THE SUBMARINE REVIEW

JULY 1997

A Quarterly Publication of the Naval Submarine League

THE SUBMARINE REVIEW IS A PUBLICATION
OF THE NAVAL SUBMARINE LEAGUE

NAVAL SUBMARINE LEAGUE • Box 1146 • Annandale, VA 22003
(703) 256-0891 FAX (703) 642-5815 E-Mail: sublague@aol.com

EDITOR'S COMMENTS

In each issue of **THE SUBMARINE REVIEW** we try to bring to the reader a mix of force status reports, program updates, serious history, sea stories (hopefully with a point), commentary, ideas to meet new situations and re-looks at old problems. Indeed, we aim for the interesting, a breadth of viewpoints, that which may add to the store of submarine knowledge, and maybe even a bright moment's reading. In this July issue we believe there is a satisfying share of that sort of thing, but there are several concepts present in these pages which call for special notice and a recommendation for particular attention. Therefore, without any prejudice to the articles not so mentioned, the Editor offers these Comments about four points raised here as worth your consideration of their importance to the future of American submarining.

The first concerns the **Submarine Way of Leadership** and the broader context of the submarine community's functioning within the social, economic and political world of today, and the probable one of tomorrow. Our lead Feature in this issue is the Banquet Address to the Annual Naval Submarine League Symposium in June given by Admiral Chuck Larson of the Naval Academy. In it he framed his description of meeting the challenge offered him by today's society in terms of what he learned in the Submarine Force. His specific comments about teaching ethics and leadership center on academic rigor in an environment of structure and discipline in order to get to the necessary focus on integrity. Those methods are very noteworthy and give us confidence in the future leadership of the navy, but one of his basic points is that such a regimen amounts to a *counter-culture*. As a professional group which is firmly structured, conducts itself with rigorous attention to detail, and is completely interdependent on each others integrity, the submarine community perhaps has a bit more to learn from Admiral Larson's recent experiences than other branches of the Armed Services. The past year has seen recommendations put before congress which would eliminate the force behind a lot of our rigor and we are constantly hearing one *outside expert* or another telling us that our way is too hard-nosed—one can perhaps conclude there is a societal force with which we might have to contend. This Editorial Comment therefore, is a request to the members of the League to comment on the effect of our current society on our

way of doing business, and even about our effect on society as a whole.

The second of these somewhat *overarching concepts* comes from the short piece concerning a study being started at MIT about the lessons to be learned from the Cold War ASW efforts. The aim of this particular study seems a good bit different from the usual retrospective analyses in that it is seeking some political-military-(cultural?) reason why the Submarine Force re-oriented itself in a future-looking way rather than following the ususal post-victory practice of getting ready to re-fight the last war. A good many of the League members lived through those times, (this writer qualified in an SSK in the '50s) and I suspect there are many different opinions as to what was the specific driver (or if there was just one). Once again this is a question that seems to go beyond simple bureaucratic-pentagonese reasons of force structure justification and it rates some considered thought by those who were there at the beginning in the late '40s and early to mid '50s, and by those who went through the operationally developing times of the '60s and '70s, and by those who did the sophisticated stuff of the '80s. It is also quite possible that some may be able to offer instances of influence from outside the submarine community which contributed significantly to those successes. **THE SUBMARINE REVIEW** welcomes the effort by Drs. Sapolski and Cote and we look forward to publishing their results.

The review by Admiral Vogt of the book China's Strategic Seapower also illustrates a higher concept of great importance to the submarine community. In this era of small threat and overriding concern for regional/littoral conflicts we may have to be the ones to sound the lonely note of warning for what the P-M pros call the *resurgent-emergent global threat*. When the question of preparing for the rise of another super-power threat was put forward several years ago as a factor to be considered in long-range national security planning the press disparaged it as a saber-rattling figment of the Pentagon's imagination, and serious public discussion has not been opened since. Since the construction of enough submarines to produce a force capable of taking on a world threat is a long, difficult and expensive process there is danger that, unless due vigilance is practiced, such a threat could develop within our regeneration time line. It remains to be seen, of course, whether or not China is able to develop into a world power, and if

it does what its intentions will be. What is clear, however, is that an enormous effort, well beyond the purchase of a few Kilos, has been put into the development of its submarine capability. The last time a continental power did that the U.S. Submarine Force had to go to extraordinary measures to stay ahead, and our staying ahead proved to be a critical factor in the preservation of world peace.

The fourth, and final, point to be made here has to do with the letter response we have received to the series on torpedo development by both Tom Pelick and Fred Milford. There seems to be no doubt that the Mk 14 was, indeed, less than problem free and user friendly. The larger point, however, may be that undersea combat is different and difficult, both in ways which may not be readily recognized by the defense establishment. As such, it may not be as amenable as the air and ground situations to the current trend of minimizing the growth of platform capability in favor of increased weapon performance. As with the conclusion about **force size** which can be drawn from consideration of the China discussion, **force quality** concerns are very important and may turn more heavily on the submarine's capabilities than on those of our weapons.

Those are the Editor's Comments about several of this issue's offerings. Let us hear from you with your comments.

Jim Hay

FROM THE PRESIDENT

The months of May and June were extremely successful for the Naval Submarine League. The classified submarine symposium at APL attracted a capacity crowd and was highlighted with speeches by the CNO, Admiral Jay Johnson, USN; Admiral Bill Owens, USN(Ret.), former Vice Chairman of the JCS and now President and CEO of SAIC; and Tony Cavaiola, recently the Special Assistant to the Secretary and the Deputy Secretary of Defense, and currently Vice President for Government Programs of the Lockheed Martin Corporation.

At the NSL unclassified symposium, in June, the presentations were similarly well received. The luncheon speaker, Admiral Archie Clemens, CINCPACFLT, and the dinner speaker, Admiral Chuck Larson, Superintendent of the Naval Academy, were superb. Chuck was especially effective in his comments honoring our Submarine Hero, Admiral Bob Long.

Each attendee had to be very impressed by the three active duty submariners who now lead the community. All three, Vice Admiral Rich Mies, COMSUBLANT; Rear Admiral Jerry Ellis, COMSUBPAC; and Rear Admiral Ed Giambastiani, Director, Submarine Warfare Division (N87) in the Office of the CNO, were particularly clear and straightforward at both symposia and especially when answering questions.

As we move into the intense and dynamic phase of Congressional review and passage of the Authorization and Appropriation Bills, I want to stress some facts which may illustrate the advances submarine design and submariners have made as we near the decisions on NSSN.

1. Manning efficiency, reduction of our manning, is under constant pressure as the Navy stresses Life Cycle Costs. In using a measure of *crew per 1000 tons of displacement*:
   FF 1052 = 70+, CG 28 = 50+, CG 47 is 35+
   CVN 76 = 30, SSN 637 = 28, SSN 688 = 18
   NSSN = 17.
2. Force Employment Efficiency (increased availability to Fleet Commanders) improves since shipyard overhaul time is reduced for successive classes, and compacted by both long lived cores and COTS:

Class	Overhaul Time as Percentage of Life of Ship
SSN 637	18 percent
SSN 688	14 percent
SSN 688I	7 percent
NSSN	5.5 percent

3. Great strides have been made in the propulsion plant. NSSN will be the first submarine designed to never be refueled. The following table will be especially meaningful to those of you have labored in the engineering spaces. The table shows the percentage reduction in NSSN compared to SSN 688 and SSN 21

	SSN 688	SSN 21
Fewer pumps	30 percent	40 percent
Fewer valves	50 percent	45 percent
Fewer circuit breakers	40 percent	30 percent
Fewer unique parts	50 percent	70 percent
Fewer pipe hangers	30 percent	35 percent

These improvements are major and ensure efficiencies in the NSSN which were never *dreamed of* just a few years ago. We have too long been the *silent service* even when discussing design, cost mitigation and maintenance. I hope the facts will encourage your active discussion, not only of the need for but also the improvements in our newest platforms.

Dan Cooper

BANQUET ADDRESS AT THE ANNUAL SYMPOSIUM

by ADM Charles Larson, USN
Superintendent
U.S. Naval Academy
June 5, 1997

I'm delighted, honored, and jumbled to be the senior submariner on active duty and to be selected as the naval Submarine League's banquet speaker, particularly on this occasion--an evening on which we honor the accomplishments and significant contributions of Admiral Bob Long.

My 39 year Navy career reflects the strong influence of Bob Long. He was a mentor and a role model in my early days and he's now a friend and a confident. When I commanded my first submarine Bob Long was OP-02 and when I came to Washington after my command at SUBDEVGRU ONE, Admiral Long was Vice Chief of Naval Operations.

He and I later would both hold the job as CINCPAC. In fact, he was president of the Flag Selection Board that selected me for Rear Admiral. See Bob, sometimes you have to live with your mistakes.

When I was asked to return to the Naval Academy as Superintendent in 1994, it was Admiral Bob Long who was instrumental in persuading me to return to the Academy for a second tour, which we both knew would be more difficult than my first.

Bob Long's leadership and his character have inspired me in many ways. And the success that I might have attained has its roots in the example set by Admiral Bob Long. I'm sure that I'm not the only naval officer here tonight who could say that.

His influence can also be seen in what we have worked to accomplish at the Naval Academy since I returned as Superintendent in 1994. When I began my second tour I knew that I faced a difficult challenge to restore the public's confidence and the Navy's confidence in the Academy. When I returned three years ago, I decided to put a heavy focus on character and leadership development. I reflected on what I had learned about leadership in the Submarine Force, and I came up with some obvious elements:

- **Integrity.** To call a spade a spade. To write the casualty report or the incident report and record the patrol report just the way it happened. To determine the facts and the faults,

take responsibility, give credit where it is due, and always do what is right.

- **Concern for people.** Maybe it's because our crews are small; maybe it's because we operate in a most unfriendly environment where, when something goes wrong it always gets worse until the whole crew solves the problem; maybe it's because we go far forward where no one else can go; with each man's life depends upon every other man aboard—but whatever it is, we grew up with a submariner's loyalty, mutual respect and concern for the total person, his family, his career, and his well-being, as well as his performance.
- **Logical thought process.** Asking the right questions, understanding what is really going on and taking appropriate action.
- **Technical proficiency.** A qualification process that evaluates our competency and requires that we be knowledgeable and that we be capable.
- **Intellectual honesty.** Making approach and attack decisions based on the best information available. Believing your indications and not indulging in wishful thinking—but always striving for the right answer and having the courage to accept it when it is not the one you would like.
- **Tenacity.** We couldn't turn back when on station. There are many sea stories in this room tonight about making things work and never giving up when the going got tough.

With those thoughts in mind, let me tell you a little about the challenges that we faced and how we dealt with them at the Naval Academy.

We knew that before we could address these challenges, we needed to answer an important question if we are to pursue our goals: Have young people and our society changed? The answer is YES. For example, on a regular basis, we hear growing numbers of reports that cheating is now very common in schools. We hear more cases of individuals who choose their actions based on what is legal, as opposed to what is right; they usually do something first and then rationalize their behavior after the fact. We see fewer individuals who demonstrate tolerance, or individuals who have the strength to accept responsibility for others. And there appears to be less peer pressure to do what is right and much more to *do your*

own thing.

I also noticed that the atmosphere, *culture* if you will, had drifted away from what had always distinguished the Naval Academy from its civilian counterparts in higher education. In fact we had become too *civilian*.

This was not a good way to buck those adverse trends in society. How did we structure our programs and how did we respond? We took major steps back toward structure, discipline. We reduced privileges. We required leadership by presence and leadership by example. We re-emphasized three levels of *responsibility*: self, shipmates and the Naval Academy.

Our midshipmen have been challenged to take charge.
And we have refocused our emphasis on character development and leadership to help our midshipmen develop their moral muscles. These are some of our initiatives:

- New leadership curriculum. We have thoroughly revamped our leadership curriculum, incorporating the principles I learned in the Submarine Force;
- New ethics course. A three-credit course, "Moral Reasoning for Naval Leaders," provides a weekly lecture by a faculty philosopher and seminars taught by senior officers (O-5 and above) with extensive fleet experience. This course is taken by all midshipmen during their third class (sophomore) year;
- Integrity Development Seminars. During these monthly, small-group meetings of midshipmen divided by company and class into about 250 groups of 15 peers, midshipmen look within themselves to define and clarify their basic moral values and to see why those values are important and how they relate to our profession. Monitoring and guiding the often lively debate are trained midshipmen and staff facilitators. The mids are upperclassmen who are selected by their company officers; staff facilitators are all volunteers, both military and civilian, who represent all communities from around the Yard, including academic faculty, the athletic department, public works and many others;
- Ethics chair. With an endowment provided by the generous support of two donors, in January 1997 we announced the appointment of Professor Nancy Sherman of Georgetown University to the new position of Distinguished Chair of Ethics. She is a world-renowned ethicist who offers her

considerable expertise to all of the Naval Academy's character development efforts;

- Ethics across the curriculum. As a coordinated component of our academic program, we continue our efforts to provide midshipmen with examples and discussions of ethical issues in all academic disciplines, from literature and history to science and engineering. This helps midshipmen to understand that ethical behavior involves every aspect of their personal and professional lives;
- Distinguished Professor of Leadership. With the generous gift from another donor, we established this new position and selected retired Admiral Leon A. *Bud* Edney. Admiral Edney is focusing his efforts on improvements in how leadership is taught and practiced, both in the Division of Professional Development and in Bancroft Hall (the midshipmen dormitory). He also serves as my special adviser on leadership, teaches core leadership and ethics courses and promotes moral development and leadership education;
- Honor concept and education. We have reaffirmed midshipmen ownership of the Naval Academy's Honor Concept, and strengthened our efforts to educate all midshipmen about the history, significance and value of our Honor Concept, which truly lies at the core of what it means to be a midshipman;
- Traditional Plebe Summer. With an emphasis on leadership by example, we have returned to a more traditional summer training period for new midshipmen, one that challenges them to reach new heights in physical, intellectual and moral performance, and one that emphasizes the importance of respect for the dignity of others; and
- Company Chief Petty Officers. For the past several years, in addition to a company officer, each one of our 30 companies has been assigned a senior chief petty officer or Marine Corps gunnery sergeant who provides a wealth of first-hand fleet experience to our young officers-in-training. Our senior chiefs and gunnies are some of the finest the Navy and Marine Corps have to offer; the tremendous value of the knowledge and experience they bring to our midshipmen is hard to measure, but harder to ignore.

Society has changed. What we are doing is truly *counterculture*. Yet we will not accept *changes in our society* as an excuse. We

will persevere in our efforts to build ethical foundations and mold the character of our young men and women. We have confidence we can do it. To help focus those efforts, we established guiding principles for the Naval Academy. From highest to lowest, we try to live by them every day. I would like to share them with you.

1. **Uphold the standards of the Naval Academy.** All of us must accept responsibility and accountability for performing our duties in accordance with our high standards.
2. **Be a person of integrity.** Each of us should be an example for others around us. When a person consistently does the right thing, it has a powerful effect on influencing the behavior of others.
3. **Lead by example (meet the standard to which you are holding others).** As with our midshipmen, each of us should hold ourselves to the same or higher standards to which we hold our subordinates.
4. **Strive for excellence without arrogance.** Excellence with a dose of humility conveys our respect for those around us; others will always recognize excellence in action.
5. **Do your best.** This is our minimum requirement. We should never be satisfied with less than the best in everything we do.
6. **Treat everyone with dignity and respect.** The Navy's and the Naval Academy's greatest asset is its people. Treat each other well, look out for each other, take care of each other and we can, together, achieve great things.
7. **Tolerate honest mistakes from people who are doing their best.** None of us has yet achieved perfection, so it is important to accept honest mistakes from those who are applying their talents and energies to the best of their ability.
8. **Seek the truth.** Rumors and unverified anecdotes undermine the bonds of a community; always seek the truth, whenever you can, from those who are in a position to know.
9. **Speak well of others.** Gossip undermines our trust in each other. Gossip or speaking ill of others demonstrates a genuine lack of respect for others in our community.
10. **Keep a sense of humor and be able to laugh at yourself.** I'll save the best for last. There is little doubt that the work we do here at the Naval Academy is challenging, because the standards we set for ourselves are so high. Yet it is crucial

that we be able to keep it in perspective and maintain our sense of humor. And being able to laugh at yourself increases the likelihood that when you achieve excellence, it will be without arrogance.

Our goal is to make both the officer and midshipman chain of command work by enhancing mutual trust, respect and good two-way communications. When we do, we will achieve greater success in providing the Naval service with the finest leaders as we enter the 21st century and begin our next 150 years. This is what Americans expect of us, and we will give them no less.

We recently conducted a survey of the entire Brigade; we found that the midshipmen were very proud of our Naval Academy. They believe in what we're doing and think it should be tough. They are committed. They believe we have a clear vision of where we're going. They support our honor concept and our character development and leadership programs. Bottom line: We made it more difficult; morale went up.

This past year has been the best year, across the board, in my six years as Superintendent. We feel very good about where we are. Measure us by the quality of our graduates, not those being thrown out. And, by the way, 109 of those outstanding graduates are enroute to our Submarine Force.

My vision for the Naval Academy is to continue to refine the programs I have outlined for you here tonight. Given continuing support, our initiatives and others hold the promise of a Naval Academy of the 21st century that will continue to earn respect and admiration of all Americans and provide them with what they expect—the highest quality leaders for our Naval service and our nation. This is what Americans expect, and we will give you no less.

So again I would like to recognize Admiral Bob Long for the standards he set and achieved during his career, the wisdom he imparted, the leadership he demonstrated, and the friendship and guidance he so freely offered.

I know I speak for the entire submarine community -- operators, their family members, builders, suppliers, and just plain supporters of this very special community -- when I say, "Admiral, you have our deepest gratitude and respect for your countless contributions, leadership, vision and spirit." Those of us who wear -- or who have ever worn -- the dolphins which indicate membership in this

community, do so with an even deeper sense of pride knowing that you have been, and will always be, a role model and influence on all of us. You have set the standards, Sir, and we are all grateful for your strong influence. We are committed to building on your foundation.

To the Naval Submarine League, thank you for inviting me to tonight's event and for making me a part of your salute to Admiral Bob Long. I am truly honored. ■

REMARKS TO A LEAGUE LEADERSHIP GROUP

Wednesday, June 4, 1997

by Congressman Herbert H. Bateman
Chairman
House National Security Subcommittee
on Military Readiness

Congressman Bateman met over breakfast on Capital Hill with a leadership group from the Naval Submarine League before the start of the Annual Symposium.

Thank you for inviting me to speak here this morning. This is certainly as distinguished a gathering as I have enjoyed the opportunity to address on an issue so close to my heart. The downside, of course, is that a group this knowledgeable leaves no room for error. Be that as it may, I am more than happy to offer a few simple observations on an issue of tremendous importance to the nation.

The Clinton Administration recently released its long anticipated Quadrennial Defense Review (QDR) setting forth the strategy and force structure it believes are required to meet our national security objectives in the years ahead. There were no real surprises in the QDR. The national military strategy has been in the main well received. The glaring defect is that the force structure and budget assumptions are not compatible. Budgets and force structure have already undergone considerable transformations since the end of the Cold War. These transformations have been so significant that our ability to execute another *Desert Storm* is seriously in question given the myriad of contingencies for which our military forces are routinely called upon.

In the debate over force structure and requirements the issue of undersea warfare must not be neglected. Even well documented evidence of the continued importance Russia places on its submarine programs have not altered the perception of an absence of risk from that submarine force. While that is the perception, we must remain cognizant that if intentions change, the Russian undersea warfare capabilities cannot be ignored.

I am not here to argue that a Russian menace exists. It does not. What does exist, however, is a still considerable role in our national military strategy for a strong undersea warfare capability.

The QDR reaffirms the Bottom-up Review's recommendations of imposing deep cuts in the size of the U.S. Attack Submarine Force, from its Cold War high in the mid '80s to 50. The QDR Attack Submarine Force of 50 is within the parameters of the 45 to 55 submarines enunciated in the Bottom-Up Review. By any reckoning the question, however, is will a force of 50 attack submarines be adequate to execute our national strategy. I defer to the experts in the audience, but I have my reservations.

Just as with many other areas of the military, the salami slice approach to force structure reductions pays scant attention to the actual real world requirements pressed upon those reduced forces. The threat of foreign navies, given the proliferation of advanced non-nuclear submarines in the inventory of hostile and potentially hostile regimes around the world must not be ignored. We must be careful that we are not driven by budget assumptions that ignore potential threats.

What we do need, however, is a Submarine Force at least minimally sized to the requirements set forth by the National Command Authority.

Sadly, individuals sufficiently cognizant of the number of attack submarines needed in the Force to meet minimal peacetime forward presence and special mission requirements are few, even in the Pentagon. The operators of our undersea warfare assets do not decide where they are going to sail and for what purpose; they are sent there by the service chiefs and civilian authorities who rightfully control the armed forces and articulate the national military strategy. All our Naval personnel ask is to be provided the platforms and personnel needed to carry out those missions.

Naval forward presence is at the core of our national strategy. The withdrawal of many of our ground and land based air forces from their forward positions places an absolute premium on our continued ability to forward deploy assets during peacetime capable of operating without concern for host country support and possessing a formidable capacity to deliver ordnance on target in a timely manner. That translates to our attack submarines. I don't need to reiterate the unique and impressive capabilities the U.S. Submarine Force provides. You know that better than anyone in the country.

The United States must maintain a capable, robust Attack Submarine Force that takes into account quality of life issues as well as the simple mechanical requirements inherent in operating

a Navy, such as maintenance and refueling schedules. The United States must continue to build submarines to maintain the capacity to do so as it is vital to the continuation of our ability to meet legitimate national security requirements. The battle that will be waged in Congress over the next several months will be difficult, but I am confident that common sense can prevail and the agreement meticulously negotiated between the two submarine builders and the Navy will be reflected in the defense bill that will be drafted beginning today.

The alternative is the loss of a unique and absolutely essential national asset: the finest Submarine Force in he world. That Force is needed to protect our interests overseas. It is needed both to execute numerous peacetime missions and to be ensured of defeating any threat in the sea lanes vital to our national interest. It is needed in attacking land targets without being detected. It is needed to support special operations which are receiving increased attention in the post Cold War era and for operating as part of task forces or battle groups. We must build new submarines to ensure that capability exists tomorrow. **Not even the minimum QDR Submarine Force structure can be maintained unless we get about building the new attack submarine.**

Few of us predicted the end of the Cold War. Few of us can predict the future 20 to 30 years out. It is for that period of time and beyond, however, that the implications of the decisions we make today will be felt. We must act responsibly and meet our national security requirements in undersea warfare. ■

ADDRESS TO THE SUBMARINE TECHNOLOGY SYMPOSIUM May 15, 1997

by Lawrence Cavaiola

Mr. Cavaiola is Vice President for Government Progams of the Lockheed Martin Corporation. He has held many positions of responsibility in government, most recently serving as Special Assistant to the Secretary of Defense and the Deputy Secretary.

It is indeed a privilege to address you today on the submarine of the future Submarine Force and the impact of technology on that Force. You will recall from that very fine introduction that I appear to be the *duty Surface Warfare guy* being served up on the luncheon menu. So as a lifelong *skimmer* or *target* as some of you might say, it's not with just a bit of trepidation that I come before you—I've never known a submariner that didn't have the obligatory periscope picture of the carrier between the crosshairs on his wall!

It's particularly interesting to be addressing you on the day the results of the Quadrennial Defense Review, or QDR, are to be released to the Congress. There have already been a number of press accounts about the QDR results, so I'd like to attempt to give some perspective beyond the numbers. The QDR is the second major examination of U.S. defense strategy and budgets since the fall of the Soviet Union. The first such examination—the Bottom UP Review or BUR—conducted under the leadership of the late Defense Secretary Les Aspin, made considerable changes in end strengths, force structures, and acquisition programs that continue to have a major impact on our military establishment.

Lately there have been some who have taken to criticizing the BUR for what it supposedly didn't do. "It wasn't imaginative enough," they say, or "the two MRC strategy it postulated didn't place enough emphasis on the lesser contingencies and peacekeeping operations we so often find ourselves in."

In considering these critiques I would ask that you take yourselves back to those thrilling days in the early part of the decade when the fall of the Soviet Union and the collapse of the Warsaw Pact induced a euphoria in some—including many in the Congress—about reaping a *peace dividend* and pushing defense

spending out of the way in favor of more money for domestic programs or tax cuts. The situation was such that the defense budget could have been likened to a swimmer trying desperately to find the bottom of the pool with his toe, but to no avail.

The BUR established where that bottom was, based on a rational—and, in light of the reported QDR results—surprisingly enduring set of strategic principles. It may not have been perfect in foreseeing every future contingency or in the purity of its thought processes in matching strategy with the budget projections of the time, but it certainly showed us the way ahead for a new and uncertain era.

