding officer screening, mission planning tactics development and validation, coordinated operations among diverse force components, and integrating technology, tactics, and training. The SSN and air-to-air communities should also have pertinent experiences to share with respect to technology application, most notably in the areas of information assimilation and display, combat data prioritization, and task management under stress.

Perhaps the most accessible bridge linking the two communities might be their vernacular associated with the dynamics of combat engagements. Fighter pilots use terms like high-low split, single-side offset, resolution cell, and so that relate to team tactics. Similar terms of art in the SSN world would no doubt resonate familiarly among fighter pilots. And for sure, any fighter pilot who had a chance to observe a sub-on-sub training engagement at first hand from the attack center and to monitor the debrief afterwards in the wardroom would feel almost instantly at home, since he would have seen it all before when it came to fundamentals. That was certainly my dominant impression gained from watching four days of sub-on-sub operations as an invited guest during a PCO training deployment in USS ATLANTA (SSN 712) in 1996. Might the same be said of a submariner after a day spent flying as an observer with a fleet fighter squadron? Whatever the answer, a trial operator-to-operator dialogue between interested representatives from the attack submarine and fighter communities would not only break new ground among naval warriors; it could also yield a learning outcome of untold professional value to both.■

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ONE VIEW OF FUTURE TECHNOLOGY

by LT Dan Geiger, USN
NROTC Unit
University of New Mexico

In the course of its evolution, the United States Submarine Force had undergone many facelifts. For years, the Silent Service enjoyed it's autonomy by maintaining that its operational security required total commitment to concealment. And indeed, this enhanced the effectiveness of the platform. No one could say with any surety what our subs were doing. This often makes the idea of the submarine more effective than the weapon itself. However, when money got tight, the submarine community found a lot of people asking the question "What do you guys do anyway?"

What do we do? Defense, offense, interdiction, espionage, research, and reconnaissance are all part of our current plans. However, if you asked a submariner in the 1970s what the mission of his boat was he would say, without hesitation, that it was deepwater antisubmarine warfare or strategic deterrence. If you ask a submariner today, you will probably get a soliloquy of varying complexity and accuracy which would include being inspection ready, and include the terms *quality of life* and *littoral*.

Do not think for a minute that I do not understand the amazing potential of this unique and efficient half-man half-machine. However, like the fire extinguisher hanging in your kitchen, you may not need to use it right now, but you better ensure it's ready to go when you do need it. And that doesn't necessarily mean that it is only useful for putting out fires. You can hit burglars over the head with it or use it to prop the door open to allow you to bring groceries in from the car. Whether for defense or resupply, it is nice to know that there is a multi-faceted, proficient tool ready for immediate use when the use arises.

Where will we be in 2030? God willing, we will be making patrols in the defense of the greatest nation on earth. We will be alert, able and ready. And we will be challenged. Those are the constants. The variables are where the challenge exists. The greatest of these is the adaptation, development, and exploitation of technology. Few people will deny the importance of technological superiority in protecting the nation. However, few people are up-to-speed at the cutting edge of technological research. Trying to convince leaders that we need to pursue technology that they consider science fiction is difficult. But we are looking 30 years into the future. Thirty years ago, would you have found a personal computer in your home? Did the transmission in your car shift without a jolt (thank you fuzzy logic)? Did the traffic lights in your town compensate automatically for changes in traffic density (thanks neural networks)? Is it wrong to think that tremendous technological changes are yet to come? If we do not stay at the forefront of technology, we will be vanquished by it.

Let's look at a meeting in the future. USS TAOS has returned from sea trials and the Captain and Department Heads are discussing the success of various systems recently implemented.

But they are not alone.

Transmission Begins...

"... had an exceptional week. The testing is over, gentlemen, and the Admiral is very interested in your findings. I'll be briefing him tomorrow. I need each of you to brief me on your departments. You go first, Eng."

"Mornin' Cap'n. As you gentlemen know, the new reactor cores use a fission/post-fission-fusion process to generate power. Our tests on the post-reaction-fusion unit have shown that existing cores can be refit with this device with only marginal reduction in efficiency. The refit is arduous since it involves work on the core outlet. But, considering it will double core life, it's a small price to pay. I know the Admiral wanted feedback on the automatic valve actuator problems we have been having. Well, here goes. Give me my mechanics back! I know the automation back aft has led to some new innovations, but we just can't keep these systems running. I hope the Navy finally realizes the amount of work that went into operating an engine room! The fact is that my guys never failed. They have been wrong before, and we have learned to adjust to that, but they have never stopped working. Tell the Admiral I'll swap a rack for a rack-and-pinion any day. We weren't able to test the Emergency Evasion Rockets due to heavy traffic in the test area, but I'm kinda glad we didn't. USS RENO cracked a screw blade when it failed to rotate to the null-drag position when the rocket motors lit off. They got out of the area quickly, but the four month refit that followed wasn't fun. Lastly, sir, the virtual reality training sessions we had at squadron were very beneficial to the crew. However, I don't foresee it as being helpful for our Reactor Examination work-up. The ORSE doesn't run the kind of drills we were simulating. Our best preparation is the same thing that we've done for the past 50 years and that's cram."

"You know I hate when you call it that, Eng."

"Sorry Skipper. I tend to be a little more cynical. Anyway, that's all I got Cap'n."

Thanks, Eng. Nav."

"Good morning, sir. Testing is complete on the remote GPS probes. They work great when you can get them docked again. We lost two of them. Sonar confirmed that they self-destructed when they exceeded 2000 feet. The old tethered versions were more reliable but I will admit that having GPS available at any depth was nice. The neural network we added to the bottom mapping computers was unbelievable."

"I saw the report. You say you were getting fixes within two feet?!"

"Yes sir. At least, that's what the techs estimate based on correlation with accelerometer data. Not only did we see the rise in accuracy, but also the network was able to differentiate between changing bottom features. It was eventually telling us what the bottom will look like in the near future. We need to get this technology to the oceanographers. They will go nuts over it."

"That's where we got it from, Nav. Do you have anything else?"

"No sir."

"Tactical Systems."

"Good morning, Captain. I wish I could report as much success with the neural network as the Nav. Our network was able to take the new towed array data and generate a three-dimensional tactical picture within two minutes of gaining a contact. That is where the good news ends. The neural network on the torpedoes has assigned own ship as a target in 4 of the 100 practice runs we did. It seems that if we run away or shoot another torpedo, the network has a 10 percent chance of assigning us as a potential target. Since we carry the multiple warhead torpedoes, we could be assigned after the initial target is hit. We're turning all the data over to the project engineer tomorrow. She says it's just a matter of presenting the network with the correct training set. I'm here to tell her that she has her work cut out for her. Our sister ship had a successful trial of FLYSWATTER. I am sending my department to be briefed next week. Apparently Admiral Geiger is anxious to get this weapon backfitted on the rest of the squadron. Of the five moving and ten stationary airborne contacts, they destroyed four of the moving and all of the fixed drones. It's apparently a pretty impressive display. Finally, the Littoral-net at ..."

"Eng, what are you doing?"

"This fly is driving me crazy, sir, I'm sorry."

"Anyway, sir, the net was down so we.."

"Don't move Ensign, I'm going to get him......don't move.."

Transmission failed...

"What happened, Uri?"

"We lost the signal from the transmitter, Officer."

"Damn, another squashed bug. Those things aren't cheap."

"I think the information was more than worth it, Officer."

"Absolutely, Uri. Send what you got back to the fleet. And I bet our Chinese friends would be interested in it too. Isn't that right, Yi?"

"Yes we would, Officer."■

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HYDROTHERMAL VENT PLUMES AS ACOUSTIC LENSES

by Joseph J. Buff

Mr. Buff is a professional writer who is working on a submarine-related project. He has used unclassified sources to postulate the mid-term (about 50 years) future of submarines for ***THE SUBMARINE REVIEW*** *(July and October of 1998). This is a further effort to present out-of-the-box thinking about the future.*

Hydrothermal vents are of potential tactical interest to submariners. They strongly impact local water temperature and chemistry, hence their plumes can alter underwater sound propagation. Hot vents were first discovered by deep submergence research craft in 1977. These *black smokers* and their associated biology have been studied extensively since then, although a review of NASA, NOAA, and NSF project proposals listed on Internet websites shows that many questions remain.

This article will briefly summarize the properties of hot vents and then will theorize how they might create undersea *acoustic lenses*. These lenses could focus, or obscure, both passive and active sonar, in a manner similar to convergence zones, sound channels and ducts, and shadow zones. We will argue here that such lensing effects could be exploited as *natural telescopes for sound*, **enhancing effective hydrophone sensitivity and improving target detection ranges**, thus increasing the military power of a naval submarine's onboard sensor hardware and software suite. We will end with a suggestion of ways acoustic lenses might be created artificially, on command of the SSN's or SSBN's skipper, to help achieve *sonar superiority* in critical tactical situations.

Review--Rules of Underwater Sound Propagation

The refraction behavior of sound is similar to that of detonation waves and electromagnetic radiation. Specifically, sound wavefronts are refracted (bent) away from areas of higher transmission velocity and toward areas of lower velocity. Temperature, pressure, and water chemistry affect sound velocity in the sea as follows:

1. A negative temperature gradient (i.e., increasingly cold)

will cause sound velocity to decrease.

2. A negative density gradient (i.e. lower mass per unit volume) will cause sound velocity to decrease.
3. Increasing pressure (depth) increases water density—seawater is not entirely incompressible.
4. Dissolved chemicals (e.g., salt) increase sound velocity (because they increase density—they may also hasten sound attenuation loss).

These familiar rules, combined with representative ocean bathythermograph traces, lead to the well known effects of surface ducting, convergence zones, thermal layer shadow zones, and deep water sound channels.[1,2,3,4] (Typically, temperature effects in the permanent thermocline predominate over density effects: sound velocity decreases with greater depth until the isothermal zone is reached, due to progressive cooling, at which point sound velocity then increases with depth, once a constant temperature is reached.)

Review—Properties of Hydrothermal Vents

Hydrothermal vents are found at hundreds of places along the 60,000 kilometer-long Mid-Ocean Ridge, a seam of spreading crustal plates which girdles planet Earth. Hot vents are often found in groups (fields), though they may also occur on isolated seamounts.[5] Seafloor fissures and magma upwellings combine to create a water circulation loop, similar to a geyser, in approximate dynamic equilibrium at large time and distance scales. Water seeps down through cracks in the seabed, penetrating perhaps a mile or two. It then comes in contact with molten lava or other hot geological formations. The seawater is heated, becomes acidic, and takes on dissolved chemicals. The hot water rises through a vent, a kind of chimney on the ocean floor.[6]

Vent nozzle diameters can range from less than one inch up to several feet. Water temperature at the opening can reach 400°C[5,7], and hotter vents may yet be discovered. Two phenomena take place in the region at and above the nozzle:

1. Temperature mixing. Pressure at many atmospheres prevents the water from boiling. Instead, it quickly cools by several processes: conduction to the solid chimney (which would then itself radiate heat outward), adiabatic cooling

(i.e., lower pressure upon release from the constricting vent pipe), and convective mixing with seawater surrounding the vent at an ambient temperature near 2°C.[5,6] Sources indicate that cooling is very rapid—in some cases ambient near-freezing water temperatures are reached in the plume within inches of the nozzle.[5] Other references indicate that a) water temperature may hover near 15°C in the immediate vicinity of the chimney[8], b) mean temperature anomalies decline to 0.02°C on a scale of kilometers[7], and c) *very warm water* can be found by towed research sleds 100 meters above an especially active (e.g., Pacific Ocean) sea floor vent field.[9]

2. Chemical transport. Hydrogen sulfide, metal sulfides, and calcium and barium sulfates dissolved in the rising super-heated water precipitate out rapidly as the water cools. This is the cause of the billowing black exudations seen at many thermal vents. Some of this precipitate accretes and forms the chimney itself. Chimneys up to 150 feet tall have been observed.[9] Some of the precipitate falls as *snow* nearby the vent. (These sulfur compounds support complex and unique biology completely independent of photosynthesis, including Archaea microbes which are of interest to submariners because of their corrosive effects.[10] After precipitation the water exuding from the vent remains saturated with numerous chemicals, including helium-3 and oxides of iron, manganese, zinc, and copper. As the water mixes with the surrounding sea, the concentrations gradually dilute. These enhanced concentrations form extended megaplumes above the vent mouth. In some cases research probes detect these chemical tracers many miles from the vent itself.[6,7]

Lensing Effects

In general, asymmetries about the vertical axis can be expected in the shape and structure of a hydrothermal megaplume. These may be caused by a) ocean currents (currents of at least 1 cm/sec have been measured near some hot vents[7] or b) the merging of plumes from vents distributed unevenly within a field (some vent fields achieve the size of sports stadiums.[5] In addition, there is not necessarily a sharp boundary between a plume and the surrounding sea, but rather an area of mixing and thus a gradual alteration of temperature and chemistry.

For discussion purposes, to establish the potential military significance of hydrothermal vents, a simple model of a megaplume will be considered: an *inverted cone* with apex lying at the vent mouth.

What is special about this plume cone? In general it can be expected to be warmer than the surrounding sea, and (adjusting for any temperature difference) also denser (due to dissolved chemicals, the same way salt in seawater raises density some three or four percent.[11] Both effects *increase sound velocity* (as discussed above, on large scales within the megaplume the chemistry is generally more important than the heat).

This hypothecated cone (just like real vent plumes) will have internal structure: *gradients* can be expected as to both temperature and chemical density. These gradients will be negative (decreasing) with distance from the vent mouth both *horizontally* and *vertically*. The two dimensions must be considered separately because, everything else being equal, *water pressure* changes vertically but not horizontally.

The properties of these gradients will show variation from vent to vent and over time at any particular vent.[7] Exact data is necessary in order to perform specific and reliable ray trace calculations with practical utility. Turbulence and *noise* close to the vent mouth can be expected to be substantial and chaotic. However, conditions somewhat further away, at distances tactically useful to submariners and ASW/USW forces, would be steadier and smoother.

Clearly, extensive seaborne computer power, sophisticated signal processing algorithms, and good real-time information on conditions in the megaplume (gathered perhaps by expendable probes or by UUVs), would all be needed to effectively harness the acoustic lensing properties of hydrothermal vents. Different considerations and engineering problems would apply to the different modes of sonar listening and analysis: broadband, narrowband, or demodulated. In practice there would be non-trivial expense and time involved to study these feasibility issues and then perfect the equipment and procedures required for operational exploitation by the fleet.

Technical Discussion

For brevity, this article will consider a megaplume deep enough to lie within the isothermal zone, i.e., the surrounding ambient water temperature is a uniform 2°C.

We will analyze two situations: one vent in isolation, and two vents near each other.

One Vent in Isolation. Let us consider first *horizontal acoustic effects*. Because of increased cooling and dissolving by ambient seawater at greater distance from the vertical axis of the megaplume, a horizontal section through the cone will have greatest density and temperature, and hence greatest sound speed, near its center, and lowest density and temperature, hence lowest sound speed, near its periphery. Thus sound rays moving in parallel in a horizontal plane, when passing through the megaplume, will tend to *diverge*, as if passing through a concave lense. See Figure 1.

Let us next consider *vertical acoustic effects*. A vertical section will capture a triangular slice through the megaplume, surrounded by ambient seawater assumed not affected by the plume. Let us imagine moving upward through this section along a vertical line. See Figure 2.

A line AB rising directly from the vent nozzle will show a steady decrease in sound speed while moving toward the ocean surface. Ignoring hot vents and shallow thermoclines, this trend would occur simply because of decreasing pressure at shallower depth—note this pressure gradient is *linear* with respect to depth. The gradient in the hot vent plume will be steeper than this, *quadratic* (second power), because dilution of the chemical burden occurs in *two* horizontal dimensions (i.e., across a *plane*) as one moves toward less-deep water and the cone cross-section diameter expands. This gradient will cause sound rays to bend upward, as they do in general below the axis of the deep sound channel, but because of this non-linearity they will bend upward *more sharply with shallower depth*, thus acting to diffuse sound rays, again like in a convex lens.

A line CD rising from the ocean floor at a point displaced from the vent nozzle itself, will show sound speed reduction with shallower depth at first, until it encounters the megaplume *boundary* at X. There will be a jump in water density and temperature near X, and hence *a jump in sound speed*. Speed will then decline once more along XD, but as on line AB density will fall at a faster rate than in *clear water*, and there will be some temperature decline effect as well. This argument supports two conclusions:

1. In the *immediate area* of the megaplume boundary at X, sound rays will *converge* in the vertical plane: they will bend upward from below and downward from above.
2. *More broadly*, moving upward from the sea floor on a planar section though CXD, a local maximum in sound speed will occur near X--the opposite of a velocity minimum at the axis of the deep sound channel. This maximum will cause an *overall vertical divergence* of sound rays.

In summary, we may conclude that a single hydrothermal vent megaplume acts like a concave lense, dispersing or diffusing sound, although there will be some local focusing of rays vertically at the boundary between the rising megaplume and ambient seawater underneath.

<u>Two Vents in Proximity</u>. Let us next consider the case of *two adjacent identical hot vents* and examine acoustic lensing *in the region between them*. See Figure 4. First imagine a *horizontal section* through AB, at a depth below where the megaplumes of hot vents 1 and 2 intersect. Chemical burden density and temperature, and thus sound velocity, reaches a local minimum at X, between two local maxima above vents 1 and 2. In this case sound rays are *focused toward* point Y--see Figure 5. Again because horizontal spreading and dilution of the plume occurs in a two-dimensional plane, the increasing density gradient from point X toward either vent nozzle will rise more rapidly than linearly, helping focus the sound rays.

This focusing will also occur in a horizontal plane through CD on Figure 4, since although there will be less dilution of each plume once they meet, there will still be a density and sound speed minimum at XX, or anywhere on a plane above XX at a point intersecting the vertical line through X.

What about the *vertical plane*? Consider a vertical slice intersecting the midpoint X between two *equal* hot vents on Figure 4. (Let this slice also be perpendicular to the line between the vent nozzles.) The discussion above pertaining to Figure 2 and 3, a vertical slice off-axis through a single plume, once more applies.

Specifically: at XX, the boundary between the intersection of the megaplumes and the undisturbed seawater lower down, local focusing occurs.

Therefore, at the point XX where two adjacent hydrothermal vents' megaplumes intersect, focusing of sound rays occurs in both the horizontal and vertical planes.

Diffusion, Focusing, Magnifiers and Telescopes

The above discussion using the simplistic inverted cone model supports two hypotheses:

1. The megaplume of a single isolated hot vent functions overall as a concave lense with respect to sound rays, diffusing and dispersing them except in the vertical plane in proximity to the boundary layer between the megaplume and the ambient sea beneath it.
2. The region *between* two adjacent hot vents, particularly at the intersection between their two plumes' outer boundaries, functions as a convex lens, focusing sound rays much as a magnifying glass focuses the sun.

We can apply these two observations to make a third: With a *supply* of lenses in a hot vent field, we can exploit *acoustic optical systems*. In particular, certain combination soft lenses can have the effect of a *telescope*, an acoustic *amplifier*. One combination is a pairing between a convex objective lense and a concave ocular (eyepiece), as in the refracting telescope Galileo constructed. The other is a pairing between a convex objective lens and a convex eyepiece. The convex/convex pairing tends to be more efficient, and is used in modern telescopes and binoculars. A naval submarine could position its bow sphere or wide aperture array at the focal point of this lensing system, to enhance the effective performance of the vessel's sonar. If test depth limits or other considerations prevent achieving this directly, a towed array or purpose-designed hydrophone complex could be dangled at the acoustic focal point. By shuttling between different lensing systems, the submarine could improve the effective signal-to-noise ratio and also could *triangulate* on an enemy target, thus helping perform a target motion analysis to derive a useable firing solution, potentially at considerable engagement ranges.