As important as its lofty strategic pronouncements might have been, the BUR also accomplished two other things for which it should be remembered. First, it established a clear imperative for improving and maintaining the Readiness of our military forces. Based on its own strongly held beliefs and still smarting from the *Hollow Army* experiences of the late 1970s, the new Democratic administration in 1993 wanted to be sure our military would never again suffer the pains and humiliation of inadequate training and maintenance. The corollary to the Readiness axiom became the improvement of the Quality of Life of military people and their families, including improvements to housing, child care, and educational opportunity.

The second legacy of the BUR is its attempts at matching acquisition programs and policies with the overall strategic and budgetary course it set. Arguably, one can point to the substantial downsizing (or rightsizing) of the defense industry in recent years as a direct result of the BUR's policies, beginning with a dinner meeting almost four years ago between defense industry CEOs and Secretary Aspin and then-Deputy Perry that many call *the last supper*. We are still digesting the series of Acquisition Reform initiatives begun as part of the BUR, and it will be a few more years before we can really assess their impact. But the BUR is unique in the specific programmatic directions it established for several of our major warfighting components. It made substantive and lasting changes in a number of acquisition programs, including attack and reconnaissance helicopters, ballistic missile defense, aircraft carriers, space launch, milsatcom, tactical air forces, and attack submarines. The Joint Strike Fighter program, for example, was born directly out of the BUR.

In the BUR, submarines enjoyed a particular level of scrutiny apparently unparalleled in the QDR. Virtually all aspects of the way we build and operate submarines came under the BUR's magnifying glass. The BUR made an attempt to match the changing threat with planned force structures and industrial base considerations, at least as far as the number of submarines was concerned. And the results were quite wide-ranging:

- The number of nuclear attack submarines was to be reduced from the Cold War goal of *about 100* to somewhere between *45 to 55*.
- That only one of the two nuclear capable shipyards should remain in the business of designing and building nuclear submarines.
- And that the next generation submarines, the New Attack Submarine, should proceed and displace the Seawolf as a *more cost effective follow-on* front line submarine.
- Later on, the companion Nuclear Posture Review determined that the number of Trident submarines should be reduced from 18 to 14 under the START II limits.

Now as we all know, some of this plan has come to pass and other parts have not. Most significantly, it was at about this same time period that the Navy became the first of the military services to articulate clearly its own vision for the post Cold War era. The 1992 publication of *...From the Sea* and the publication of the companion, *Forward...From the Sea* changed the complexion of anticipated naval operations from their heretofore blue water emphasis to a distinct preference for operations near the shore—the so-called littoral regions of the world—in support of forces ashore in joint and combined operations.

No component of our naval forces has been more affected by this change than our Submarine Force—arguably the *bluest of the blue water forces* the Navy possesses, for although nuclear attack submarines have always operated near the shore in a wide variety of missions important to the national security, their traditional emphasis has been on anti-submarine warfare for protection of shipping lanes, our ability to project power, and in support of our nuclear deterrent. So the importance of the Navy's shift to a littoral strategy cannot be overemphasized in any discussion of the

future of the Submarine Force or the technologies that support that future. More on this in a moment.

So why the discourse on the BUR and Navy vision? After all, isn't this pretty old news? Perhaps I just have a warm spot in my heart for the early '90s? No, the point is this: all of the reporting on the QDR points to a result that will do five basic things: first, reaffirm the BUR strategy of maintaining the capability to fight two major theater wars almost at the same time; second, give added visibility to the smaller, real-world contingencies that place high demands on certain forces; third, continue the high emphasis on Readiness and Quality of Life issues; fourth, place force modernization higher on the priority list; and fifth, in the absence of an increased DOD topline, pay for the added equipment with relatively modest force structure and personnel reductions, more efficient business operations, and cuts in the tactical aviation programs of the Navy and the Air Force.

Now all of the publicly available indicators suggest that the QDR is unlikely to change the broad outline for the future of the Submarine Force as conceived by the BUR—force structure will remain about the same (probably less a couple of attack submarines), no new earth-shattering strategic rationale will emerge for why we have a Submarine Force, the New Attack Submarine program will continue roughly as it has before, and the lingering concerns about the submarine industrial base will remain, although on this latter point the QDR appears ready to side, at least implicitly, with the Navy's approach to letting the marketplace try to work out the solution to the problem that the BUR tried to mandate.

So what's left to discuss if we are essentially *underway as before*? Well, allow me to submit that there's plenty to talk about. Just below the surface of every one of the QDR's decisions (or non decisions) regarding the Submarine Force lies a host of issues yet to be resolved. Some in the Congress, for example, remain unsatisfied with both the Navy's technical approach to the New Attack Submarine and the acquisition strategy that accompanies it. Others suggest that we have reached a strategic crossroads regarding the future employment of our attack Submarine Force. Still others opine that the QDR's apparent emphasis on modernization should mean more opportunity for the Submarine Force to *get well*.

We could spend hours discussing any one of these issues. But let me focus on the one issue that quickly and invariably becomes the key element of any discussion of the future of the Submarine Force: and that issue is **Technology**. It is truly testimony to the importance of technology in the Submarine Force that the Naval Submarine League can hold a very high quality, three day symposium on the subject every year, yet we can barely *sweep the horizon* on the range of topics and depth of knowledge both resident in and necessary to keeping our Submarine Force at the leading edge and preventing technological surprise.

I suspect that the Submarine Force has always been fertile ground for technological innovation, from the earliest employment of submarines during the Civil War to the present. During my professional association with submarine programs over the past decade and a half, the technology focus has remained strong and sometime contentious. As a way of illustrating this point, let me read to you some observations and see if you can tell when they were written:

(1) "[our next generation submarine] was a low-risk design that will have less capability than [its predecessor] in several key areas."

(2) "...the same Department which proposes to build [revolutionary aircraft] proposes to build a next generation submarine which appears to be anything but next generation."

(3) "...the Navy's current submarine technology program is unduly restricted to issues relating to the design of its forthcoming class of attack submarines..."

(4) "...[our adversary's] ambitious R&D program...may well produce...a [qualitatively superior] submarine unless our own R&D efforts at least match theirs in scope and productivity."

Now the first two statements were made during congressional hearings this spring on the future of the New Attack Submarine and the extent to which it will incorporate the requisite level of technological innovation. The latter two statements were made nearly 10 years ago in a report issued by a special panel on submarine technology and ASW of the then-House Armed Services

Committee, a panel that included among others Bill Perry, Paul Kaminski, and Harold Smith.

Just a few weeks ago Dr. Kaminski directed the Defense Science Board to undertake a study of the "Submarine of the Future", citing the shrinkage of defense resources and the need to, in his words, "examine cost/capability tradeoffs in considering the design of a Submarine Force appropriate to the future environments in which naval warfare may occur." Dr. Kaminski further directed the DSB to examine potential roles for submarines over the next two decades—including radically different roles to those played today—as well as, and I quote, "the technology improvement barriers that need to be overcome for very significant improvement of the ideal Submarine Force mix or radically different submarine."

Let me go out on a limb here and speculate that when the DSB gets around to its work it will find a great deal of technical innovation has occurred in the Submarine Force over the past several years in a number of areas, including: quiet propulsion plants, even when operated at tactical speeds; long-range, highly lethal weapons; and sophisticated, complex combat systems. All of these are associated with the blue water ASW missions mentioned earlier, though each has utility in other scenarios.

But the kinds of things submarines are likely to be called upon to do in the post QDR world and, more importantly, the things they could be asked to do given the right set of capabilities, will be spawned by a different set of imperatives, including: an emergent blend of operational tactics with innovative technologies; the need for connectivity-with-stealth versus disconnected silence; and the rebalancing of our technology efforts to support the Navy's littoral warfare focus.

As a way of summarizing these thoughts (and providing you with a more *target-rich environment*) let me summarize some of these ideas in four broad categories.

First, there's still a threat, it's still ASW-oriented, but it's quantitatively smaller and qualitatively different. There's no question that Russian submarines continue to get quieter, despite the difficult economic conditions faced by the rest of the Russian military. According to recent congressional testimony by the Director of Naval Intelligence, the latest Akula II and Sevorodvinsk submarines approach our own SSN 21 and New Attack Submarine classes in quiet operations, particularly in the narrowband noise

spectrum. But there will be fewer of these submarines than might have been expected in the past, with the number of modern Russian nuclear attack submarines expected to be cut nearly in half over the next decade. As such, their submarine force will tend to get older on average as time progresses, good news for our operators, though perhaps not such good news for environmentalists. It is also true that Russian submarines continue to operate out of area, sometimes along our coasts. But these operations are significantly fewer than in years past, more out of the ordinary than the routine they used to be.

Two more recent threat phenomena need to capture our imagination as we consider new submarine technologies. First, the world wide proliferation of sophisticated, non-nuclear propelled submarines continues unabated. What's new is that there is now available a much wider variety of sensor, weapon, and combat system technology in the marketplace, meaning that an adversary focused on keeping us out of a given area could put together a reasonably good submarine force from sophisticated parts—and yes, there are those around the world who are willing and able to integrate it all for them. And second, there are at least three countries that concern us today and are of potential concern for the future that are making considerable investments in submarines besides the Russians, and these include Iran, North Korea, and China.

The point is this: Some would suggest that if the United States sizes and shapes its Submarine Force to handle the Russian threat, then all other submarine threats would be *lesser included cases* of that posed by the Russians. I would suggest a somewhat different approach. We should use the Russian submarine force to provide the *benchmark* against which we measure our quieting technology for the foreseeable future. But it would be unwise to stop there; with apologies to Satchel Paige, we must look back, because others may be gaining on us, and in ways that are asymmetric to our regular thought processes. As Dr. Kaminski recently noted, "The U.S. is no longer confronted by a one-dimensional threat, but by several actual and potential widely distributed regional threats." In that spirit, perhaps we should ask Hollywood to consider a remake of the movie, *The Hunt for Red October* to include the Iranian Kilo and Chinese Type 094 SSBN among the cast of characters.

Second, we need to have afresh look at submarine require-

ments, then drive technology to help us fulfill those requirements. As the HASC panel noted several years ago, "The most fundamental issue in considering future SSNs is what their missions should be...We need to consider other roles for submarine which, with their inherent stealth, can penetrate areas denied to surface ships and aircraft."

While acknowledging the continued importance of the ASW mission, let's consider a couple of other areas where submarines can have a major impact.

First, of course, is support to the littoral campaign. As I noted earlier, one could argue that submarines have been doing this effectively for a number of years, and you'd be correct. But the Navy's landward reorientation presages a whole new realm of potential activities for the Attack Submarine Force. Technology is helping this effort already, with new sensors and weapons, notably the vertical launched Tomahawk cruise missile and the possible employment of a naval version of the Army's TACMS—Tactical Missile System. The linchpin to the submarine's added value to the littoral campaign is going to be integration with other forces, both other naval forces and in the joint environment. Neither the Navy nor the CINC can afford to have three Navy's show up, each trying to conduct its own version of the littoral campaign.

Some of the key technological innovations that would be useful in improving submarine operations in the littoral might include: all weather, day/night sensors that can positively identify combatants against land clutter; weapons that can defeat small, fast, shallow draft units that hug the coastlines; weapons that can defeat ASW or minelaying aircraft; better mine detection and neutralization capability; and connectivity to offboard sensors, perhaps including CEC. *[Ed. Note: Cooperative Engagement Concept.]* On this last point, our focus on readily accessible bandwidth should start to become as important as wideband (or narrowband) noise.

A second requirement calling for reexamination is attack submarine support to the battle group. A recent article in the Naval Institute Proceedings by one of our bright young SSN skippers observed that, "SSNs no more support the CVBG than wet roads support traffic safety. No harm intended—just not a lot of help." He went on to observe that, "no one seems to know what the submarine is supposed to do for the CVBG," but that in order to remedy this situation the "submarine would leave behind the

notion that it can only operate alone, that it is an organization defined by an aloofness..." Perhaps this conundrum was best summarized in a recent briefing by Rear Admiral Ed Giambastiani when he posed the dichotomy for the Submarine Force, "Silent Service versus Stealthy Teammates".

The implication of these examples is the need to at least consider a **rebalancing** of our technological emphases, a *front of the boat versus back of the boat* effort where we better match emergent needs for the Submarine Force with our current research and development programs. As the HASC panel summarized nearly a decade ago, "...improvements in speed and depth capability, while possibly dramatic, might turn out to do less for combat effectiveness than an equal investment (dollars, space, weight) in other kinds of improvements." This, presumably, is what the DSB will examine in its upcoming study.

Submarines cost too much. We hear this lament repeatedly in these days of constrained defense budgets. Wouldn't it be nice if we could build a really good nuclear attack submarine for under a half billion dollars? Wouldn't it be terrific if the 30 year life cycle cost could be reduced significantly? Now I'm sure it's of little comfort to this audience that the same things are said about the surface Navy's latest ships, or with some *minor* tinkering with the numbers of the aviators' latest heartthrob.

I'd make a couple of observations on this phenomenon. First, it seems that up to a certain point you buy these platforms by the pound; that is, submarines, surface ships, and aircraft each seem to cost a certain amount simply because they are of a certain size. Second, we have traditionally placed performance above cost in our hierarchy of important parameters when it comes to the design and lifetime operation of these systems. Nowhere has this been more the case than for our submarines. So it appears that at some point on the displacement axis, costs continue to increase as we drive more and more capability into the boat.

Some have suggested that better sensors, both organic to the submarine and those readily accessible from offboard, can lead us down a path to smaller ships. Increased detection range, they offer, can reduce the need for speed, thereby reducing power plant size, and ultimately, the overall size of the ship. While I'm not an expert on naval architecture, it seems that there's an inherent logic in this argument; I'm just not sure how far we can push it.

Others have suggested moving to single-mission or less capable

submarines as a way out of the cost problem. They surmise that less capable means, among other things, smaller; thereby reducing overall costs. Again, the logic is interesting, but I suppose that ensuring that you have the right numbers of the right kinds of submarines in the right places at the right times could be a bit of an operational problem.

Once again, technology needs to be part of the solution to this problem. Unfortunately, in times of tight budgets and large, ongoing construction efforts we tend to give technology investments short shrift. This is shortsighted at best and dangerous at worst. Perhaps such technology investments would be better perceived if they had a somewhat different focus. That is, rather than focusing solely on performance as we have largely done in the past, we need to consider simultaneously ways of using our technology to reduce both the acquisition and life cycles costs of future submarines.

Let me also add a plug for program stability. Having a submarine R&D and procurement program that enjoys widely based support in the Pentagon and on Capitol Hill goes a long way toward reducing costs in the long run.

Which brings me to my final point:

COTS is too important to the future Submarine Force to fail. It's a well documented fact that the DOD no longer controls the technological innovation and product offerings in important sectors of its supplier base. Nowhere is this more evident and important than in the areas of computational technology, signal processing, networking, and electronics manufacturing. The design of complex and highly integrated sensor, command and control, and communications systems demands that we take advantage of what the marketplace has to offer us, both from a performance standpoint and, equally important, from a cost standpoint.

Use of both commercial off-the-shelf, so-called COTS, equipment and the accompanying Open Systems Architecture design philosophy are at least a partial solution to the cost problem noted earlier. The New Attack Submarine has the Navy's lead position for getting this approach into the fleet as soon as possible. The New Attack Submarine's C3I system promises tremendous savings relative to its predecessors, including a 60-70 percent reduction in the amount of software to be developed; a 70-80 percent reduction in hardware development costs; and a four to one reduction in system recurring and support costs.

The key to all of this is maintenance of the discipline on the part of both the Navy and the industry developer to truly use both commercial hardware and software **directly** off-the-shelf without further modification. To help in maintaining this discipline we must be sure to pick the right commercial products for our applications, we have the right overall architecture that will adapt to change gracefully over its lifetime, and that we have a solid process for managing that change, which in the commercial world comes assuredly and repeatedly. Change will be needed to maintain commercially current versions of software and hardware in the systems, as well as to *refresh* the technology and improve performance.

An important unknown in all of this is the ability of the government and industry acquisition and life cycle support communities to adapt to this new way of doing business. Our old ways of buying and maintaining equipment won't allow us to reap the benefits promised by COTS, so we simultaneously need to change both the acquisition processes as well as the designs themselves. If done correctly and pursued vigorously, COTS has the potential to change for the better the daunting slope of the submarine cost/displacement curve.

Having made these few observations permit me one final point in closing. For the duration of the Cold War submarines came to be viewed as our premier fighting force, the new capital ships of the 20th century. Because the Submarine Force was so important to our national security it engendered great debates on the efficacy of the technology efforts being applied to it, debates that raged in the Pentagon, on Capitol Hill, and in industry and academia. The central questions were: what kind of technology program should we have, who should be running it, and how much should we be investing in it?

Needless to say, things have changed a bit since those debates took place, but in this new world environment with new things for submarines to do, similar questions remain regarding the size and shape of our submarine technology efforts. I hope that I have given you a few perspectives here today that will help each of you in making these choices for the future.

Thank you again for the honor of allowing me to share some of my ideas with you today. ■

REMARKS TO THE NSL ANNUAL SYMPOSIUM

June 5, 1997

By VADM Richard W. Mies, USN
COMSUBLANT

I am very pleased to be here at this year's Annual Symposium to speak to you about the current state of the Atlantic Submarine Force and the U.S. Submarine Force. If you look at a snapshot of the Atlantic Submarine Force today it will show you that we have approximately 16,000 personnel, 48 attack submarines, have dramatically reduced our submarine tender inventory to two, and our budget continues to decrease in parallel with the rest of the Navy's. It's a disturbing thought to think that the 48 SSNs in the Atlantic will be, in the not too distant future, close to the total number of SSNs in our entire inventory. That is difficult for me to imagine. Also, I expect that we will soon be a Navy with only two submarine tenders overall—one forward deployed in the Mediterranean and one forward deployed to Guam. This will be another significant change in the way we do business.

We have some really positive highlights to talk about from the last year. Our attack submarine program has been a great success story. Since the beginning of nuclear power with NAUTILUS 43 years ago, we have commissioned 189 nuclear powered submarines. The commissioning of USS CHEYENNE last fall completed one of the largest and one of the most successful attack submarine construction programs in our history. She is our 62nd and final Los Angeles class submarine. This is our largest class of submarines, but frankly, as most of you are aware, our 688s aren't really a single class of ship. CHEYENNE is a far more capable submarine than our first 688 and we now have 23 of these quieter, Arctic capable, improved 688 class submarines. CHEYENNE is currently in post shakedown availability and will head to the Pacific upon completion.

USS SEAWOLF completed her sea trials and I expect her to deliver later this month. We have had a few problems in the development and testing of the ship, including the foundations for the wide aperture array. However, the number of problems have been minimal considering the revolutionary nature of the technology we put on board. By far this is the fastest, quietest, and if you

discount the Trident submarines, the most heavily armed submarine in the world. This is a great platform. We got what we paid for, and it will serve well as our bridge to the next generation of submarines.

Our future is in the New Attack Submarine. It incorporates a lot of the Seawolf technology and addresses the affordability issue while providing us with a formidable submarine. The real advance is the architecture that allows us to freely integrate commercial-off-the-shelf (COTS) equipment which will truly enable us to keep pace with industry and the rapid change of technology that our existing systems don't allow us to do.

Similarly, our strategic submarine program has been another great success story.

USS WYOMING, our 17th Trident, was commissioned and has now completed all its post new construction preparations and will soon be added to our strategic force.

USS LOUISIANA, the last of our Trident class, is scheduled to commission later this year and will leave us with 18 Tridents to serve as the cornerstone of our nation's strategic deterrent. These ships will take us through some lean budget years and our studies have indicated that we can extend the life of the ship, if necessary.

The sad part of the last year is that we decommissioned seven SSNs and two submarine tenders. The wakes are outnumbering the births and this will continue for some time. There are many familiar names on this list—GROTON, SUNFISH, TAUTOG, BIRMINGHAM, GRAYLING, HOLLAND—and one of the most difficult aspects of my job is to attend these inactivation ceremonies.

I'd now like to touch on some of our operational highlights over the last year. Battle group operations continue to be the centerpiece of much of our attack submarine operations. We routinely deploy two SSNs with each battle group and I see battle group operations continuing to evolve, resulting in more effective and varied use of the SSNs. We have had some integration and interoperability problems and you have probably heard some anecdotes about the difficulties of submarine employment in the battle groups but I think we are making great progress now. One of the enablers has been improved connectivity which has greatly enhanced our ability to communicate with the battle group and facilitates giving the battle group commander tactical command. Also, assigning submariners to the battle group staff has further

supported this initiative by allowing them more direct control of submarine water space, allowing greater integration into CVBG planning and execution. We are seeing some positive results from this as recent deployments have indicated a noticeable rise in productive SSN employment by the battle group.

I'd like to talk about C4I for a minute. As I have said C4I is the enabler for our interoperability with the other services and our coalition partners, and we continue to be the *not so Silent Service* in a connectivity sense. As the gap widens between the need for our forces and the resources to support them, we must look for force multipliers, and information technology is one of them. Information and data flow will allow us to achieve a force capability that is greater than the sum of the individual pieces, and an effective C4I system is the critical element. As an example, C4I is the *glue* that will effectively bring together all the pieces of our ASW team. I will get back to this later.

We have made some great initiatives and innovations in this area. Two submarine lieutenants assigned to USS THEODORE ROOSEVELT invented a system now called BGIXS II. BGIXS II consists of a laptop computer which uses our SSIXS capability to directly link our submarine with the battle group and has made the exercise of tactical command by the battle group commander a matter of routine. This capability is now used routinely providing a significant enhancement to our battle group connectivity and has been so successful that the battle group commanders are now also using it on their battle group surface ships. Additionally, BGIXS II also provides us with some imagery transfer capability and is also giving our submarines an internet e-mail capability.

The Joint Deployable Intelligence Support System (JDISS) is also being used on some of our SSNs and gives the submarine improved imagery/video transmission capability. USS MONTPELIER participated in an exercise in the MED/CENTCOM AOR and using sub-JDISS she was able to pass data at 64 kbps successfully demonstrating the capability to pass real time imagery to the local and shore commanders.

Most of our ships are becoming JMCIS (Joint Maritime Communications Information System) capable. This is the wave of the future as JMCIS will fully integrate Navy C4I into the Global Command and Control System (GCCS).

Next month, two submarines, ATLANTA and SCRANTON, will participate in the Joint Warrior Interoperability Demonstration

(JWID-97) which will test a wide variety of information technologies in the attempt to establish a seamless, interoperable communications environment.

Finally, EHF is rapidly becoming the circuit of choice for battle group strike coordination and we have given high priority to outfit at least one of the two SSNs assigned to the battle group with EHF.

Overall, we are making great strides in the C4I area and I am very pleased with the results.

We are also expanding our operations in the Special Warfare area. We have three submarines in the Atlantic specially configured for dry deck shelter operations (DDS), USS JAMES K. POLK, which can carry two dry deck shelters, and USS ARCHERFISH and USS L. MENDEL RIVERS, which can carry a single dry deck shelter. These ships generate a lot of interest, a lot of capability, not just with our special forces, but also with our Mediterranean allies because this type of warfare addresses many of their needs. We routinely have one of these submarines on station in the Mediterranean at all times. During infrequent gaps in this presence, we assign another SSN that is specially outfitted with special warfare equipment, designated as a seal submarine (SEASUB). Our real capability lies with our dual DDS ships and we are looking at extending the life of these two ships, POLK and KAMEHAMEHA to take them beyond their nominal 30 year life. The long term vision is that the NSSN will be able to carry the Advanced Seal Delivery System (ASDS) and some of our 688s will be backfitted with this capability. Unlike the dry deck shelters, the ASDS is a true submersible; it is a mini submarine with a significant combat radius. It will be carried by the mother submarine into the theater and then detach to go and conduct its mission. The ASDS will be piloted by 1120 submarine officers—just like our DSRVs are today.

We are also making some great gains in precision strike. We are never going to be the predominant strike platform. I think we recognize that and had never intended to be. But we provide covert, precision strike when covertness and surprise are necessary. Submarines are able to bring the Tomahawk weapon into places that we can't bring other Tomahawk shooters. And we have worked hard to improve the Tomahawk weapons system reliability. Frankly, the *wooden round* concept where you bring the weapon on board and never do any maintenance on it, never train on it, never use it, is foreign to us and our submarine maintenance culture.

Even for our strategic systems we routinely run end-to-end testing of the systems supporting the weapon to ensure they will work when called upon. Tomahawk doesn't allow us to do that with the *wooden round* concept, so we have worked with NAVSEA and NUWC to develop some innovative ways to provide simulators which now provide us more end-to-end testing capabilities and these initiatives have dramatically increased our confidence in the reliability of the entire system. And as an indication of our improved system reliability, three exercise missile launches were conducted last year in the Jacksonville operating areas—all of which were successful.

Peacetime intelligence collection, surveillance and reconnaissance continues to be one of our key missions. We support national, multi-national and NATO objectives. We conduct surveillance both in the open ocean and the littoral areas; in the Atlantic, Mediterranean and Caribbean. We are involved in a number of operations and just finished three years of continuous surveillance operations in the Adriatic in support of the embargo of the former Yugoslavia.

Our SSBN force is still the pre-eminent leg of the strategic triad and the reliability and credibility of that system continues to be one of our greatest success stories.

The D-5 missile is still the most reliable and accurate weapon in our inventory and we just completed our 74th consecutive successful D-5 missile launch.

As a result of the Nuclear Posture Review a consolidation of the Navy's nuclear weapons infrastructure has been completed. The Submarine Force will remain the only community in the Navy with a nuclear weapons mission. We have now assumed overall responsibility for the safety, security, inspection, maintenance and oversight of the navy's nuclear weapons program. This realignment has reduced billets, saved money, better supports the customer and aligns the Navy nuclear weapons program for the next century.

Last fall we participated in Global Guardian 97, a major strategic exercise that STRATCOM runs on an annual basis in which we test the survivability, viability and reliability of our strategic capability. The exercise was highly successful and for the first time included testing our ability, on short notice, to regenerate the tactical nuclear capability of one of our SSNs. The submarine, USS BOSTON, successfully completed a nuclear Tomahawk

regeneration and firing of a test missile.

Let's talk a little about submarine forward presence. Our submarines are everywhere and yet, they are nowhere. What I mean is that our presence is observed around the world as we come in and out of ports. Our allies and our potential adversaries know we are in their theaters. Despite all the restrictions on nuclear power, we go into more ports around the world than any other submarine force in the world demonstrating that we are *forward engaged*. On any given day about half of our operational submarines are at sea, and on any given day about one quarter of our operational submarines are forward deployed.

We talk a lot about the NSSN, rapid COTS insertion, the R&D process, and in general, just a lot about hardware. But I want to reemphasize that the underpinning of our success both today and surely for the future is our people.

We continue to attract the best and the brightest officers and enlisted personnel. We train them well and they are promoted, screened and advanced at encouraging rates. The Submarine Service still offers a bright future for this nation's young people.

Our accession quality continues to be very high and this is supported by the class standings and academic performance of the individuals we are bringing in. We recruited 106 percent of our goals in the enlisted technical ratings and initial projections for 1997 look even more promising. A couple of indicators of the quality of our young enlisted is that 24 percent of the young sailors recently selected for Seaman to Admiral Program and 13 percent selected for the Enlisted Commissioning Program are submariners. And that's from a community which represents only seven percent of the Navy.

Our career first and second term retention is on the upswing and we are at or above the Navy's goals. Officer retention is on the rebound and we are presently at 32 percent. Our goal is to reach 38 percent officer retention by the year 2000 in order to meet our manning needs for the future. We also increased the nuclear bonus last year to the maximum allowed by law, $12,000, to keep pace with inflation.

In reflection of the quality of the training that our Nuclear Power School graduates receive, we have two new initiatives that will offer them college credits just for completing the Nuclear Power School curriculum. Both Old Dominion University and Rensselaer Polytechnic Institute offer course credits that add up to

about one-third of the required courses for a fully accredited Engineering degree. Thus far, the program has been so successful that ODU is looking at expanding the offerings outside of the Norfolk area.

In the officer community, we all know that joint education continues to be crucial for upward mobility. We have taken the initiative to increase the opportunities for our young officers to obtain joint professional military education (JPME) by bringing it to them. We recently began a pilot program in Kings Bay by working a special arrangement with the Naval War College to send civilian professors to Kings Bay in the hope that all the officers can receive JPME phase I education within three off-crew periods. If Kings Bay is successful, a JPME program in Bangor will be next. Another initiative we are taking concerning JPME education is, on a voluntary basis, to provide some of the modules of the correspondence course (four of twelve total modules) to the officers attending department head school in New London. Without going into any more details, the bottom line is we are taking the joint education of our officers seriously, and have devoted resources to enhance their chances of completing it early in their careers.

If you look at the upward mobility of our sailors and officers, most of the indices—advancement, CO and XO screening opportunity and promotion rates—are moving in the right direction. We, as a community, enjoy numbers that are equal to or better than the other communities and I feel good about our overall health in this area.

We continue to be the *not so Silent Service* in many ways. We have had a robust and dynamic effort aimed at getting the word out about submarines. We have continued to make great progress at familiarizing the general public with submarine operations. We hosted over 80,000 visitors aboard our submarines last year which included 22 Congressional embarks, an invaluable contribution to our efforts to ensure the Submarine Force and its inherent capabilities are clearly understood.

This week we will be distributing a new Submarine Force brochure, aimed at educating the reader as to what the submarine brings to our nation's security.

We have even joined the internet and activated a SUBLANT home page on the world wide web (http://www.norfolk.navy.mil/-sublant), further providing the public with information on what we do for a living. Our home page is linked to N87, SUBPAC, our

squadrons and our ships, and you can also download the Submarine Force quarterly community newsletter.

We have taken an in-depth look at our submarine staff organization are making some changes to improve our effectiveness and efficiency.

Effective this month we will reactivate Squadron Four in New London and Squadron Sixteen in Kings Bay, and we have already canceled plans to inactivate Squadron Six in Norfolk. The goal is to do this without any increase in billets. Our intentions are to improve the operational readiness of each squadron by reducing the number of operational submarines assigned to approximately six per squadron and by removing many of the collateral duties the squadrons used to have, thus improving the ability of the squadron commander to focus on the operational readiness of the submarine wardrooms and crews.

Admiral Smith asked a good question earlier, "Who does ASW?" I agree and share many of the concerns he voiced. I have recently assumed the responsibility for all Atlantic area ASW as CTF 84 and I am working hard at reinvigorating our efforts and addressing many of our ongoing problems. CTF 84 previously consisted of 12 separate task groups organized along geographic boundaries. Control of assigned forces was convoluted and resulted in many situations where assets were inefficiently utilized. Accordingly, we reorganized the task force and the headquarters staff to make them more functional and efficient. This change along with the other initiatives provides us the opportunity to develop a synergy between all of the ASW communities and will provide a mechanism to interface with CNO N84 to influence resource sponsor decisions which affect ASW. As I have said many times before, ASW is a team event—submariners cannot do it alone—and the Submarine Force will take a lead role in forging that team.

I'd like to talk about the one topic that takes up much of mine and Rear Admiral Ellis' time, and that is the programmed Submarine Force structure reduction.

We continue to be in a period of great transition. The rightsizing of the Submarine Force is near the steepest part of the curve and it is really starting to significantly affect us. As a total Submarine Force, right now we number 72 SSNs, 67 of which are operational, and that number will decrease rapidly over the next couple of years.

One of my principal concerns is managing this very rapid decline in force structure. If you look at the drawdown curves, it isn't so much the end point that concerns me, but the glide path—the slope we are one. It is a steep slope and that means in a very short period of time some significant and rapid transitions in the way we do business will take place. The challenge is to keep in balance all the different and complex factors that are affected—our people, training, resources, logistics and operational schedules.

To keep these things in balance is more difficult when you are on a steep glide path than on a more gradual one. This transition requires a significant amount of management attention to keep all these factors in sync. We've made a number of efficiencies to try and address the issue of how we can continue to do better rather than more with less and I will speak more on that later.

Obviously, a crucial aspect of the force structure reduction is meeting our operational commitments, and that will become increasingly difficult over the next few years. Rear Admiral Ellis' and my staff, as well as our predecessors, looked very hard at what level of SSNs were necessary to meet existing and anticipated CINC operational commitments and we felt very strongly that we needed 72 SSNs. We need 72 but obviously we cannot afford that many. The JCS Study of 1993 specified 51-67 SSNs would be required and, of course, the Bottom Up Review specified 45-55 SSNs. Now the QDR is saying that 50 SSNs are necessary. Whatever the final Force structure is, there are two key elements to our future. First, the New Attack Submarine build rate is crucial. Even at a build rate of two NSSNs per year, in the out years our SSN inventory will drop below 50 and reach 39 SSN s in 2026. Secondly, no matter what the build rate is, the 688 class submarines will be the bulk of the Force well into the next century. Therefore, 688 modernization cannot be ignored and is of paramount importance to the future health of the Force.

But there is good news. Despite the drawdown we have not taken it out on the backs of our people. As our Force structure declines, it becomes more of a challenge to control our OPTEMPO, and we expend significant effort to do so. We have managed to maintain a reasonably steady OPTEMPO and we are projecting that we are not going to change it significantly. Our plan is to continue to operate our submarines at about a mid to low 40 percent OPTEMPO range.

As I mentioned earlier, we have taken some actions to mitigate the impact of the drawdown. To deal with how to do better with less, we have looked hard at reducing our deployment *overhead*. We are moving towards elimination of short deployments and making all of them six months in length; in other words, we will deploy longer but less frequently to attain operational savings due to fewer workups and fewer ocean transits. The end result will be that our submarines will spend more time in a deployment status and this will allow us to continue to meet many of our commitments with fewer submarines.

Additionally, a great success story has been the operating cycle extension of our 688s. We have dramatically reduced the amount of time over the life of a ship that they spend in a shipyard environment. From 1974 through 1995 we have reduced the time in a depot period by over 50 percent. The costs have also been significantly reduced since refueling overhauls have also been eliminated. The culmination of this initiative is greater operational availability of our SSNs and lower life cycle costs.

A couple of weeks ago at the Submarine Technology Symposium, Rear Admiral Jerry Ellis and I talked about how important it was for the acquisition, technical and fleet communities to work closely together to ensure we maintain our undersea superiority into the future. I want to reemphasize that philosophy, and particularly how important it is for the fleet to be fully integrated into the mechanism for setting requirements. The N8 organizations on our staffs are now set up to interface more closely with N87 to address fleet concerns and to ensure the fleet has a voice in the budget process.

The combined effects of rapidly changing technology and diminishing resources mandates a close working relationship, a partnership if you will, to ensure we set appropriate requirements and spend our resources wisely. It is crucial that smart decisions are made in this area and that the fleet view is integrated into the process. The overall goal of the improvements to the requirements process is to more wisely spend our limited resources and ensure that appropriate priority is given to the fleet's needs.

I'd like to change directions for a minute and talk briefly about the future of the Trident force. The Submarine Force has programmed for 14 Tridents early in the next century. A recent issue has been that with the reduced warhead requirements of START II and START III that we should be able to reduce our Trident force to

one base. I want to stress that it is absolutely crucial to the survivability of our SSBN deterrent that we maintain two homeports and a two ocean presence. The issue is not the number of warheads but the viability of our Force to remain survivable under all postulated scenarios. Keeping two homeports and a two ocean presence assures our survivability and is a cheap insurance policy in deterring the use of weapons of mass destruction.

The debate continues as to the role of naval forces and submarines in the future security environment. Secretary of Defense William Cohen gave a speech in May 1997 in which he asked a fundamental question, "Are we a continental based power with global interests? Or a maritime operating power with global reach?" He later stated in his speech that "our military forces (must be) able to respond to the full spectrum of threats and contingencies. That means having forces that can get to a crisis area quickly and be able to dominate the battlefield ... We also want those forces to be flexible—flexible enough to carry out missions besides full-scale warfare..." Fundamentally, I believe his second statement answers his first question. I interpret his remarks to mean that we are a maritime power with global reach. I further believe our Submarine Force is well positioned to meet this challenge.

As we look to the future and try to craft a Submarine Force vision of where we are headed, we have to face some enduring national realities that serve as our *stars to steer by*. These realities are:

- Global interests
- Maritime nation
- Reduced overseas bases
- Dangerous, uncertain world
- Need for flexibility
- Tight budgets; zero sum game
- Need to leverage high technology
- High threshold for mission success and survivability

These realities serve as the backdrop for our future decisions regarding the roles and missions of submarines and what the corresponding force structure should be. When you talk about what submarines bring to the table, the answer becomes clear when you consider the submarine's enduring attributes:

- **Stealth** - unlocatable credible, non-provocative presence, surprise
- **Endurance** - protracted on-station dwell time with minimal logistics tail; self-sustaining
- **Agility** - global reach; to respond rapidly without the need for air superiority; sustained high speed capability
- **Lethality** - a high ratio of offensive to defensive weapons because stealth brings its own defense; a high payload of not only precision weapons but *heavyweight* weapons
- **Survivability** - self-defense inherent in stealth; virtually invulnerable from attack; supports the national threshold not to put our people at risk
- **Versatility** - multi-mission; variable payloads; growth potential for alternative roles and ability to tailor the submarine for the mission
- **Reliability** - high operational readiness
- **Responsiveness** - robust connectivity; readily reconstitutable

All of these attributes play quite well into the new Joint Vision 2010 operational concepts of *dominant maneuver, precision engagement, full dimensional protection* and *focused logistics* as articulated by the Joint Chiefs of Staff.

To further this debate I'd like to *dispel some common submarine myths*. Just as the Navy is moving toward widely dispersed forces as the fleet shrinks, so is the Submarine Force. We are returning to our historic roots—a multi-mission focus for our submarines. We have come full circle—we have moved away from the almost exclusive blue water ASW focus that the Cold War necessitated to multi-mission operations in both blue water and the littorals. The bottom line is that *submarines don't only exist to fight other submarines*. In fact, *submarines have utility across the full spectrum of operations*, from peacetime engagement *operations other than war*, through crisis response and deterrence, to warfighting operations in support of a joint commander.

Many argue that the SSN is expensive. I want to shift the debate away from initial acquisition costs, which I think is like comparing apples and oranges, and focus more on life cycle costs. Submarines have one time fuel costs as refuelings are no longer required. We have a small crew which make for large savings over the life of the ship. Our maintenance costs have been greatly reduced as I talked about earlier, and we don't require other ships

for support or defense. These savings play out very well when comparing the life cycle costs of submarines to other major weapon systems.

Finally, I don't think I need to say much on the myth that submarines only operate independently. Rear Admiral Ellis and my predecessors have worked hard to integrate our submarines with our joint and combined forces, and we continue towards the goal of full integration into joint task forces.

The good news is that there have been numerous independent studies and reviews validating the utility of submarines for the future national security environment. For example, I recently noticed that the Institute for Foreign Policy Analysis published a detailed report exploring the role of the submarine platform in future U.S. Naval and Joint Force planning. And the JCS Study in 1993 and the Bottom Up Review further validated the role of submarines. There are also several other studies ongoing; a Defense Science Board summer study, the National Defense Panel review, an OSD Net Assessment of Undersea Warfare, and an SAIC study analyzing Submarine Force structure options. I am confident that each of these efforts will present submarine utility in a favorable light.

My bottom line when you look at the macro view of the Submarine Force and consider life cycle costs is that it should be quite clear that we are a *lean and mean* organization and the taxpayer gets a pretty good bargain from the Submarine Force. In the conventional deterrence mission, our attack Submarine Force provides approximately 30 percent of the Navy's combatant ships utilizing only 11 percent of the budget and seven percent of its people. For the strategic deterrence mission, the numbers are just as dramatic—for only 19 percent of the strategic budget and 35 percent of the strategic personnel, we provide 54 percent of the warheads and nearly 100 percent of the survivable warheads.

Finally, to conclude, I am very pleased with the health of the Force, and I am very pleased in the vision for the Force and where we are headed. I think it is robust and vibrant and we are supporting the CNO's objectives. We are *ever ready, capable, forward deployed and forward engaged.*

Thank you. ■

THE NAVY AND THE THIRD BATTLE OF THE ATLANTIC

by Owen R. Cote , Jr. and Harvey M. Sapolsky

Owen Cote is Assistant Director of the International Security Program at Harvard University's Center for Science and International Affairs. Harvey Sapolsky is Professor of Political Science and Director of the Security Studies Program at M.I.T.

Military organizations are always accused of preparing to fight the last war, and often there is some basis for this claim. It is difficult for military organizations to change in response to the demands of a new security environment, and it is therefore important to understand the causes of such change when it does occur. One organization that certainly could not be accused of fighting the last war was the U.S. Navy's undersea warfare community after World War II.

During World War II, U.S. Navy submarines strangled the Japanese war economy by sinking its merchant ships and interdicting its sea lines of communication, while in the Atlantic, U.S. Navy ships and aircraft helped prevent German Navy submarines from cutting Allied sea lines of communication. Yet early in the Cold War, the United States faced a new threat to its sea lanes which threatened all of these undersea warfare platforms with obsolescence. Using advanced submarine technologies developed by the Germans at the end of World War II, the Soviet Union threatened Allied ASW forces with defeat in a third Battle of the Atlantic. Furthermore, as a continental power whose lines of communication did not span oceans, the Soviet Union was immune to the formidable commerce raiding capabilities of U.S. submarines.

But by 1950, a radical shift in the U.S. Navy's approach to ASW was well underway, with submarines becoming the preeminent ASW platform, and passive acoustics becoming the primary sensor. In this new paradigm American submarines hunted Soviet submarines, using the sounds they emitted as a signature, and Soviet submarines designed to evade existing air and surface ASW platforms employing radar and active sonar met their match. The early days of the Third Battle of the Atlantic, if it had occurred,

would not have resembled the early days of World War I and II, which were happy times for enemy submarines. Instead, Soviet submarines would have been thrown on the defensive by an integrated, combined arms, ASW force led by U.S. submarines. The story of how the U.S. Navy met this early Cold War ASW challenge and maintained its edge over the Soviet submarine fleet for the balance of the Cold War is important for at least three reasons.

First, this story is a largely untold success, and the technical, operational, and organizational ingredients of success need to be understood and communicated. Americans largely take for granted the historic fact that they have been able to gain wealth and project power from the sea, just as they take for granted that they will dominate the air. But unlike air forces, whose activities and successes are easy to see and widely celebrated, ASW forces wage a silent, unseen war. Victory in this war gives Americans largely untrammeled access to the sea, and it is important to understand the tools used in this struggle, the changing nature of the threat, and the fact that success does not come as a birthright.

Second, this is a case of rapid, radical change by a military organization. Such innovations are rare, and it is important to understand their causes. This particular example of innovation gains further importance because it appears not to be explicable by any existing theories of how military organizations change. These theories explain innovation as the result either of intervention by outside high level political leaders, protracted struggles for control within a service among its branches, or inter-service competition between independent military services in areas of mission overlap. It is difficult to explain the post-war ASW revolution in any of these terms: high level political leaders seem largely absent from the story at the outset: the changes appear too quickly and decisively to be the result of the normal pulling and hauling between internal Navy platform communities; and ASW was a mission area that the Navy had largely to itself, unlike carrier aviation and missiles, which did become major bones of inter-service contention. Identifying the factors which caused both the submarine community and the Navy as a whole to so quickly recast their entire mode of ASW operation in the immediate aftermath of a great victory will help to develop better theories about the sources of military innovation. Such theories, in turn, can help U.S.

political and military leaders with the practical task of adjusting to the demands of a radically new, post Cold War security environment.

Third, the U.S. submarine community, the larger undersea warfare community, and the Navy as a whole may be able to learn more specific lessons from a retrospective look at the last time their main adversaries changed and their main platforms were forced to change their mission orientations. This might help speed and smooth the process of adding new missions for U.S. submarines, developing new, combined arms ASW techniques against increasingly capable diesel submarines, and discovering or rediscovering organizational structures for the Navy as a whole that help spur innovation in response to a challenging new security environment.

With these goals in mind, we are beginning a retrospective study of the Third Battle of the Atlantic, sponsored by the Navy, and managed by the Applied Physics Laboratory of The Johns Hopkins University. This study will begin the process of understanding and explaining the organizational, technical, and operational underpinnings of the Navy's success in its Cold War ASW competition with the Soviet submarine force. Of course, many readers of THE SUBMARINE REVIEW and members of the Submarine League were a part of this story, and we would welcome their suggestions. ■

REGULUS CREWS GET DETERRENT PATROL PIN NOD

SUBLANT April 15, 1997. When USS GRAYBACK (SSG 574) slipped its moors and headed into the Pacific Ocean in September 1959, it began an era of submarine history that would go unrecognized for almost 40 years.

The accomplishments of sailors assigned to the Navy's handful of Regulus guided missiled submarines are long and storied. The five Regulus submarines, USS GRAYBACK (SSG 574), USS TUNNY (SSG 282), USS BARBERO (SSG 317), USS GROWLER (SSG 577) and USS HALIBUT (SSGN 687) deployed on 41 deterrent patrols under the earth's oceans over the course of five years.

Recognition of those 41 patrols, which ended when HALIBUT returned in July 1964, is finally being made.

Vice Admiral Richard W. Mies, Commander, Submarine Force U.S. Atlantic Fleet, has notified the Bureau of Naval Personnel that crewmembers "who conducted Regulus missile deterrent patrols are hereby authorized to wear the SSBN Deterrent Patrol Insignia in accordance with article 142-130 of the MILPERSMAN and in the fashion prescribed by the Naval Uniform Regulations".

Regulus deployment dates eligible for a patrol pin, by submarine, are as follows:

SUBMARINE	DEPART	RETURN
USS TUNNY	23 Oct 59	16 Dec 59
	22 Apr 60	17 Jun 60
	14 Jul 60	12 Sep 60
	23 Jul 61	28 Sep 61
	04 Nov 61	12 Jan 62
	24 Aug 62	29 Oct 62
	12 Jan 63	15 Mar 63
	13 Jul 63	03 Oct 63
	10 Feb 64	11 Apr 64
USS BARBERO	30 Sep 60	02 Dec 60
	23 Dec 60	04 Mar 61
	23 Jul 61	28 Sep 61

	04 Nov 61	12 Jan 62
	24 Aug 62	29 Oct 62
	12 Jan 63	15 Mar 63
	10 Jul 63	28 Sep 63
	4 Jan 64	13 Mar 64
USS GROWLER	12 Mar 60	12 May 60
	10 Nov 60	18 Jan 61
	18 Mar 61	12 May 61
	11 Feb 62	24 Apr 62
	24 May 62	1 Aug 62
	24 Nov 62	11 Feb 63
	14 Jun 63	12 Aug 63
	04 Oct 63	13 Dec 63
USS GRAYBACK	21 Sep 59	?? Dec 59
	31 May 60	30 Jul 60
	24 Aug 60	29 Oct 60
	05 Jun 61	13 Aug 61
	12 Sep 61	13 Nov 61
	02 Apr 62	03 Jun 62
	07 Oct 62	22 Dec 62
	20 Feb 63	11 May 63
	07 Sep 63	02 Nov 63
USS HALIBUT	09 Feb 61	10 Apr 61
	01 May 61	28 Jun 61
	20 Dec 61	31 Mar 62
	09 Jul 62	15 Sep 62
	29 Apr 63	20 Jan 64
	19 Nov 63	20 Jan 64
	07 May 64	14 Jul 64

CHINA'S STRATEGIC SEAPOWER

by John Wilson Lewis
and Xue Litai
Book Reviewed by RADM Larry G. Vogt, USN(Ret.)

Rear Admiral Vogt served as the Director of Strategic Planning and Policy, J5, on the staff of Commander in Chief, U.S. Pacific Command, from 1991 to 1993. In that capacity he helped coordinate U.S. policy throughout Asia and has traveled extensively in the region. He also served as Senior Member, United Nations Military Armistice Commission and held 13 meetings with the North Koreans at Panmunjon in Korea. He served as Commander, U.S. Naval Forces, Korea.

Referencing Naval Intelligence sources, Defense Week reported in the 7 April 1997 issue that after the start of the next century China would have a new submarine launched ballistic missile, JL-2, which would be able to reach the United States. China's development of the intercontinental submarine launched ballistic missile (SLBM) and the associated nuclear submarines (both SSNs and SSBNs) is the subject of this authoritative and well documented book. No political, technological, industrial, or doctrine development stone is left unturned.

Professor John Lewis and his associate, Xue Litai, are experts on Asia with unsurpassed access to Chinese industrialists and military *think tanks* inside China. This is an outstanding reference book which also proves to be interesting reading to the curious minded who want to know more about the awakening Asian tiger. Although written in 1994, it is as timely today as it was then. China is the country to be reckoned with during the next 25 years.

The authors weave an intricate and complicated history of the major decisions and political upheavals affecting those decisions and the industrial and scientific challenges faced by the Chinese technical community. Because of its complexity and the unfamiliarity with numerous Chinese names, most readers will have difficulty following the personalities and the timeline of the missile and submarine development programs. In fact, the absence of a timeline summary is a major drawback of the effort. I found it necessary to make my own timeline as I read. (See Table 1.) Only then did the magnitude of the program and its challenges emerge.