Creating Artificial Megaplume

The exploitation of undersea acoustic lensing with the goal of greater *sonar superiority* need not be dependent on hydrothermal vent fields. The critical component is an area of water with the necessary thermal and/or chemical properties. This might be achieved artificially, on demand and at an arbitrary location, in at least one of two possible ways:

1. Deployment of chemical-dispensing and/or heat-generating canisters by the submarine, similar to noisemakers but with a different purpose.
2. Exploitation of the heated water discharged from the vessel's main condensor cooling loop, perhaps with the introduction into the discharge of water-soluble chemicals.

Approach 1 might have two disadvantages: the canisters may be noisy in operation, thus compromising stealth, and each one represents a point source, so that a useful megaplume would be generated slowly. Approach 2 appears at least to offer ease of implementation: by cruising slowly in tight upward or downward spirals, for instance, thus laying trails of warmer water with the desired controlled geometries, the boat could produce non-chaotic lensing areas that require no special equipment and create no inordinate noise. Note that in both these artificial approaches the lenses would gradually dissipate, whereas natural hydrothermal plumes are continuously renewed.

Conclusion--Military Applications

Hydrothermal plume acoustic lensing can have both offensive and defensive applications. A single vent can be used as an acoustic diffuser, to disguise a submarine's active and passive signatures from observers on the other side of the vent, thus enhancing stealth. Conversely, a correctly spaced pairing between a) *objective* focusing effects between two adjacent hot vents, and b) *ocular* effects using another single hot vent (concave eyepiece) or another adjacent pair (convex eyepiece), can produce an acoustic amplifier, a kind of sonar telescope, boosting first-detection distances and sharpening directional resolution, helping achieve *sonar superiority*. Even if the *field of view* were narrow and inflexible, say along a single fixed line of bearing, a useful long-range surveillance barrier or *tripwire* could be produced.

Obviously these effects require that both the target and the observing hydrophone/transducer array be positioned properly with respect to the vent field megaplume geometry. (As discussed in the previous section, this limitation could be avoided by creating temporary acoustic lenses *artificially*.) Furthermore, good sonar directivity and spectrum filters would be needed to delete noise emissions from the vent nozzle itself and from underlying magma movements, and considerable computer power combined with lengthy integration intervals—and thorough sonar watchstander training plus experience—would be needed to make useful sense of the underlying signal. Practical utilization therefore has two requisites: *databases*, and *platform/user capabilities*.

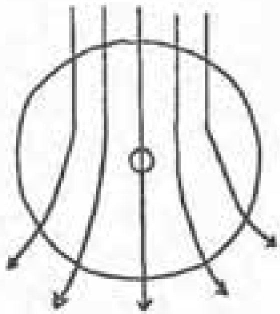
The databases would need detailed maps of hydrothermal vent locations. The databases would also need real-time statistics on the characteristics of specific hot vents, in particular on temperature gradients and chemistry/density structures in three dimensions. Presumably such real-time data could be sampled by XBT probes or SUAVE chemo-sensors.[6]

Two real-world situations come to mind where *existing platforms* and their commanders might find acoustic lensing useful. The first would be SubForce mission tasks in regions of the globe where hot vent activity affects depths reachable by current SSNs and SSBNs—this might include the Red Sea and the Persian Gulf.[10] The second would be situations where bottom-moored SOSUS nets—including temporary/tactical listening systems[12]—have been or might be deployed near vent fields, or where towed arrays, sleds, or other gear could be trailed at the proper depth from a parent naval submarine.

Certainly, detailed calculations using actual hot vent data, applied in advanced (possibly classified) sonar propagation models, would be called for to validate this concept, before reliable results could become available having military applications. This is one manner in which oceanographic research can be significant to national defense and to the proactive maintenance of peace. *Thermo-chemical acoustic lensing* is also an example of how making the most of the ocean medium in which all undersea warriors operate can yield strategic advantage if and when armed intervention does become required.■

FIGURE 1

HYDROTHERMAL VENT: HORIZONTAL SECTION THROUGH MEGAPLUME



Dissolved chemical density declines away from center. Sound rays therefore diverge.

FIGURE 2

HYDROTHERMAL VENT: VERTICAL SECTION

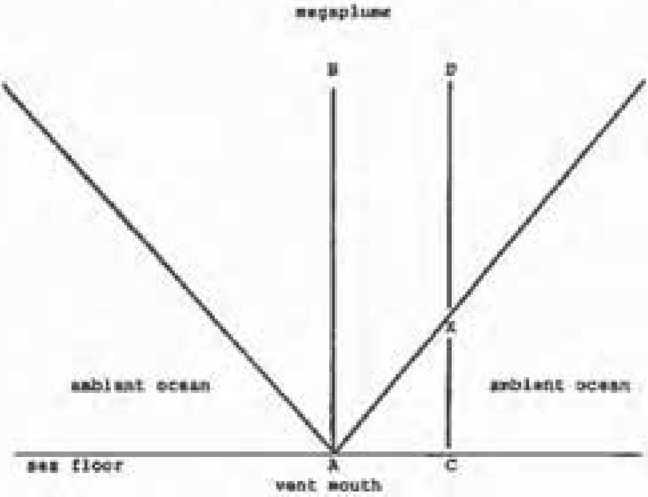
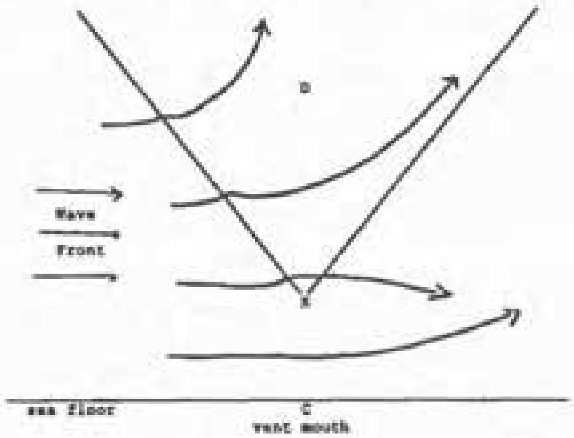


FIGURE 3
SOUND RAY TRACE: OFF-AXIS VERTICAL SECTION



Locally, sound rays near X are focused. Within megaplume overall, sound waves diverge.

FIGURE 4
TWO ADJACENT HYDROTHERMAL VENTS: VERTICAL PROFILE

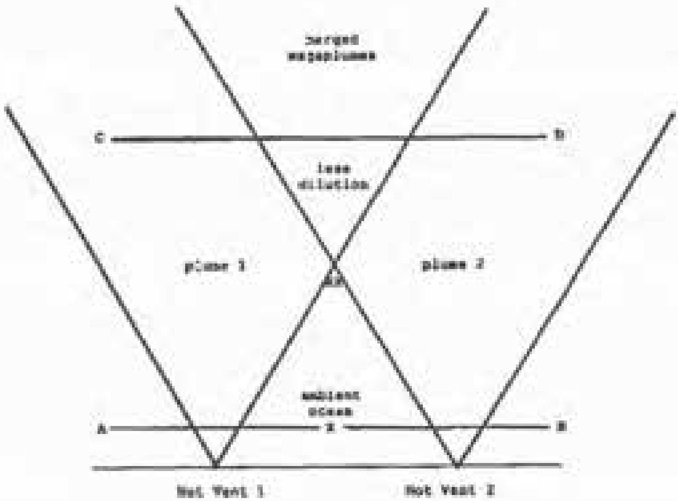
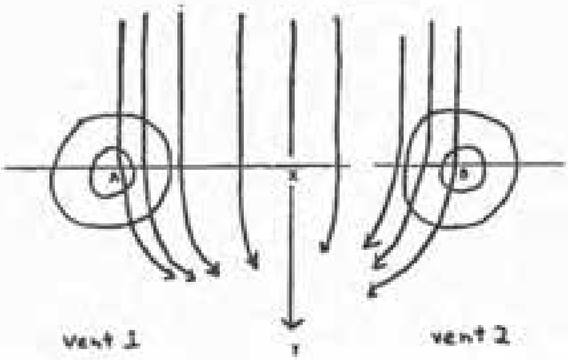


FIGURE 5

TWO ADJACENT HYDROTHERMAL VENTS: HORIZONTAL SECTION



Sound velocity has maxima at plume centers A and B.
Sound velocity has minimum at midpoint X.
Sound rays therefore are refracted toward a focus at Y.

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DEVELOPMENT OF MARINE NUCLEAR POWER PLANTS FOR SUBMARINES AND SURFACE SHIPS

by N.S. Khlopkin,
Full Member of the Academy of Sciences,
Recipient of the Title of "Hero of Socialist Labor,"
Lenin and State Prize Winner

Editor's Note: Taken with permission from a Russian-published book, Russian Science for the Russian Navy (Rossiskaya Nauka – Voenno Morskomu Flotu; Russian Academy of Science 1997; 398 pp); this book is a collection of articles devoted to the 300-year anniversary of the Russian Navy and its close ties with Russian science. The following article is an excerpt of N. S. Khlopkin's contribution to the anniversary book.

The use of nuclear power to propel and energize ships and vessels truly revolutionized their characteristics. It brought about a radical change in their combat capabilities, their armament systems and the very nature of their use, as well as in the principles of shipbuilding and naval architecture. Nuclear power plants enabled submarines to make prolonged solo voyages without rising to the surface. As a matter of fact, they became true undersea ships, unlike their *diving* cousins powered by diesel engines. Surface naval ships, too, acquired a capability for protracted voyages at high speeds and could be used to accomplish combat missions without replenishing their fuel reserves.

Thanks to an all-out effort launched on a nation-wide scale, in which the government managed to mobilize the country's scientific and industrial potential; notably, the Academy of Sciences, foremost scientific research institutions, design and development establishments, scientific organizations of the Navy, and some of the finest manufacturers in the defense, shipbuilding, nuclear power and other industries, the Soviet Union built the world's largest fleet of nuclear-powered naval ships and a unique icebreaker fleet.

The first nuclear-powered submarine, Project #627 (Ed. note: this class designated November class SSN by NATO), and the first nuclear-powered icebreaker were put into operation just a few years after the design work in that field had commenced. A lot of the credit goes to A.P. Alexandrov, a full member of the Academy of

Sciences, the scientific coordinator of the program for building the country's nuclear-powered fleet and a scientist who possessed a unique gift for translating achievements of fundamental science into specific engineering solutions in naval shipbuilding. This is how it all began.

In view of press reports about possible uses of nuclear power to propel U.S. submarines and aircraft carriers, the First Governing Directorate (PGU) of the Council of Ministers of the USSR resolved, at its meeting on March 24, 1947, that it was essential to embark on scientific research and preparatory design work to develop power plants of that type, primarily for use in submarines.

In 1948 Alexandrov suggested commencing to implement the nuclear-powered submarine program. At that time, however, his suggestion was deemed poorly timed, as any such efforts were likely to distract resources from the development of the atomic bomb. But then in 1949 the first A-bomb was tested—a factor that made it possible to resume work in the sphere of nuclear power engineering.

Large-scale work on marine nuclear power plants began in November 1949 when three marine reactor design options were offered:

- the proposed ShG 'Small Ball' reactor was a graphite-moderated and helium-cooled facility, for which A.P. Alexandrov of the Institute of Physical Problems was scientific coordinator, and B.M. Sholkovich of the Gidropress Experimental and Design Office (EDO Gidropress) was chief designer;
- the proposed VT reactor was a beryllium-moderated and helium-cooled system, for which A.I. Leipunsky of the Physical Energy Institute was scientific coordinator, and that same B.M. Sholkovich was chief designer;
- the proposed AM reactor was a graphite-moderated and water-cooled facility, for which I.V. Kurchatov of LIPAN was scientific coordinator, and N.A. Dollezhahl of the Scientific Research Institute of Chemical Machine Building (NIIKhimmash) was chief designer.

It was decided to build a complex comprising all of the above reactors, code-named V-10, at the site of the Physical Energy

Institute and the three units were scheduled to be put into operation. Soon thereafter, however, the projects were put on the back burner because the necessary resources and funds were re-directed into the development of industrial reactors: AI and I facilities.

On September 9, 1952, on the suggestion of I.V. Kurchatov, A.P. Alexandrov and N.A. Dollezhahl supported by V.A. Malyshev, Vice-Chairman of the USSR Council of Ministers, a resolution was issued under the hand of Josef Stalin, ordering an all-out effort to build a nuclear-powered submarine.

In late 1952, a fourth design option was added to the previous three. Proposed by LIPAN, it was a vessel-type pressurized-water power reactor, code-named ERKT and soon renamed VM. The scientific coordinator for the project was A.P. Alexandrov of LIPAN and the Chief Designer N.A. Dollezhahl of NIIKhimmash. The VM version appeared as the logical consequence of the need to reduce the size of the proposed AM graphite-uranium reactor so that it might fit into a submarine compartment. What made it a possibility was a reduced volume of graphite, whose role as neutron moderator lost much of its significance, in fact, to such an extent that scientists and designers proposed removing all of it from the nuclear core. The proposal was implemented.

A panel chaired by A.P. Alexandrov was established and chose the VM reactor as the main option for the first nuclear-powered submarine. A pressurized-water reactor proved to be simpler to build, employed the heat exchange agent already tested by that time in power engineering and, as compared with other reactor options, carried a smaller load of uranium-235. The decision makers also recognized the merits of the VT version with liquid metal coolant.

The work on the ShG version was terminated in view of difficulties related to retention of fission products in an uncladded fuel element and the inability to fit such a reactor into a submarine.

In view of its large size, the AM reactor, too, could not be used in a submarine. Nonetheless, it was redesigned and put into use in the world's first industrial-scale nuclear power plant, which, by the way, served the Navy for a long time as the main facility for on-the-job training of electrical-engineering department (BCh-5) staff for submarine complements, and specialists for the LENIN icebreaker.

The design of the first nuclear-powered submarine with a water-moderated reactor, for which the chief designer was V.N. Peregudov, was ready in June 1954. The Ministry of the Ship-Building Industry (Minsudprom) then reviewed it and submitted the design to the Government for approval.

During preparations for discussing the submitted documentation, the Government realized the need to involve scientific research organizations and specialists of the Navy in design work (previously they had not taken part in designing the submarine). As a matter of fact, the assignment formulating the required tactical characteristics and specifications had been prepared without any consultations with the Navy. In accordance with this scientific design document, the submarine was to be used to attack naval bases and ports by launching nuclear-tipped torpedoes with a diameter of about two meters.

After a naval panel headed by Rear-Admiral A.Y. Oryol presented its expert opinion on the matter, operational and tactical requirements made for the proposed submarine were altered. Henceforth, it was intended for torpedo attacks on fighting ships and transport convoys of the enemy on the high seas. For such a purpose, it was proposed to fit out the sub with eight, rather than one, torpedo launchers and give it 20 torpedoes. The submarine's fore-body was redesigned and the entire design, after being agreed upon with the Navy, was approved by the Government.

In 1954, an experimental reactor was put into operation at LIPAN to study the possibility of attenuating neutron fluxes by various materials and shields in between the core and the reactor vessel. Two objectives were pursued, namely, to reduce the reactor dimensions through reducing the number of the shields, which was a demand of the factories involved, and to reduce thermal stresses arising in the vessel because of the heat releasing as a result of neutron and γ-quanta absorption in vessel walls, which was considered a very dangerous effect by some specialists. Fortunately, these concerns were not realized.

To elaborate the basic equipment of the reactor facilities, a good many stands were built at OKBM, NIKIET, EDO Gidropress, etc. Main coolant pumps, steam generators, fittings, drives of regulating bodies, etc., underwent thorough bench tests prior to being mounted at the facilities.

Finally, prototype stands of full-submarine scale were constructed, including the entire power facility, turbogenerators, and the line of the shaft with a hydraulic brake.

The first of them, 27/VM, was commissioned in the town of Obninsk in 1956. A reactor stand with liquid metal coolant, 27/VT, was put into operation in 1957 (in Obninsk as well). After that, prototypes of various facilities were put into service in towns of Paldiski and Sosnovy Bor. Those stands allowed not only complex checking of the working capacity of the equipment and elaboration of all operating regimes, but also training of the field staff.

The construction of the first nuclear submarine was entrusted to the Severnoye Mashinostroitelnoye Predpriyatiye (Sevmash) plant #402 (Director Ye.P. Egorov) where the submarine was laid down on the stocks in 1955.

The submarine reactors were built in September 1956. In August 1957, the submarine was launched. In the first quarter of 1958, the work was completed and factory tests were carried out.

The activities to bring the reactors to power were started on April 17, 1958. That night, by the order of A.P. Alexandrov, the on-duty officer wrote down a historical phrase in the log book, "For the first time in the Soviet Union, steam was produced on a submarine without coal or masut."

By the end of June 1958, mooring tests of the nuclear reactor facility and all other systems of the ship had been completed. The flag of the Navy was hoisted on July 1, 1958 in the presence of S.G. Gorshkov, Commander in Chief of the Navy.

In July 1958, the K-3 submarine put out for state tests in the White and Barents Seas that lasted until December 1, 1958. In December 1958, the decision was made to pass on the submarine to the Navy for experimental operation. The submarine was to be kept at the plant while the shortcomings revealed during trials were eliminated.

The first generation of nuclear submarines proved the feasibility of high-power small-scale reactor facilities, their sufficient safety and reliability. The achieved underwater speeds opened the possibility of lasting cruises. The submarines exhibited satisfactory habitability with acceptable climatic conditions while staying underwater for a long time.■

About the Author: Academician Nikolai Sidorovich Khlopkin is the Director of the Transport Nuclear Reactors Branch of the Institute for Nuclear Reactors at the Russian Research Center

KURCHATOV INSTITUTE in Moscow, where he has worked since 1949. He was born on August 9, 1923. He is a veteran of the Great Patriotic War. In 1950, he graduated from the Moscow Institute of Power Engineering where he specialized in thermal physics.

In addition to being Full Member of the Russian Academy of Sciences, he is Laureate of the Lenin Prize, Soviet State Prize, and Hero of Socialist Labor.

*Editor's Note: A more personal account of the development of the Soviet Union's first class of nuclear submarines has been written by Captain 1 Rank George Sviatov and it will appear in the January 2000 issue of **THE SUBMARINE REVIEW**.*

DOLPHIN SCHOLARSHIP FOUNDATION APPLICATION

The DSF updated application is now available for distribution to potential applicants, high school counselors, and submarine-related commands.

The new form reflects DSF's decision to change the requirement for an applicant's sponsor to have served in the Submarine Force for a minimum of 8 years or a minimum of 10 years in submarine support.

As in the past, the deadline for completed applications and supporting documentation to arrive on premises is April 15.

For further information, please contact Karen Sykora at (757) 671-3200 or write to the Dolphin Scholarship Foundation at 5040 Virginia Beach Blvd., Suite 104-A, Virginia Beach, VA 23462.

THE NETWORK CENTRIC NAVAL OFFICER

by LT D.L. PACKER, USN

Editor's Note: Lieutenant Packer's paper won The Naval Submarine League Essay Contest for Submarine Officers' Advanced Class 99010. He is currently Engineer in USS OHIO (BLUE).

Introduction

The naval officer of the future must be different than the naval officer of today or the naval office of the past. The environment within which the Navy operates has become much more complex. Consequently, the naval service must change in order to be effective and relevant in the dynamic and uncertain environment of the future. This demands that the combat forces, if not the rest of the Navy, be organized in a flat hierarchy. There will be little time for information to flow up and down the chain of command. Decisions are going to have to be made at the most junior level possible. Therefore, the Navy must undergo a transformation from a directive, top-down, machine-like organization to a networked organization based on connected nodes of decision makers . We require officers capable of working and leading in this new organization. We need officers capable of making decisions and officers, more importantly, capable of creating and leading decision makers. We need the Network Centric Officer. (See Figure 1.) In this article, I will briefly depict the international and technological changes within the Navy's operating environment that are dictating this transformation, and I will identify clusters of skills, knowledge, and abilities that should make future naval officers successful.