Table 1.

China's Strategic Seapower

Time Line Composed by RADM Vogt

1950	1960	1970	1980	1990
Korean War 1950-54	Moscow cuts off assistance	5/70 prototype begins test ops 7/70- at 100% (48M-W)		
	Nuclear fuel plant completed in Baotou	Initial crit of SSN reactor 8/71 surface sea trails Cultural revolution cont		six SSNs commissioned
	Project slowed due to economy End of 3 hard years	Full scale rocket launch from GOLF SSN sea trials continue with many probs	Commission of Science, Tech & Industry for Natl Def established JL-1 first successful flight from GOLF	"Seven guiding principles"
	Major reorg of defense industry Equip Mfg. Bureau resumes control over 12 factories	Original target date for SSBN launching Defense Ind Development 5 Year Plan 72-77	Final tests on electrical torpedo (YU-3) ..."noisy"	
NAUTILUS launched	A-bomb test	First SSN commissioned LONG MARCH (SSN 401). Many probs after 20 sea trials		

(Cont'd next page)

PRC starts A-bomb project	Competing reactor designs (German's GKSS or Lenin) Project 09 started (land-based) Lenin selected	SSN 401 has no torpedoes or electronic equipment	Start design on advanced torpedo	
First US SSBN program approved PRC navy planning for SSN	First fuel rods tested (that met tech stds) SSN's mission to be ASW Torpedo range built. Made decision to build SSN w/tear drop hull first	Search for new strategies from *minimum deterrence* Gang of Four arrested Green light to continue SSN/SSBNs		
USSR agrees to help PRC with nuclear industry. Lenin launched USSR agrees to provide A-bomb and missiles New Defense Tech Accord	Purge of 3800 naval officers, many of whom had worked on missile programs Only ground work on prototype completed to date At end of year, work accelerated Tentative SSBN design complete	Second SSN (402) commissioned	PRC begins build up of its navy (528 shipyards, 540K workers, 162 factories, 80 research institutions)	
Kruschev replaces Bulganin and wants to *deal* with PRC Taiwan crisis PRC makes decision to build nuclear sub	Nuc Powered Sub Proj 11/68 hull laid for SSN at Bohai shpyd		Missions of navy focused to four major areas Succesful submerged launch of JL-1 from GOLF	

(Cont'd next page)

Org in place for SSN/SS-BN programs PRC gets GOLF from USSR USSR/PRC relations cool	PRC/USSR border disputes slow project Zhou En Lai gets involved Cultural Revolution	Full scale missile tests from submerged GOLF	Production of YU-3 China Sturgeon torpedo 3M people, 2000 defense plants and 1000 other related industries in SSN/-SSBN work	

Submarine and SLBM Development: Projects 02 (Nuclear Weapons), 05 (Ballistic Missiles) and 09 (Submarines)

Some claim that as early as 1956, only a year after NAUTILUS was underway, the Chinese Navy planned for acquisition of a nuclear submarine. If this is true the idea was given a slight push by the Soviets in 1957. Under the terms of the New Defense Technical Accord signed that October, Moscow agreed to provide the PRC a prototype atomic bomb, some missiles, and major industrial equipment related to the nuclear weapons and missile programs. However, this was a tumultuous time for both China and the USSR. Russia wanted a joint submarine flotilla based in China and the erection of a strategic communications antenna on Chinese soil. Mao said *NO* stating fears of challenges to China's sovereignty. Also, the U.S. and PRC were facing a dire situation in the Taiwan Strait with the shelling of Quemoy on August 23, 1958. In the confusion and anger over the major issues of sovereignty and basing, Khrushev informed China of a two year suspension of assistance on nuclear weapons thereby reversing its promise to supply a prototype atomic bomb and related technical data. In the turmoil that followed, Mao realized his only path to complete Projects 09 and JL was self reliance. In a snit he stated, "We will have to build nuclear submarines even if it takes us 10,000 years."

By early 1960, the transfer of technology from the Soviet Union, though selective and contentious, had raised the levels of competency in industry and high command. Major reorganizations evolved over the years as the programs mimicked those of the United States strategic programs. Major evolution in industry and science was put into motion by Projects 09 and JL and undoubtedly

contributed to China's economic prowess today.

Early efforts were marred by major setbacks. In the 1960s there were famine, the drying up of Soviet assistance and funding cutbacks. The *three hard years* occurred during this period. Additionally, China had no computers. All calculations were done by hand for power distributions at full and reduced power. (Remember nuc school!) A decision had to be made on what to build first, an SSN or SSBN, and which design to use. In 1966 the decision to build the SSN was given highest priority. It was to be built at a shipyard in Uludao, Liamoning Province (an area north of North Korea). A German design (Ottohalen) was ditched in favor of a Lenin design with primary pumps outside the main containment vessel. This of course meant susceptibility to steam and primary leaks. In 1969 design plans were completed and a land based facility was finished in 1970.

The builders had all the problems you could expect. They had to learn welding techniques in the '60s and '70s, and they didn't have installation plans. In many cases it was reported that materiel arrived on the pier with no one knowing where or how to install it. But these problems were gradually overcome and the hull was completed for the first SSN 401 in December 1970. Professor Lewis reports that things moved rather quickly from that point. In June '71, they achieved initial criticality with sea trials occurring on August 23. If this is true it is no wonder that the sea trials were marred by many incidents and problems. Many crew members suffered over exposure to radioactivity. There were reports of *dead fish* in the wake of the SSN. Navy men resisted assignment to nuclear crews. There were numerous primary-to-secondary leaks and primary valve leaks, and major corrosion problems were noted.

In addition to production and design problems, SSNs 401 and 402 had no sonar and no weapons, no long range communications or navigation equipment.

Navy leaders said that these submarines were *sharks without teeth*. In the mid 1980s, acceptable subsystems were installed. By 1992 six Project 09-1 (LONG MARCH) submarines were commissioned. Obviously, I have left much to your imagination. There were many major political upheavals between the Project's inception and its completion and you will find the reading interesting and probably surprising. Some of you will recall your own

experiences with the nuclear program and sympathize with the Chinese crewmen.

The nuclear weapon and ballistic missile programs experienced similar jumps and starts after technology infusion from the Soviet Iet Union. They first installed a conventional missile in conventional submarines. Testing was done on these platforms as the problems were identified and resolved. The Chinese exploded their first atomic bomb in 1964 and full scale missile tests were conducted in 1979 from a GOLF diesel submarine. The first JL-1 launch was conducted from GOLF in late 1982. The '80s, particularly the latter part of the decade, were very productive. They developed compatible torpedoes and advanced designs for longer range, quieter ones for the nuclear submariners resulting in the production of the YU-3 China Sturgeon Torpedo in 1989. There was massive infusion of workers, money and technology into the Projects during this period. The only thing left to develop was an overarching strategic policy.

The Strategy

In the beginning the major threat to China was the United States evidenced by the Korean War and the Taiwan Strait crisis. The initial decisions to build nuclear weapons and submarines appear to me to be based on achieving parity with the U.S. and U.S.S.R. after the snubs from Russia and the confrontations with the U.S. Strategic military plans were defensive and called for protection of the coastline. If the coasts were breached, invading armies would be absorbed in China's interior. Clearly this doctrine (greatly abbreviated by this reviewer) would not sustain justification for a 20 to 40 year building program. The experts realized ..."that a process of doctrinal osmosis was occurring and they let it happen. They knew that the system was being strangled by outmoded ideas, and while their subordinates were perfecting technologies, they were exploring alternative ways of thinking."

Because of the Korean War and U.S. ability to *intimidate China* with nuclear weapons and lethal firepower and air power, Beijing secretly started the Projects described above. This led to a dictum: "People's War Under Modern Conditions". This doctrine

"...is the concept of 'active defense' (jiji fanugy). From the

earliest days of the revolution, Mao and his successors regularly studied the likely character of future conflicts and the potential weaknesses and strengths of the enemy and embraced a concept of active defense that, when stretched out over time, became 'protracted warfare'."

The *people's war under modern conditions* transformed to a strategy of *minimum deterrence* in the '60s. After Mao's death in 1976 the search for alternative strategies speeded up. It was during this time that the Gang of Four, who were continentalists, relegated the Navy to a secondary role. With their arrest, the Navy was again given the green light to continue its submarine and missile programs at an accelerated pace. Alternative strategic thinking also continued and basically stemmed from the *quintessential deterrence* doctrine stated 2500 years ago by Sun Zi [Sun-tzu]:

"Forcing the other party to resign to our will without fighting a battle and attacking the [enemy's] strategy [are] superior to engaging in diplomatic negotiations; engaging in diplomatic negotiations is superior to waging field operations; and waging field operations are superior to attacking fortifications."

In 1987, in referring to defense of the homeland, the PRC Navy said, "This doesn't mean in anyway that our Navy should only cruise the coastal seas, and that the imperialist countries alone [have the right to] build up their navies as strategic armed services for the purpose of seeking hegemony in waters far away from their countries...China, of course, needs to build a navy powerful enough to match its international standing." Liu Huaqing, the PRC naval commander, listed four missions for nay planning in order of importance:

- To safeguard China's territorial integrity
- To conduct a possible blockade of Taiwan
- To defeat a sea-based invasion
- To make ready survivable nuclear retaliatory forces

In regard to the first: island disputes would most likely result in war at sea. But, *without control of the air, there will be no mastery of the sea.* This resulted in naval air improvements which

will probably lead to the acquisition of an aircraft carrier. In the interim the 1700km DF-25 conventional missile would be used. They would also need replenishment ships and amphibious capability.

Although the Chinese Navy thinks that they can blockade Taiwan today, they admit that "...submarines would represent the frontline force". This may account for the Kilo buys from the Russians.

To defeat an invasion from the sea, they would create a *layered defense* from coastal defense (jinhai fanguy) to offshore defense (jinyand fanugy) which would extend from 200-400km from the coast and even further southward in the South China Sea. Their goal is to conduct off-shore patrols by 2000 and blue water patrols by 2050. Their enablers for off-shore patrols are: underway replenishment, acquiring a long distance communications system and a global navigation system. These requirements could indicate spending priorities for the Navy. Note: PRC navy ships recently completed ship visits to Hawaii and San Diego.

The satisfactory employment of a quiet SSBN and its intercontinental ballistic missile will satisfy the fourth principle. Mao's dictum that *political power grows out of the barrel of a gun* and his conclusion that "If we are not to be bullied in the present day world, we cannot do without the [atomic] bomb" has led to the development of today's strategy: Limited Nuclear Deterrence.

This strategy consists of seven guiding principles:

1. No first use
2. No tactical nuclear weapons *(Note: This has probably been revised with the development of a 600km range, DF-15/M9 missile for theater level conflict.)*
3. Smaller number but better
4. Small but inclusive (different types similar to triad concept)
5. Minimum retaliation
6. Quick recovery
7. Soft kill capability (i.e., urban areas—they don't require accurate navigation.)

The Triad probably looks something like this:

Land	Attributes
First generation (old but still in service)	soft kill
DF-3, DF-3A (liquid rockets)	slow response
DF-4, DF-5	larger radar cross-section
	poor accuracy
Second generation (solid propellants)	
DF-21, DF-31, DF-41	
Air Force	
Bombers H5, H6	weak and not a viable leg by itself

Sea

Movement of a large fraction to sea based platforms has been accelerated.

JL-1

JL-2 new development as Projects 09-4 and JL-2

Evolution of the Navy's Strategic Guideline
(Extracted from page 224)

Period	Policy	Comments
1950-1975	Coastal defense with continental bias	Though the navy possessed aircraft, and fast attack craft by the early 1970s, it was not in a position to conduct effective sea-based coastal defense.
1976-1982	Sea-based coastal defense	This capacity was achieved with the addition of 33-class submarines, 051-class destroyers, and 053H-class escort vessels, 1976, respectively, all using domestic systems and equipment.

(Cont'd next page)

1983-2000	Sea-based coastal defense under the condition of limited nuclear retaliation	With the successful flight testing of the JL-1, SLBM in 1982, the Navy entered the era of limited nuclear retaliation. The JL-1 could be launched in extreme emergencies in that year, but its design was not finally validated until the test from an 09-2 class submarine in 1988.
2000-	Integrated sea-based nuclear deterrence	The 09-4, China's second generation missile sub, is expected to be completed by about the year 2000. The sub will have grater survivability than the 09-2 boat and will be equipped with JL-2 missiles of 8000km range.

Summary

Looking back on the political and social changes taking place in China, the development of the nuclear submarine and its associated nuclear tipped SLBM was a crowning achievement. The United States and USSR had modern scientific and industrial bases from which to start their programs. China did not. For Beijing's leaders, the submarine and other strategic weapons projects provided an additional impetus to organize, create, mobilize and finance that base. Thus the long term goal must have been as much creating a scientific and industrial capability as was national security. This base has morphed to the civilian industrialization of China with 70 percent of the military industry going to civilian production which is leading China's economic engine. The authors said it best: "In the end, the programs helped define the limits of politics and the nation's objectives even as they catapulted China into the nuclear age."

I highly recommend this book to readers with an interest in political-military studies, policy and strategy development, and China as an emerging economic giant. ■

HMS TORBAY

Tony Miers in the Corfu Channel

by CDR R. Compton-Hall, RN(Ret.)

The Victoria Cross, Britain's highest military award, has been won by a total of 14 Royal Navy submariners in both World Wars. The VC, a bronze cross simply inscribed For Valor, compares with the Congressional Medal of Honor.

One of the traditional teachings of English Public (i.e., expensively Private) schools is that a man must always *play the game*, and that he should be *a good loser* if the game goes the wrong way.

Anthony Cecil Capel Miers, of Scottish fighting stock, attended excellent schools and played games well but, most emphatically, he never became a good loser: he was fiercely competitive and determined, from his youngest years, to win—whatever and however.

Tony Miers, known as *Gamp* on the lower deck and *Crap* by officers for reasons that have not been convincingly explained, joined the Submarine Service in April 1929. He made his mark as "totally loyal, fearless, hot-tempered and incautiously outspoken". A prescient training officer wrote that he would either be awarded the Victoria Cross or a court martial: in the event he received both. The latter was reputedly for the self-confessed, and possibly self-invented, offense of striking a rating who was to blame for failing to secure a victory for the ship's football team (the story varies, and may be mythical); but the bronze cross was for a well recorded and undoubtedly valiant submarine exploit, albeit one which resulted from extreme bad temper at not being an immediate winner against a collection of enemy vessels in the Eastern Mediterranean early in 1942.

HMS TORBAY arrived on the Mediterranean station in less than ideal circumstances. She had been hurriedly sailed from the UK for an urgent Biscay patrol en route: key officers and ratings were on long leave and vacancies had to be filled with young and inexperienced men. Miers, in command, was only just back in submarines after three-and-a-half years with the surface Navy; and Paul Chapman, freshly appointed First Lieutenant (Exec), was barely 21. Nonetheless, TORBAY sank two tankers and four small

craft on her second Med patrol; and on the third she sent the Italian U-boat JANTINA, a transport, a tanker and seven caiques to the bottom of Mussolini's *Mare nostrum*.

Off Crete, Miers acquired notoriety (amongst the few who knew) for ordering the machine gunning of German soldiers who had taken to a rubber float while their caique was being sunk by TORBAY crewmen with a demolition charge. Accounts of this episode are conflicting; but TORBAY crew members, and Army personnel embarked, speak of what would have been called an atrocity at the Nuremberg trials. We might recall the post war execution of U-852's commander, Kapitänleutnant Eck. He was tied to a post on Lunenburg Heath and shot by a British firing squad for killing survivors of the Greek ship PELEUS in the Indian Ocean on 13 March 1944 to avoid the activities of his U-boat being jeopardized. In contrasting vein there are those who may raise an eyebrow at the apparent immunity from blame enjoyed by Lieutenant Commander Dudley W. Morton, USN if they read about the carnage following USS WAHOO's attack on a Japanese transport in January 1943.

But so...Eck was a loser; Miers and Morton were winners. Victory in war is achieved by any means that destroy the enemy's willingness to continue the fight: a patriotic pragmatist, such as Miers, might argue that the only inadmissable *atrocity* (if such a thing exists in unlimited warfare) is one which lowers, by its observation, the morale of one's own forces.

On 1 March TORBAY, recharging batteries by night on the surface amidst rain squalls, sighted an Italian destroyer a mile away: Miers dived to attack, and did not think that the submarine had been seen (the Italians did not have radar at the time) until a pattern of depth-charges persuaded him otherwise—with "six simply deafening reports". Two more patterns followed.

The damage was slight, but it was obvious that the enemy was fully alerted. In fact, every available A/S vessel in the Grecian arena was soon at sea.

Next day the boat's Asdic (sonar) operator detected distant *pings*, but it seemed safe to surface for the usual charge that evening some miles south of Corfu Island. (The snorkel, invented by the Dutch Navy and brought to Britain in 1940, had been declared unwanted by the Admiralty). In due course a small convoy appeared to the southwest; but a chase which required,

whilst dived, an hour at three-quarter power, thereby seriously depleting the *box*, did not succeed in closing the range sufficiently.

Chapman (who, as Jimmy of a British boat, doubled as electrical officer) was more than a little troubled by the expenditure of amps. But many more amps were needed when, at 0925, masts appeared on the eastward horizon: a sizeable convoy was steering in a northerly direction along the mainland coastline. Fifty-five minutes later, and still five miles away, four big troopships, escorted by three destroyers and two aircraft, became clearly visible. The targets were a submarine captain's dream—but with the battery so low, owing to the previous abortive approach, there was no hope of Miers getting within realistic torpedo range, which was about 5000 yards at most.

Crap was cross—very cross. To intensify his ire, and ignite the exceedingly short fuze with which he was born, the important vessels were seen to be passing through the very position where TORBAY would have been lying had she not hotfooted—fruitlessly—after other less valuable targets.

At this point it is worthwhile starting to ask questions about the real Miers. Was he blindly impetuous, as his personality might suggest to a casual observer?; or could it be that there was method in his madness? Was he not in fact one of the most closely reasoning and coldly calculating of submarine commanders anywhere, despite his apparently irrational rages? After all, *Crap* was a brass-hatted Commander and 36 years old (unusually senior and long in the tooth for his job) with two DSOs already on his chest and a wealth of tactical experience. There are others —some of us may recognise ourselves amongst them—who have deliberately staged dramatics to stimulate a ship's company, or even to divert an admiral's staff, at trying times.

While Miers watched through the periscope in full frustrated fury it looked as though the transports were making for Corfu Roads, perhaps to refuel or merely to rest in safety during the night until airborne escort could be resumed at daybreak. The principal anchorage in the Roads was two-thirds of the way—20 miles—up the eastern and landward side of the leg-of-mutton Corfu Island which itself lies parallel with, and close to, the mainland of Greece. The narrow northwesterly dividing strait, 30 miles long from south to north channels, is sheltered from storms and easy to guard against intruders such as TORBAY—hence the partiality of the

British Mediterranean Fleet for Corfu Roads before the war.

The dangers were plain, but Miers had not the slightest hesitation in drawing up a plan to follow the convoy and attack it in harbour. Chapman calculated the chances of stealing unseen into the Roads as fair, although the dice were heavily loaded against getting out again, but he kept his doubts to himself.

The bottle, into which Miers intended to insert TORBAY, was less than two miles across at the northern neck; and although the bottom strait seemed spacious on the chart it was only a trifle wider, for a submarine drawing 60 feet at periscope depth, because of the incursive Bianco Shoal. The operation would require, on the return journey, four or five hours of submerged navigation to regain the open sea to the south—through what would doubtless be a stirred-up hornets' nest of anti-submarine avengers. It is not clear why Miers did not plan to exit via the northern channel, which was much nearer to the area of attack, but it may be that an insufficient study of the chart misled him.

Miers believed that he could make the approach passage from the south on the surface, in spite of an almost full moon, and then give the thirsty batteries a three hour charge to between 60 percent and 70 percent capacity, while actually off Corfu town. It was a plan of quite extraordinary daring—supreme *chutzpah* (although Tony Miers was absolutely Roman Catholic Christian and surely did not know the word); but without that charge there could be no escape, in any direction, after the torpedoes had done their work.

There were some secluded inlets on the way up to the Roads where TORBAY might be able to sit on the surface and charge more safely, but it was more important to keep the targets under observation in the anchorage lest they make off through the North Channel during the time that *Tono* Kidd, the Engineer Officer, needed to put those vital amps back into the box. In any case, a submarine bows-on against the dark mountains of Greece would be hard to spot, or so Crap assured his team, and none would dare challenge the captain's opinion.

The alternative of ending around the island on the surface during hours of darkness, and catching the convoy when it emerged indue course through the northern channel, was rejected—better to strike quickly, whatever the risks, in the most promising place.

The submarine neared the southern channel at slow economical speed dived. Soon after sunset (but with the moon up and

visibilities perfect) Miers surfaced, charging on one engine and propelling on the other. The T class, like all British submarines except the U class, was diesel-or-electric rather than diesel-electric—and by 2200 TORBAY was level with Corfu town. The ballast tanks were then partially flooded and both engines were applied wholly to charging the batteries.

At 0100—it was now 5 March—a patrol vessel puttered up from the Corfu shore. Miers hurriedly dived, although fearing that the unavoidably noisy evolution of opening main vents would be revealing. But, half-an-hour later, the unwelcome visitor departed without fuss. Chapman reported, meaningfully, that the box was fairly well up; so Miers decided to remain dived, which is what the prudent Chapman intended, while stealthily approaching the Roads at creep speed on one motor.

At about 0200 the lights of the nearby northern entrance came on, to admit a merchant vessel: they were extinguished again when the ship entered the Roads. A few minutes later a motor launch glinted momentarily in the moonlight bright: it stopped engines, apparently to listen, but there was no sign of TORBAY being heard. Then it dropped two small explosive charges; but Miers, never rattled by irrelevant events, decided that these were merely to discourage frogmen.

At 0235 TORBAY was in the anchorage itself, at periscope depth. She nearly rammed a destroyer, seen just in time when the moon, now setting, lit its camouflaged side. The incident may well have arisen from *Crap's* unadmitted defective eyesight, which only the loyal Chapman surmised after his captain made a similar error while the boat was working up in Scotland.

Any ships in the Roads were invisible through the periscope (even to a well-sighted observer) against blacked-out Corfu town. Miers realised, doubtless prompted by Chapman, that an attack must await the brief twilight before dawn. Accordingly, he reversed course and withdrew eastward for a couple of miles. The delay meant that the submarine would have to depart through the south channel by daylight.

Miers waited four interminable hours, dodging numerous patrol craft as they slowly and quietly crossed and recrossed the harbour, dropping scare charges: sometimes the only indication of an enemy presence was announced by Petty Officer Telegraphist E.K. Kember (an imperturbable ancestor of today's Sonar Chiefs) on the

primitive passive Asdic gear. *Crap's* report remarked, with typical understatement, that the vigilant wait was "a fairly harassing experience".

Eventually, shortly before 0600, *Crap's* strained patience permitted him to think that there was enough light to have another try. He was nearing the Roads again, on a guesstimated firing course (British submarines had no continuous angling gear, and normally had to aim torpedoes one after the other in a *hosepipe* salvo in line with the submarine itself) when yet another patrol vessel, this time going fast and purposefully, screamed overhead. Miers went to 90 feet and turned a full circle before lining up for the third time.

The last interruption meant that the attack would be made in bright sunlight and in glassy clam water. Miers accepted the terms without debate and cautiously exposed the periscope.

Two fishermen were rowing past, very close, making it impossible to take a good all-round look; but, next time Miers swung the lens around, the field of view was all too clear. The convoy of troopships had gone: indeed, it had probably never even paused in the Roads on its way north.

It was a bitter blow. But the Roads were not empty: two supply ships, of about 2000 and 8000 tons (respectable targets) were lying at anchor, beam-on to TORBAY's bow tubes; and a destroyer, at a more awkward angle, was with them.

Six torpedoes fired at about 0730 ensured that the supply ships would never sail again, although the destroyer was unscathed.

Retaliation erupted swiftly, but the anti-submarine defences were not coordinated. *Crap* crept south and kept his periscope down for 25 minutes—a further test of scant patience. When next he looked there were plenty of craft milling around the position from which he had fired, but none was in pursuit: full-size depth charges were being dropped in large numbers—all at random. From the other direction, the patrol craft covering the south channel, TORBAY's way out, were racing back to the anchorage. The Italians, perhaps with their own very successful but limited-range harbour-penetration *human torpedoes* in mind, were sure that no intruder could have left the harbour precincts.

As always, fortune had favoured the brave.

There was a final cause for concern for TORBAY when a schooner appeared to be dragging some king of net across the

channel ahead; but the submarine was clear of the strait by 1120, 17 hours after she had first passed through the gap on the previous evening. An anti-submarine trawler waddled into range 10 minutes later; but, for once, *Crap* gave the opportunity to engage the enemy a miss. The battery was again practically flat and key members of the crew had been at action stations for a least 24 hours.

All the same, Miers ordered "Gun Action Stations" when a supply schooner hove in sight an hour afterwards; but its life was spared by the sudden appearance of an Axis aircraft overhead. It is not impossible that TORBAY's men were grateful to that lone aeroplane.

Throughout the latter part of his turbulent career Tony Miers was blessed with a resilient and beautiful Australian wife, Pat: the Royal Navy's Submarine Service remains indebted to Lady Miers for keeping her husband under control (more or less) as he rose to high rank and gained a Knighthood in addition to the VC and a good many other distinguished decorations.

Those of us who were privileged to know *Crap* appreciated his steadfast loyalty to those whom he approved (meaning, in the main, men and women who were not afraid of standing up to him); but we were also very aware of his implacable stance, in peace or war, towards any enemy of Britain as well as his open condemnation of those unfortunates (including several notable naval wives and a goodly proportion of non-submariners) whom, by no means always justifiably, he judged to be weak and therefore worthless.

It is interesting to note that, during a tour with the U.S. Navy towards the end of the war, Tony Miers was not signaled as anything but a well behaved and welcome brother-in-arms. United States naval officers are famously polite and tolerant towards visitors from overseas, which could account for the lack of archival adverse comment; but it does seem that Tony Miers was perfectly capable of polite socialising and amicable cooperation, when he genuinely respected the people he was with, and when those qualities did not conflict with fighting, most vigorously, any perceived enemy—which after the war might range, it has to be said, from an Admiralty department down to an incompetent sanitary engineer.

Naturally, the Royal Navy Submarine Service remembers the hazards, as well as the rewards, of serving *Crap*. But the memory also remains of the royal summons to Commander A.C.C. Miers,

VC, DSO and Bar, DSC, Royal Navy to visit Buckingham Palace for his Victoria Cross investiture. Three of his officers were to receive high decorations at the same time; and 24 of TORBAY's ratings were to have the CGM (Conspicuous Gallantry Medal) pinned on them, but there was no definite date for the latter when the initial command was issued.

Miers promptly joined battle with the Lord Chamberlain. He informed that dignitary's office that health would not permit him to wait upon His Majesty unless he, their captain, could be decorated by the King at the same time as his crew.

Awards were always presented, person by person, in strict order of precedence. The Victoria Cross came (and still comes) first, followed by the Order of Merit, Knighthoods, DSOs and DSCs; CGMs for ratings, were way down the list.

On the due day of *Crap's* VC Investiture protocol suffered severely. The procession in the Throne Room, was led, as a band, by Tony Miers and the ship's company of His Majesty's Submarine TORBAY. ■

REUNIONS

USS PICUDA (SS 382)
USS QUILLBACK (SS 424)
USS TRUTTA (SS 421)
October 6-11, 1998, New Orleans, LA. Contact:
Jimmy Brown
21317 Allens Lane
Rock Hall, MD 21661

Thurston Hahn
7 Chuckwagon Lane
St. Rose, LA 70087

USS PIPER (SS 409)
August 20-25, 1997, Mobile, AL. Contact:
Frank Whitty, P.N.C.
U.S. SubVets, Inc.
87 Oak Street
Middleboro, MA 02346

ABOARD A DELTA I IN THE RUSSIAN PACIFIC FLEET

by RADM Malcom I. Fages, USN

Rear Admiral Fages is Commander Submarine Group Two. In February 1997, he was a member of a Center for Naval Analysis delegation to Russia. This article describes the delegation's visit aboard an operational Delta I SSBN in the Russian Far East.

Picture this opening scene...the thermometer reads minus 20 degrees, the wind is howling at 30 knots. A delegation of Russians and Americans has just pulled over at a roadside rest stop in the Russian Far East. The amenities include a frozen outhouse, shish-ka-bobs cooking over a small hibachi tended by an old man standing in the snow, and a gasoline tanker truck dispensing fuel to any driver with hard currency. And then, as the party reboards its Japanese minibus, they discover that the engine won't start in the bitter cold. That was the less-than-auspicious prelude to an exciting trip to the Povlovskoye Naval Base, three hours from Vladivostok. I was privileged to be a member of a Center for Naval Analysis (CNA) delegation, hosted by the Russian Pacific Fleet Commander, for a visit aboard a Delta I SSBN. Our adventure was in conjunction with the ninth in a series of exchanges between CNA and its Russian counterpart organization, the Institute for U.S. and Canada Studies. This particular trip included seminars in Moscow and Vladivostok as well as the Delta visit which will be detailed in this article...and we were eventually able to get the bus started!

In Moscow, we participated in a seminar in which we were fascinated to find ourselves on the sidelines of a heated debate between members of the Russian Duma and General Staff regarding military reform as well as find ourselves on the receiving end of visceral dialogue regarding all of the ills that would come with NATO enlargement. We also had private sessions with the Deputy Chief of Naval Operations, members of the Security Council, the Defense Council, and officials at the Ministry of Foreign Affairs.

Our flight from Moscow to Vladivostok was aboard a Boeing 757 operated by TransAero Airlines. TransAero is an upstart competitor with Aeroflot. The flight was as comfortable as any

nine hour flight in coach class can be and was remarkable only in the fact that the breakfast meal was whatever had not been eaten six hours earlier. White wine and breaded calamari as a *special* breakfast treat!

Landing in the Russian Far East, only 50 kilometers from North Korea, we were met by our military hosts and spirited to the Vlad Motor Inn—believe it or not. This hotel was a Canadian venture which purported to provide Western style accommodations, hot and cold running water, and a menu with foodstuffs that were recognizable. We anticipated spending only one night and then were to board Russian military aircraft for a flight to Kamchatka and visit aboard a Delta III at the Petropovlovsk Submarine Base. Ultimately, that portion of our trip had to be canceled due to blizzard conditions in Kamchatka. We all regretted missing the opportunity to visit that remote and mysterious submarine outpost. None of us were unhappy, however, that we had missed the chance to swim in the Kamchatka hot springs and then roll in the snow, an adventure our Russian hosts had also promised to avail to us!

Vladivostok was a bustling, though rundown metropolis of about one-half million. Moored at the harbor in the center of the city was a Slava and three Udaloy class surface combatants. The ships were handsome and appeared well-preserved. We paid a call on Admiral Kuroyedov, Commander of the Pacific Fleet, who was engaging, forthcoming, and optimistic about the role the Pacific Fleet would play in the economic development of the region in the years ahead. He was also realistic about the current economic difficulties facing the Navy. Another seminar would be held in Vladivostok the next day, to be followed by our excursion to Povlovskoye.

We left the next morning for a three hour drive through the Russian countryside. The birch trees and snow covered landscape were reminiscent of the movie Dr. Zhivago. Along the way, we made a *pit stop* at a wide spot in the road. It was at this juncture that we joined our Russian hosts in an impressive display of Navy to Navy cooperation and push-started that minibus before we all froze on the road to Povlovskoye!

After passing through several checkpoints, we were met by the Base Commander and escorted onto the base. What a sight to crest a hill, look down on a protected harbor and see an Akula, three Victor IIIs, Delta III, three Delta Is, and four Echo Is. The harbor

was ice covered and there was essentially no movement at the waterfront. We saw no industrial activity, no maintenance facilities, and many empty buildings. Robust physical security measures were not evident. This was the rare submarine base which does not have a parking problem!

We were met at the brow of Delta I by the Commanding Officer, a 42 year old Captain Third Rank (O-6) who was in his tenth year of submarine command. He and his Base Commander had been notified of this visit about 18 hours earlier, so the snapshot we saw was probably quite representative. His ship was 20 years old and would be retired in the next year or so as a consequence of START treaty limitations. Its nominal service life was 25 years.

This Delta had two crews, but such was not necessarily the norm. We were told that for many SSBNs there were three crews for two ships and for SSNs, four crews for three ships. The crew was composed of about 40 officers, 40 warrants or *michmen*, and 40 enlisted conscripts. The on-crew cycle was not of fixed duration, but depended on how long it took for a crew to complete its certification process. Certification was followed by a somewhat indeterminate period in which the ship and crew were considered combat operationally ready. In 1996, this crew had conducted one 60 day patrol. At the time of our visit, the crew was combat operationally ready, but there was no scheduled underway period on the horizon.

The sail superstructure through which we entered was well preserved and below decks, the ship was clean and odor free. We were taken to the Control Room and issued two piece denim coveralls for the tour. The skipper indicated the coveralls were provided to each crew member and this clothing was easily disposed of if it became contaminated! Each crew member carried breathing protection that offered about five minutes of oxygen, to allow for space evacuation. There is an emergency air breathing system, but the masks are fixed in place.

The Control Room was of another era and reminded one of NAUTILUS. With the exception of a damage control status panel, nothing appeared to have been modernized over the years. There were no digital displays. The ship control panel had a joystick control for the rudder and a single joystick control for the horizontal control surfaces. The fire control panel display was a single

PPI. One depressed a push button to select the parameter to adjust. Torpedo presets were ordered from this display. There was one sonar display in the Control Room. Periscopes were raised and lowered by cable host. A remote monitor was available in Control for observing certain reactor and turbine compartment areas. It did not appear that manual target motion analysis was conducted in Control. The Navigation Space, aft of Control contained inertial navigation displays and a plotting table. Remarkable in this space was the slide rule that was used for performing navigation calculations.

The Torpedo Room contained two over two, centerline 53 cm tubes. Outboard each side at deck level was a 40 cm tube used for decoy launch. Torpedoes are pneumatically launched. The ship did not carry wire-guided units. There were no electrical connections through the breech door. Four units were tube loaded and eight were stowed in the room. Units in the room looked like Type 53-65s. Some had metal propellers and some propellers were plastic. Torpedo firings were a routine element of each crew's certification process.

Delta carries the SS-N-8 liquid fueled SLBM. Eight tubes are in the forward missile compartment and four in the aft compartment. Missile Control Center was guarded and closed to our visit. We saw nothing that would suggest additional precautions for liquid fueled missiles or more robust fire fighting equipment.

The Commanding Officer's stateroom was of similar size to ours but remarkable for its total absence of instrumentation, not even a gyrocompass. Officer berthing was in four man compartments. Crew berthing was throughout the ship, including the turbine spaces, so that there were always people living in the compartment in which they worked. We were told that annual radiation exposure for Engine Room personnel was on the order of several rem, with five rem as the limit. We wondered if the measure of effectiveness for a shielding engineer was to design a system that allowed exposure close to the limit, or to design a system that minimized personnel exposure!

The Wardroom was tired, but clean, and could accommodate about 16 at four tables. It was also home to a family of cats that were obviously well fed—and we saw no mice aboard! We concluded our visit with several rounds of toasts and a light snack. As a departure gift, we each received a sailor's cap, a kerchief, set

of anti-contamination underwear (as described by the Captain), and the denim coveralls we had worn below decks. And, needless to say, we each came away with wonderful memories of a never to be forgotten experience.

It would be easy to draw the wrong conclusion from this visit. Clearly the capabilities of this ship were very limited and it will soon be decommissioned. But, the crew and her Captain seemed committed and proud of what they were doing with the tools they and been given. As we all know, the Russian submarine force has some very impressive platforms and ships like those in the hands of a well trained crew will remain a force to be reckoned with for years to come. We must never lose sight of that fundamental fact as we continue to stabilize our relationship with the Russian Federation. ■

IN MEMORIAM

Russell Bouth

CAPT John H. Bowell, USN(Ret.)

GMC Keeven (Gunner) Hurtt, Jr., USN(Ret.)

CAPT J.S. Schmidt, USN(Ret.)

Daniel H. Wagner

Gordon W. Yetter

U.S. NAVY TORPEDOES
Part Five: Post WWII Submarine Launched/ Heavy weight Torpedoes

by Frederick J. Milford

While it is not our purpose here to discuss defense economics or national security policy, it is important to remember that the end of WWII dramatically changed the requirements, the associated force structure and the budget of the U.S. Navy. In 1946 the total number of ships in the U.S. Navy was about one-fifth what it had been in 1945, there were fewer than half as many destroyers, one-fourth as many submarines and one-tenth as many destroyer escorts. Aircraft are more difficult to count, but there were probably one-fifth as many serviceable naval aircraft in 1946 as there were in 1945. Annual expenditures for the Navy in 1946 were a third of what they had been in 1945 and fell to one-fourth the 1945 level by 1947. Total obligational authority dropped to one-tenth the 1945 level by 1948. Torpedo acquisition had to be pursued within this austere environment.

The end of WWII also brought an end to the ambivalence reflected in the *hold hands with the devil* description of U.S-U.S.S.R. relationships during the war. It was not until 1948 that a formal national security policy towards the Soviet Union was issued, but for naval planning and weapons acquisition purposes the hypothetical enemy was the U.S.S.R. even in the early post war years. In 1946 the Soviet Navy consisted of about 130 ocean going submarines, 10 large surface combatants, 68 destroyers, 68 minesweepers and numerous coastal vessels including small submarines. Whether as a result of astute analysis, or the need to have a credible mission to survive[1], the U.S. Submarine Force, given the structure of the Soviet Navy, seized on anti-submarine warfare as one of its most important missions. This decision had a profound affect on post WWII torpedo programs. No torpedo of any kind without the capability to attack submerged submarines has entered service with the fleet since 1945, whereas the only

---

[1] Frank Andrews in "Submarine Development Group Two", The Submarine Review, April 1983, p. 5, says "In 1946 it was evident that there would be no budget bucks for submarines unless they could be put to a meaningful use."

submarine launched torpedo with that capability that even reached prototype stage before 1945 was the Mk 33 of which only 30 models were built.

In 1946 the U.S. Navy found itself with huge stocks of a variety of operational torpedoes and numerous torpedo projects in various stages of completion. Post war funding could not support all of the development projects, so they were pruned down to those that could quickly produce useful interim ASW weapons and those that had major longer term potential. Subsequent development projects not only incorporated increasingly sophisticated refinements of concepts that were originated during WWII, but also introduced entirely new concepts. Three of the more important new concepts were wire guidance, discrimination and onboard attack logic. Such refinements greatly enhanced the effectiveness of torpedoes and were made possible in large measure by the continued rapid development of electronics in the post-war era. These and other improvements, however, raised the unit cost. A modern submarine launched torpedo carries a 1997 price tag that easily exceeds $1M. On the other hand, if one torpedo destroys a $1B enemy SSN, the exchange ration is very favorable.

Post-WWII torpedoes fall naturally into two groups: heavy weight submarine and surface vessel launched torpedoes and light weight air and surface vessel launched torpedoes.[2] Interestingly, there have been no torpedoes developed in the post war years exclusively for surface ships. All post-WWII surface launched torpedoes have been adaptations or dual use versions of air or submarine launched weapons. Accordingly, after a few comments on the continued use of WWII torpedoes, we consider the development of heavy weight torpedoes since 1945. Light weight torpedoes will be considered in the next part of this series.

Post-War Use of WWII Torpedoes

The straight running steam, electric and Navol torpedoes, Mks

[2] The split is at about 1000 pounds. Some air-launched torpedoes exceed that limit. We use *light weight* as synonymous with *air launchable* in accord with contemporary usage.

13, 14, 15, 16, 17, 18 and 23, which were operational[3] at the end of the war continued as service weapons. By 1950 only Mks 14, 15 and 16 remained in service[4] and the Mk 15 disappeared as trainable 21" torpedo tubes were removed from destroyers. Mk 16 (Navol) remained n service until 1975 and the venerable Mk 14 (steam) was not finally withdrawn from service until 6 March 1980.[5] The three homing torpedoes that had entered service during WWII, Mk 24 (air launched ASW), Mk 27 Mods 0 (submarine launched anti-escort) and Mk 28 (submarine launched anti-surface vessel) continued in service until they were replaced by improved weapons, the Mk 28 remaining in service until 1960. Many torpedo projects were discontinued, in some cases after reaching the prototype or pre-production stage. As noted below, some WWII projects were continued or reactivated during the immediate post war years. Thus much of the U.S. Navy torpedo programs from 1945 to 1950 represented refinement and adjustment of WWII programs to new peace time requirements.

Heavy Weight Torpedoes

Mark 35. The value of homing torpedoes as anti-submarine weapons had been well demonstrated by the Mk 24 torpedo, and in 1943 a program was begun to develop a submarine launched homing torpedo with both anti-submarine and anti-surface vessel capabilities. This torpedo development, designated Mk 33, was discontinued in 1945 after 30 test and evaluation units had been produced. The concept was, however, retained in a new program, the Mk 35, with the same contractor, General Electric, beginning in 1945. This was an ambitious program that originally envisioned passive acoustic search, active homing, a seawater battery and

---

[3] Mks 16 and 17 were the two U.S.N. Navol (hydrogen peroxide) torpedoes. Both were in production at the end of the war, but neither was used in combat.

[4] Mk 18 electric torpedoes were, however, occasionally found in after torpedo rooms even in the early '60s.

[5] NAVSEA letter to CNO 63Z222:AB8510 Ser 142 dated 6 March 1980. The Mk 14 was declared obsolete around 1960, but this designation was officially withdrawn in 1969 and it continued in service as above.

launch from submarines, surface vessels or aircraft. Development was slow and cancellation was a real possibility on several occasions. The air drop capability was eliminated in 1947 and the first of approximately 500 production torpedoes appeared in 1949. Fleet use was, however, limited and the Mk 35 was withdrawn from service around 1960. Among the unique features of the 21" x 162", 1770 pound Mk 35 were: gyro controlled run out, active/passive guidance, a seawater battery to give a range of 15,000 yards at 27 knots and a deep, by late 1940s standards, diving capability.

Mk 27 Mod 4. With the Mk 35 program experiencing difficulties and the engineering development program for the Mk 37 torpedo, which is discussed below, just beginning, the U.S. submarine service found itself in 1946 with an ASW mission, but without a weapon capable of attacking submerged submarines. Further, neither the Mk 35 nor the Mk 37 could reasonably be expected to be available quickly. This situation and the sizable Soviet submarine force were probably the driving forces in the initiation of the Mk 27 Mod 4 project at the Penn State Ordnance Research Laboratory (ORL) in early 1948.[6] The Mk 27 Mod 0 torpedo had been a useful anti-escort weapon during the last 11 months of WWII. Several improved models had been developed including Mod 3 which, like the other improved Mods, had been lengthened to a little over ten feet to accommodate a larger warhead [7] and an improved battery. Mod 3 was unique in having a gyroscopic control for initial runout making a standoff offensive rather than purely defensive anti-escort weapon. When the Bell Telephone Laboratories withdrew from the torpedo program at the end of WWII, six Mk 27 Mod 3 torpedoes had been completed and

---

[6] See Thomas J. Pelick "Post-WWII Torpedoes 1945-1960", The Submarine Review, July 1996, pp. 94-99. A January 1948 intelligence report crediting the U.S.S.R. with 229 confirmed submarines is cited in Norman Polmar and Jurrien Noot "Submarines of the Russian and Soviet Navy, 1718-1990", Annapolis: U.S. Naval Institute Press, 1991. It seems unlikely that the Korean War which was unexpected and began in June 1950 had any impact on the decision to begin the Mk 27 Mod 4 development.

[7] Mods 1 and 2 were also a little over 10 feet long and had large warheads.

three were ready for field testing.[8] About 100 additional Mk 27 Mod 1 torpedoes were available for conversion to Mod 3 and some may have been fairly far along in the conversion process. Apparently work on the Mk 27 Mod 3 continued at a low level through 1947, possibly at Navy laboratories. In 1948, with increasingly ominous intelligence estimates of the Soviet submarine fleet as backdrop, the Navy and ORL negotiated an urgent development program for the Mk 27 Mod 4 torpedo. With the existing Mk 27 torpedo developments as background and several years of post-war electronics development to draw on, the Mk 27 Mod 4 was expeditiously developed by ORL engineers. What emerged was a 19" x 125.75", 1175 pound torpedo with a 128 pound warhead, a 15.9 knot speed and a range of 6200 yards (12 minutes). The acoustic control system consisted of four body mounted hydrophones, amplifiers and servo systems very similar to those of the Mk 24 and earlier Mk 27s.[9] Gyroscopic control provided for a preset initial straight enabling run on a predicted intercept course. After enabling, a circular search was initiated and continued until a target was acquired by the acoustic system. The acoustic signals guided the torpedo on a pursuit course to the target. If acoustic contact was lost, the circular search mode was re-established. Electrical fire control settings were used. These features were similar to those in the Mk 27 Mod 3, but the implementation had been greatly refined and many important additions and improvements were made by the ORL project team. The most important addition was the selectable capability to attack either submerged submarines or surface vessels. Mk 27, Mod 4 was not, however, fast enough to make a successful attack on an alerted 17 knot Type XXI submarine. With that proviso, the Mk 27 Mod 4 was an available, high performance anti-submarine/anti-surface vessel weapon for U.S. submarines. This was the first submarine launched torpedo capable of attacking submerged submarines adopted for U.S. fleet use. About 3000 were procured from

---

[8] Bell Telephone Laboratories "Torpedo Mark 27", Report 6.1-sr1294-2338 to NDRC/OSRD dated 17 August 1945.

[9] Illustrations in the Ordnance Pamphlet for the Mk 27 Mod 4 torpedo, OP 699, show body mounted hydrophones. There may have been experimental modes with nose mounted transducers.

AVCO Corporation and Naval Ordnance Plant (NOP), Forest Park, between 1949 and 1954. Mk 27 Mod 4 was gradually replaced by Mk 37 Mod 0 between 1956 and 1960.

Mk 37. Even before the Mk 35 became operational the development of another superficially similar torpedo, the Mk 37, began. In retrospect, the Mk 37, which is frequently described as the first modern ASW torpedo, is clearly a major milestone in torpedo development. Engineering development of the Mk 37 began in 1946, but its origins are found in WWII projects at Harvard Underwater Sound Laboratory (HUSL) and ORL. The active homing systems pioneered by these laboratories had many sophisticated and useful features. One of these was Doppler enabling which rejected echoes from stationary targets and so avoided homing on reverberations or other false targets. Another important feature was conical scanning, using four quadrant transducers, during reception. This system used a single amplifier to generate both azimuthal and depth steering signals. The ORL system[10], which was a significant improvement on the original HUSL system, had been tested in modified Mk 28 torpedoes. Beginning in 1946 Westinghouse and ORL combined this active homing system with a passive homing system, appropriate logic circuits, a new propulsion system and a new torpedo body to make the Mk 37.

The Westinghouse-ORL team produced 30 torpedoes for development testing in 1955-56. Large scale production was undertaken at NOP, Forest Park and the Mk 37 began its long career as the primary U.S. submarine launched ASW torpedo. The Mk 37 Mod 0 was 19" in diameter by 135" long; weighed 1430 pounds; used two speed, 26 knots (10,000 yards) and 17 knots (23,000 yards), electric propulsion; and carried a 3300 pound warhead. The guidance was a preset straight gyro controlled enabling run on a predicted intercept course followed by passive acoustic search using snake or circular search pattern. After target acquisition, the torpedo was guided by the passive acoustic system

---

[10] The active homing system as developed by ORL is often called the *project 4 panel*. The designation *panel* arose because torpedo electronics were arranged on circular panels in the Mk 24 and the name simply stuck.

until, at a range of about 700 yards, the echo strength in the active system became sufficient for active homing and attack. The active homing mode was, as previously noted, Doppler enabled to prevent attacks on stationary false targets.

The Mk 37 Mod 0 torpedo was a very sophisticated weapon, but the initial straight enabling run, which could take up to 15 minutes, was preset and not alterable until it was completed. During that time the target could, either incidentally or for deliberate evasive purposes, maneuver and compromise the homing phase of the attack. To obviate this problem and old idea[11], wire guidance, was resurrected. The first effort in this direction was the Mk 39 which was a Mk 27 Mod 4 modified by the addition of a wire dispenser, appropriate controls and improved propulsion. The modifications were developed by ORL and Vitro Corporation. One hundred twenty torpedoes were converted by Philco and used, beginning around 1956, for fleet familiarization and evaluation, mainly in the seven SSK conversions of WWII fleet boats. In addition to the torpedo modifications, it was necessary to modify the fire control system to provide appropriate control signals and the torpedo tubes to accommodate the wire. In operation the Mk 39 became a *bearing rider*, that is it was manually steered to keep it on the line of bearing from the launching submarine to the target. This form of guidance is not particularly efficient and it has other limitations among which we note: 1) only one wire guided torpedo at a time can be launched and controlled, 2) for the run time of the torpedo the maneuverability of the firing submarine is limited, 3) torpedo noise masks the acoustic signature of the target, and 4) the torpedo on the bearing line indicates the direction to the firing submarine.[12]

---

[11] Wire guidance was used in the 19th century Nordenfeldt and Sims-Edison torpedoes. The idea had been pursued, though not in conjunction with acoustic guidance, by the German torpedo establishment during WWII and a wire guided shore based German torpedo, called SPINNE (T10), was developed. This torpedo carried over 5000 years of wire and was built in small quantities. After the war the Royal Navy experimented with wire guidance for torpedoes using SPINNE wire dispensers, but prototypes of useful service weapons were not produced until 1955.