The International Environment

The international Environment is evolving into an increasingly complex network of nation states, pseudo-nation states, and other non-governmental organizations. This environment is going to place great strains on the military to adapt. Martin Van Creveld in *The Transformation of War* argues that the state's attempt to monopolize violence in its own hands is faltering. He believes that the rise of low intensity conflict may, unless it can be quickly contained, end up destroying the state. Van Creveld states that transnational organizations will take over and dominate war in the future because nation-states are failing in their ability to protect their people from the violence of transnational organizations. In this scenario, combatants become intermingled with noncombatants to avoid the threat of modern weapons such as missiles and nuclear weapons. This intermingling, Van Creveld maintains, will render modern, large, technologically advanced weapons such as aircraft, ships, and tanks useless. As such, combat will resemble the struggles of primitive tribes rather than the high tech warfare envisioned by the military-industrial complex of the United States. "Weapons will become less, rather than more sophisticated," and "troops may well have more in common with policemen (or with pirates) than with defense analysts."[1] This may be somewhat extreme, but it illuminates the growing complexity of international conflict where the difference between combatants and non-combatants is diminishing.

The Technological Environment

There is a growing consensus that we are in the midst of a revolution in military affairs (RMA). An RMA is a fundamental shift in military strategy, doctrine, and tactics that occur generally—but not always— due to a change in technology. Past RMAs have included the introduction of gunpowder, submarine warfare, and nuclear weapons. The current RMA has three primary components. The first major component is what former Secretary of Defense William Perry has coined the "system of systems."[2] The "system of systems" is shorthand for a collective synergy achieved by the melding of formerly disparate means to establish battlespace awareness, command and control, and precision force. The second major component of the RMA is information dominance, which is the ability to control the flow of data on the increasingly interdependent global information network. The third major component of the RMA is the corollary to the second, information warfare. Information warfare is the capability to disrupt or override enemy information systems while defending our own information systems.[3]

The "systems of systems" component of the RMA revolves around three advances: advances in the gathering of intelligence, advances in the processing and distribution of intelligence, and advances in precision guided munitions.[4] Advances in the gathering of intelligence include what Admiral William Owens, USN-(Ret.) Calls ISR systems (Intelligence, Surveillance, and Reconnaissance) such as satellites, unmanned aerial and undersea vehicles, and Aegis radars.[5] Second, advances in processing and distributing of information have evolved under the umbrella of C4 systems (Command, Control, Communication, Computer systems). These systems include today's Global Command and Control System and the Navy's Cooperative Engagement Capability and are the means in which the sensor and the shooter are closely linked. The third advance is in long range precision guided munitions (PGM) involving weapons like the Tomahawk missile and the Joint Direct Attack Munition (JDAM), PGMs give the military the ability to successfully attack targets with fewer rounds while at the same time reducing collateral damage.

Any one of the these advances, by itself, does not constitute a revolution. It is the synergy of these systems that represents the quantum jump in lethality. For the Navy, this means that we have the ability for the simultaneous massing of dispersed fires on common targets, geographic dispersal for improved own force protection, and perhaps most importantly a tremendous increase in the tempo of operations.[6] The increase in operations tempo will be the result of self-synchronization. Self-synchronization is the mutual adjustment of the operating core through collaboration vice the traditional hierarchical chain of command method of the past. With the chain of command decentralized and flattened, officers at the lower levels, empowered with the knowledge gained by the new sensors and the new information backplane, connected in a networked, nearly boundaryless, virtual organization, can make decisions on the spot without the need to consult higher authority on a regular basis for the purpose of integrating effort. It is this increased operation tempo which proponents of the RMA contend will "usher in an era of conflict based on paralysis and shock rather than attrition."[7]

Extended information dominance through the ability to control the flow of data is a major component of the RMA that many confuse with the "system of systems" component. It is a separate component because it allows us to provide information instead of military capital in the form of troops and equipment. This will allow the United States to better execute alliance obligations, undertake stand-off operations, and realize greater combat efficiencies. Information dominance in this context becomes a commodity that we can give our allies so that they can leverage their systems more effectively while our forces have some modicum of safety.[8]

Information warfare, also referred to as hacker warfare, command and control warfare or cyber warfare, deals with the attack on and the defense of information systems and is the third major component of the current RMA.[9] In the past few years, this new type of warfare has received a good deal of attention as Pentagon computer systems have been under attack by computer hackers from different parts of the world. The importance of this new area cannot be overestimated, as every sector of society grows more and more dependent on information systems ranging from banking ATMs to communications, to the Internet.

A Vision of the Network Centric Officer

These changes in the international and technological environments dictate that the naval officers of the future must be different. The future naval officer corps will need to be populated by more specialists than generalists (URL officers). Three factors necessitate this shift. First, reduction in crew sizes and the likely shift in emphasis from manned to unmanned aviation and precision guided missiles will lead to the need for fewer generalists.[10] Second, the growing complexity of technology, especially information technology, will require specialists capable of understanding and applying technology at greater depths than ever before throughout the fleet. Most importantly, the growing complexity of warfare requires the full immersion of the generalist warfighter into the study and use of all types of force in war and conflict short of war. As a senior military officer that I interviewed noted, "the use of military power in the early 21st century will be so subtle as to require extraordinary situational awareness that [only] comes with full immersion". There will not be time in the warfighters career to manage or learn how to manage an organization as large as the Navy or the Department of Defense. Consequently, the jobs in support of fleet operations that generalists have filled in the past should be filled primarily by specialists. Generalists or more accurately specialists in warfare while on shore duty should generally perform functions that hone their combat skills and/or create combat skills in other specialists in warfare.

Table 1 lists the Skills, Knowledge, and Abilities (SKA) of the future officer. These were formed by synthesizing:

(1) selected readings on modern leadership and management,
(2) recent literature on the future operating environment, the future of conflict, and the revolution in military affairs,
(3) the Skills, Knowledge, and Attributes for the field grade Army officer of the 21st Century as identified by the Science Applications International Corporation for the Army's OPMS XXI Task Force, and
(4) The interview results of 15 active duty military officers ranging in rank from O-6 to O-10, two retired military officers (one retired O-6 and one retired O-8), two senior level civilian Department of Navy officials, and four professors from the Naval Postgraduate School.

The SKA are organized into Task clusters. These clusters are designed for the URL, officer/specialist in warfare of the future at the senior division officer/department head level. They also apply, but to a lesser degree, to the specialists that we are going to need in the future.

The Traditional Platform Centric Cluster

The future generalist naval officer, like the generalist Naval officer of today, will have to be capable of, understand how to, and be able to drive and handle ships, submarines, and aircraft. Officers will have to be able to handle and maneuver their platforms as well as understand the engineering and operation of their platforms.[11] There is no substitute for competence in this cluster. It is the baseline capability for the URL officer/specialist in warfare.

The Leadership Cluster

Naval officers are raised on the stories of charismatic leadership from Admiral Horatio Nelson during the Napoleonic Wars to Admiral William Halsey in World War II. These men were absolutely courageous and in their day, great leaders. The problem is that all too often we model today's leadership after them. Yes, there are lessons to be learned from the exploits of these great men, but the days of solely relying on charismatic leadership are waning. In today's complex and uncertain world, there is too much information for one man to digest. There is no time for the information to travel up and down the chain of command so that the charismatic leader of old can act. In addition, information technology has changed the rules of leadership in the past, the chain of command has served as the conduit and filter for information flow between the upper and lower ranks. Today, any junior enlisted or officer can e-mail the highest levels within the Navy organization. The ability of subordinates to bypass the chain of command electronically is making the traditional role of the chain of command increasingly irrelevant. Consequently, the leader is losing some control as power shifts lower in the organization. Therefore, we must adapt and find a new leadership model to fit the future Navy.

Peter Senge provides a potential new leadership model when he describes his vision of a learning organization. In the Senge model, the leader is not concerned with controlling the work of his organization. He ensures the organization's effectiveness through what he calls "The Leaders New Work" which is comprised of three roles. The first role is that of designer. As a designer, the leader is responsible for the designing of processes that (1) develop a vision and core values for the organization, (2) develop policies, strategies, and structures that translate guiding ideas into operational decisions, and (3) develop effective learning processes. The leader is not in control of making these decisions. He is instead designing the processes to make these decisions. The second role of a leader is that of a teacher. As a teacher, the leader should "help people restructure their views of reality to see beyond the superficial conditions and events into the underlying causes of problems and therefore to see new possibilities for shaping the future". The third role of a leader is that of a steward. According to Senge, the leader's stewardship operates on two levels: (1) stewardship for their subordinates and (2) stewardship for the larger purpose of the organization.[12] A critical component in "The Leaders New Work" is the ability to develop and embody a vision, for it is this combined with the accurate view of reality that forms the creative tension that leads to generative learning.

Another dimension in leadership that has garnered a great deal of attention in the past and will continue to demand the attention of naval leaders in the future is the ability to lead and manage personnel from diverse backgrounds, e.g. ethnicity, race, and sex. Population projections for the future predict that the non-white proportion of the population will grow by 36 percent from 27.5 percent in 1998 to 37.6 percent in 2025.[13] Consequently, the ability to lead and manage personnel from diverse backgrounds will become more important as they make up more and more of the force.

The final area in the leadership cluster is the need to understand the human dimension of warfare and the ability to use this human dimension to one's own advantage. War has a significant impact on the human psyche and can significantly reduce human effectiveness. In *Achilles in Vietnam: Combat Trauma and the Undoing of Character*, Dr. Jonathan Shay notes several leadership and organizational characteristics that prevented or alleviated the onset of combat trauma, most notably the maintaining of unit integrity. The officer of the future needs to understand the impact of war on the human psyche and how through leadership, team building, and personnel management he can prevent or alleviate the onset of combat trauma and thus maintain combat effectiveness.

The Decision Making Cluster

The naval officer of the future will have to be able to make quick decisions in a dynamic and uncertain environment. Therefore, we need to treat decision making as a discrete event that is critical to mission success. Consequently, all naval officers require the tools of decision making especially at the junior level because that is where a great deal of the decisions will be made as we try to respond with great speed to the dynamic and uncertain environment. These tools include an understanding of naturalist/intuitive decision making, for use in combat situations where speed is of the essence; an understanding of heuristic decision making and risk management, when the uncertainty is high but speed is not as essential; and finally officers will have to be skilled at rational analytical analysis for complex non-combat related decisions.

The Integrative Cluster

This skill cluster is related to the decision making cluster in that it also is the result of the migration of decision making down the chain of command. In the past, military force was integrated through a vertical hierarchy. With speed becoming the driving factor, the vertical hierarchy is becoming less relevant. Integration in the future will be accomplished through self-synchronization by relatively junior personnel. Consequently, senior division officers and department head level personnel will need to be able to integrate naval, joint, and coalition forces in formulating, articulating, and linking mission requirements to direct actions. This capability requires that junior naval officers have a breadth of knowledge that they have never had before. They will have to understand at least to some degree the art and science of warfare. They will be required to have a thorough knowledge of how the U.S. and any potential allies organize and conduct military operations. Finally, junior officers will have to have an understanding of the tactical, operational, and strategic characteristics of potential adversaries ranging from terrorist non-governmental organizations to other world powers.

The Information Technology Cluster

Information technology is the enabler for the speed that is going to make the Navy effective and relevant in the future. As such, it is going to be a core competency for the Navy. We will need specialists in both information management and in information warfare. In addition, generalist/URL officers will require a thorough understanding of the information science and information technology. In particular, generalist officers will have to be able to employ a variety of sensors, remote and local, to their platform's optimal advantage. They will have to be able to utilize C4ISR systems to obtain and disseminate information, and finally, they will have to be able to use information obtained via the network to direct weapons, and they will have to be able to do this fast, very fast.

The Management Cluster

Over the years, people have argued over the differences between leaders and managers and over which area, leadership or management, it is best to place emphasis. Leadership in this context refers to the setting of a system direction while management is the mastery of system design elements such as human resource management and material management. Consequently, naval officers, in order to be leaders, have to be competent managers, first. This is a baseline capability and not a competitor or detractor from leadership as so many have implied.

Conclusion

Our environment has changed and will continue to change. Our tasks, technology, and structure are changing with the RMA, Joint Vision 2010, and Network Centric Warfare. We need to align our officer corps with technological and structural changes to transform the Navy to meet the challenges of a dynamic and uncertain future. Speed and responsiveness need to permeate through every *nook and cranny* of the organization. This requires that we develop a shared vision of the future naval officer, one that is different from what we are today. We need the Network Centric Officer.■

Figure 1.

The Importance of the Naval Officer of 2020 and the RMA
to
Speed of Command and Effectivness

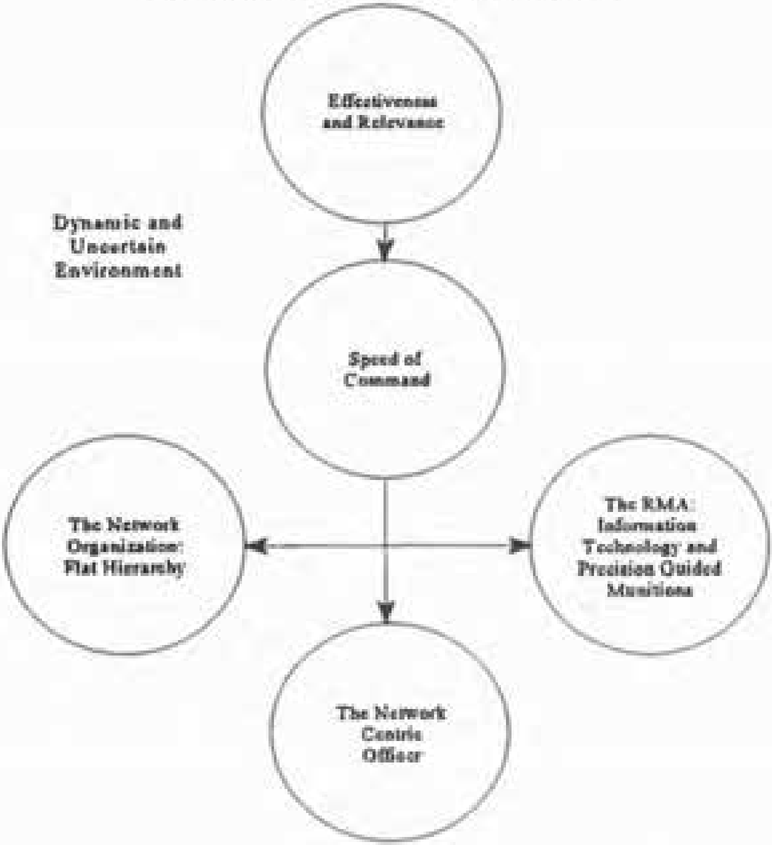


Table 1. Clusters of Skills, Knowledge, and Abilities for the Network Centric Officer

(A) Traditional platform centric cluster

- Ship and aircraft handling and maneuver
- Knowledge of and the ability to apply technology on the platform level
- Knowledge of and the ability to perform single unit operations and tactics. (More emphasis is needed here than is typically done today.)

(B) Leadership cluster

- Ability to lead in the new era with more emphasis on collective learning and less concentration on charismatic leadership.
    1. Ability to deal with the shifting nature of power in the information age and the ability to deal with the loss of control of leaders in an information technology revolution.
    2. Ability to undertake what Senge's calls the leader's new work[14]
        - design and/or engineer processes
        - education and training of subordinates, superiors, and peers
        - stewardship of subordinates and the mission.
- Ability to delegate to the lowest possible level.
- Ability to develop and embody a vision.
- Ability to build, participate in, and lead multi-disciplinary teams.
- Ability to lead and manage personnel from diverse backgrounds.
- Knowledge of the human dimension warfare and the ability to use it to one's own advantage.

(C) Decision making cluster

- Ability to make quick decisions in a dynamic and uncertain environment.
- Thorough understanding of naturalistic (intuitive) decision making.
- Thorough understanding of the principles of heuristic decision making and risk management.

- Ability to use a full complement of rational analytical skills.

(D) Integrative cluster
- Ability to integrate naval, joint, and coalition forces to formulate, articulate, and to link mission requirements to direct actions.
- General understanding of the art and science of war to include:
  - Understanding of how the U.S. military and our potential allies organize to conduct military operations.
  - Understanding of the tactical, operational, and strategic characteristic of potential adversaries ranging from terrorists to world powers.
  - Understanding of the historical and contemporary role of the military in American society.

(E) Information technology cluster
- Ability to employ sensors to optimal advantage.
- Ability to utilize C4I systems to obtain and disseminate information.
- Ability to utilize information systems to direct weapons.
- A general understanding of information technology and science to include topics on computers, satellites, etc.

(F) Management cluster
- A general understanding of and the ability to apply modern management principles and techniques
- A general understanding of financial management, contract management, and general business practices.
- A general understanding of logistics management.

(G) Communication cluster
- Ability to communicate a vision and current reality.
- A thorough understanding of the use of communications media, individual contact, meetings, video teleconferencing, e-mail, memos, etc.
- Ability to express oneself clearly and concisely in both writing and speaking.

NOTES

1.Martin Van Creveld, *The Transformation of War*, (The Free Press, New York, New York, 1991), pp. 192-212.

2.William J. Perry, "Military Action: When to Use It and How to Ensure Its Effectiveness," in Janne E. Nolan, ed. *Global Engagement: Cooperation and Security in the 21st Century*. (The Brookings Institution, Washington, D.C., 1994), p. 240, as quoted in James R. Blaker, *Understanding The Revolution in Military Affairs: A Guide to America's 21st Century Defense*, (Progressive Policy Institute: Washington, D.C., 1997) p. 5.

3.James Stavridis, "The Second Revolution," *Joint Forces Quarterly*, (Spring 1997), p. 9.

4.The Future of Warfare," *The Economist*, (January 1997), p. 21.

5.Blaker, p. 7.

6.James FitzSimmonds. "The Cultural Challenge of Information Technology." *The Naval War College Review*. (Summer 1998., p. 1.

7.Thomas G. Mahnken, "War in the Information Age." *Joint Forces Quarterly*, (Winter 1995-96), p. 40.

8.Stavridis, pp. 9-10.

9.Ibid, p. 10.

10.Unmanned aviation and precision guided missiles will never totally eliminate the need for manned aviation. There will, however, be a shift in emphasis that will reduce the need for naval aviators and consequently will reduce the need for generalist/URL officers as aviators represent the largest part of the URL.

11.There is a perception among at least a few naval officers that there is not enough emphasis on tactical employment in the development of naval officers especially relatively junior ones.

Lieutenant John Hindinger in an October 1997 *United States Naval Institute Proceedings* noted this lapse in tactical expertise at the Submarine Officer Advanced Course (Department Head School for submarine officers) where officers apparently failed even the most basic tactical exercises.

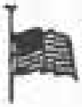
12.Senge.

13."Population Projections of the United States by Age, Sex, Race, and Hispanic Origin: 1995 to 2050."

14.Peter M. Senge. "The Leaders New Work: Building Learning Organizations." *Sloan Management Review.* (Fall 1990).

<u>IN MEMORIAM</u>

Mr. Philip W. Filer
Dr. John E. Griffin
Mr. Joe Masterangelo
VADM Marc Menez, FN (Ret.)
CAPT Walter F. Sullivan, USN(Ret.)
CAPT George J. Troffer, USN(Ret.)
Mr. A. Avery Young



THE HELL SHIP OF CONVOY MATA-30
U.S. POWs and U.S. Submarines
by CDR John D. Alden, USN(Ret.)

The signs of impending invasion were ominous as U.S. carrier-based aircraft ranged over the Philippines in early October 1944. With Manila and its crowded harbor being subjected to repeated bombing attacks, the Japanese were in desperate haste to move everything useful but not essential to the immediate protection of the islands—ships, material, and personnel—to places of greater safety within the shrinking inner defense perimeter of the Empire. Among the least essential of these assets were the thousands of American and Allied prisoners of war still being held in work camps and hospitals throughout the Philippines. Although they would be an obvious impediment to the defense of the islands, the prisoners could still be of value to the Japanese war effort in Manchuria or the homeland, whether as laborers in mines and factories, on farms, or simply as hostages whose presence might deter American bombers or amphibious assaults.