[12] The last of these is relatively unimportant for a quiet torpedo, but for a high speed, noisy torpedo it would be a distinct disadvantage. Later guidance paradigms avoid this particular problem. The other aspect of the argument is that

In spite of these limitations, the Mk 39 program clearly demonstrated the improved effectiveness of wire guidance against a maneuvering target.

The success of the Mk 39 led to the development by Vitro Corporation and ORL of the Mk 37 Mod 1, a wire guided version of the Mk 37, which began its long service with the fleet in 1960. The guidance system was generally similar to that of the Mk 39 with the incorporation of corrected intercept guidance in addition to the bearing rider mode. Command enabling and new search modes were also introduced. The Mk 37 Mod 1 was longer, slower and heavier than the Mod 0, but it offered greater target acquisition effectiveness and was more effective against agile submarines.

Mk 37 Mod 0 torpedoes were withdrawn from service and refurbished and reissued as Mod 3; Mod 1 torpedoes were similarly converted to Mod 2 with deliveries beginning in 1967. The refurbishing involved many changes, one of note being the switch from magnetostrictive to ceramic piezoelectric transducers. This change enhanced the acquisition range to about 1000 yards and avoided loss of sensitivity with depth.

The Mk 37 was an excellent anti-submarine weapon until the submerged speeds reached the 20 plus knot[13] range and diving depths began to exceed 1000 feet. The probability of sinking or seriously damaging a submarine capable of over 20 knots with a 24 knot torpedo is unacceptably low (unofficial figures given 10 percent for the Mk 37) and meeting such threats required new weapons. Significant upgrades of the Mk 37 have been made and its progeny remain in service with many navies as the NT37C, D, E and F which are much faster, operate deeper and boast modern

---

a faster torpedo requires submarine maneuvering limitations for a shorter time.

[13]NAUTILUS (SSN571) was commissioned in 1954 and was capable of submerged speeds in excess of 20 knots. The first Soviet nuclear powered submarine was laid down in 1954 and completed in 1958. By 1962 the Soviet Navy had completed perhaps as many as 23, 10 (of 13) November, eight Hotel and five Echo I, nuclear powered submarines capable of submerged speeds greater than 20 knots and the large Echo II class was on the way. Initial estimates of the speed of the November class were low. It was eventually learned that these submarines were capable of 28-30 knots submerged.

solid state control systems. The U.S. Navy, probably wisely, developed new torpedoes to address the new threats.

Mk 45. Two solutions to the high speed, deep diving submarine problem were implemented. The first was the nuclear warhead incorporated in the Mk 45 (ASTOR). The torpedo itself was relatively conventional except for the use of a seawater activated battery to power a 160 hp electric motor. This propulsion package gave a speed of 40 knots and a range from 11,000 to 15,000 yards. Guidance was by a gyro, depth gear, wire combination using the attacking submarine's sonar to track the target. There was no homing capability. The warhead was detonated only by a signal sent along the wire; there was no contact or influence exploder in the torpedo. The wire guidance and command detonation were not only important in getting the torpedo to the target, they also satisfied the requirement for positive control of the nuclear warhead. Development of the Mk 45 was completed in FY60, it was approved for service use in FY61 and production deliveries began in FY63.[14] It was withdrawn from service in 1976 when the Mk 48 had demonstrated its capability and the advisability of using tactical nuclear weapons for ASW purposes became questionable.

The basic Mk 45 torpedo was modified by Westinghouse to make a conventional torpedo for foreign military sales, the so-called Freedom torpedo. A few demonstration models were built but none were sold.

Mk 48 and Mk 48 ADCAP. The non-nuclear approach to the high speed, deep diving submarine was a very fast, deep diving torpedo with a high performance guidance system, that is, a much improved Mk 37 that would take full advantage of post WWII technology. Consideration of such weapons, both submarine launched and air launched, began in November 1956 as part of the RETORC (Research Torpedo Re-Configuration) program. By 1960 a specific heavy weight torpedo project had emerged and was designated first EX 10 and later Mk 48. Development characteristics for the new torpedo included a range of 35,000 yards at a

---

[14]These dates are from the unclassified versions of SecDef reports for the appropriate fiscal years.

speed greater than 55 knots and a 2500 foot depth limit. After a bidder qualification exercise and competition between the qualified bidders, a project definition contract was awarded to Westinghouse. A parallel contract was awarded to Clevite for the development of an alternative acoustic system. The Westinghouse contract was subsequently extended to include the development of the turbine powered Mk 48 Mod 0 which had only an ASW capability. Some Mod 0s were produced for evaluation, but by 1967 it had been decided that an anti-surface vessel capability was also needed. Some feeling persists that this was more a ploy to keep Clevite in the running than a significant operational requirement. A competition between the Mk 48 Mod 1, which had emerged in rudimentary form from the Clevite contract, and Mk 48 Mod 2, a redesign of the Westinghouse Mod 0 followed. The Westinghouse torpedo used a Sunstrand turbine, as used in the Mod 0, for propulsion while Clevite used Otto fuel in an external combustion, axial piston engine. One of several selection factors was apparently the better efficiency of the piston engine, especially when running deep, as opposed to the quieter, but less efficient turbine. The acoustic systems were also somewhat different. In 1971 after competitive evaluation a full scale production contract was awarded to Gould[15] (formerly Clevite). The first Mk 48 Mod 1 torpedoes were delivered to the fleet in 1927, 12 years after the development characteristics had been approved.

The Mk 48 Mod 1 torpedo was 21' by 230', weighted 3440 pounds and carried a warhead with 650 pounds of PBXN-103. Frequently published, but unofficial, data indicate that it was capable of 55 knots for 35,000 yards and could operate as deep as 2500 feet, but not at maximum speed. Its acoustic homing system is reported to have an acquisition range of 4000 yards, about four times that of the Mk 37. This performance is impressive and

---

[15] Both the bureaucratic process and the contractor base have convoluted histories. The former occurred during the early McNamara years and rivals the TFX (F-111) in complexity and political undercurrents. Among the contractors, in 1969 Clevite and Gould merged with Gould being the surviving name. To further confuse the situation Westinghouse bought the Gould torpedo business in 1988. In March 1996 the Westinghouse defense and electronics business was sold to Northrop-Grumman. Gould produced the bulk of the Mk 48 torpedoes and Hughes and Westinghouse produced the ADCAPs.

generally adequate for dealing with 30+ knot, deep diving targets.

The Mk 48 torpedo is divided into five functional sections (groups).[16] These groups and their contents are briefly:

- the nose, containing the acoustic system and the homing control logic (HCL)
- the warhead, containing the high explosive, exploder and the Mk 12 electronic assembly, which is presumably a proximity fuzing device
- the control group, comprising the command, gyro and power control units
- the fuel tank containing not only the fuel but also the guidance wire dispenser
- the afterbody/tailcone group comprising the engine, control surfaces and actuators, combustion chamber and the alternator.

Most of the electronics was designed as functional item replacement (FIR) units (the approximate equivalent of aircraft line replaceable units) to reduce maintenance time and simplify the process. This concept also facilitates upgrading by installing new FIRs. The command control unit Mk 154, for example, was replaced by Mk 168 to accommodate the change to two-way communication in the wire guidance system for Mk 48 Mod 3.

The combination of substantial onboard capability (HCL) to control search, homing and re-attack maneuvers and wire guidance provides a formidable weapon. The addition of two-way communication (TELCON) in the Mod 3 provided data from the torpedo sonar and actual torpedo operating data (course, speed, depth etc.) To the submarine fire control system, thus substantially enhancing performance. Mod 4 added envelope expansion features, including increased speed and deeper diving, and a fire and forget capability. Existing torpedoes were upgraded by kits and Mod 4s were production torpedoes from 1980 on. Mod 5 was an interim upgrade of existing torpedoes pending the availability of ADCAP. The Mk 48 torpedo had teething problems, but it is a very sophisticated, high performance weapon. Published photographs of the destruction of targets attest to its effectiveness. The main

---

[16] This description is based primarily on "Jane's Weapon Systems", 1986-87 and 1987-88 editions.

technical criticism of the Mk 48 seems to be that it is very noisy.

Prior to the mid 1960s Soviet submarines had diving depths of 650 to 1000 feet and submerged speeds under 30 knots. Early Mk 48 capabilities were clearly capable of attacking such targets. The advent of the Soviet Alpha submarine[17] with its non-magnetic titanium hull, 2500 foot diving depth and submerged speed in excess of 40 knots apparently produced a validated threat against which the Chief of Naval Operations issued a new operational requirement in 1975. Two approaches to satisfying this requirement were initiated. The first was the Mk 48 *envelope expansion program*, mentioned above, which exploited the capabilities of the existing torpedo. The second was essentially a new torpedo[18], ADCAP. The major changes in ADCAP involved entirely new digital electronics, inertial guidance (replacing the gyro system), a major reduction in volume devoted to electronics, a corresponding major increase in fuel capacity, a strengthened shell and, of course, inclusion of the Mk 48 envelope expansion features. The Mk 48 piston engine was retained but with a greater fuel flow rate to yield an estimated 63 knot speed. Much of the change was made possible by the introduction of integrated circuits, including microprocessors, whose small size made it possible to move many of the functions of the control group into the nose. The guidance wire spool was moved to a position aft of the enlarged fuel tank

---

[17] Construction of the first Alpha submarine began in 1965 and was completed in 1971, but it suffered manifold problems. The second was completed in 1979 and was followed by five more. Unclassified photographs of Alpha appeared in 1978-79 with rudimentary lengends. Unclassified Congressional testimony in 1982 indicates that the Navy was aware of the Alpha program in 1976-77. The Alpha submarines may have been viewed as precursors to large scale serial production of submarines with similar characteristics, however, the Sierra class has a reported diving depth of 2100 feet and submerged speed of 34 knots. The late Akula class is reported to have a diving depth of 1300 feet, a submerged speed of 35+ knots and, for the improved Akula, a greatly reduced acoustic signature. Assuming that these reports are reasonably accurate, the high speed, deep diving threat that materialized was not as severe as that presaged by the Alpha.

[18] According to Friedman (WNWS 1991-92, p. 713) the designation EX 49 was assigned to the new torpedo in 1977 followed by Mk 49 in 1984. Mk 49 was, however, never used and the torpedo is known only as Mk 48 ADCAP, or simply ACAP, derived from advanced capability.

and other layout changes were made. FY94 saw the final buy of ADCAPs. Improvements in ADCAP are to be made by modification of the existing inventory. The first of these is known as MOD ADCAP and entered production in FY95. Research on quieting the ADCAP has been underway since 1986, but the justification for quieting has been recently questioned by GAO.

ADCAP is externally essentially identical with the Mk 48, but it requires a modified fire control system. Appropriate modifications have been made or incorporated in new construction and the ADCAP is the principal torpedo for attack submarines. Trident SSBNs, however, continued to carry Mk 48 torpedoes, though the appropriate fire control modifications may be being implemented.

Several other heavy weight torpedo projects were initiated after WWII. Two were discontinued because of the success of other projects, Mk 38 because of the success of Mk 37, and Mk 47 because of the success of Mk 48. The Mk 42 pattern running development was simply overtaken by events, more capable torpedoes preempted its mission. As noted, Mk 49 was intended for the ADCAP but not used.

Summary

The main trends in post WWII U.S. Navy torpedo development are relatively easy to identify. Soon after the end of WWII, the principal target became the submarine with surface vessels really secondary targets at best. Two types developed, heavy torpedoes for submarine and light weight torpedoes primarily for aircraft but also deployed on surface ships. Traditional steam torpedoes were phased out, though the Mk 14 lingered for a long time, in favor of electric propulsion. Electric propulsion gave way to advanced external combustion piston engines as the submerged speed of submarines increased to around 30 knots. The appearance of the Soviet Alpha presented an apparent threat that required even higher speeds and further propulsion improvements yielded adequate torpedo speed. The most striking evolution, however, has been in guidance and control. The rudimentary homing systems of WWII evolved into sensitive, high power, long range systems operating in both active and passive modes. Wire guidance was added to heavy weight torpedoes to provide mid-course guidance based on the attacking submarine's sonar and fire control system. As the

size and weight of electronics decreased, onboard signal processing and command logic were added. Modern U.S. Navy torpedoes are sophisticated guided weapons capable of following instructions delivered by wire or operating autonomously to attack and, if necessary, re-attack their targets. ■

Mk 14/23 AND Mk 28 TORPEDOES

Fred Milford and Dick Boyle are interested in obtaining date on circular runs by Mk 14/23 and Mk 18 torpedoes. Anecdotes would be fine. The period of interest is from December 1941 through 1980 when the Mk 14/23 was officially withdrawn from service.

Dr. Frederick J. Milford
1411 London Drive
Columbus, OH 43221-1543
(614) 451-5738
E-mail: fmilford@postbox.acs.ohio-state.edu
Or fmilford@juno.com

Richard J. Boyle
P.O. Box 157
Los Ojos, NM 87551
(505) 756-2543
(505) 756-1806 (Fax)
E-mail: dboyle578@aol.com

THE SUBMARINE REVIEW

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

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

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

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

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

THE BIG PICTURE

360-Degree OmniDisplay System

by LT Thomas J. Monroe, USN

Lieutenant Monroe wrote this article while a student at SOAC. It was the winner of The Naval Submarine League award for Class 96050. He is now Navigator/Operations Officer on USS CITY OF CORPUS CHRISTI (SSN 705).

After clearing baffles and raising the scope, the Officer of the Deck (OOD) gives the order to proceed to periscope depth. Looking forward, he concentrates on the OmniDisplay centered overhead. As the scope breaks the water, seas prove to be state 4 as predicted by sonar, but the digitally-stabilized display maintains level with the horizon. During his initial visual search, the OOD notices that the ship is 10 degrees off course and corrects the helm; the ship is now back on course. On the horizon there are two visual contacts detected: a merchant and an aircraft. The view is digitally magnified on both contacts and the system automatically begins tracking both contacts, providing observations to the fire control system transparent to the OOD as he reviews the navigation plot, with the JOOD maintaining a visual search. ESM alerts the OOD that an enemy aircraft radar has been detected, but is very weak. Deciding to take a closer look, he calls up the zoom view and magnifies the aircraft 128 times and sees that it is an enemy fighter, but is flying away with no counter detection suspected.

Just moments before going coming down from PD sonar detects a submarine. The OOD immediately goes deep and maneuvers to avoid. He looks at the sonar display, called up as a window on the OmniDisplay, and sees that the screen has become quite confusing with six merchants and two warships now displayed. He becomes concerned as he considers how to tactically employ the ship, as well as sort out all the data. Quickly sweeping a glance around the OmniDisplay, he sees the enemy submarine displayed on the port beam drawing aft. Having a confident picture of the tactical situation, the OOD deftly maneuvers the ship into optimal position moments before the Captain makes it to the conn.

Why is it that the OOD on a surfaced submarine stands his watch on the bridge? What benefit is so great that the OOD is

separated from his watchstanders and the navigation plot, and braves the freezing winds and cold waves over the bridge windshield—it is the panoramic view. The clear 360 degree view afforded by standing watch high in the sail optimizes the most vital sensor to safely navigating a submarine on the surface. While it is obviously more thrilling for the OOD to stand watch on the bridge, all the activity pertinent to his watch is occurring below in control, making the increase in the safety of ship well worth the loss of some direct supervision over the watchstanders.

While on the surface, standing watch on the bridge is possible, but this option clearly does not exist while the ship is submerged at periscope depth. In these cases the OOD is restricted to a view with a width limited to that of the magnification of the scope and is compelled to *dance with the one eyed lady* while making the periodic high and low power sweeps. How then can we gain the benefit of the 360 degree panoramic view while submerged and at the same time free the OOD from the physical constraints of the periscope?

The latter part of this question has already been answered with non-penetrating periscopes with which, using high definition video cameras, the OOD can conduct a visual search from a monitor in control. This technology has already been tested on several ships and will be incorporated into future classes of submarines.

However, it is the first part of the question which I intend to answer in this paper, focusing on a completely different method of displaying information for the OOD. The technology that I propose is not, to my knowledge, under development, but instead is an idea which I feel is worth serious consideration.

OmniDisplay

Figure 1 shows the fundamental element of the system which I propose: the OmniDisplay. This is a 360 degree display which is centered in the overhead above the conn allowing the OOD a clear view of the display and of the control room. This display will give a panoramic view from the scope at periscope depth using a completely different optics system, discussed later, or can be used to display the multitude of screens that the OOD must contend with on the conn (e.g. Sonar, WLR-9, JMCIS, etc.). Figure 2 shows the view of the OOD from the conn looking forward.

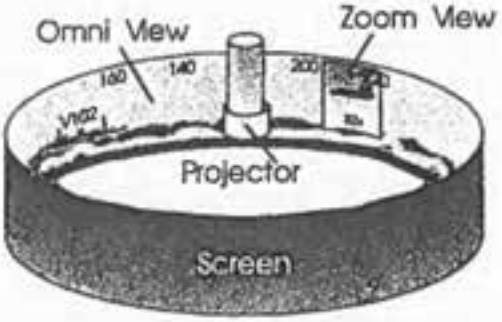


Figure 1. OminDisplay

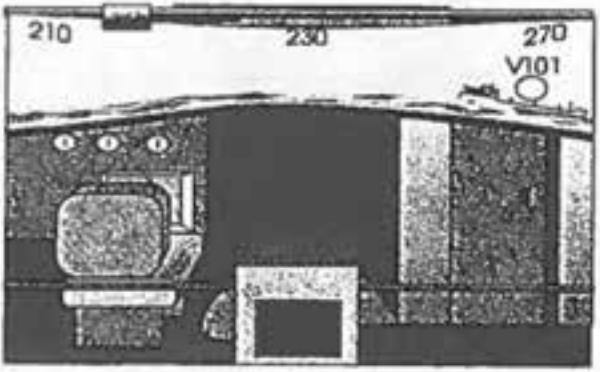


Figure 2. View from the Conn

The Scope

The proposed scope design is comprised of three component sections and is shown in Figure 3. These sections are the Antenna Group, the Omni Group and the Zoom Group. The Antenna Group is self explanatory. The Omni Group is the primary component for use with the OmniDisplay. It uses an inverse conical mirror to focus a 360 degree image onto a flat plane for the video camera. A similar conical mirror arrangement is used to project the images on the conn OmniDisplay. However, there are some restrictions in vertical coverage and magnification would be limited to a digital zoom with reduced resolution by expanding the individual image pixels. The solution to this problem is the third group of the scope. The Zoom Group would use a servo controlled mirror and traditional optics to magnify an image, improving resolution. It also allows for viewing of objects at high elevation.

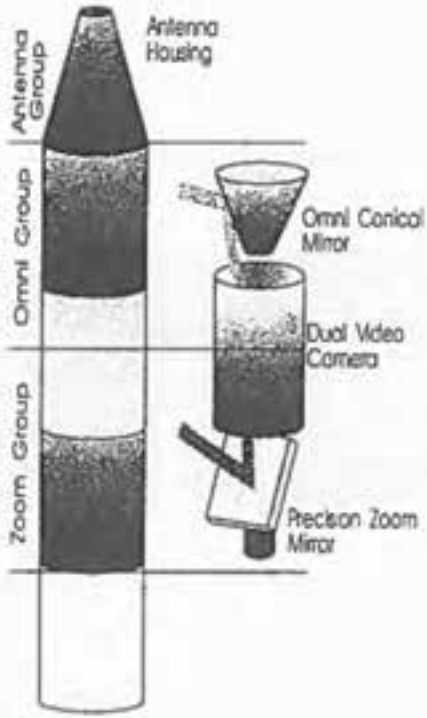


Figure 3. Scope Configuration

Referring back to Figure 1, both the Omni view and the Zoom view may be readily seen. The Zoom view would be temporarily superimposed with the Omni view at the same bearing. The example in the figure depicts an aircraft magnified 32 times. This image would be captured using the Zoom Group of the scope.

Image Processing

All images would be processed by a single microcomputer. Input from the Omni Group, the Zoom Group, as well as sonar, fire control, E.M., radar, JMCIS, and ships parameters would be processed into a single 360 degree display above the conn. Visual images are digitally stabilized by horizontally fixing the image on the visual horizon. The system would also automatically track visual contacts and could estimate range and angle on the bow. In contact rich environments, this would be a valuable aid and backup for the OOD. Figure 4 shows what the display may look like while submerged. Obviously no visual data may be displayed, but contacts can be visually simulated and displayed (note the submarine and merchant ship in the figure below) based on the fire control solution, better aiding the OOD to maintain a full understanding of the tactical picture. Since the display is simply a screen with a digital image projected onto it, the system allows for windows to be placed at the users discretion, allowing a great deal of flexibility for future modifications as technology continues to develop.

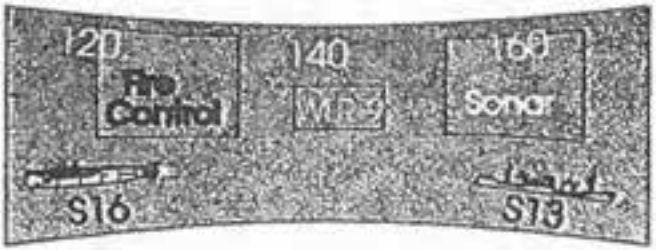


Figure 4. Segment of Submerged Display

Conclusion

The display system which I propose would have the following features:

360 degree view
Digital and optical zoom
Unified display of all contact and sensor data on the conn
Easy upgrade and/or modification
Allow for a scope with low radar cross-section
Assist the OOD in maintaining spatial orientation of the threat environment
Make use of COTS (commercial off-the-shelf) image processing equipment

Submarining has at its very heart technology, but it is those who tactically employ the ships who are most essential to its success. To that end, improvements to submarines should not be merely applications of new technologies because they are available, but should directly enable the crew in better sensing and understanding the threat environment in order to best fight the ship. The display enhancements which I have proposed will assist the OOD in maintaining a clear picture of the threat environment, benefitting safety of the ship in peace time and aiding the ship's primary mission in wartime.

Back at periscope depth and having cleared datum, the OOD overhears the Captain, who is in his stateroom, discussing the recent hostile submarine encounter with the Battle Group Commander on EHF. Control is still filled with the battle stations watchstanders as phones and coffee cups are put away. There is discussion of battle damage assessment by a P-3C who is dropping sonobuoys over the datum. Suddenly, an alert from the visual tracking system detects an incoming aircraft and zoom reveals it to be a P-3C Orion, probably the one that was just discussed. Doing a quick sweep to ensure that no other masts are raised and realizing that all comms are lined up on the scope, the OOD then continues as the Orion with its ISAR radar safely passes overhead without detecting the submarine below. ■

RUSSIAN NUCLEAR SUBMARINES WITH TITANIUM HULLS

by CAPT 1 Rank Igor Bogachenko, Russian Navy(Ret.)

Nuclear powered submarines with titanium hulls were a big achievement of the Soviet Union's shipbuilding industry. The navies of other countries have no such submarines.

Designing and building them pursued the goal of reaching technological and tactical superiority in comparison with the submarines of potential adversaries.

Soon after commissioning of the first Soviet attack nuclear submarine (Project 627), on August 18, 1948, the Decree of the Soviet Government was issued. "About creation of a new high speed submarine, new types of power plants and research and development for submarines." In accordance with that decree, works began on a new high speed nuclear submarine with anti-ship cruise missiles launched underwater and a hull from titanium alloys (Project 661-Papa).

The submarine was laid down in Severodvinsk in December 1963 and commissioned in December 1969. She had four 433 mm torpedo tubes with 12 torpedoes, and 10 Ametist 1600 mm missile tubes. The range of Ametist was up to 60 km.

With two reactors, two turbines, and two propellers in a nuclear power plant of 80,000 hp, the submarine (surfaced displacement 5200 tons) reached a speed of 44.7 knots.

Her test depth of 400 meters (m) (100 m more than Project 627) was provided by using titanium alloy 48-OT3B with a specific weight of 4.5 gram/cubic centimeter and a yield of 6000 kg/square centimeter.

For building the project 661 submarine a new metallurgical branch was created for production of plates and profiles from titanium and also of forging and stamping from that material.

The Severodvinsk shipyard gained experience with titanium hull welding and the production of castings and frameworks. To work with titanium hulls special shops had been built. Static, cyclic and dynamic tests of titanium structures showed high qualities including blast resistence.

The Project 661 submarine was built in December 1969, but due to high cost and too long a building process, serial production did not take place.

The first serial production of a titanium nuclear submarine became Project 705-Alfa.

She was built in Leningrad and commissioned in December 1971. During the period of 1972-1982 two more submarines were built in Leningrad and three in Severodvinsk.

With a surfaced displacement of 2300 tons, a test depth of 400 m, six 533 mm torpedo tubes (18 torpedoes and anti-submarine missiles), one reactor and one turbine power plant (40,000 hp) and a complement of 25-30 submariners, she reached 42 knots. The serious deficiency of that submarine appeared in her reactor with a liquid Pb-Bi heat carrier which was unreliable and difficult to maintain in fleet conditions.

The same titanium alloy played its role in reduction of her displacement and increase in her diving depth.

The full implementation of titanium advantages took place on the nuclear submarine KOMSOMOLETS (Project 685) which was designed in Leningrad from 1966 and built in Severodvinsk in 1978-1983.

Using a titanium alloy with a yield strength of 7200-7500 kg/square centimeter, allowed a test depth of 1000 meters with her hull weight about 39 percent of the surfaced displacement. One reactor, one turbine nuclear power plant (40,000 hp) provided a speed of more than 30 knots. The submarine had six 533 mm torpedo tubes (28 torpedoes or anti-submarine missiles). Unfortunately she was lost in the Barents Sea in 1994 as a result of fire in the seventh compartment.

Serial production of titanium attack nuclear submarines was also attained with Project 945; the Sierra class submarine on which the author of this article was Chief Navy Supervisor.

For building of these submarines, Krasnoe Sormovo (Nizhny Novgorod) *internal* shipyard was chosen and that factor put a strict limitation on her displacement. The Sormovo's Design Bureau Lasurit (Chief Designer Nikoly Kvasha) designed that submarine.

The most important differences between Project 945 (Sierra) submarine and the previous Project 671 (Victor) submarines were increases in her weapons payload and in test depth (up to 40 torpedoes and/or anti-submarine missiles and 600 m test depth).

Titanium alloy 48-0T3V (yield strength 6000 kg/square centimeter) provided the possibility to reduce the hull weight (and thus displacement) of this submarine by more than 10 percent in

comparison with a relevant steel submarine.

Other positive qualities of titanium alloys were:

- corrosion steadfastness (endurance) in sea conditions
- non-magnetic
- more possibilities to increase yield point in comparison with steels.

At first it was planned to build a series of about 40 units of that class of submarines. They had to be built in two shipyards: Krasnoe Sormovo and Severnoe Mashinostroitelnoe Predpriyatie in Severodvinsk. But ultimately only four submarines were built in Sormovo and were commissioned to the North Fleet in 1984-1993. The Project 945 Sierra class submarines has the following characteristics:

Purpose: blue water anti-submarine and anti-ship operations

Surfaced displacement	6,000 tons
Submerged displacement	10,000 tons
Reserve buoyancy	29 percent*

Surface unsinkability with one flooded compartment

Length	107 m
Beam	12 m
Draft	8.5 m
Test Depth	600 m
Collapse depth	840 m
Submerged speed	35.5 knots

Torpedo/missile tubes, bow 4-650 mm and 4-533 mm
Weapons 12-650 mm and 28-533 mm torpedoes and ASW missiles
Sonars/fire control: SCAT and BICS
Reactor: one OK-650, 190 mgwt
Turbine: one 50,000 shp
Manning: approximately 60 (30 officers and 30 petty officers)

In spite of the above mentioned advantages of the third generation Soviet titanium attack nuclear submarines, submarine development went back to the building of steel submarines with Project 974-Akula. (Design Bureau Malachite in St. Petersburg,

*Editor's Note: Technical review by American naval architects confirms that Russian methods of determining a reserve buoyancy differ from those commonly used in the U.S. Navy.

Chief Designer Georgy Tchernyshov, Chief Naval Supervisor Igor Bogachenko) construction was in the Komsomolsk and Severodvinsk shipyards.

The main reason in favor of steel was lower cost and more developed technological process.

The negative consequences of the return to steel were an increase in Akula's surfaced displacement up to 8000 tons and submerged displacement up to 13000 tons and reduction of her speed to 33.0 knots. Positive changes were the introduction of anti-land cruise missiles and more sophisticated hydroacoustic/weapons control systems. Her hull material was steel AK-32 with a yield strength of 10,000 kg/square centimeter.

From 1984 to 1996, 14 Project 971 submarines were built (seven for the Pacific Fleet in the Komsomolsk on Amur shipyard and seven for the Northern Fleet in the Severodvinsk shipyard).

In conclusion, it is reasonable to return to the advantages of titanium as a submarine hull material. The author of this article continues to consider it as a superior potential option.

The number one titanium advantage is the so-called specific strength: the ratio between yield strength in kg/sq mm and specific weight in g/cubic cm. They are:

Steel		Titanium	
1960s -1970s	1980s-1990s	1960s-1970s	1982-1990s
80/7.8=10.3	100/7.8=12.8	60/4.45=13	72/4.45=16.0

The number two advantage is in the submarine's magnetic properties. When a submarine is sufficiently quiet the magnetic field plays an important role in her stealthiness. If the magnetic field stress of titanium submarines is less by 8-10 times than that of steel ones, their magnetic moments are less by dozens of times. In other words, the mine threat for titanium submarines is much less and degaussing devices are much simpler.

The number three advantage is corrosion resistance. The titanium hull practically does not need repair. If one can speak figuratively, it is eternal.

A disadvantage of titanium is the higher cost of material and shipbuilding technological processes. The cost of one ton of titanium is twice that of steel. The cost of shipyard hull work is more than steel by 20-30 percent. But these ratios are for initial

steps of titanium submarine building in very limited numbers. The increasing of diving depths, reduction of displacements, unmagnetness and corrosion resistance makes titanium nuclear submarines more than cost effective in comparison with their steel counterparts. ■

DOLPHIN SCHOLARSHIP FOUNDATION

The Foundation has recently announced that 25 students were selected as 1997-98 scholars on the basis of scholastic proficiency; non-scholastic activities, character, and all-around ability; and financial need. Applicants, must attend an accredited, 4 year college or university and must intend to work toward a BS or BA degree. Scholarships are to be used for tuition and related expenses and are renewed for up to 4 years of undergraduate studies as long as the student remains in good standing with the school.

The Foundation is funded by Navy Submarine Officer Wives Club fundraisers and Dolphin Stores, individual and corporate contributions, foundation calendar and book sales, and memorial donations.

The Dolphin Scholarship Foundation sponsors 100 ongoing students with a grant of $2500 per year. Approximately 25 new grants are awarded yearly, renewable for up to 4 years of undergraduate study.

For more information or an application, please contact:

Director
Dolphin Scholarship Foundation
1683 Dillingham Boulevard
Norfolk Naval Station
Norfolk, VA 23511
(757) 451-3660
(757) 489-8578 (Fax)

UNDERSTANDING THE ART OF SUBMARINE FIRE FIGHTING

by LT Albert A. Brady, USN
USS NEBRASKA (SSBN 739)(Blue)

Lieutenant Brady's article won The Naval Submarine League Essay Prize for Submarine Officer Advanced Course 97101.

Fires are a submariner's worst enemy. From the acrid odors we have all smelled to the inferno that engulfed BONEFISH, fires have touched everyone of us and will continue to challenge our ability to survive in the submarine world. Although the Naval Sea Systems Command and Naval Research Laboratory (NRL) have done an adequate job on promulgating NSTM 555 volume 2 (Submarine Fire Fighting), much more can be done with existing resources to improve fighting fires on submarines.

Compared to other disasters onboard ship, fire presents one of the most likely paths of removing a submarine's warfighting capability.[1] Most systems (electrical, integrity of hull) have redundant backups. Loss of electrical power on David Bushnell's TURTLE (the world's first submarine), would not have been so traumatic, but on today's micro-switch/micro-chip operated boats this could be a huge disaster. At hundreds of feet deep, with no lights or depth control, the submarine is certainly in peril. Yet, we have all handled this casualty. Backing up our ship's service turbine generator is another turbine generator, a large storage battery, and a diesel generator. Engineers created levels of redundancy, protecting the submarine from an electrical power failure. Flooding is another serious casualty. Again, through redundancy of hull and backup valves, remotely operated flood control valves, and an emergency ballast tank blow system, the impact of the casualty is minimized on the ship's mission. The potential flooding hazard is also minimized by the continual surveillance of attentive watchstanders. Submarine fires on the other hand, happen without warning with no redundant protections.

---

[1] NSTM Chapter 555 vol. 2, Ch 35 pg. 23, Art 555-35.10.2, July 1996.

Submarine fires are awesome.[2] In less than two minutes, a compartment can be over pressurized. In a minute, visibility reduces to near zero. It takes no time at all before the atmosphere is completely toxic and the tissue in our lungs seers at 160°F. The compartment temperatures quickly achieve flashover levels of 1100°F. The submarine with all of its combustibles from oil and HP air, to electronics and weapons becomes a time bomb; the crew is the only EOD team available.

Each submarine crew learns the basic NSTM 555 knowledge. From this they each develop their own strategy on combating fires. Each ship varies this attack plan as it sees fit and coordinates its resources in the best array it knows how. Some COs envision this coordination as a *flowing of effort* toward the fire *from all parts of the ship*. This coordination of resources and flow of effort is the art of fire fighting. The engine room will still over pressure in two minutes, the temperatures will still reach 1100°F very shortly: these things will not change. How your boat eventually extinguishes the fire and gets back to fighting the war may be considerably different from mine though.

Naval Submarine Base New London and Submarine School have an excellent opportunity to conduct controlled experiments testing the effectiveness of submarine crews' *coordination of resources, flow of effort*, or *art of fire fighting*. With approximately one-third of the entire U.S. submarine fleet home ported in New London[3] providing an ample source of participants and the award winning[4] SubScol Fire Fighting Trainer, the factors are right for change. The Fire Fighting Trainer could be an excellent extension of the NRL. My suggestion is that the trainer not only promulgate basic guidance, but conduct research using actual submarine crews and their methods in the controlled setting of the trainer.

A SubScol fire fighting instructor mentioned that the trainer staff does nothing more than promulgate and reinforce the basics

---

[2] NSTM Chapter 555 vol. 2, Ch 31 pg. 1-22, July 1996.

[3] JO2 Johnson, G., *A Hardworking Day in the Life of NSSF*, The Dolphin, pg. 12, Jan. 27, 1997.

[4] JOC Polson, W., *SubScol Firefighters Accept Another Hot Award!*, The Dolphin, pg. 1, Feb. 20, 1997.

laid out in NSTM 555. This is a waste of an elaborately controlled potential research setting. New recruits and experienced submarine personnel perform the same canned scenarios. Should a real fire develop on their boat, these experiences may be of limited value. Sea returnee attendees also receive a basic lecture on the fundamentals of fire and fire fighting equipment, rehashing information contained in NSTM 555. Instructor sea stories bring home some of the points in the NSTM, but this is just one instructor's artistic impression of our worst enemy. The environment in New London is ripe to improve the submarine community's critical understanding of fire fighting through better use of the SubScol Fire Fighting Trainer platform.

One way to use the SubScol Fire Fighting Trainer better is to conduct controlled experiments[5] investigating the variability of each submarine crew's fire fighting art. Let's investigate how these experiments might be undertaken.

In conducting a controlled experiment, one must consider a number of points:[6]

- Select relevant dependent and independent variables.
- Specify the level(s) of the treatment.
- Control the experimental environment.
- Choose the experimental design.
- Select and assign subjects.
- Pilot test, revise and test.
- Analyze the data.

A research coordinator should be selected as an initial step. He must have an understanding of process control, be able to maintain the timeline of the research, coordinate the experimental effort, and look out for situations that could threaten the experiment's validity. The research coordinator may be the SubScol Fire Fighting Trainer Division Officer. He would compile a board of experts to help

---

[5] Campbell, D. & Stanley, J., Experimental and Quasi-Experimental Designs for Research, Chicago: Rand McNally, 1 963. A u universally quoted discussion of experimental designs in the social sciences.

[6] Cooper, D., & Emory, C., Business Research Methods, Richard D. Irwin Inc., pg. 353, 1995.

produce the seven steps above. The panel's theoretical chair would be COMSUBGRUTWO, with other members to include CO, NAVSUBSCOL, Commodores of Squadrons Two and Twelve, their Squadron Engineers, and others. These experts would help the research coordinator approve some basic research questions like: "Does a crew that uses X techniques (or X piece of gear) attain improved fire survivability?" Next, the coordinator states a hypotheses such as: "Crews that use X technique (or X piece of gear) extinguish fires and ventilate the space quicker than crews who do not."

The process of setting up this experiment is not easy. The coordinator must consider the many aspects of the design and test them before implementation if the results of the experiment are to remain valid after publishing for public review. The sample research question given above is only a suggestion. The board of experts may decide to explore a number of different questions such as, "Does the use of color coded hoses lead to improve fire survivability", or "Does assigning fire fighting team members by division rather than the watch bill improve fire team command and control?" Regardless, the research coordinator's next challenges are: choosing variables that best represent the idea being studied, determining how many variables to collect data on, and selecting or inventing measures for these variables.

In choosing variables based on the sample research question, the research coordinator needs to select a set of variables that best convey the meanings of *crew, X technique, and improved fire survivability*. Does having the flames extinguished in five minutes represent *improved fire survivability*? Does fire survivability depend on *ventilation of the space*, or *number of injured fire fighters*? Defining the word *improved* is critical so the results may be analyzed statistically using a significance test[7] such as chi square or T-test.

The remaining steps are equally challenging, but more intuitive. Time spent on designing a well though out set of experiments using all the submarines home ported in New London may reveal powerful insights or guidelines for fighting and surviving fires

---

[7] Campbell, D. & Stanley, J., Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally, 1963.

aboard submarines. Such revelations may result in a deeper understanding of how we currently fight fires and how we can improve. Any step in this direction would be a more effective use of the Fire Fighting Trainer and would reduce fire fighting casualties aboard ship.

Another, less rigorous step in finding better ways to conduct submarine fire fighting is through an improved use of seminars, as described in COMSUBLANT/COMSUBPAC INST 3500.1A, *The COMSUBLANT/COMSUBPAC Training Manual*. Seminars are group meetings set up by Squadron Commodores to address certain topics.[8] Attendees include submarine COs, department heads, and their selected representatives. At this squadron level, COs could come together at the Fire Fighting Trainer to discuss how they fight fires. Junior officers may attend these seminars and perhaps participate in discussion of how to best combat this, our worst enemy.

A third way to improve the effectiveness of the submarine community's fire fighting skills is to create a fire fighting competition among submarines. This would not only get the crews talking to one another about fire fighting, but also instill a competitive drive amongst the crews. These sub versus sub competitions could be similar to the volunteer fire department competitions held at county fairs across the nation. Central Illinois has yearly competitions where volunteers arrive for a parade and then later conduct races that test their basic fire fighting skills, like spraying a suspended ball with a stream of water down a guide wire. Although this act in itself would never be met in a real fire, the acts of quickly dressing in gear, assembling equipment and directing a stream of water surely are. A county fair atmosphere could be set up on each pier by the duty sections during the summer. Families would be invited down for a steel beach picnic after the competition.

As Sun Tzu, in his book The Art of War said: "for to win one hundred victories in one hundred battles is not the acme of skill.

---

[8] CSL/CSP INST 3500.1A, Article 1004 paragraph 3.a.

To subdue the enemy without fighting is the acme of skill."[9] In the art of submarine fire fighting, there are not battles. Fire prevention (subduing the fire before it ignites) has always been our hallmark. Once a blaze has erupted though, there is no turning back. A *war* of epic proportion may be just moments away and we must use our pooled fleet corporate knowledge on how to best survive.

Successful fire fighting and prevention is critical to the health and well-being of a ship and its crew. Using the trainer to research the best fire fighting tactics, improving the quality of fire fighting seminars, and designing activities to engage the crews in both discussing fire safety and practical fire fighting skill will result in more effective fire fighting training. Long lasting benefits will be the result. The above has not only highlighted our need to become more open to each other's submarine fire fighting knowledge,[10] but has also recommended a set of solutions on how to accomplish this with current resources. ■

[9]Handel, M., Masters of War. London: Frank Cass & Co. LTD, pg. 75, 1992.

[10]Senge, P., The Fifth Discipline: the Art & Practice of the Learning Organization. Bantam Double Day & Dell Publishing Group, pg. 283, 1994.

JOINT VISION 2010
A Submariner's Guide

by CDR Charles J. Leidig, USN
Commanding Officer
USS CAVALLA (SSN 684)

As the Submarine Force plans for the future, it's imperative that we develop a vision that is synchronous with the future roles and missions of the U.S. military. This vision development process can only be successful if we first make a legitimate commitment to evolve and mature into a community of true joint warfighters. With a joint vision, we can then build and design future submarines that incorporate joint compatible systems and capabilities. For the Submarine Force this means we must continue the evolution or even, the revolution, that began with the end of the Cold War. We've proven our adaptability in the Submarine Force as evidenced by the changes introduced into the New Attack Submarine program and the ease with which submariners assumed new roles and missions in support of the Navy's "Forward...From The Sea" strategy. Nonetheless, the revolution in military affairs that will occur in the next decade will be even more sweeping and challenging than that which we've recently experienced! The Submarine Force must be looking well ahead in order to retain its primacy in the U.S. military.

The Next Decade

There are many questions that we, the submariners of the 21st century, should be considering. For example, how can the Submarine Force stay in step with future defense planning and the incredible pace of technological advances? Will our weapons and communication systems be compatible and integral with the Joint Task Forces of the next century? Will our next generation of submarines meet the needs and requirements of the unified combatant commanders?

Joint Vision 2010

Recently, the Joint Staff provided a much needed vision for the

next century entitled Joint Vision 2010.[1] It is a conceptual template whose purpose is to provide "a common direction for the services in developing unique capabilities within a joint framework of doctrine and programs..."[2] As General Shalikashvili, Chairman of the Joint Chiefs of Staff writes, "It must become a benchmark for service and unified command visions".

There's no arguing that the Submarine Force brings considerable and unique capabilities to the arena of joint operations. Sea control and denial through sea superiority, forward presence, strike against land and sea targets, special operations, surveillance/indication and warning are but a sampling of the roles that exemplify the versatility of an attack submarine. However, the success of JV 2010 demands that these capabilities fit seamlessly into joint force operations. It's clear that we are not there yet! The Submarine Force must adopt JV 2010 as its *benchmark*, in order to be a key player in future joint operations.

JV 2010 Operational Concepts

As JV 2010 points out, the success of future joint warfighting will rely on technological innovation and information superiority. Out of these core strengths four operational concepts must be developed: dominant maneuver, precision engagement, full dimensional protection and focused logistics. The service wide application of these concepts will then give the U.S. military "the capability to dominate an opponent across the range of military operations", in other words, full spectrum dominance. To ensure submariners are fully ready to support the future roles and missions of our Armed Forces, we must closely analyze these new operational concepts.

---

[1] Joint Vision 2010 is available on the Internet at http://www.dtic.mil/doctrine/jv2010

[2] All quotes are from JV 2010 unless otherwise documented.

Dominant Maneuver

Dominant maneuver, as envisioned in JV 2010, will require the employment of widely dispersed joint land, sea, air, and space forces to achieve operational objectives. These forces must be proficient at conducting sustained and synchronized joint operations. The enabling capabilities for these type of operations will be rapid and compatible communication systems that provide information superiority.

Today, submarine force communication systems severely lag behind the high data rate systems in service both commercially and throughout the rest of the military. As shown on the next page, existing submarine communications capabilities already fall short of mission needs as defined by the Space and Naval Warfare Command and the gap will rapidly increase after the turn of the century. One system currently under development is the Submarine High Data Rate (Sub HDR) Satellite Communications Program. As designed, this system will meet assessed mission needs until the year 2002, at which time a follow-on system must be developed.[3] This is but one example where significant paradigm shifts may be required, in submarine antenna design perhaps, if we are to keep pace in the next century.

Dominant maneuver is also defined as the ability to attack cross-dimensionally, such as sea against ground and air, in order to create asymmetric advantages in battle. For the Submarine Force this means we must break old molds and develop weapons and delivery systems that will give us the capability to engage real-time both land and air targets.

---

[3] JCOMS Newsletter, Vol. 4, No. 1, December 1996.

Envision a submarine deployed to a forward area not yet under U.S. control, providing Theater Ballistic Missile Defense (TBMD) supported by real-time satellite targeting data. At the same time a screen of SSNs could be providing a vital layer of in-depth anti-air and cruise missile protection for an amphibious readiness group as it approaches the coast without CVBG escort. The same submarine conducting TBMD defense is simultaneously tasked to control several UAVs as they conduct battlespace preparation and surveillance for the JTF embarked on the Amphibious Group. The next day, this forward area SSN then plays a major role in the opening phase of the strike operation as part of an all-stealth attack when the submarine executes a SAM site strike. Additionally, the SSN carries out its assignment of providing defensive air support for an F-22 squadron that will be egressing the target area by an oversea route by taking out two pursuing aircraft. Once the land operations commence, the SSNs are moved closer to the coast, still undetected, but in position to provide direct, real-time fire support to both Army and Marine units as they advance on their objectives. The potential scenarios are endless and are limited only by our vision of the future. Clearly, the inherent stealthiness of the submarine makes it an ideal platform to conduct these visionary cross-dimensional missions. Attacking unseen from below the ocean surface exemplifies the asymmetrical advantages described in JV 2010.

Precision Engagement

Equally important in achieving the goal of full spectrum dominance is precision engagement. The rapid attainment of operational objectives while minimizing the risk to U.S. forces will require a *system of systems* that is responsive, accurate, and flexible. It must enable our forces to pinpoint a target, rapidly conduct an attack, assess damage and re-engage if required. For the Submarine Force, this again emphasizes the importance of compatible, high-data rate communication systems but it also defines some vital characteristics for our future weapons systems. Simply stated, submarine weapons in the 21st century must be multi-purpose, rapidly re-targetable, highly accurate, long range and we must carry a lot of them!

Multi-purpose weapons are critical to increasing a submarine's effective payload. These multi-purpose missiles (MPMs) should be capable of land attack, anti-ship, and anti-air missions. Their missions should be easily modified by simplifying downloading the mission type from the fire control system such that the re-programming is done automatically and quickly with the push of a button. These MPMs must be both vertical and tube launch capable.

The ability to rapidly retarget will provide the flexibility and agility to support a fast-paced operation. The times required to currently retarget our cruise missiles won't support the dominant maneuver envisioned in the future. The ability to quickly retarget will significantly reduce the time of the joint commander's decision cycle thus giving him the ability to operationally outmaneuver the enemy in the time domain.

The military and political benefits of high accuracy weapons are apparent from recent military operations. It not only assures national and military leaders of achieving the desired effects but also lessens the risk to our own forces while minimizing collateral damage.

Longer range capability will give submarines a much larger role in joint operations. While the submarine force advertises we can cover about 75 percent of the earth's land masses, could it not be more?

Probably most important in this discussion is the absolute requirement to increase our submarine payloads. This would require larger weapon stowage areas, more external launchers, smaller missiles, and perhaps a change in primary mission focus.

I believe we should examine the real load requirement for ASW torpedoes. Why not shift to a defensive torpedo load while adding improved evasion devices and an anti-torpedo system? Employing submarines as USW platforms to search for or attack quiet submarines is not necessarily effective or efficient. I believe our SSNs could be better employed as stealth cruisers with a true multi-mission capability. That is what a JTF commander wants and needs. The direct result would be a larger MPM loadout. Then we would be talking *Death From Below*, to revive an old submarining phrase.

Full Dimensional Protection

While the next century will surely bring technological advances that will enhance a submarine's effectiveness, it also is likely to produce new capabilities that could increase our vulnerability. While our focus has primarily been on minimizing a submarine's acoustic signature, we must now protect our submarines from the very technologies that we are exploiting. In JV 2010 this increased effort for the next century is defined as full dimensional protection.

Not only is this operational concept essential for ensuring a submarine's survival but it will also provide our military forces the battlespace control necessary to ensure that freedom of action is maintained during combat maneuver and engagement.