On 10 and 11 October 1,782 prisoners were hurriedly rounded up from the camp at Cabanatuan and from Bilibid prison in Manila and marched or carried to Pier 7, where they boarded ARISAN MARU, a Japanese cargo ship of 6,886 tons. Five hundred ninety-nine of the men were from a draft ordered to be shipped to Manchuria for unspecified service with the Kwantung Army; the other 1,183 were mainly sick or wounded inmates of the camp and hospital.[1] About 100 of the group were civilians, including a few British, Dutch, and other nationals. There were also some Navy and Marine Corps men, but most were U.S. Army personnel who had been captured on Bataan or Corregidor in 1942. (One of the officers, Royal Gulden, was the brother of my next-door neighbor, which gave me a personal interest in this particular ship.)

Guarded by a detachment of 40 soldiers under a 2nd Lieutenant Yamaji, the prisoners were crowded into two of the ship's holds. The forward hold had not been prepared to accommodate passengers and still had a layer of coal at the bottom; nevertheless, about 600 prisoners were forced to cram themselves into the filthy space. The men in the after hold were packed into a compartment with three tiers of rough bunks spaced about three feet apart. It was grossly overcrowded and soon became almost as foul as the forward hold. Like other ships used by the Japanese to transport prisoners of war, ARISAN MARU quickly earned the name and well deserved reputation of *hell ship*.

As soon as the ship was loaded, it got underway on 11 October, but instead of setting course northward toward Formosa, it sought to evade the American aircraft by hiding among the small islands to the south, ultimately dropping anchor somewhere off the coast of Palawan. There it remained, becoming increasingly hot under the tropical sun, until the prisoners could not bear to touch the sides of the holds. In a futile effort to escape the stifling heat and humidity, most soon stripped themselves almost naked. None were allowed on deck except for about ten who were detailed to cook the prisoners' daily rations of about two handfuls of rice per man, served with a little water almost too filthy to drink. During this period four unnamed prisoners died of unspecified illnesses. On 15 October, Major Robert B. Lothrop made a desperate attempt to escape but was recaptured and summarily shot, apparently as an object lesson to the rest of the prisoners. The bodies of the deceased were simply thrown overboard.

On 20 October, even as General Douglas MacArthur was leading American invasion forces ashore on the island of Leyte, ARISAN MARU returned to Manila, took on additional supplies and apparently some Japanese passengers, and departed late that evening in a hastily assembled convoy consisting of 12 ill-assorted ships and five escorts. Officially designated as Manila-Takao convoy MATA-30, it was commonly known as the *Harukaze* convoy after its leading escort, a destroyer of that name. The ships were loaded with various combinations of cargo and passengers, but as far as is known no others were carrying prisoners of war.[2]

The makeup of the escort force is revealing of the extent to which the Japanese Navy had been reduced to scraping the bottom of the barrel. HARUKAZE, of 1,400 tons, commissioned in 1923, was a survivor of one of the oldest classes of Japanese destroyers. The veteran warship had enjoyed a charmed life so far in the war. On 16 November 1942 it hit a mine near Surabaya and had its bow blown off, but was able to return to Kure after temporary repairs. There it was refitted with a new bow of simplified design and returned to service in 1943. KURETAKE, a second class destroyer of 900 tons, was even older. The newest of the escorts was TAKE, a 1,530 ton ship of the Matsu class, a war built type similar to the U.S. destroyer escorts. The only other regular warship was the 460 ton submarine chaser CH 20. The fifth escort was KURASAKI, originally the commercial OHA MARU, that had been taken into the navy as a refrigerated store ship and obviously was ill-fitted to guard a convoy.[3]

The weather was stormy, blowing almost a typhoon, when the ships put to sea, and motion sickness soon added to the misery of the prisoners. Although the convoy's designated speed was eight knots, it was actually limited by ARISAN MARU, which was capable of making only six or seven knots. Early on 23 October, when the convoy was about 180 miles west of Cape Bojeador near the northern tip of Luzon, the escorts picked up radio signals from U.S. submarines and put the lookouts on special alert. It was planned that when the convoy entered Luzon Strait, between the Philippine Islands and Formosa, the five fastest ships would pull ahead at their maximum speed, leaving the rest to follow as best they could.

Waiting in the area known to U.S. submariners as *Convoy College* were two wolfpacks. *Banister's Beagles* was headed by Alan B. Banister in SAWFISH (SS 276) together with ICEFISH (SS 367) under Richard W. Peterson, DRUM (SS 228) commanded by Maurice H. Rindskopf, and SNOOK (SS 279) under George H. Browne. *Blakely's Behemoths*, led by Edward N. Blakely in SHARK (SS 314), included SEADRAGON (SS 194) under James H. Ashley, Jr. At 1730 on 23 October SAWFISH drew first blood in a periscope attack, putting one of five torpedoes into the port side of No. 7 hold of KIMIKAWA MARU, a 6,863 ton converted aircraft tender. Having been torpedoed on 8 October by BECUNA (SS 319), the damaged ship was unable to make full speed and was being returned to Japan for repairs, carrying a mixed cargo of crude oil, bauxite (aluminum ore), and aviation gasoline together with 300 Japanese passengers. "Abandon ship", was immediately ordered and some lifeboats were lowered, but the ship went down in two and a half minutes, taking 24 crewmen and 81 passengers with it.

Shortly after midnight on the 24th, ICEFISH in a submerged attack using sonar bearings fired six torpedoes at the 5,878 ton freighter SHINSEI MARU #1. Only one hit, a dud that failed to explode. However, it punched a hole in the ship's side, requiring it to slow down to make emergency repairs and leaving it vulnerable to further attack later.[4]

About ten minutes later the passenger-cargo ship KOKURYU MARU, 7,369 tons, was struck on the starboard side in No. 2 hold and the engine room by two of five torpedoes fired by SNOOK in a surface attack. In about 30 minutes the stricken ship rolled over and sank. Of 1,357 passengers on board, apparently all Japanese nationals, 324 lost their lives along with 68 members of the crew. A few survivors reached shore on rafts and 47 others drifted in lifeboats for five days before being picked up by ships in another convoy.

The convoy now broke completely apart in confusion as the remaining ships scattered in various directions, but at about 0315 SNOOK, in another surface attack, fired three torpedoes at each of two ships, one of which was missed while the other became the submarine's second victim. The first hit on KIKUSUI MARU, a smallish 3,887 ton oil tanker, was a dud but two more struck the starboard side in the bow and boiler room, causing the ship to catch fire and sink stern first with the loss of about 12 crewmen. The rest escaped in boats and were rescued five hours later.

Next to be hit was TENSHIN MARU, a 4,236 ton cargo ship loaded with 6,250 tons of bauxite, also torpedoed by SNOOK at 0605 in a twilight attack on the surface. Two hits on the port side in No. 2 hold caused the heavily laden freighter to break in two forward of the bridge and go under in two minutes, taking 52 of the crew to their deaths. Only ten were saved at the time, while a few others were picked up several days later.

At about 0800 the people on SHIKISAN MARU spotted five torpedo tracks coming in from the port side. Efforts to dodge the missiles were futile; three hit in No. 3 hold, under the bridge, and in No. 4 hold, completely smashing the 4,725 ton freighter, which was carrying a full load—3,300 tons of manganese ore, 3,000 tons of raw rubber, and 1,500 tons of general cargo. The ship went down in less than two minutes, with the loss of 15 men. The killer this time was DRUM, which fired four torpedoes in a periscope attack. The hapless HARUKAZE sighted a submarine heading in the opposite direction at this time, but was not able to make a counterattack.

Some three hours later, SEADRAGON, in a submerged periscope approach from starboard, fired four torpedoes at TAITEN MARU. Two missed ahead but the others hit at the engine room and No. 4 hold, causing an explosion and fire. The ship, a 4,642 ton naval auxiliary, started to sink and was quickly abandoned by all except five of the crew who were killed.

Shortly after noon the previously damaged SHINSEI MARU #1 was also caught by SEADRAGON and hit in No. 3 hold by one of four torpedoes fired. The freighter went down in approximately three minutes. Thirteen of the crew and about half of the passengers were killed; 100 or so survivors were picked up by EIKO MARU, but that unlikely vessel was soon hit in the port bow by another salvo from SEADRAGON. The ship, a small freighter of 1,847 tons, stayed afloat for about ten minutes and only one crewman was lost. Only three ships of the ill-fated convoy—RYOFU MARU, TOYO MARU #3, and EIKAI MARU—escaped to reach Takao on 26 October.

But what of ARISAN MARU? Lagging ever farther behind the rest of the convoy, the prison ship kept plodding along through the heavy swells. At about 1730 on 24 October the sky was starting to darken and the cooks delegated from among the prisoners were preparing rice for the evening meal when two or possibly three torpedoes struck the starboard side. One hit in No. 3 hold, which was empty, and another destroyed the steering gear. The stricken ship immediately stopped, appeared to buckle amidships, and began to settle by the stern. The Japanese closed the hatches over the prisoners and hastily abandoned ship, taking the only two lifeboats, which were inadequate to hold everyone. The rest went into the water and were picked up by the escorts. Japanese postwar accounts state that 27 passengers and 15 crew members lost their lives, while 347 (presumably their own people) were rescued by the destroyers and taken to Takao. These records make no mention of the prisoners and fail to explain what happened to them.

Their story first came to light when five survivors—Captain Don E. Meyer, Lieutenant Robert S. Overbeck, Sergeant Calvin R. Graef, Sergeant Avery E. Wilbur, and Corporal Anton E. Cichi—were recovered and brought back to the United States in December 1944 and their harrowing tale was published a few weeks later.[5] Before abandoning ship, the guards cut the ropes leading into the forward hold, thus depriving those captives of their only means of escape. The trapped men started to panic, but were calmed down by several chaplains who were among the prisoners. After about 30 minutes, prisoners in the after hold saw that the guards had left.

Forcing the hatches open, they made their way up to the deck and threw the ropes back down to the men who were trapped forward. Some of the prisoners found life jackets and immediately jumped into the water despite the ten foot swells, expecting to be picked up by the nearby destroyers. Instead, the Japanese crews beat off those who tried to climb aboard and pushed others away from the ships' sides. Seeing that rescue was hopeless, many of the swimmers gave up and drifted off. Other prisoners seized the opportunity to ransack the galley and storerooms for food, water, and cigarettes. Several hundred simply settled down and resigned themselves to go down with the ship.

Lieutenant Overbeck was one of those who tried to climb aboard a destroyer only to be clubbed and driven back into the water. Along with about 35 other men he started to swim toward one of the partially swamped lifeboats, which the Japanese had abandoned after throwing its oars, sails, and emergency provisions overboard. The wind kept blowing the drifting boat out of reach of the prisoners until only Overbeck, an unusually strong swimmer, was able to catch up to it. During the night a floating box happened to drift alongside that miraculously contained a boat's sail, which Overbeck seized before the box was carried away again. Still later Wilbur and then Cichi drifted by on bits of wreckage and were pulled into the boat. Early the next morning they picked up Meyer and Graef. The exhausted men *played dead* to avoid the attentions of a searching Japanese destroyer, then rigged up the lifeboat's mast and headed toward the Chinese coast. After two days they encountered some friendly fishermen, who fed them and brought them to a port that was not occupied by the enemy. From there they were smuggled through the Japanese lines to Free China and eventually returned to the United States.

Two other survivors added their bits to the story after the war. Philip Brodsky, a sergeant in the Medical Corps, and Glen Oliver encountered each other while clinging to floating wreckage. Later they found some rafts, on which they drifted for four days before being picked up by a passing convoy and taken to Takao. Until these men were repatriated following the Japanese surrender, it was believed that only five prisoners had survived from ARISAN MARU.

It is not clear whether any prisoners were killed when the torpedoes hit; several of the survivors were sure that no one in either hold died in the initial explosion. Although abandoned by the Japanese, the ship remained afloat for over two hours, during which time many prisoners are known to have gotten into the water. Except for the seven known survivors, the rest of the prisoners must have drowned, succumbed to exposure and exhaustion, or gone down with the ship.

What is certain from the reports of the survivors is that there was no struggling or fighting among the prisoners. Many were too tired and weak to care what happened to them. Others were resigned to death and viewed it as relief from many months of misery. Two of the survivors had been on the Bataan Death March and said that the voyage on the prison ship was even worse than that ordeal. The prayers and calming presence of the chaplains undoubtedly brought a measure of peace to many as they faced their end bravely and quietly.

There is a poignant sequel to the tragedy of the Hell ship ARISAN MARU. Late on the afternoon of 24 October SEADRAGON received a radio message from Commander Blakely of SHARK reporting that he had radar contact on a single freighter and was going in for the attack. Nothing further was heard, repeated efforts to contact the boat were futile, and in due course SHARK and her crew of 87 were given up for lost. Based on the limited information available at the time, the Joint Army-Navy Assessment Committee credited SNOOK as probably responsible for sinking the prison ship. After the war it was revealed that the Japanese destroyers HARUKAZE and TAKE had depth charged a submerged submarine on 24 October and brought up "bubbles, and heavy oil, clothes, cork, etc."[6] This was accepted as the most likely explanation for the loss of SHARK, but it appeared that the fatal attack had taken place well before ARISAN MARU was torpedoed. More recent records indicate that HARUKAZE made two attacks on 24 October, dropping 17 depth charges each time. The second attack was made at 1742, shortly after ARISAN MARU was torpedoed. None of the other submarines present fired torpedoes at that time, so credit must go to SHARK. Some analysts have speculated that Commander Blakely may have recognized that American prisoners were among the men in the water, and risked exposing the submarine's presence to the Japanese destroyers in the hope of rescuing some of them. Like the lost prisoners of ARISAN MARU, SHARK and her gallant crew are at rest somewhere under the South China Sea, but the exact circumstances of their deaths will always remain a mystery.■

NOTES

1.Details about the prisoners on ARISAN MARU are from translated Japanese records and interviews with some of the survivors. I am grateful to Gregory Michno for providing copies of the relevant documents.

2.The history of convoy MATA-30 is from Wartime Transportation Convoys History (Senji Yuso Sendan Shi) by Shinshichiro Komamiya. I am indebted to William Somerville for translating extracts from the Japanese original.

3.Jentschura, Jung & Mickel. Warships of the Imperial Japanese Navy, 1869-1945. Annapolis, MD: Naval Institute Press, 1982.

4.The Joint Army-Navy Assessment Committee did not have Japanese information pinpointing the times each ship was torpedoed. It credited TENSHIN MARU to ICEFISH, SHINSEI MARU #1 and ARISAN MARU to SNOOK, and KOKURYU MARU to SEADRAGON. The attributions in this article are based on the comparison of firing data from the submarines' patrol reports with the timing of torpedo hits as given in the Japanese convoy history.

5.Associated Press story from the Washington DC Evening Star, February 17, 1945; copy courtesy of Mrs. Joseph Goodman.

6.U.S. Submarine Losses World War II (NavPers 15,784). Washington, DC: U.S. Government Printing Office, 1949, p. 123. (Although the information quoted is attributed to postwar Japanese sources, it was probably obtained from a Japanese message intercepted and decrypted by Ultra during the war.)

TORPEDO DEVELOPMENT

by LCDR Patrick Tailyour, RN(Ret.)

The torpedo was one of the most potent maritime weapons for nearly one hundred years. Its reliability was proven as late as 1982 when a Mark VIII xx torpedo, designed in 1936, sank the Argentine cruiser BELGRANO. In the two World Wars the torpedo sunk more tonnage than mines, gunfire and bombs combined.

In its form as a locomotive (including electricity) torpedo, as generally understood, it was the idea of one man, Robert Whitehead. He was the English manager of an engineering firm established at Fiume, Austria in the 1850s under English management. The firm made the engines of the Austrian flagship at the Battle of Lissa, 1866, when the Italians were defeated. It was in that year that Whitehead with his son, John, age 12, and one trusted workman completed his prototype torpedo after two years work. It was a cigar shaped automobile weapon, propelled by a pneumatic engine, designed to run at any chosen depth, independent of the firing craft and designed to explode on hitting the target. These identical principles were embodied in all torpedoes throughout the life of the weapon. So successful was it that it was in production at Woolwich Arsenal (England) by 1872.

It is, however, proper to recall that in 1884 an American naval officer, Commander J.A. Howell, USN, constructed a torpedo in which the gyroscope was the influential component. He is accorded the father of gyro stabilisation and rose to flag rank. Howell's torpedo was in some respects superior to the contemporary Whitehead. The basic idea was revolutionary, for the propulsive energy was stored in the fly-wheel. The Howell torpedo, tried before the U.S. Navy Board in 1884, was a 14 inch weapon. The fly-wheel stored 378,000 foot pounds when spun to 10,000 rpm and gave a speed of 15 knots over 200 yards. An improved model tried before the French in 1890 gave 24 knots to 400 yards and ran on to 800 yards at reduced speed. By 1898 the performance reached 30 knots to 800 yards, this being equivalent to that of the contemporary Whitehead. Most of Howell's torpedoes were made by the Hotchkiss Ordnance Company. It was quoted that "it undoubtedly ran through to the point at which it was aimed, something which no other torpedo could be depended upon to do". It lost that advantage when the Whitehead torpedo was fitted with the Obry gyroscope. The gyroscope adopted in the Whitehead torpedo was invented by Ludwig Obry formerly of the Austrian Navy. The wheel reached its maximum speed of 2,400 rpm in something less than half a second so that it was in nominal control of the torpedo as soon as it was launched.

The Obry gyroscope was adopted in 1896 by the United States Navy. As an indication of the accuracy expected, the 18 inch Mark I USN torpedo when run on the proving range, was required to be within eight yards right or left of the target at 800 yards; whereas without the gyroscope the deviation accepted was three times that amount.

The British Navy possessed 4000 Whitehead torpedoes which had to be modified to take the Obry gyroscope. In 1897 a number of these were tried out in the Channel and Mediterranean fleets and in 1898 it was decided to modify them with the Obry gyroscope paying a royalty of £25 per set to Whitehead.

The first Obry gyroscopes purchased by America were fitted with *angling gear* whereby the gyroscope could be pre-set at any desired angle up to 90 degrees with the axis of the torpedo. However, there are noted torpedo warriors who are firmly of the belief that *the less you ask of the torpedo the more likely you are to get satisfaction.*

The Spanish American War of 1898 provides very few instances of torpedo activity. The United States Navy then possessed very few torpedo craft. The principal torpedo incident occurred in the armoured cruiser ALMIRANTE OQUENDO which was damaged by the explosion of her above water torpedo warheads when hit by shell fire. The result was that the United States Navy abandoned the firing of above-water torpedo tubes, except in torpedo craft, for some years.

Torpedo manufacture in the United States began, as previously mentioned, with the Howell fly-wheel type but in 1891 the American manufacturing rights of the Whitehead torpedo were bought by the Brooklyn firm of Bliss and Williams—later E.W. Bliss and Company—makers of machinery for canning and sheet metal work. The negotiations were carried out by a notable engineer, Frank Leavitt. He did not endorse the Whitehead Brotherhood engine and proposed to fit a turbine instead. Leavitt's turbine driven heater torpedo appeared in 1903, and in 1905 the

United States Navy placed an order for 300 Bliss-Leavitt torpedoes.

Early in the century a very substantial increase in progressive performance was obtained by heating the air charge. In 1904 the British Sir W.G. Armstrong, Whitworth and Company of Newcastle-upon-Tyne patented the Elswick heater. In this the contents of the air vessel are warmed by a spray of liquid fuel, injected by compressed air and ignited by the firing of a cartridge. The Elswick heater was tried out at Weymouth, Dorset, England in an 18 inch Whitehead torpedo before British and Japanese naval representatives in 1905 and confirmed an increase in speed of nine knots over 1000 yards compared to running cold. Thus the two basic improvements were in place, gyroscope steering and the heater system.

The original Whitehead Brotherhood 3 cylinder radial engine made in Peterborough, England, remained in vogue for a very long time and is still traceable in later torpedoes, including the German 21 inch G7A which came into service in 1937. Admission was by cam-operated valves, originally of the piston type, the exhaust escaping through ports in the cylinder walls uncovered towards the end of the power stroke, and thereafter through a slot in the piston, uncovered by relative movement of the gudgeon. From the crank case the exhaust air emerged through the hollow propeller shaft, contributing to the speed of the torpedo. The pronounced heel by a single screw being replaced by contra-rotating screws. This engine had other applications in the British Navy such as producing power for electricity generators.

Even Louis Schwartzkopff, who pirated Whitehead's design, adopted the Brotherhood radial engine for his torpedoes for the German Navy. He improved upon the reliability and maintenance requirements by using phosphor bronze in the construction and this design became attractive to new navies such as the Japanese and even the British Admiralty purchased some to make up requirements.

Encouraged by the principle of heating the air charge the Whitehead Company developed a superior *wet heater* system in which fuel was sprayed into a combustion chamber through which the air passed before entering the engine. This improved the performance of the locally made (Fiume) torpedoes which could now do 2,200 yards at 34 knots and 4,370 yards at 29 knots. The

British Admiralty was not happy with the complexity of this design, however, and a simplified *wet heater* was designed by Engineer Lieutenant S.U. Hardcastle, RN and it became known as the RGF (Royal Gun Factory) heater. It was combined with a new four cylinder engine and had a range of 7,000 yards at 29 knots or 550 yards at 35 knots.

The manufacture of torpedoes begun in 1872 at Woolwich, England (Royal Gun Factory) ceased in 1912 and a new Royal Naval Torpedo Factory was opened at Greenock on the Clyde in Scotland. The first new torpedo to bear the RNTF name was the 18 inch Mk VIII specially designed for submarines for tubes of that calibre. Whitehead at Weymouth Dorset, England continued to supply torpedoes of RGF design as well as their own, being the only Royal torpedo factory in the United Kingdom after 1909. The Leeds, England firm of Greenwood and Batley who began in 1886 ceased production in the same year. By 1914 many navies possessed this dominant maritime weapon. In the years 1875-1917, the Fiume works produced about 12,000 torpedoes; the Weymouth firm started in 1890 and, believe it or not, a works was established at St. Tropez, France, started at about the same time. Both were still in existence in 1939, by which date their business lay largely in the export of models to navies too small to warrant the establishment of national torpedo factories, such as Brazil, Holland, Turkey, Poland, and Greece to name only a few supplied.

The torpedo was chosen by the British Admiralty in 1913 as the main weapon for naval aircraft. A prophetic decision when one considers the result of the Taranto assault by the British Navy in 1940, and also the BISMARK engagement. But even more so, the use by the Japanese and the United States of air borne torpedoes in the Pacific in 1942-45.

Torpedo manufacture in the United States began, as previously mentioned, with the production of the Howell fly-wheel type in the early 1880s and later by Whitehead by the Brooklyn firm of Messrs. Bliss and Williams--later E.W. Bliss and Company. The latter's turbine driven weapon was adopted exclusively in 1905 and expanded during 1914-18, work being undertaken by the naval torpedo station at Newport, RI. The USN torpedo assembly at Alexandria, Virginia, with a planned capacity of between 2,500 and 3,000 annually, was in completed 1919. The author of this article served in one of the 50 flush decked American destroyers in 1942 and thinks that the torpedoes were Bliss-Leavitt models. In 1940, despite reverting to their original line—canning machinery—the Bliss Company undertook a British Admiralty order to build submarine torpedoes, which were in short supply. These were of the current British design—Whitworth threads and all.

In 1920 the newest Royal Navy torpedo was the 21 inch Mark V introduced in 1918. This torpedo was designed to be launched above-water and was capable of 29 knots for 15,000 yards. In order to increase this range and speed an interesting development took place in the British Navy. The air vessel of the heater torpedo accounted for one third of the total weight of the weapon, but the air it contained was made up of only 21 percent oxygen. The obvious answer was to increase the amount of oxygen and to find a more volatile fuel. Experiments were begun in HMS VERNON at Portsmouth in the early 1920s.

By 1926 the development of the 24.5 inch torpedo had reached the stage of manufacture. This was an enriched air torpedo and they were manufactured for use in the battleships NELSON and RODNEY. However, enriched air was dangerously unstable, although the Japanese developed a pure oxygen torpedo. It was known as the "Long Lance". It carried a warhead of over 1,000 pounds of explosive and could be set at 49 knots for 24,000 yards and 36 knots for 43,000 yards. This was a surprise to the Allies in the 1939-45 war.

Now we come full circle to the faithful Mark VII; the best alternative was the burner cycle semi-internal combustion torpedo engine. This was a four cylinder radial, fed with air from the main vessel. The fuel (initially shale oil, later paraffin) was burned in the air before it entered the engine but most of the oxygen was retained to be burned within the cylinders as more fuel was injected into them. Ignition was spontaneous as in a diesel engine and exhaust gases were ejected through ports in the piston crown and cylinder liner into a hollow propellor shaft. In fact an improved Brotherhood engine.

So was born the 21 inch Mark VIII, easy to maintain, rugged and reliable, and destined to remain in service for over half a century. The initial Mark VIII had a range of 5,000 yards at 40 knots and appeared in 1927. It went into service in the P class British submarines of 1930-31. An above water launched torpedo was also developed. It entered service as the Mark IX in 1930. Its range was 13,500 yards at 30 knots and 10,500 yards at 35 knots.

It has been mentioned that the United States Navy abandoned above-water tubes in major war vessels for some years and likewise did the Royal Navy. The answer was to construct submerged torpedo rooms in all major warships. However, constructors were never enthusiastic about them and the two submerged torpedo flats in the British battleships ROYAL OAK and QUEEN ELIZABETH were done away with in the 1930s and NELSON and RODNEY, with their enriched air torpedoes, were fitted with bow submerged tubes.

In concluding this article it would not be suitable for submariners to discuss only submarine torpedo discharge so it might be of interest to review the other very potent carrier of the torpedo, the aircraft. It was Lieutenant D.H. Hyde-Thomson of the British Navy, a torpedo officer, who is credited with submitting in 1911 a number of papers in conjunction with Commander Murray Suetor (later Rear Admiral) stressing the potentialities of the combination of aircraft and torpedo. I have no doubt that the United States Navy, more air-minded than the British Navy, could put forward an earlier subvention. However, Mr. T.O.M. Sopwith, the noted aircraft designer, was asked by the Admiralty to design a torpedo-carrying seaplane and the first flight was made in this machine from Calshot near Southampton, England at the end of 1913. The pilot was Lieutenant A.M. Longmore, RN, later to become an Air Chief Marshal, Royal Air Force. In 1915 the 310hp Short seaplane was developed to carry the Mark IX aircraft torpedo. Mr. Sopwith later designed the Cuckoo, a folding wing biplane powered by a 200hp Hispano Suiza engine as a carrier torpedo aircraft. Alas, in 1918 the Royal Navy lost its air component and this acted as a brake on the rapid development of maritime torpedo warfare.

The British naval torpedo planes at Taranto and in the BISMARCK engagement were obsolete Fairy Swordfish armed with the 18 inch Mark VIII torpedo. The principle Luftwaffe torpedo aircraft were the Ju 88's carrying two 18 inch torpedoes. The standard USN torpedo plane on entering the war was the Douglas Devastator and took a leading part in the 1942 Battle of the Coral Sea.

Perhaps if the British Navy had kept control of its air arm between the wars we would not have experienced the calamity of the sinking of PRINCE OF WALES and REPULSE. Similarly the lack of appreciation of the power of the submarine torpedo nearly brought the 1939-45 war to an end in 1943 despite the lessons of 1917.

To conclude, Robert Whitehead died on November 14, 1905 at the age of 82. No official recognition was ever given him in his native land. In 1883 he bought an estate at Paddockhurst near Worth in Sussex, England with beautiful views. He died at Worth, a far cry from Fiume where he spend most of his life.■

Note: I am indebted to the publication Engineering which carried a number of authoritative articles on torpedoes in 1945 and 1946 by the late Commander Peter Bethell, RN. They have kindly allowed me to use extracts from these articles. Similarly, I am indebted to Admiral Poland, the author of The Torpedo Men, H.M.S. Vernon's Story 1872-1986. To both I extend my thanks.

LCDR Patrick Tailyour, RN(Ret.)

THE SUBMARINE REVIEW

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A SHORT HISTORY OF THE ARMA GYROCOMPASS

by Richard Pekelney and
Terry Lindell
The National Maritime Museum Association
USS PAMPANITO (SS 383)

The invention of the gyrocompass was arguably more important than the invention of the present day Global Positioning System. At the turn of the century, the problem of magnetic compass error started to grow exponentially as Navy ships used more steel, generated more electric fields, and could shoot further. The problem was even worse for submarines. When submerged, a submarine's only method of navigation was by dead reckoning. This made the submarine incapable of operating under the surface in restricted waters where they would be most effective. Even an extended underwater run in open water was a dangerous proposition.

The gyrocompass is key not only for navigation, but also for accurate fire control. The gyro is an integral part of a WWII submarine fire control system that includes the torpedo data computer, dead reckoning analyzer, dead reckoning racers, dummy log, pit log, sonars, and radar. This highly integrated system was years ahead of competitive systems and was one of the crowning achievements of WWII technology.

The Anschutz Company invented the first gyrocompass in 1906. After taking part in an Arctic expedition, Dr. Hermann Anschutz-Kaempfe (1872-1931) planned a 1902 expedition based on going to the North Pole in a submarine. He quickly learned that one of the major obstacles was navigation under the ice. He tried to build a gyrocompass in 1903 but found that there were many small forces that limited the usefulness of the device to only short periods. By 1906, Anschutz had formed a gyrocompass company. By 1908, the Anschutz Company had developed a device that worked well enough to pass sea trials on DEUTSCHLAND, the German fleet flag ship. Although the German compass worked, it was difficult to use, requiring careful calculations based on several tables that corrected for errors generated by the device. Even so, the fact that it was useable attracted the attention of navies throughout the world, including that of Elmer Sperry.

The Sperry automatic error-correcting gyrocompass was developed over the course of 12 months by the creative genius Elmer Sperry (October 21, 1860-June 16, 1939). In September of 1909 Sperry applied for his first of many gyrocompass patents (U.S. Patents No. 1,242,065, 1,279,471, and 1,255,480 - automatic error corrections).[1] Although simple in concept, creating a practical gyrocompass is very difficult. Sperry had access to the erratic performance data on the Anschutz compass and focused on fixing the weak points of its design. By January of 1911, the Sperry compass was ready for sea trials. It is clear from the records that Sperry had the full support of the U.S. Navy during period, which did not want to buy gyrocompasses from Germany.

The Sperry system featured an automated limit on motion in the third degree of freedom, and a servo feedback system based on an analog computer. This computer could automatically dampen and adjust out the errors generated by the changes in latitude and the ship's pitching and rolling. These were major advancements over the Anschutz system, and the U.S. Navy quickly realized that they had the better navigation system.[2] For the first time in history it was possible to accurately determine a vessel's location at all times, no matter what forces caused its motion. It worked in all weather, was less prone to local anomalies, and could be used no matter how much steel was used to build the ship.

Elmer Sperry and his company held a monopoly on this critically important technology through its patents. Soon Anschutz developed its own servo based error correction mechanisms, and Sperry sued for patent infringement in 1914 in the international court at The Hague.[3] There is extensive correspondence between Sperry and his lawyers showing his deep personal interest in the progress of the case.[4] Unfortunately, by 1918 WWI had overtaken the infringement claims, making it impossible for Sperry to go any further with his legal claims.

At the end of WWI the U.S. Navy took the Anschutz gyrocompass technology from Germany as a prize of war.[5] The Navy turned this technology over to the ARMA Corporation in an effort to create a competitor to Sperry. ARMA improved the Anschutz design with its own innovations and produced a gyro. Sperry then sued ARMA for the same infringements that the company had used to sue Anschutz.[6] The argument of Sperry being able to sue the Government for setting up ARMA in the gyrocompass business was taken from the Court of Claims all the way to the Supreme

Court in Sperry vs. ARMA Number 239.[7]

The Anschutz compass had several advantages over the Sperry design, most importantly the refinement of putting the gyro wheels at an oblique angle to each other. This approach was inherently more stable than the orthogonal Sperry arrangement. It allowed creating smaller, more accurate gyros. The trade off was that in order to read the course it was necessary to adjust the frequency of the wheels rotation based on the latitude. This adjustment was simple to implement and with uniquely ARMA improvements, a very fine gyrocompass was created.

The exact terms reached between the U.S. Navy, ARMA, and Sperry are not known except that all of the Navy gyrocompass business was divided between the two companies. ARMA remained in the gyrocompass business and Sperry remained the primary gyrocompass supplier. However, because of its critical importance to modern warfare, the Navy insisted on two suppliers.[8] The same was true of the critical fire control equipment and stable elements.

The ARMA equipment was supplied to all submarines for several reasons. First it was inherently smaller, more stable and required less maintenance. Second, it was easier to adjust during operation. Third, it had lower power consumption. Lastly, it was easier to start and stop, an important advantage in a submarine that was trying to evade enemy acoustic detection. Surface ships used either type of equipment, but more Sperry equipment was installed. It is interesting that the very largest ships--aircraft carriers, battleships, and cruisers--received mostly ARMA gyrocompasses.

As the ARMA Corporation slowly decayed until it ceased to operate in 1976, support for the equipment underwent a consolidation among the third party vendors. Gyro Systems, Inc., a leader in the repair of this technology, slowly acquired the market of customers and inventories of parts and equipment until it remained as the last remaining center for ARMA gyros. The last of these gyros was removed from active service in the late 1980s.

The Current Status

Because ARMA was the Navy's secondary supplier, fewer ARMA gyrocompasses were made and few of these have been saved.

USS PAMPANITO (SS 383), a Balao class (1943 built) submarine memorial and museum in San Francisco, is in a unique position to restore and preserve its original ARMA Corporation Mark VII gyrocompass. PAMPANITO was refit with the latest submarine fire control and navigation technology just before the end of the war and has received no post WWII upgrades or modifications. The National Maritime Museum Association's preservation program's goal is to make PAMPANITO as complete and as accurate as possible, striving for a summer 1945 configuration. Her torpedo data computer (the second most important part of the fire control system) is in the original WWII configuration and is the only one in the world that has been restored to operation, including its inputs from the gyro. (Editor's Note: See Restoration of the TDC Mk III Aboard PAMPANITO on page 65 of the April 1995 issue of **THE SUBMARINE REVIEW**.) All necessary power systems have been restored. We have assembled all the other major components necessary to complete both the gyrocompass and the other components of the original WWII fire control system. We understand this system's great historical significance and the need for its preservation. This project is of importance not just for PAMPANITO, but for the entire national historic naval ship fleet. Once documented, other ships will have the information needed to preserve their own gyros. Although perhaps 15 ARMA Mark VII gyrocompasses survive on historic naval ships, we know of no other museum currently capable of restoring and thereby preserving this technology.

On PAMPANITO, we believe that the operation of most types of equipment is a necessary component of a long term preservation plan for many reasons. First, idle equipment frequently deteriorates faster than operating equipment. The operation distributes lubrication, dries components, discovers incremental problems in their nascent stages, and avoids material creep. Second, although PAMPANITO has had no post WWII additions, modifications and removals did occur during the 1960s and 1970s when she was used as a reserve trainer and then opened for stripping by other Navy units. Consequently, wiring was modified and parts were removed from many systems on the boat. No system can be assured complete and accurately assembled until it has been operated at least once. Third, our experience has shown that many safety problems are found and corrected during the restoration of equipment to operational status. Fourth, in restoring equipment to operation, the skills of repair and operation are themselves preserved in a way not possible with static displays. Finally, operating equipment inspires respect and care not offered inoperable equipment. This is true not only of its caretakers, but also those that might be inspired by it. There is magic to teaching with a complete and operable system that is not possible with equipment of unknown condition. Of course, when long term operation is not sustainable, equipment is brought to operable state and then properly laid up.

The existing ARMA documentation does not sufficiently capture the process of setting up the sensitive element to a level that would allow repetition after the current generation of experts are gone. Servicing any mechanical gyrocompass has always been more an art than a science. The reason is that the forces at play to make the compass work are very small and are dependent on a delicate balance of all components to be expressed accurately. This is an apprenticed skill that has never been completely captured in writing. Among those servicing these gyros, craftsmen of greater skill were known and respected among their peers. Gyro Systems Inc. has two men still working who are skilled in the servicing of these gyros and all the specialized shop equipment. When they retire, and the shop dismantled, this art will be lost.

The Future

The PAMPANITO crew is planning the restoration of PAMPANITO's ARMA Mk VII gyrocompass to operable condition. Preservation will enable the future study of not only the gyro on its own, but also integrated into the surprisingly sophisticated WWII fire control system. During educational programs it will be used to interpret navigation technology, principles of physics, and the principles of fire control. We serve over 200,000 visitors a year, including several thousand children in overnight programs.

We need your help to implement this plan. Through a combination of donation and purchase we have acquired the missing motor generators and amplifiers. Gyro Systems, Inc. has very generously donated all the spare parts we can use. Further, they still have all the shop tools, gauges, equipment, etc. needed to setup an ARMA gyrocompass sensitive element (the delicate rotor mechanism) and have offered the use of these facilities for free before they are dismantled. We were hoping to get a retired Navy chief to perform the 200+ hour shop job of setting up the sensitive element. Unfortunately family health problems have made this impossible. When we could not get the skilled labor for free, Gyro Systems offered to supply the skilled labor at their cost. These are the most qualified people available anywhere to perform this work and quite probably the only ones not yet retired. It is almost certainly the only properly equipped ARMA gyro repair shop intact. However, we still need to raise $20,000 to complete the project.

The NNMA is prepared to document, restore and preserve a fine example of WWII ARMA Mk VII gyrocompass. Outside of the extraordinary technology of this device, the ARMA gyrocompass has a special place in history. But we must act now while the craftsmen are still available to document the sensitive element setup. If you can help, please contact the authors at:

USS PAMPANITO
Pier 45
San Francisco, CA 94129
Phone: (415) 775-1943
Fax: (415) 441-0365
E-Mail: pampanito@maritime.org
Internet: http://www.maritime.org/pamphone.shtml

ENDNOTES

1.Elmer Sperry, Inventor and Engineer, by Thomas Parke Hughes, 1971, Johns Hopkins Press, Chapter 5.

2.Bulletin of Information No. 1002, Sperry Gyroscope Company, 1912.

3.Letter from the Sperry Gyroscope Company to Elmer Sperry, May 28, 1914. "Your letter No. 265 of May 16th, in regard to patents and the Anschutz infringement suit has been carefully gone over with everybody here that can be of assistance in getting together the information. ... I shall try to get this matter as far along as possible before you return and shall be glad of any further suggestions in regard to matters that we can take care of for you."

4.All references on this page are reproduced with the permission of the Hagley Museum and Library, Wilmington, DE 19807.

5.Letter to Elmer Sperry from the U.S. Department of State, December 18, 1916.

6.Inter-Office Memorandum, from H.H. Thompson (Esq.) to E.A. Sperry, May 21, 1923. "The Legal Department would like instructions concerning the proposed suit in the Court of Claims on account of the ARMA Compass. There is no doubt that such a suit could be lodged at this time."

7.Memorandum of the Opinion of the Supreme Court in Sperry Vs ARMA, Number 239.

8.ARMA Corporation, Copyright 1943, ARMA Corporation Company History, pages 6-7. "The Navy was so impressed with the record the Company had made with the searchlights that it took David M. Mahood and Arthur P. Davis into its confidence explaining that a delicate situation had arisen in the Gyroscopic Compass field and asked if they could develop, at their own expense, a compass with a design different from that being produced by another company already in the field." Caption on picture of same page: "the USS PILLSBURY, the first ship to carry ARMA Compass Equipment (US Navy Official Photo).

NAVAL SUBMARINE LEAGUE

A LOGICAL EXPLANATION AS TO THE LOSS OF USS SCORPION (SSN 589)

by CAPT T.J. Smith, USN(Ret.)

The recent book Blind Man's Bluff: The Untold Story of American Submarine Espionage by Sherry Sontag and Christopher Drew and a previous Proceedings article title *Why They Called the Scorpion Scrapiron* by Mark Bradley theorize as to the loss of SCORPION. I will not comment on the above works other than stating that the authors do not have a modicum of submarine knowledge or experience and their writings reflect this deficiency. Additionally, Bradley's title for his article is reprehensible as 99 submariners lost their lives on SCORPION.

Digressing on this matter a little further, submarining is a complex and technical business and the uninitiated can easily be overwhelmed by a plethora of evidence or data, be it fact or fable, and being unable to separate the fact from fable, founder in their various conclusions as to a probable cause for the loss of SCORPION. They are not alone as even seasoned submariners still harbor, in my opinion, misconceptions as hard evidence in SCORPION's loss. I may be wrong in my theory and conclusions. However, they are in my way of thinking, logical and do not deal in surreal assumptions or impractical hypotheses.

A more recent Proceedings article titled *How the Scorpion Went Down* by Captain C.A.K. McDonald, USN(Ret.), a submariner, also develops a theory as to SCORPION's demise. I would like to comment on his article and then describe my theory as to her loss.

Captain McDonald's theory, in summary, postulates that the propulsion battery in a Mark 37 torpedo exploded, for no known reason, which resulted in a series of events which brought about SCORPION's loss. He theorizes that as a result of the battery explosion, the boat ascended to periscope depth and ultimately surfaced in order to ventilate the interior after the explosion and resulting fire. Some 22 minutes after the start of the casualty, the torpedo warhead exploded. This event happened while attempting to tube load and jettison the torpedo and this explosion blew two hatches out of the torpedo room causing it to start to flood. The warhead explosion also collapsed the torpedo tubes, ramming the loaded torpedoes against the torpedo tube outer doors with sufficient force to open one or more at least partially. One tube, with an open breech door, had its outer door blown open. This series of events resulted in uncontrollable flooding of the torpedo room. As SCORPION began to settle rapidly, one crew member donned a life jacket and clambered out on deck through the engine room or after escape trunk. Other crew members tried the same escape route but were engulfed by sea water and trapped in the then flooding engine room. Ninety-one seconds after the torpedo warhead exploded the boat passed crush depth and the engine room and operations compartment imploded. The watertight bulkhead between the torpedo room and operations compartment was bowed into the operations compartment due apparently to the warhead explosion, but the weakened bulkhead after hull implosion was then bowed toward the torpedo room or in the opposite direction.

I find great technical fault in Captain McDonald's theory and will comment on each postulated significant event plus other statements made in his article with reasons why his assumptions, in my estimation, are without merit.

To begin with, an internal or external torpedo explosion did not sink SCORPION. Photographs of the hull reveal no evidence of a torpedo impacting SCORPION externally and also no evidence of an internal torpedo explosion. If in fact there was an external torpedo explosion it would have totally destroyed and perhaps separated the bow compartment (torpedo room) from the rest of the hull resulting in massive and immediate internal flooding. If the warhead exploded internally, it would very likely have separated the bow compartment from the rest of the hull as the explosion would be *confined* within the compartment and would thus produce maximum destructive force. A Mark 37 torpedo warhead contains 330 pounds of HBX explosive. This amount of explosive (about 1.5 times more powerful than TNT) would certainly do considerably more damage than blowing a couple of hatches open and collapsing the torpedo tubes. If it didn't then the Submarine Force was being supplied with a torpedo with marginal capability and this was not the case. To expand this subject further, when the writer was Executive Officer of USS ENTEMEDOR (SS 340) in 1964, we fired a warshot Mark 37 torpedo at ex-USS SPIKEFISH (SS 404) in Long Island Sound. By the time the debris from the explosion fell back into the water, SPIKEFISH was gone. Additionally and to further dispute the internal exploding torpedo theory, Captain McDonald refers to only one torpedo exploding.

This would not be the case. SCORPION carried 23 torpedoes and a reasonable torpedo load would be 14 Mark 37s, 7 Mark 14s and 2 Mark 45s Astors (nuclear warheads). Excluding the Mark 45s because they are a different breed, the remaining 21 conventional torpedo total warhead explosive weight would amount to 7,770 pounds or approximately 3.9 tons of high explosives. If one torpedo warhead exploded internally it would have certainly detonated all the other torpedoes and SCORPION would have been blown to bits. She was not, therefore, again, a torpedo detonation was not a probable cause for her loss. Mention was made in the article that perhaps the explosion of the Mark 37 warhead may have been "low order". This is not possible. "Low order" detonations by definition occur only in nuclear weapons where the conventional explosive associated with the weapon explodes but not the nuclear material.

An activated or *hot running* Mark 37 torpedo can definitely occur. When the writer was Weapons Officer on USS ABRAHAM LINCOLN (SSBN 602) in early 1961 we had a *hot running* Mark 37 torpedo experience. The *hot run* occurred while conducting a routine maintenance test on a rack stowed Mark 37. Upon attaching the test cable from the torpedo test set to the test receptacle on the torpedo and turning power onto the test set, it activated the propulsion battery. An activated battery over time generates a great amount of heat and the battery is separated only by inches from the warhead. The possibility of a warhead *cook off* was cause for real concern. To further compound the problem, battery activation provides electrical power to the torpedo propulsion motor.

This motor turns the counter-rotating propellers and in our case the torque from the motor sheared the propeller locks and we were now confronted with a run away motor increasing in speed and with the real possibility that it could disintegrate. This eventuality would also not be in our best interests. We attempted to shut the torpedo down by changing course in order to activate the anti-circular run (ACR) switch. This was not successful as the torpedo gyro was still *caged* or essentially not activated and as such the ACR switch was immobilized. We finally succeeded in shutting the torpedo down by slewing the gyro using the gyro test hand crank on the test set. Gyro slewing through the test set activated the ACR switch and shut down the propulsion system. Since the torpedo was a fully ready warshot, we removed the exploder, tube loaded the torpedo and fired it into the Norwegian Sea where it resides to this day. The torpedo was activated by inadvertently plugging in the test cable to test receptacle on the torpedo upside down. When the test set was turned on, electrical power fired the battery squibs activating the battery and propulsion system. Upon our return to Holy Loch, Scotland we reported the casualty and the Submarine Force was immediately informed by high precedence radio message of the problem and an ordnance alteration (OrdAlt) was rapidly developed and issued to preclude this casualty from happening to other submarines. Since LINCOLN experienced this problem in 1961 and a *fix* was developed then it does not seem logical that a *hot running* torpedo with subsequent warhead detonation would be the cause of SCORPION's loss some seven years later.

Captain McDonald also states that one torpedo tube, with an open breech door, had its outer door blown open due to the torpedo warhead explosion with subsequent uncontrollable internal flooding. I believe that this is conjecture. Why was the breech door open and how does he know this? If the breech door was opened in an attempt to load and jettison the Mark 37 torpedo damaged by the battery explosion, it most likely was a useless evolution as explosive damage to the torpedo would most likely not permit it to fit into a 21 inch torpedo tube.

Additionally in his article, I believe there must be some sort of mistaken identification when TRIESTE II found a body on the ocean floor wearing a life jacket. SCORPION was lost in May 1968 and TRIESTE II surveyed the wreckage commencing in June 1969. I think a human body exposed to the harsh environment of the sea for better than a year would be hardly recognizable or even exist. Additionally, a life jacket by design provides buoyancy which should preclude a body *lying* on the ocean floor.

Captain McDonald further states that as SCORPION passed crush depth the engine room and operations compartment imploded. This could not happen based on a previous statement that the engine room was flooding through the after escape trunk while crew members were attempting to escape. Flooding the engine room from sea would mean that the internal pressure in the engine room would be equal to sea pressure thus negating crushing or imploding. SCORPION's engine room was in fact rammed into the auxiliary machinery room by sea pressure as she sank. Subsequent implosion of the pressure hull resulted which can only occur when sea pressure is greater than the structural strength of the pressure hull. SCORPION most likely flooded internally due to the hull fracturing at the engine room/auxiliary machinery room implosion interface and also subsequent implosion of the operations compartment.

Captain McDonald also states that the weakened bulkhead between the torpedo room and the operations compartment somehow became bowed toward the torpedo room. It was initially bowed toward the operations compartment supposedly due to the torpedo warhead explosion. Since we've concluded that a torpedo explosion did not occur, then what would cause the bulkhead to bow toward the torpedo room? Newton's First Law of Motion can most likely explain the deformation. Some estimates of SCORPION's speed concluded that she could have exceeded 40 knots upon impact with the ocean floor. This seems realistic considering the fact that she was flooded and a free falling body for a distance of 11,000 feet or slightly more than two miles. Newton's Law, for our purposes, states that a body in motion remains in motion unless acted upon by an external force. The external force, in this case, was the ocean floor and impacting it at her estimated speed could cause equipment in the operations compartment to slam into the bulkhead bowing it toward the torpedo room. One piece of equipment in that compartment, as an example, was a 126 cell battery weighting by itself about 63 tons. This Newton's Law is why we wear seat belts in automobiles.

A battery explosion due to hydrogen gas build-up during a battery charge and subsequent loss of battery well ventilation is a leader in probable causes of SCORPION's loss. This is a very remote possibility but, in fact, did happen to two submarines: USS COCHINO (SS 345) resulting in her loss off Norway in 1949 and several years later, 1955, severe damage to USS POMODON (SS 486) while in a naval shipyard. Lead acid storage batteries are potential trouble makers, but have been in submarines since the first Navy submarine in 1900. Two mishaps in 68 years after thousands of battery charges in U.S. submarines alone is an exceptional safety record considering the potential for problems inherent in wet cell storage batteries. SCORPION's battery appeared to be destroyed but most likely by the boat's impact with the ocean floor rather than an explosion as explained in the previous paragraph.

There are many other theories postulated as to her loss including internal flooding through a faulty Trash Disposal Unit, a submerged collision with an underwater object, torpedoes by a Soviet submarine, an irrational act by a mentally unstable crew member, inadequate crew training and many more. All of the above when scrutinized have serious flaws and thus are not logical causes.

Having explored scenarios that are not plausible, then what could be a logical cause and one that is supported by the available evidence? The *evidence* in this case is SCORPION's wreckage. Starting with her wreckage and walking backwards to determine what could have caused her to be in the condition that she is in seems to be a more logical approach than trying to fabricate a casualty or casualties not supported by the physical evidence. In actuality, there is no sinister mystique or far out science fiction scenarios associated with submarine casualties. There are, however, various degrees of severity in any type casualty and SCORPION could have encountered a situation that she didn't immediately recognize or was slow in taking corrective action, or that any kind of corrective action on her part could not resolve her dilemma in favor of her survival.

For background information, SCORPION was a Skipjack class submarine with the following characteristics:

Displacement, tons	3075 surfaced; 3500 submerged
Length, feet	251.7
Beam, feet	31.5
Draft, feet	28
Torpedo tubes	6-21 inch
Torpedoes	23-mix of Mk14, Mk37, Mk45
Main engines	2 steam turbines; approximately 15,000 shp; 1 shaft
Nuclear reactor	1 pressurized water cooled S5W
Speed, knots	20 surface; 30+ submerged
Complement, average	93 (8 officers, 85 enlisted)
Test depth, feet	700 (as designed)
Crush depth, feet	1050

Note particularly the high submerged speed (30+ knots) and the relatively shallow calculated hull crush depth (1050 feet).

Reviewing her wreckage again, numerous photographs reveal that it is relatively intact as compared to being ripped apart by an explosion. Her bow (bow compartment) however appears to be offset from the hull centerline and partially separated from the rest of the hull but with no other major exterior physical damage with the exception that the topside escape trunk and torpedo loading hatches are missing. The operations compartment has substantial damage that appears to have been caused by the compartment crushing or imploding as a result of sea pressure. Photographs of the after portion of the engineering spaces reveal pressure hull failure at about the juncture of the engine room and auxiliary machinery room which resulted in the engine room being literally driven into the auxiliary machinery room a considerable distance. This catastrophic hull failure is attributed to sea pressure with resultant internal flooding of the submarine. Of interest is that the sea pressure at SCORPION's resting place in 11,000 feet of water is 4,840 pounds per square inch or 2.42 tons per square inch.

Having explored a number of scenarios that are not plausible, then what could be a probable cause and one that is supported by the available evidence which in this case is, again, SCORPION's wreckage. My theory for her loss is that she suffered a stern plane casualty in the *dive* position when at high speed either real or inadvertently imposed by the stern planesman from which she could not recover. Bradley's article alludes to SCORPION having "chronic problems in hydraulics, which operate both her stern and sail planes", but this statement is not substantiated by a reference. The court of inquiry record noted that "the stern plane control system constitutes one of the most potentially hazardous systems affecting the safe operation of high speed nuclear submarines". This statement is 100 percent correct and this fact coupled with her high speed, in my opinion, resulted in her loss and the lives of all 99 of her crew.

A reasonable operating scenario for SCORPION on her homeward transit to Norfolk, Virginia after a Mediterranean deployment could be as follows: High speed (in the range of 30 knots), comfortable in their ability to operate the boat for considerable periods of time at this speed, not too concerned about their relatively shallow test depth, plus perhaps complacent in that they have done this many times before and what they are doing is relatively routine. A stern plane problem could have developed from a variety of factors including but not limited to mechanical, electrical, human or perhaps any combination of the three. Regardless of the cause we will analyze what would happen if SCORPION was transiting at a depth of 300 feet, at a speed of 30 knots and suddenly assumed a down angle of 30 degrees due to a casualty to her stern planes. It should be noted, however, that given the above speed parameter a 30 degree down angle is not in the least excessive. On the contrary, it is quite moderate. Based on the above conditions, simple trigonometry shows that SCORPION's vertical speed component based on a 30 degree down angle is one half her actual speed of 30 knots or 15 knots straight down. A vertical speed of 15 knots equates to SCORPION increasing depth at a rate of 25 feet per second. The following table of *Time* and *Depth* is derived from this descent rate and shows that with no emergency recovery action taken by the crew, SCORPION would reach her crush depth of 1050 feet 30 seconds after the casualty occurred. *Sea Pressure* is also listed in the table and is a function of depth.

Time (Sec.)	Depth (Feet)	Sea Pressure (psi)
0 (casualty occurs)	300	132
5	425	187
10	550	242
15	675	297
20	800	352
25	925	407
30	1050 (crush depth)	462

There is a rudimentary emergency recovery procedure for this type casualty, but it may not have been adequate for this class submarine. It is known as *Blow, Back and Pray*. *Blow* all main ballast tanks to gain positive buoyancy thus slowing the descent. *Back* down emergency to further reduce descent speed. Put the rudder over full, which will tend to give the boat an up angle, plus the rudder also acts as a dive brake. And finally, full rise on the sail or fair water planes, which also helps produce an up angle. *Pray* needs no definition. Blowing main ballast tanks as SCORPION descends will not empty water from her ballast tanks as rapidly as she would expect or like. As she increases depth, sea pressure also increases from 132 psi to 462 psi or 3.5 times from her transit depth to her crush depth, thus requiring more air and a longer period of time to blow water from her ballast tanks in the recovery procedure; and time, as we now see, is her greatest enemy. As a startling example, blowing her ballast tanks at crush depth would require 21 times more air pressure and for a considerably longer period of time than a normal surfacing at periscope depth.

Compounding SCORPION's dilemma is her weight or displacement in conjunction with her high speed. A physics formula states that Momentum equals Mass (weight) times Velocity (speed). How do you stop a mass of 3,500 tons moving at a velocity of 30 knots in a distance of 750 feet or the length of 2.5 football fields in 30 seconds? This distance is the difference between SCORPION's estimated transiting depth and crush depth. I think the answer is that it could not be done with the recovery procedures available to SCORPION and unfortunately she proved it. Also compounding her dilemma was that she was not a *SubSafe* boat with retrofitted safety features as a result of the USS THRESHER (SSN 593) tragic loss in 1963. Lack of SubSafe reduced her recovery capability and perhaps significantly. The Skipjack class were very high speed submarines with a relatively shallow crush depth and this combination was perhaps not recognized by their designers at the time as a dangerous marriage.

It is not possible to even envision what happened to SCORPION when she exceeded crush depth and proceeded towards the ocean floor. At crush depth the hull must have been relatively intact. Then, as sea pressure continued to increase during her descent, the hull most likely started to deform, twist and distort to the point where sea pressure forced the engine room into the auxiliary machinery room. This could have been followed almost instantaneously by the implosion of the operations compartment with resultant flooding. Hull deformation could have broken the dogs securing the forward escape trunk and torpedo loading hatches. Upon impact with the ocean floor, these hatches could have been sheared from their hinges. Other hatches are also missing and probably for the same reason. A periscope and two antennas are in the raised position in the wreckage and could have possibly been *raised* by impact with the bottom.

Based in the available evidence, it appears that a ship control problem was perhaps the most likely cause for SCORPION's loss; but then again, we will never know. Stern plane casualties do occur. They are relatively rare but the writer experienced one on USS COBBLER (SS 344). USS CHOPPER (SS 342) experienced another that I am aware of, which was compounded by human error, that almost resulted in her loss.

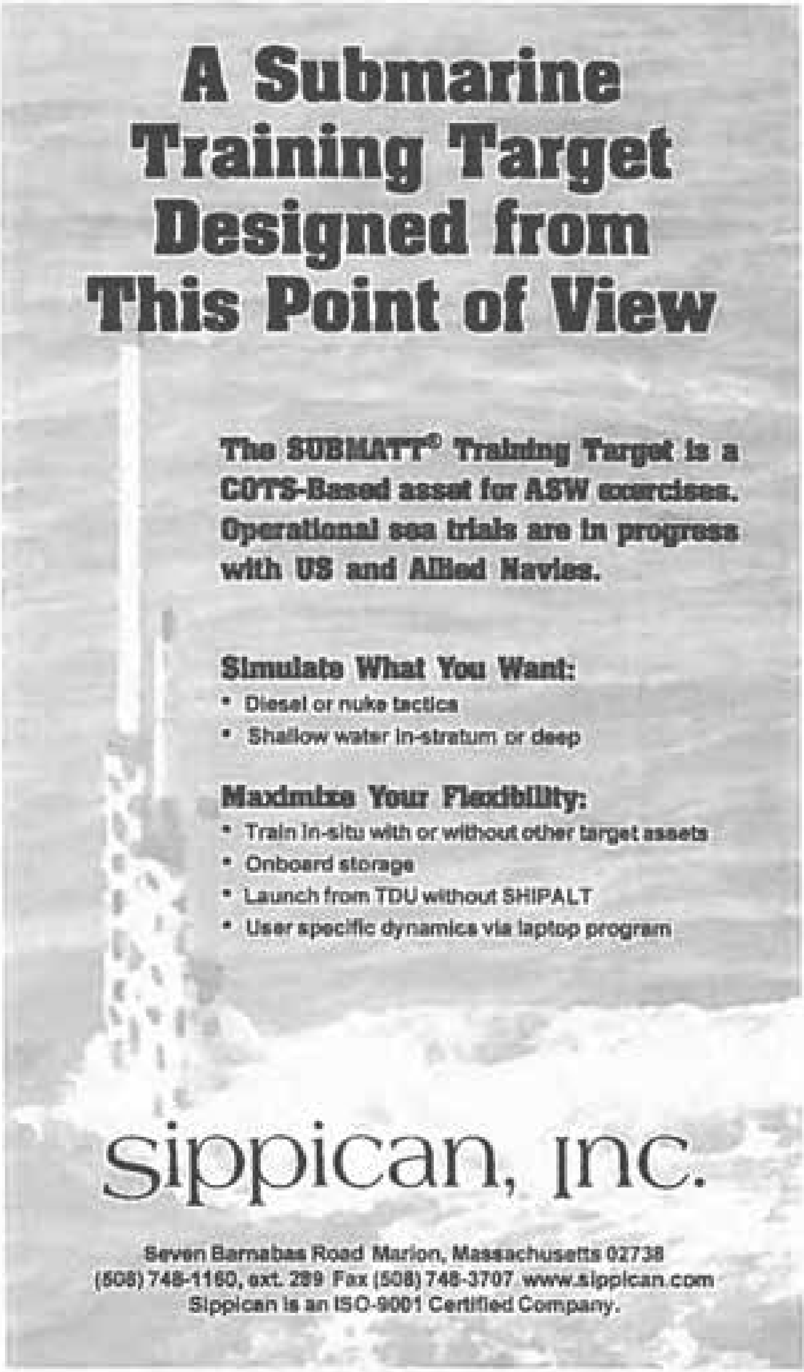
Losses of submarines are painful; however, submariners learn from each loss. Looking at this further, THRESHER's loss proved that lack of proper design and procedural practices on deep diving submarines can be catastrophic and as a result, the SubSafe program was developed. SCORPION's loss was more a lesson on how we operate submarines. This loss resulted in the development of safe operating envelopes for high speed, deep diving submarines, based primarily on parameters of speed, depth and probable casualty scenarios. The loss of both submarines brought about the untimely death of 228 submariners in a short five year span. We morn the loss of these men but because of their loss we learn and knowledge, hopefully, will preclude further submarine lessons due to material problems, operating procedures and perhaps the unforeseen.■

A THANK YOU TO THE NSL

The Dolphin Scholarship Foundation would like to express our appreciation for the opportunity to participate in the 1999 NSL Symposium held June 3rd and 4th. This event provided us a forum to share information about our foundation and our scholars with NSL's many supporters.

Again we thank you for the invitation to attend the symposium and look forward to continuing our relationship with the Naval Submarine League.

Sincerely,
Cindy Giambastiani
President
Dolphin Scholarship Foundation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FREDERICK B. WARDER: LETTERS TO HOME FROM USS SEAWOLF

by Sam Stavros

Admiral "Fearless Freddy" Warder is now 95 years old and living in Florida. Professor Stavros is a historian and is married to Admiral Warder's granddaughter. He has given ***THE SUBMARINE REVIEW*** *this human interest article based on the Admiral's personal correspondence.*

Somewhere in a small town in central Florida is a typical and modest house. One would drive by it without taking any note whatsoever. In one of the back rooms that is no longer used for living, amongst the circa 1950's furniture, hangs a now fading testament of a life; dedicated and committed to a great cause. The telling memento is a photograph, in black and white, of Chester Nimitz sitting on USS MISSOURI signing the surrender ending World War II. The inscription reads: "To Rear Admiral F.B. Warder, U.S. Navy, with best wishes, warmest regards and great appreciation of your contribution to the war effort in the Pacific during the long retreat from the Philippines in World War II which made possible the above moment."

As everyone knows it is easier to travel a road clearly paved to victory. But Frederick Warder's story, at least during his *crowded hour*, is the story of determination when no person could *reasonably* expect such an outcome. As the first commander of the now famous submarine, SEAWOLF, Warder struggled with huge problems well noted in the many excellent books written about the period. The chaos caused by the early Japanese onslaught and the astoundingly deficient torpedoes that the early Submarine Force used as they went into battle are but two.

But throughout the tension building years towards WWII, and during the dark days before the first glimmers of hope created at Coral Sea and Midway, Warder maintained a confidence that enabled him and the crew of SEAWOLF to excel. This confidence is displayed in some personal correspondence that his family is now looking over.

Before the war Frederick Warder oversaw the building of SEAWOLF. While doing so he injured his knee in a fall from a ladder at Portsmouth Navy Yard in New Hampshire. On a couple of occasions that knee injury almost caused him to lose SEAWOLF. There was talk of a transfer over to SEARAVEN before the ships were even completed. Later in the Philippine islands his good friend Richard Vogue, commander at the time of SEA LION stood by, as ordered to take over SEAWOLF on account of Warder's bad knee, an unexplained stomach ailment, an ear infection, and his *aching teeth*. In November of 1941 the situation became critical. He wrote home to his wife Mary that he was "getting more shots than ever before" in his life. The next week while on maneuvers he suffered from prickly heat. In a later letter he stated that removal from SEAWOLF on account of his health "would have broken my heart". He noted that he was the last of the original captains in his division and hoped that he did not "go the way of the other captains. One of which was shot by accident."[1]

This is an early example of the tenacity that later resulted in Warder becoming one of the early *aces* of the war. Other things contributed to his success. An excellent crew which was trained well. Admiral John Wilkes, who was in charge of Submarine Division 202 and a person not prone to high praise, complimented Warder on the "well running boat" which Warder penned to his wife was "quite a concession".

Warder and the crew worked well together. At times both made up for some slight imperfection. According to Warder he had "good men in the ship but their activity on the beach has been a bit trying on me—and no damn good on my service reputation". Service reputation or not he defended his men to the brass when deserved. Indeed this, according to a family member, was the first time he was fitted with the moniker "Fearless Freddy". Before the war, when questioned about their activities by MPs, some (possibly semi-inebriated) enlisted men said, "Why we've been flinging fish with Fearless Freddy."

On another personnel issue he wrote of the toll the venereal list was taking on the unmarried men. But then, possibly to offer reassurance, he wrote Mary, "It speaks pretty well for the faithfulness of the married ones (and the respect they have for their

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[1]Unless otherwise noted, all quotes are from Frederick B. Warder's personal papers dated between June 1941 and January 10, 1942.

families) that more of them have come down with nothing."

But it wasn't all Warder looking out for the crew. A few unnecessary *blowups* must have occurred for Warder confided in another letter to his wife, "You know my disposition is not of the sweetest and I think they [the crew] like my sour moments very well indeed." But these confessions are overshadowed by his constant high praise for the crew in several letters. He especially praised William Deragon, his gunnery and torpedo officer, as a "tower of strength". He also gave blanket praise in this private correspondence to his superiors when he wrote in many letters, "My bosses are the best.".

Work for Captain and crew of SEAWOLF intensified as the war, unbeknownst to them, closed in. During gunnery practice SEAWOLF always scored at or near the top. The letters back home reflect the added tension for Warder even as he attempted a casual tone. While he admitted to getting only "two hours of sleep" per night he went on to say, "I cannot discuss the international situation. I don't believe there are many who could intelligently. Let's remain optimistic and hope for a good long quiet leave together and a leisurely shore duty."

The disaster of Pearl Harbor and the beginning of the war dashed those hopes. On December 8, 1941 SEAWOLF began its first war patrol as it pulled out of Cavite Naval Base at 5:00 PM. About two hours later the ship began to navigate the protecting minefield. Much to the consternation of Warder, the Army, as usual, illuminated the buoys with powerful searchlights. The lights only managed to blind the bridge personnel creating a few tense and dangerous situations. Warder recommended that this practice be stopped.[3]

After clearing the minefield SEAWOLF began its zigzagging. This also irritated Warder. Wanting to get into action as soon as possible he noted that it "delayed the convoy considerably". On December 9 during the regular radio skeds Warder reported another problem; he heard "nothing but static on the loop [radio]" which might have been caused by Japanese jamming which inhibited some American communications. There was nothing to

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[3]National Archives, Submarine War Patrol Reports, December 26, 1941.

do but carry on. SEAWOLF headed toward San Bernadino strait.[3]

Late that night, just before the strait, SEAWOLF surfaced in the middle of a rain squall. As the men came out for the watch rain battered their faces. Visibility became a problem and seas became heavy with a wind force of 4. This is the weather that Warder listed as "typical". The ship could not be controlled at a depth of 60 feet. Weather became such a problem in the later part of the patrol that SEAWOLF maintained a depth of 120 feet at times. Even at that depth the captain reported that "force of sea appreciable" and when attempting periscope observations described the seas as "almost mountainous".[4]

Despite the weather Warder figured that the straits could be cleared by day and took SEAWOLF to full speed bypassing SCULPIN and S-39. His energetic approach paid off as SEAWOLF cleared the straits at about 5:00 AM on the morning of the 10th. They set a course due north. Then *sound* reported two ships in the area. Warder investigated at periscope depth but could not see anything. He attempted no further investigation of the matter, stating his experience proved that the majority of such reports were false. Later Warder figured men working in the torpedo rooms and the engine room had caused the alarms. He also noted that the alarms came from the same sound operator. That attention to detail while under the duress of combat resulted in the success of SEAWOLF. For the time being Warder wanted to get to his patrol area as soon as possible and rough seas, narrow straits, and probable false alarms were not going to get in his way.

However, much to his chagrin, Frederick Warder's anxious journey north ran into engine problems. Engines 2 and 4 began to leak oil. During SEAWOLF's submerged travel of the 10th the crew disabled those engines and began repairs. Despite every effort the engines remained unfixed when SEAWOLF surfaced after sunset. SEAWOLF traveled on engine number one at only nine knots. After two hours of this Warder, in his urgency to get to his patrol area, continued charging batteries with both auxiliaries and took engine 3 for main propulsion along with engine 1. Now

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[3]Ibid.

[4]Ibid.

SEAWOLF cruised at 12 knots. It took two more excruciating hours before SEAWOLF ran on all four engines and made a speed of 17 knots.[5]

As December 10th turned into the 11th SEAWOLF received an order from COMSUBS directing it to a new patrol area; the Babuyan Channel north of Luzon. They arrived at that destination on the morning of the 12th. SEAWOLF continued to get thrashed by a sea condition of 6 and a wind force of 5. Then, finally, after several false alarms and many periscope observations SEAWOLF made contact with its first possible prey when a sound operator picked up pinging bearing 278 degrees. Warder immediately turned SEAWOLF in that direction and discovered a Japanese destroyer patrolling north of Palaui Island west of Aparri.

The alarm sounded and the crew rushed to battle stations. They fed information into the Torpedo Data Computer. But after 30 minutes of tracking SEAWOLF could not close the range for a suitable attack. Warder decided to secure from battle stations and proceed undetected into Aparri in order to collect information on the disposition of Japanese forces. After surfacing SEAWOLF again detected pinging and briefly made a surface pursuit but once again found no shipping. After the crew secured from battle stations late that night SEAWOLF cleared Camiguin Island and closed on Aparri for the planned reconnaissance.

At 4:47 on the 13th SEAWOLF dove in the waters off of Aparri Harbor. One and a half hours later sound operators again picked up pinging. They had located another destroyer but SEAWOLF could get no closer than 12,000 yards. While tracking the destroyer inside the 30 fathom line the crew observed enemy patrol planes attempting to find American submarines. Even though the planes dropped flares twice, SEAWOLF remained undetected.[6]

The first six days of this first war patrol for SEAWOLF had been fairly anti-climatic. December 14 proved to be different. The ship headed towards San Vicente. SEAWOLF submerged and about one hour later loud pinging suddenly began. Quickly the crew shut down all blowers, fans, air conditioning, and refrigera-

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[5]Ibid.

[6]Ibid.

tion. The temperature began to rise, making the men uncomfortable in the well over 100 degree heat. Warder ordered evasive action and then more bad news. A second ship began pinging. SEAWOLF crept out to the 100 fathom line.

Four hours later, at 1:30 PM, SEAWOLF returned and Warder spotted a seaplane tender or a "fleet supply ship" at San Vicente. He ordered the crew to battle stations. Warder estimated the range to be 5,500 yards. Then they heard new pinging. In spite of the enemy now attempting to track SEAWOLF Warder pressed home the attack. They fired the four bow tubes at a range of 3,800 yards.

The torpedoes had a depth setting at 30 and 40 feet. Unknown to the crew, poor design and bad manufacturing caused the torpedoes to run about 15 feet below the setting. All four went ineffectually under the ship although *sound* reported two explosions subsequent to firing.

The crew reloaded the tubes in about seven minutes. Warder then ordered a dive to 90 feet. He positioned the ship for a salvo from the stern torpedoes. These were set for a depth of 15 feet. By now 20 minutes had elapsed and the range grew to 4,500 yards. The crew fired four torpedoes. Men in the engine room reported four muffled explosions. Warder, brutally honest, was skeptical about any possible success from the daring attack.

Three minutes after the attack pinging began. SEAWOLF, then inside the 30 fathom line, needed to escape. Then the inevitable Japanese counter attack began. A first set of depth charges exploded "well distant". Warder ordered the men to depth charge quarters. After five or six more depth chargings things became quiet. SEAWOLF turned north and silently left the area.

The rest of the patrol consisted of a few false alarms and ship maintenance. During the 18 day patrol Frederick Warder began an intermittent letter to Mary Warder which he mailed upon his return. He informed Mary that as an officer he must self censure his mail. This he said would probably result in his giving her even less information than regulations allowed. On December 17 Warder included a little bravado writing, "unlike Perry I will not be able [because of censorship] to write 'we have met the enemy and they are ours,' but I can say that we have had a splendid baptism and have had success at the northern latitudes."

Continuing the letter on Christmas Eve, Frederick Warder felt more separated from his wife and family. This is understandable on such a day which families traditionally share together. He described in great detail the Christmas tree that the men fashioned using a "broom stick, medical applicators, medical cotton, green and pink file paper" etc. He told her that it reminded him of all the happy Christmas pasts they had shared. He looked forward with confidence to more family Christmas' in the future.

On December 26, the first war patrol officially ended as SEAWOLF surfaced, cleared the minefield, and laid anchor at Mariveles. Warder had returned to a changed world. Cavite Naval Base was gone, destroyed by the Japanese on December 10th. His good friend and classmate Richard Vogue's submarine was wrecked and scuttled. Another close friend and classmate Morton Mumma had relieved himself from command. Despite all of these disaster, not to mention the torpedoes that did not work, Warder remained optimistic. He wrote home shortly after his arrival at Mariveles, "I'm very proud of my crew. They are going to beat the hell out of these gents [the Japanese] in time. In the meantime they are going to be very annoyed."■

LAST VOYAGE OF USS SUNFISH: CLOSING OF A CIRCLE

by Tony Robles
USS SUNFISH Plank Owner

September 27, 1996, nearly 28 years after her first sea trial, SUNFISH's low black silhouette hunkered beside a concrete pier at the Ballast Point Naval Station in San Diego. For the first time in more than a quarter century the warrior was unarmed, stripped of the torpedoes she carried through much of the Cold War.

The crew of the Sturgeon class nuclear powered submarine was the last of a line of sailors that threaded back through time to the day her keel was laid in 1965. Most were seasoned submariners with time in. A few had orders to new commands. Others remained with SUNFISH for a time, watching over her final days as she was dismantled piece by piece. For now their job was to accompany this proud and noble warship to her final resting place, to close the last chapter of a story that spanned four decades. If there was sadness in their souls I could not see it. Some have put boats to rest before. For them this is just another job. For me it was the closing of a circle. I was part of the commissioning crew that took her on the first sea trial.

The crew treated me like a VIP. The XO shared his stateroom. He let me use the upper bunk. I recall that Admiral Rickover slept here during the first sea trial. As a young seaman, I stood watch outside the door just in case the admiral needed something.

The maneuvering watch was set and on a sun-splashed San Diego afternoon SUNFISH got underway. I got permission to go to the bridge. As SUNFISH headed out of the harbor, a fishing boat was in her path. The officer of the deck called to the boat on a marine radio. We are a U.S. warship outbound, he says. A warship! I like the sound of that. It had been a long time since I was underway on a warship.

The status board above the quartermaster's station said SUNFISH's next dive will be number 1022. I was in the control room to watch. The diving officer asked me if I would like to take the helm for SUNFISH's last dive. I think I was speechless, but I heard myself say "Yes!" I was nervous as I marked the course and speed and requested permission from the officer of the deck to relieve the helm under instruction. I slid into the helmsman's seat and gripped the wheel with sweaty hands. The officer of the deck gave the command to dive. The helmsman leaned over my shoulder, instructing me as I pushed the stick forward. SUNFISH and I slipped beneath the waves together for the last time.

The crew settled smoothly into underway routine. The captain had cleared me for *confidential* sea stories. It said so in the plan of the day. I was allowed to visit every part of the ship. I put on my old, faded SUNFISH sweatshirt and wandered around the boat, shooting the breeze and reminiscing.

Dinner was served and the line formed, beginning aft of the crew's mess and winding down the stairs into the torpedo room. I took a place at the end of the line. A sailor offered to let me move ahead. I declined. I was not a member of the crew, only a rider. I said let the working men eat first.

Watches were relieved. Sailors headed to the mess deck or to the rack. Today's sailors still have the same preoccupations: food and sleep. The perennial topics of discussion are 'what's for dinner' and how much rack time they will get. I tried to sleep, but I was too excited. I got up and wandered around the ship. I drifted into the sonar room. I hung out in the control room. I peeked at the chart and listened to the banter and good-natured insults. I went down to the crew's mess. I sat at one of the padded benches at the forward, starboard corner. The movie screen used to hang here. At the end there was a TV built into the forward bulkhead. I rested my back against the starboard bulkhead and stretched my legs on the bench. Just like old times, I got sleepy and nodded.

I headed for the rack. I laid in the XO's upper bunk with the privacy curtain drawn listening to the sounds of the ship and feeling her vibration. She felt the same, smelled the same. She was humming and thrumming, lulling me gently to sleep. I fluffed the pillow and rolled over, pulling the blanket around me like a cocoon. At last I relaxed and let sleep overtake me. I had come back to snuggle like a child in the bosom of my beloved boat.

As SUNFISH neared the coast of Washington her license to run submerged expired. Her last trip from the depths was an emergency surface from 400 feet. I asked permission to take the helm. Permission was granted. Slowly, cautiously, SUNFISH climbed to periscope depth. The sea was choppy. SUNFISH bucked and

I struggled to control her. I did not want to broach. It would have been embarrassing—for me and for SUNFISH. Having confirmed that the coast was clear, we got the order to take her deep. Some of my new friends had come to the control room to watch me bring SUNFISH up for the last time. At 400 feet the order came to surface. On command I pulled back the stick. SUNFISH pointed her prow upward and shot to the surface for the last time.

Nighttime, transiting on the surface, SUNFISH made her way along the coast of Washington. The control room was rigged for black. I stood under the trunk and looked up at the dark circle of the upper hatch. "Can I go up to the bridge?" I asked the Chief of the Watch. He reached for the microphone and asked "permission for the only plank owner onboard to go to the bridge". A response came that will resonate within my soul forever: "send all plank owners to the bridge!"

The waves rocked her relentlessly. Her prow dipped beneath the froth, cutting through the cold, black water. The breeze wet my face with salty spray. A large wave came up her sail and splashed me. That's it, I said, I'm going below. In the crew's mess, the cook served up a cream soup. Grey and oily, it sloshed around in the big pot. I filled a bowl and grabbed some crackers. In spite of its appearance, the soup tasted good! I had a second bowl. I surprised myself by taking the rough seas like a seasoned sailor. Some of the crew did not fare as well. In a scene reminiscent of the first sea trial, the quartermaster threw up on the chart table.

The following afternoon, the last maneuvering watch was set. It was a clear sunny day. I stood on the curved deck with the line handlers as the proud warship sailed into her last harbor. Her job was done. It was time for the warrior to sleep.■

NAVAL SUBMARINE LEAGUE
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Elizabeth Anne Hoska Jones
CAPT M.R. Maxfield, USN
LCDR William F. Ruoff, III, USNR-R

E-MAIL ADDRESSES

***THE SUBMARINE REVIEW** continues its list of E-Mail addresses with those received since the July issue. We can be reached at subleague@aol.com.*

Almer, Francis B., falmer@fast.net
Averill, R.C., raverill@flash.net
Beckley, Jerry E., beckley@erols.com
Betzel, Albert F., al.mar.bet@worldnet.att.net
Bishop, Harold R., hrbishop@arete-dc.com
Bromwell, R. Wayne, rwayneoiii@aol.com
Bump, Stan, stanbump@aol.com
Crawford, Larry, Larry.Crawford@jhuapl.edu
Frick, R.E., rfrick@lmco.com
Geary, Robert B., LFGeary860@aol.com
Grady, James W., subssr267@aol.com
Gudis, Richard, rpshg@aol.com
Guthrie, Wallace N., wnguth@gateway.net
Haigis, John, haigisj@email.msn.com
Hanna III, Robert G., rghannaiii@aol.com
Lee, David A., DAVID_LEE@cqm.co.uk
Logue, Sr., George, geloguesr@webtv.net
Martin, Mike, mdmartin@his.com
McDonald, Jr., John J. jacksubic@aol.com
Miller, Alan H., amiller@starstream.net
Mitchell, Jr., Michael G., mitchellmg@aol.com
Mullaney, Sr., Gerald J., gjmesq@easy-pages.com
Munns, Chuck L., clmunns@aol.com
Murtha, William P., Bmurthasr@aol.com
Oser, Eric, eoser@prodigy.net
O'Brien, David W., nyseadog@aol.com
Reilly, Dan, jreilly@buncombe.main.nc.us
Sees, John A., seeshome@erols.com
Standrich, Elvin B., Estandrich@infoave.net
Talbert, Jr., Joe, JtalbertJ@aol.com
Terpstra, Richard Paul, rterpstra@subasekb.navy.mil
Wilson, James C., jcw49@pinehurst.net
Wolff, William, wwolff1@nycap.rr.com
Woods, Charles E., chazbo@compuserve.com

Wright, James T., jwright@snip.net
Yuill, John, uyillog@ids.net

Changes

Bize, David, davidbize@aol.com
Buchanan, Rick, rbuchanan@fnni.com
Covington, Richard, covington.richard@navy.hq.mil
Dobes, Joseph, j.dobes@worldnet.att.net
Dunn, Frank, fdunn@odu.edu
Hirt, Harry, hj_hirt@ieee.org
Jordan, Will, why@hawaii.rr.com
Kennedy, John, kennedys1@home.com
Leon, Hayden, hayden_l_leon@md.northgrum.com
Martin, George W., geowmartin@aol.com
McGinley, Skip, skip.mcginley@fluordaniel.com
Nesbit, Keith, keith@nesbit.net
Paine, John, john_paine@liebertgs.com
Peoples, D. Louis, dpeoples@mba1972.hbs.edu
Pride, John, jfuruno@att.net
Sminkey, Robert, sminkey@olg.com
Stoll, Ralph, ralph_stoll@pangearesources.com
Thayer, Bradley, bthayer@d.umn.edu
Warner, Dave, dcwarner@prodigy.net
Yarbro, Jr., John F., yarbro1@home.com

Corrections

Scherer, William L., wlsa@eci.esys.com
VanHoof, Eugene, evanhoof@aol.com

RASHER ORGANIZATION

July 20, 1999

The USS RASHER (SS/SSR/AGSS 269) Organization would like to hear from: former crewmembers who served in RASHER 1942-1974; anyone who worked on the boat (civilian or Navy) in a refit or overhaul unit; anyone who was employed by American Ship Dismantlers, Portland, Oregon and participated in the scrapping of RASHER; anyone who has RASHER stories to share; anyone who owns or knows the whereabouts of RASHER memorabilia (flags, pennants, photos, artifacts, documents, diaries, etc.) and would like to donate them to the growing collection of RASHER material bound for a submarine museum.

For more information, or to join the RASHER Organization, contact Dick Traser, editor of "Through the Scope", the official RASHER newsletter, at (760) 499-6907 or e-mail: ussrasher269@-usa.navy.org.

Thanks for your consideration

Peter Sasgen

RE: WWII U-BOATS

9 August 1999

I must take issue with the review by Ralph Enos of Clay Blair's Hitler's U-boat War in the April issue of **THE SUBMARINE REVIEW**. Indeed, Blair did a masterful job in compiling this history of submarine warfare in the Atlantic from 1939 to 1945.

But three of the key *observations* in the review do not ring true:

1. Discussing torpedoes, Enos notes "Despite a much speedier response [than the U.S. Navy to its torpedo problems] on the part of the German high command once a torpedo crisis was recognized, solutions were slow to enter the fleet and in some cases never did." Part of the reason for the slow response was that new, more capable torpedoes were being developed. Those weapons took up the effort needed to more rapidly fix older torpedo problems.
2. Enos states, "German U-boats lacked radar and sonar, and

their fire control and listen gear was only so-so." German submarines were fitted with radar toward the end of the war; more significant, their GHG sonar was the most advanced acoustic detection system in service with any navy. (The German Navy had experimented with the antecedents of the GHG as early as 1927.)

The GHG from a Type XXI U-boat was installed in USS COCHINO (SS 345) and a direct copy of that sonar became the U.S. Navy's BQR-2, our principal passive sonar of the 1950s. Further, the GHG was the key to an advanced fire control system fitted in the Type XXI submarine. The submarine's echo-ranging gear and plotting table were linked to a special instrument for so-called *programmed firing* in attacking convoys. As soon as a U-boat had succeeded in getting beneath a convoy, data collected by sonar was converted and automatically set in the Lüt pattern-running torpedoes, which were then fired in spreads of six.

After launching, the torpedoes fanned out until their spread covered the extent of the convoy. Then they began running loops across its mean course. In this manner the torpedoes covered the entire convoy. In theory these torpedoes were certain of hitting six ships of from 197 to 328 feet in length with the theoretical possibility of success of 95 to 99 percent. In firing trials such high scores were in fact achieved!

3. The review also states, "While the Allies continued to improve their weapons, sensors, tactics, and competence, the German posture stayed essentially the same as in 1939, or deteriorated." The Germans did put to sea advanced torpedoes—the world's first operational acoustic homing torpedo, pattern-running torpedoes, and when the war ended the Germans were producing the first wire-guided acoustic torpedoes. Also developed were acoustic torpedoes that could *out-fox* the Allied Foxer countermeasure device used to deter acoustic torpedoes, and a wake-homing acoustic torpedo!

The Type XXI submarine, entering service when the war ended, was the world's most advanced undersea craft and served as a model for our Guppy conversions and post-war submarines of the Tang (SS 563) and K1 (SSK 1) classes. Planned Type XXI variants—with amidship torpedo tubes among other innovations—and the closed-cycle Walter submarines gave promise of even more potent U-boats.

Other points of the Blair book and the Enos commentary also could be contested.

The German armed forces were plagued with largely inept leadership, organizational infighting, and production problems. But, in virtually every field of military endeavor—especially submarines—the Germans were highly innovative.

Finally, the concern by the British Admiralty over the 84 ships (635,000 tons) sunk in March reflected the fact that most were sunk while in convoys (believed to be the answer to the U-boat threat), relatively few U-boats were sunk in return, and the rate of loss was greater than the rate of merchant ship construction. Such a trend was most ominous.

Norman Polmar

A CORRECTION RE: ARGONAUT

11 August 1999

I wish to draw your readers' attention to a serious omission in my book The Last Patrol published by Airlife Publishing in 1994. The book deals with the losses of United States submarines during World War Two.

In the chapter concerning the loss of USS ARGONAUT (SS 166), I observed that the boat's skipper, Lieutenant Stephen G. Barchet, was relieved of his command after her first war patrol. Specifically, I wrote "The lack of aggressiveness caused discontent in the boat and on return to Pearl Harbor the commanding officer was relieved of his duties."

My assertion requires some explanation as new information has been received to show that a number of factors were not taken into consideration. These include the old ARGONAUT's defensive mission as a mine laying submarine, the boat's limited operational capabilities, and the prolonged patrol assignment.

In fact, COMSUBPAC letter April 1942 commended Lieutenant Commander Barchet for his exemplary conduct of ARGONAUT's first war patrol. In due course change of command on June 12, 1942 at Mare Island Navy yard near the end of a long overdue and much needed overhaul of ARGONAUT, Lieutenant Commander Barchet transferred command of the boat to Lieutenant Commander John Pierce. Subsequently, Lieutenant Commander Barchet assumed duties as Commander Submarine Division 32 and was promoted to the rank of Commander.

I should then point out that Commander Barchet went on to another submarine division command, a distinguished war record with the 7th Amphibious Fleet in the Pacific Theatre, held peace-time major commands both ashore and afloat and rose to the rank of Rear Admiral upon his retirement from active service in 1964.

I consider the U.S. Submariners of World War Two to be the Bravest of the Brave and I am more than happy to put the record straight with regard to Lieutenant Commander Stephen G. Barchet.

Sincerely,
Harry Holmes
27 Cooper Fold, Middleton
Manchester, M24 6JN, England

RE: ALBACORE

19 September 1999

In the article "The Origin of the ALBACORE" by Mr. R.P. Largess, it was stated that the hull material was reported by Captain Frank Andrews to be HY-80. The material was not HY-80 but the forerunner of it. The material was designated as HTS-ST. The ST was for special treatment and it approached HY-80 but the chemicals were not the same. The tensile strength was slightly different and the welding procedures were much more stringent than for HY-80. The first hull of HY-80 was in SKIPJACK (SSN 585) built at EB.

ALBACORE also had the first hemispherical hull structure at the forward end. The plates were formed of petals pressed out by Lukins Steel Corporation and delivered to Portsmouth and assembled under rigidly controlled circularity and welding temperature conditions.

The early history is very interesting and much can be verified by Captain Harry Jackson and Captain Don Kern. Both were deeply involved in the design and fabrication of this high speed submarine.

Sincerely,
CAPT R.J. Dzikowski, USN(Ret.)

SALT AND STEEL

Reflections of a Submariner
by Captain Edward L. Beach, USN(Ret.)
Naval Institute Press
Annapolis, Maryland 1999
Reviewed by CAPT James C. Hay, USN(Ret.)

The American public knows Edward L. Beach as a premier *submariner story teller*, his Navy colleagues know him as a consummate professional who led a highly distinguished career and his shipmates know him as a tactician, an excellent ship handler, a teacher, and most particularly as a friend who dearly loves the Navy. In Salt and Steel, his telling of the twentieth century Navy story in terms of his own experiences, Ned has produced, not a memoir, but a very personalized illustration of that unique deep relationship to the service, to the ships and especially to the people who share that feeling which every sailor knows.

This is a book which will appeal to all who already know the general story; the history buffs, the WW II types, those who fought all the unification battles of the '40s and the '50s, the Cold Warriors and the people who are now responsible for building the Navy of the future. It should be read also by young naval officers, and those who aspire to be one, as they seek to find their own way and set their own standards in the naval profession. It is the general public, however–those who know Ned as the author of Run Silent, Run Deep, Around the World Submerged and many other books and articles (remember Beachly Edwards writing in the Saturday Evening Post?)–who, along with the U.S. Navy itself, will benefit most from a wide reading of this very personal set of reflections on the service from one who spent an entire lifetime experiencing the best of it.

One source of Ned's *reflections* is from his family. The way his mother and father met is a very navy story and Ned's childhood memories of life in the Mare Island Naval Shipyard are tied to his own desire for a naval career. Naturally, a main source for his *reflections* is his long and eventful sea duty. After eleven successful war patrols, some purely spectacular, Ned even had command of a boat during the war, only six years out of the Naval Academy. In all Ned Beach commanded five ships and each and every one of those commands was special and a standout in the memory of all the others involved. PIPER's patrol at the end of the war, AMBERJACK's high angles, the new TRIGGER's shakedown cruise, SALOMONIE's need for preservation (which earned him the *Red Lead Ned* nickname), and of course the submerged circumnavigation in TRITON are all mentioned by Ned as illustrious of the history and purpose of the Navy.

His shore duty stations also figure prominently in forming Ned's *reflections*. It would be safe to say that he was in a unique position to view the naval scene in the post-War II/early Cold War period because his assignments were well above the usual Washington postings: Aide to the Chief of Naval Personnel, the Atomic Defense Section of the OpNav staff (and an early involvement with then Captain Rickover), the office of the Chairman of the Joint Chiefs of Staff when General Omar Bradley held that position, and Naval Aide to President Dwight D. Eisenhower.

Ned Beach even offers a bit of a mystery in his story about a "Joe Blunt". Using the name of a character from his novel Run Silent, Run Deep, he tells of a senior officer who asked Ned to use his position as Naval Aide to the President to help the senior's chances for selection to Flag rank. When Ned refused to do so he felt that his own subsequent promotion selections were adversely impacted by "Joe Blunt". The full identity of "Joe Blunt" is not revealed in the book, but there are probably enough clues sprinkled around in the story to help his submarine contemporaries solve the mystery without too much trouble. I know that I'm curious and I hope one of them tells me.

The last chapter in the book is titled *Ideas for Our Navy's Future Years*. Coming from one with such long and distinguished active service, followed by many years of thinking and writing about the Navy, the several *ideas* about personnel are well worth consideration by all involved with internal Navy policy. The real meat of the book, however, is in a section headed simply as *The Influence of the Submarine Upon Sea Power* and it is not just about internal Navy matters but it concerns the future of our national security efforts. It is, therefore; of importance to the American public and the top level decision makers they send to Washington to oversee those national security efforts.■

REGULUS–THE FORGOTTEN WEAPON

by David K. Stumpf
Turner Publishing Company
Paducah, Kentucky, 1996, 191 pages
Reviewed by CAPT R. Norris Keeler, USN(Ret.)

The Regulus program was in existence from 1957-1962. Regulus was a cruise missile with a strategic mission, which was replaced by the Polaris program. The decision was made in January 1956, but Regulus remained in service until 1963, when the Regulus boats became involved in other missions. Regulus was carried aboard the launching submarines TUNNY, BARBERO, and HALIBUT, and guided by other submarines with the radar suites P-1X/BPQ-1/BPQ-2. As Admiral Slade Cutter once said, "TUNNY would take the ball, hand it to CUSK, and then it would be relayed to CARBONERO to take it over the goal line"—not surprisingly using the football metaphor.

The author has provided a useful service to the submarine community. He was handicapped by never having been in the military or in any technical field, let alone having served in submarines. So, in spite of these shortcomings he undertook this effort, and produced the only real history of the Regulus, however flawed. This is a wholly commendable effort. But its limitations should be pointed out.

The author had significant help, only briefly acknowledged in the book. In the middle of his effort, Rear Admiral Russell E. Gorman, at the time the senior Naval Reserve flag officer, intervened and, after a considerable effort, obtained access to classified archives for the author. Without this access, the author, who had never previously held security clearances would have been severely limited. In the unclassified material available initially, only a small fraction of the history was generally known.

There are two flaws in the book. The first is the author's preoccupation with Chance Vought airframes. This area is important to the program, of course, but the avionics propulsion and control systems existed previously on the F-80, and droning had been carried out on other airframes. Nevertheless, these details were important, and were thoroughly covered. On the other hand, the most innovative and creative elements of the overall system, ignored by the author, were the radar tracking and guidance. Off skin tracking with an airborne beacon provided clutter elimination and a number of ECCM advantages; pulse spacing modulation provided guidance signals, and lobe switching gave a bearing accuracy far superior to the crude section scan capability. These technological innovations appeared time and time again in subsequent military systems.

The most troublesome shortcoming in the book, and one which makes it unsuitable for the general public is the failure to network and contact key personnel in the early and exciting stages of the program. Two of the key personnel never contacted were Rear Admiral J.B. Osborn and Lieutenant V.M. *Dutch* Klotzner. This reviewer was able to locate Lieutenant Klotzner in 48 hours and Admiral Osborn's address has always been posted in the directory of the Naval Submarine League. Submariners are well aware of the accomplishments of Osborn, who was hand picked by Admiral Rickover to be the first commanding officer of GEORGE WASHINGTON.

It is difficult to know what to make of these omissions. Perhaps it is just immaturity, or perhaps it is inability to gain perspective on an important and interesting part of naval history. Or perhaps the author just didn't want to take the trouble to track down the key individuals, and focused on various individuals who were part of the later (and less significant) part of the program.

The reviewer can recommend this book to submariners who were attached to the Regulus program and other interested submariners. One can only wish that Stumpf had arranged to co-author the book with Rear Admiral Osborn. That would have given his work imprimatur and authenticity.■

THE SUBMARINE PIONEERS

by Richard Compton-Hall
Sutton Publishing Ltd.
Gloucester, UK
November 1999

Reviewed by THE SUBMARINE REVIEW Staff

The **SUBMARINE REVIEW** received a pre-publication typescript of Richard Compton-Hall's new book and is presenting this review a little earlier than is to be expected because the subject matter, dealing with the time and events leading to the modern submarine era, are of particular interest as we start the Centennial Year.

It must be noted at the outset of this review that Compton-Hall for no less than eight previous volumes about (mainly Royal Navy) submarines and most recently for an excellent series of articles in these pages about submariner winners of the Victoria Cross, gives unqualified credit to John Phillip Holland as the *...clear winner of a long race...* to produce a viable, credible and militarily effective submarine—even though he completes that acknowledgment with The submarine, as we know it, really is an Irish invention...".

Compton-Hall's account of man's attempts to harness the military benefits of stealthy undersea warfare covers a period of about three and a half centuries prior to 1904, which he establishes as a base date for the *burgeoning* of the British submarine service because Admiral Jackie Fisher was then C-in-C Portsmouth and an avid submarine advocate. He paints a most readable and educational picture of the ideas and inventions of dreamers, entrepreneurs, and those desperate to offset the advantage of adversaries with overwhelming naval might. As an experienced submariner himself, in addition to being a most knowledgeable author and researcher, Compton-Hall offers some assessment of the various contrivances to provide a context for evaluating their real effectiveness. In that process, of course, he manages to deflate, or at least question, some of the stories which have generated from the actual events. Bushnell's TURTLE and Sergeant Ezra Lee's mission of September 1776 against HMS EAGLE, then part of the British squadron blockading New York harbor, is the primary target of this demythologization. Even so, the author does illustrate the multiplication effect of a myth arising from a submarine potential.

All the old stories are here and, although almost all of them are worthy of books unto themselves, the compilation is most impressive in getting across the difficulty of mastering both the physics required and the mechanics necessary in coming up with an effective submarine. The very early 16th and 17th century experiments are recounted and also discussed are several theoretical works of the time which gave continued impetus to work of the inventors, both gifted and not so gifted. In the 18th and 19th century, besides Bushnell's, Fulton's story is told as is that of the valiant men of CSS HUNLEY, and the always entertaining tale about the Rev. George W. Garrett and his RESURGAM as well as his participation in the Nordenfelt/Zaharoff efforts to sell submarines to Greece and Turkey. The story of Bauer in Germany is told and his feat in getting his crew out of his bottomed submarine bears repeating whenever possible. Space no doubt prevented a fuller telling of the French efforts to field a submarine force useful in their competition with Great Britain. The intellectual work of their *jeune ecole*, which led to a significantly sized French submarine armada around the turn of the century, and the design engineering of Monsieur Laubeuf in the 1890s both deserve a special place in the early history of submarining. It would be well worth the reader's effort to follow up on the coverage by Compton-Hall to gain a better understanding of the French experience of this time and the reasons it did not come to more than it did.

Richard Compton-Hall is to be complimented for producing this very useful *pre-history* of military submarines at this time. In looking back over the twentieth century's achievements and advances in undersea warfare it is instructive to realize that many of the reasons for having submarines today were present way back then, if only in somewhat different form. Then, as now, that was true for both strong and weaker maritime powers.■

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