From a defensive standpoint we must continue efforts to reduce submarine detectability from non-acoustic sensors and perhaps most importantly from spaced based systems. The world-wide coverage provided by satellite constellations possibly incorporating new sensor technology could soon start to *clear up* the current opaqueness of the world's oceans.

At the same time, there are offensive actions that can be employed to protect our forces. We must be able to tactically engage and employ joint information warfare as a capability to protect submarines during peacetime and combat operations. This might include the identification of operational adversaries that must be located, tracked, and destroyed by other joint forces in order to maintain our stealth or survivability. No longer will submarine warfare be *us* against everybody. Information superiority will provide submariners increased warning of attack, enhanced operational deception, and joint, integrated defense against detection and attack by enemy forces.

Focused Logistics

In order to optimize the three preceding concepts, the enabling concept of focused logistics must also be developed. JV 2010's goal is simple, the logistics of the future "...will be fully adaptive...providing support in hours or days versus weeks." This in turn will enable joint forces to be "more mobile, versatile and projectable from anywhere in the world."

This is an important operational concept that submarine warfighters too often take for granted. Consider the following scenario where the opening phase of strike operations against a heavy armoured advance is still in progress and the six submarines in the joint task force expend their MPM load after only one week. The JTF commander not only wants six fully loaded submarines to replace those returning for weapons resupply but he also wants the turnaround completed in under two weeks. Where will the weapons reload be conducted? Can we and how will we get the weapons there? What will our airlift requirements be? How will we handle multiple ships requiring simultaneous voyage repairs at forward sites? Can we support long term, continuous forward area operations with our current overseas infrastructure and number of tenders? Should we have pre-positioned equipment and capabilities near the world's hot spots?

As you can see forward area logistics during combat operations quickly become a *joint problem*. These types of contingencies require well though out and specifically tailored combat support systems. To be successful in the future we will have to integrate our combat support with other service and defense agencies to take advantage of advanced commercial practices, global networks, and revolutionary information technologies.

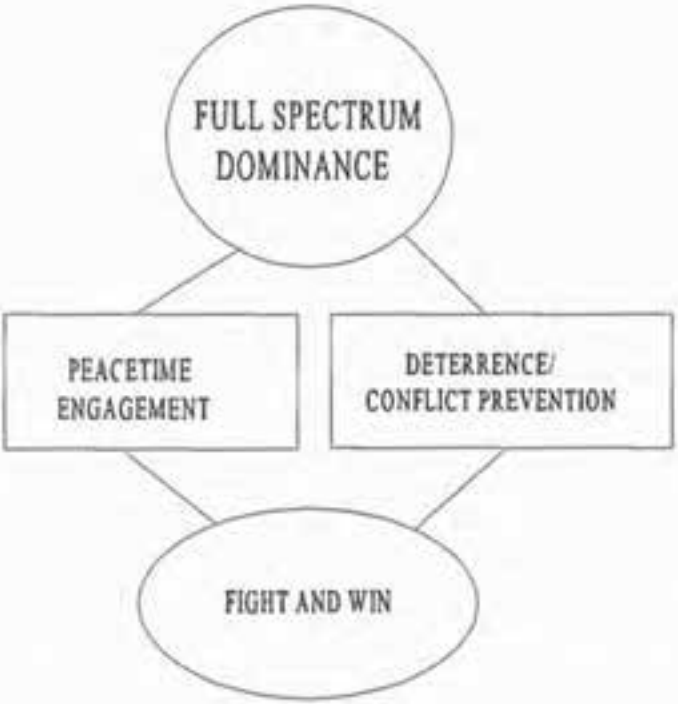
Full Spectrum Dominance

The synergy created by the integration of these four operational concepts transcends current conventional warfighting. Taken together these concepts will enable the U.S. military "to dominate the full range of military operations from humanitarian assistance, through peace operations, up to and into highest intensity conflict".

It is also recognized that no matter how sophisticated technology becomes, the judgement and skill of tactical warfighters will ultimately determine the success of future joint operations.

Submarine Force Vision 2010

The time for implementing Joint Vision 2010 is now! It begins with joint education, training, and doctrine. We can begin now by developing and testing JV 2010's new operational concepts in simulations, demonstrations, and exercises. While affordability may limit the acquisition of some future technologies, it should not limit our vision. Finally, as we pursue this vision, we must be mindful of our ultimate mission, "to prevent threats to U.S. interests from emerging, deter those that do, and defeat those threats by military force if deterrence fails. ■



CAUTION: THE DOOR OPENS BOTH WAYS

by LT Richard Bryant, USN

Lieutenant Bryant's article won The Naval Submarine League Essay Prize for Submarine Officer Advanced Course 96060.

The Submarine Force enjoys a rich and proud history. Due to the nature of its business, it has developed a distinct organizational culture; one characterized by independence, competence and courage. We have traditionally been considered an elite force: hand selected, highly educated and groomed for positions of higher authority and responsibility within our Navy. Recently beset with lower than average junior officer retention and a decreasing propensity for USNA midshipmen to *go submarines*, the Force may be well advised to take a step back and reevaluate how it is meeting the market's needs. Just as with any great organization, the Submarine Force must adapt to changing market conditions. One possible area to explore is the Force's organizational or corporate culture; its affect on those areas in which change is desired and recommendations for affecting that change.

Big business has taught us an important lesson in adapting to market conditions. Regardless of the corporation's size or perceived dominance, if it fails to adapt to its internal and external environment, it soon finds that it loses market share to its competition. The changes which occur generally result in a shift in the corporate culture. Corporate culture is best described as a *system of shared values, beliefs, and habits within an organization that interacts with the formal structure to produce behavioral norms*. As its environment changes, corporations find it is not enough to change the product or service, but they also have to reinvent the way they do business, often shifting their fundamental beliefs to be more in line with market expectations. The TQM movement is probably the most notable of these transformations. Corporations have found that in addition to producing a better product or service (external), they also develop a system of management conducive to continued improvement and better quality of life (internal). The goal in transforming a corporate culture is *to convert worker apathy into corporate allegiance*. A side effect is to also draw the most talented and motivated people to become employees of the corporation, increasing one of its strategic resources. In evaluating change

in the organizational culture, the factors to consider are: the work group, individual leadership style, organizational characteristics, administrative processes and external environment.

The environment of the immediate work group affects one's perception of the overall corporate culture. For most of us, this translates into the *boat*. For those who make it through the pipeline and serve only one tour of duty, the boat is the Submarine Force. This leads us to individual leadership style. Each boat and crew is as unique as its hull number. Command climate reflects the personality of the commanding officer, its wardroom and crew. While none of this is news, it does provide insight into the specifics of our corporate culture. The boat is our first line of defense. Regardless of the vision that N87 or COMSUBLANT/-PAC has for us, if it is not internalized on the unit level, it makes for a hollow corporate culture. Furthermore, the boat is that part of our organization which regularly interfaces with the external environment. The implications are that if we lose here, we won't show Congress, the rest of the Navy or our midshipmen the true vision and capability of our force.

The crew size of a submarine is relatively small. Additionally the Submarine Force is small compared to the surface or aviation communities. The very nature of submarining leads to a great deal of interdependence between the men, thus less stratification of rank, and more mutual respect and camaraderie. The officers and crew have traditionally enjoyed this relationship, and this fact has contributed to our being viewed as an elite force. On a more macro level, we are left to question who drives the Submarine Force; is it N87; is it COMSUBLANT/PAC; or is it Naval Reactors? Naval Reactors determines whether you can join the Submarine Force. Submarine officers are well aware that Naval Reactors plays a role in officer assignment. An officer's performance in the nuclear power pipeline is used for wardroom composition, as well as a determinant in whether an officer will be assigned as an engineer officer as a department head. While officers are told that each department head has an equal chance to succeed, the engineer receives a spot (pay and rank) promotion to Lieutenant Commander and has enjoyed the highest selection rate to Executive Officer of any of the three department head billets over recent years. Regardless of the reality, the perception is that nuclear power is submarining, but the truth is that submarining

existed well before Naval Reactors was formed. Our corporate culture has a distinct flavor, which sometimes obscures the art of submarining, allowing potential submariners to shy away and current submariners to leave, based on a narrow view of what the Force could be. In parallel, the administrative processes where performance level is linked to reward covers everything from medals to promotion. This factor is common to all communities, and the Submarine Force is not unique in its efforts to find equity. Perception is at play here as well. It is worth mentioning that officer instructor duty at NAVSUBSCHOL is not generally considered a *career enhancing* shore billet. In fact, a vast majority of the instructors leave the Navy after they complete their tour there. This is not to say that they don't do a good job; to the contrary, there are many who would serve the Force well to stay in. But once again, our culture has given the impression that our priorities lie elsewhere. This is far from the *Hallowed Halls* environment of which Admiral Kinnaird McKee, USN(Ret.) spoke almost 10 years ago at the 1987 NSL Symposium. We don't seem to get the same sense of history and feeling of urgency that was pushed by instructors named Pete Snyder, Ted Swain, Ira Glass and Yogi Kaufman a while ago. The point here is that the Force has several perceptions which directly effect the way submariners view the Force and their opportunities within the Force.

Unlike the previous factors, external environment cannot be directly controlled by the corporate body. Stress from the external environment provides the driving force for transformation of the overall corporate culture. With the end of the Cold War, downsizing of the armed forces and the accompanying reduction in budget dollars, the Submarine Force's resources and missions have changed significantly over the past decade. In the downsizing, the Force lost competitive officers who fully wanted to continue their naval service. With the decommissioning of boats and none to replace them, screened COs had no place to go. All of these issues add up to cause misconceptions such as the reduced importance of submarines in the grand naval strategy and the thought that only 5.0 water walkers need apply or stay in. This dynamic has probably been the most damaging over the recent years. While our external environment is reality, we can and must do something to change our corporate culture to adapt and compete in our market for the resources we need; primarily: motivated and talented

accessions, motivated and satisfied officers and material support. One way to get there is to shift from an organizational culture to an organizational character.

The shift from culture to character is best exemplified by the character development program instituted by Admiral Chuck Larson, USN, Superintendent, United States Naval Academy. In his push for *excellence without arrogance*, Admiral Larson is taking the steps to ensure that USNA remains competitive as a commissioning source well into the 21st century. For more than 150 years, the USNA experience has been a four year total immersion into its own culture, complete with its own language, traditions and values. The character development program pushes midshipmen to explore the limits of their analytical abilities, causing them to *stretch for excellence*. By participating in integrity development seminars, midshipmen are able to discuss various aspects of morality and values, while having the chance to bounce those thoughts off of their own personal beliefs. It is this thought process which causes them to start from ground zero and bring their relationship with loyalty, tradition and discipline back into focus. Thus they develop their own personal courage, honor and commitment. No longer looking to be fed, but taking ownership in their own growth—building their own character. Only by knowing ourselves can we best find our place in the Navy, and build that synergy we so desperately need in these times of scarce resources and problems of increasing complexity. Likewise, the Submarine Force needs to develop its organizational character. By doing so we: 1) ready ourselves to adapt to our ever changing naval mission, 2) give our officers a forum for the moral ownership needed to develop an environment of constant learning and improvement, and 3) hopefully reduce misconceptions by providing feedback up the chain of command. To paraphrase Admiral James D. Watkins, USN(Ret.), in a speech from the 1980s, "If we are to bring meaning to our lives and leadership to this nation, we will need to develop the moral person within." Perhaps we can use USNA as a model for our wardroom training. It is hoped that the discussion will foster an increased sense of camaraderie, esprit and understanding among the officer corps.

As a submarine junior officer approaching the 21st century, I am forced to consider the health of our Force and assess how I best fit into its future. Particularly, I reflect on my eight years of experi-

ence and try to reconcile the decision of my classmates, shipmates and friends who have left the Navy in search of other objectives. Camaraderie brought me to Annapolis, but it was the consummation thereof that drew me to the Submarine Force. After my first deterrent patrol on USS NATHANIEL GREENE (SSBN 636)-(Blue), I was convinced that the Submarine Force held the answers to my questions of service, purpose and future. While on board GREENE, Captain Bill Grimm, USN(Ret.) took a personal interest in me. We would spend hours at a time discussing subjects, which as I look back on them now, were very sophisticated for my level of knowledge, having only completed my plebe year. More importantly, he asked me to think, pushing me to the edge of my limits and helping me to grow as a person. As a midshipman, I had the pleasure to serve with such stars of the Force as Rear Admiral Bill Habermeyer, USN(Ret.), Rear Admiral Virgil Hill, USN(Ret.), Rear Admiral Al Konetzni, USN, and Admiral Chuck Larson, USN, all men of staunch characters, who brought the silent service to us on a personal level. We did not go to work for the Submarine Force—we joined a family. Personal involvement and personal development appear to be my dominant buying motive or *why I went Navy and stayed Navy*. In making our naval experience a quality one, we leaders must sometimes consider forgoing the expediency of directive leadership in order to foster a sense of camaraderie and brotherhood. This adds value to our service, constructing an environment conducive to recruitment and retention. Thank you for your time and Happy Hunting! ■

SUBMARINE AIR INDEPENDENT PROPULSION AND THE U.S. NAVY

by Richard M. Rosenblatt, M.D.

Dr. Rosenblatt is a board-certified anesthesiologist in private practice and a member of The Naval Submarine League.

Recent technologic advances that have been made in air independent propulsion (AIP) for submarines have improved the operational performance of non nuclear submarines and, in doing so, rekindled a long standing debate pertaining to the optimal means for submarine propulsion. The cessation of the Cold War and the change in submarine missions from strategic blue-water operations to an era oriented to combat in littoral regions has contributed to this acrimonious debate. The recent commissioning by Sweden of two submarines, specifically designed with an AIP auxiliary propulsion unit, has furthered this controversy. With numerous nations contemplating the acquisition of advanced submarines, built with AIP propulsion or capable of future retro-fitting, the optimal means of submarine propulsion no longer remains an academic question.

Numerous articles on this subject have been published in the marine engineering and naval science literature. The technologic attributes of AIP were recently discussed in a comprehensive review article published in Jane's Defense '96. Notwithstanding the engineering technicalities of AIP that remain to be resolved, several associated factors warrant further discussion. The introduction of this new technology will have a significant impact on submarine warfare and present a new challenge for the U.S. Navy.

With the launching of the first nuclear propelled submarines NAUTILUS, in 1954, the United States Submarine Force has benefitted from nuclear power and throughout the ensuing years became committed to this means of underwater propulsion. Four decades of consecutive operation and numerous analyses has confirmed their dedication to the nuclear powered submarine. The reluctance by the submarine community to consider alternative means of propulsion is neither unexpected nor unwarranted.

Throughout the era of the Cold War, conventional diesel electric submarines played a minor role. Diesel electric submarines were able to conduct on rare occasions successful attacks on surface

ships and submarines while engaged in naval training exercises. In contrast, the supremacy of the nuclear submarine, in one dramatic moment, was well documented during the Falkland's War when the British established naval dominance by sinking the Argentine cruiser BELGRANO with torpedoes launched from the nuclear submarine HMS CONQUEROR. Overlooked by the general public, but not by naval analysts, was the fact that the German-built diesel electric submarines, SAN LUIS REY, operated by the Argentine Navy, nearly sank HMS ILLUSTRIOUS. Had the Argentine torpedo guidance system not malfunctioned, the loss of HMS ILLUSTRIOUS would have profoundly altered the tactical deployment of British forces. The Argentine submarine undertook its attack on the carrier despite the best efforts of the British at conducting an aggressive ASW defense.

Isolated vignettes from the Cold War and the Falkland's conflict do not, by themselves, represent sufficient impetus for the U.S. Navy to adopt non-nuclear propulsion for its submarines. It does portend, however, that the future threat from submarines equipped with AIP will complicate future naval planning as the operational characteristics of these submarines are improved and as more of these naval vessels are introduced into service.

The issues raised by the introduction of AIP and enhanced operational-characteristics of conventional submarines cannot be addressed by merely an engineering or operations research analysis. The impact, despite the newness of the technology, is profound and warrants a fundamental review of the historical origins of the modern submarine and its role in combat.

While numerous primordial attempts had been undertaken to develop submarine technology, the formulative years occurred early in the 20th century and were led by two highly competitive individuals: John Holland and Simon Lake. Both of these inventors made substantive contributions which gave rise to the modern submarine. Both men were fiercely nationalistic and they developed submarines as a means to counter British naval supremacy. John Holland even received financial backing from the Fenian Brotherhood, an association of Irish militants. This influence, and the historical context of the times, profoundly shaped the course of submarine development.

Although John Holland is credited as the father of the modern submarine, Simon Lake—his arch rival—was the better inventor.

His early craft were superior in performance and design features. He configured his submersibles for shallow water operations on the undersea floor and even equipped them with wheels for locomotion while submerge. He also incorporated the prototype of the modern lookout chamber into his submarines and the first snorkel. This unorthodox approach, nevertheless, was successful. He gave repeated demonstrations of his craft's unique capabilities to travel along the bottom in shallow water. In an attempt to attain financial backing for his efforts from the U.S. Navy, he once displayed his craft's prowess by penetrating the harbor at Hampton Roads, Virginia, located and moved mines laid for harbor defense, and then conducted mock attacks on naval ships within the port. Despite this successful performance and a 1000 mile voyage from Norfolk to New York, he was unsuccessful in his bid to secure governmental or commercial funding.

The established navies of the word, as well as the Fenian Brotherhood, were oriented to the strategic sea control and denial potential of the submarine. John Holland ultimately emerged as the winner of this competition despite the fact that his submarines were technologically inferior to Lake's and required several decades of refinement before being truly operational. Both inventors did share one common trait: neither were successful businessmen, and they died equally destitute.

Since World War I, submarine designers have emphasized the strategic role of the submarine. The changing world environment, following the Cold War, has modified this requirement. A profound and dramatic change in the mission of submarines has come about with the orientation of naval combat to littoral warfare. The ability to conduct anti-surface and anti-submarine warfare is no longer the primary role for the modern submarine. Special operations, covert reconnaissance and mine warfare have assumed paramount importance in this new defense environment.

The ability to operate in shallow water, less than 300 feet, is now the key constraint. The very economies of scale realized by the progressive increase in size of ocean-going nuclear submarines has become a limiting factor and detriment to littoral underwater operations. It is evident that a larger submarine is less maneuverable and more easily detected in shallow water, despite contentions to the contrary, than its corresponding smaller counterpart. Furthermore, the design of the current modern submarine, whether

nuclear or conventionally-powered, is optimized for deep water and open-ocean operations.

The combined height of the sail atop the cylindrical hull results in a tall vertical displacement. By doing so, it increases the minimum depth at which the submarine can operate while submerged in a safe manner. This necessitates at least 40 to 50 feet of water under the submarine's keel for safe operation, while the sail itself must be submerged an additional 40 to 50 feet to preclude the submarine's presence being subject to detection from the air by various means. It is thus apparent that the modern nuclear submarine, as presently configured, can operate safely on a routine basis in waters that exceed 120-140 feet in depth.

This factor precludes effective submarine operations in many vital littoral regions of the world. The choice of submarine propulsion, in reality, is a secondary consideration once the issue of submarine size and hull configuration are determined. There exists, no doubt, a minimum critical displacement below which nuclear power is neither feasible nor practical. The smallest nuclear powered attack submarine in service today is operated by the French Navy: their Rubis class nuclear submarine displaces 2700 tons submerged and has a length of 236 feet. In contrast, the type 206 submarine, produced by Germany in the early 1960s, displaces 460 tons and was designed for operations in the confined waters of the Baltic Sea. A far more specialized craft was produced by the German Navy in World War II. SEETUEFEL, a submersible equipped with tractor propulsion, displaced a mere 35 tons but carried two heavyweight torpedoes slung in external mounts alongside of the tracks. It could be adapted for special operations and discharge frogmen through an underwater lockout chamber. While it is speculative, a submarine of similar size and probable configuration was used by Soviet Special Forces to penetrate Swedish harbor defenses in the 1980s.

This supposition is based on the finding of underwater track marks found within Swedish territorial waters and by the size of the openings cut in the anti-submarine nets enclosing their naval base. A much smaller submarine or swimmer delivery vehicle would have neither sufficient range to accomplish the mission nor the power to drag along the bottom the three to four ton cement blocks that were used to anchor the anti-submarine nets. These findings suggest that the Soviet Navy built a specialized submarine

with tractor propulsion and configured for operation in ultra shallow waters.

Current submarines, whether conventional or nuclear powered, are not intended for sea floor operations. The accidental grounding, in Swedish territorial waters, by the Soviet Whiskey class submarine S 363 in the approaches to the Karlskrona naval base substantiates this point. Although this incident proved to be a diplomatic embarrassment for the Soviet government, such an occurrence in wartime would have been catastrophic.

It is evident that the underwater range and endurance of specialized submersibles is quite limited due to the use of lead-acid batteries. The substitution of modern batteries (i.e., lithium polymer) augmented with an AIP unit would yield a marked mprovement in speed and operational range. By today's standards, such a propulsion plant would be more compact, yet have higher power ratings. The resulting improvement in performance should not be underestimated. Based on relative specific power densities, there could be nearly a ten-fold increase in range and a commensurate improvement in speed.

The flexibility inherent in the placement of advanced batteries and an AIP unit within a submarine would allow for a radical departure from the design of present submarines. Concurrent advances in materials science and production techniques allow submarine designers a unique opportunity to fabricate a bottom-crawler submarine with tractor propulsion that little resembles its larger brethren. The result may look more like the advanced designs being proposed for the low observable airborne autonomous vehicle (AAV) than any submarine now in service. The few illustrations released to the public that show the shape of the Tier III (minus) AAV are startling: the Dark Star, the name given to the previously highly secret project, appears capable of operating in either an airborne or underwater environment.

Many of the contentions presented in recent articles in the defense of the current modern nuclear submarine would no longer be valid given the development of a compact submarine configured for littoral warfare that incorporates the advanced technologies now available to submarine designers. Such a unique underwater combatant would manifest excellent stealth characteristics, having minimal acoustic, optical and thermal signatures. The use of tractor propulsion and azimuth pod thruster units, the latter located

amidships in pivotal mounts, would improve dramatically maneuverability in confined waters. The hybrid propulsion unit has the potential to provide sufficient energy for greater underwater speed and endurance; in particular, the performance characteristics could be improved further by the adoption of high efficiency electric motors. The corresponding technologic developments in computer science and electronic miniaturization would, in turn, reduce the critical minimum displacement of the submarine, its energy requirements and the size of the crew. The increased range, albeit still insufficient to transit the major oceans, could be addressed by either forward positioning of the craft or transportation to the theater of operations aboard commercial heavy sealift vessels. The small displacement of these submersibles makes this latter option highly attractive. In doing so, it negates the major attribute or nuclear power—its preeminent excellence at high speed, long distance transits.

The availability of such a vessel would augment the existing capabilities of the U.S. Navy and its nuclear powered Submarine Force in this era of littoral warfare. To date, submarine operations within the Persian Gulf have been limited and problematic. A shallow water submarine, designed with AIP and advanced technologies, would expand the role of the submarine community in this region of the world. Such a submarine could be used in a manner that precludes safe deployment of either a Los Angeles class submarine or the proposed NSSN. AIP represents a further evolutionary trend over the course of this century. While its full potential has yet to be ascertained, this technologic advance must not be dismissed simply because of its newness. It will not replace nuclear power for submarines in the U.S. Navy; rather, it has the potential to complement existing capabilities. Failure to capitalize on this emergent technology and pursue an aggressive proactive approach can only result in malefic consequences. It should be noted that this new development has not been overlooked by foreign submarine designers. AIP, even without incorporation of other advanced technologies, has the potential to alter markedly the dynamics of undersea conflict as we have known it. ■

THE SUBMARINE COLD WAR MEMORIAL

by CAPT Thomas M. Jaskunas, USN(Ret.)
Submarine Memorial Committee
South Carolina Chapter, NSL

I always thought that I had done my job well and ended my command tour with a proper although bittersweet gesture. After commanding my ship at sea for over two years and then supervising the decommissioning of this proud FBM submarine, I commanded a small task group comprised of several ocean going tugs towing decommissioned nuclear submarines and accompanied by two surface warship escorts all the way from Charleston, South Carolina, through the Panama Canal and to their final resting place in Bremerton, Washington.

Upon mooring at the shipyard in Bremerton, I helped tie up my former command alongside the other submarines awaiting dismantling. Among those once proud ships were all of the submarines on which I had ever served. They were all there, THEODORE ROOSEVELT, THOMAS EDISON, SARGO, and POLLACK. Now I was bringing in LEWIS AND CLARK to join them. As a final formal gesture, I had saved the last few items on the turnover checklist. I turned off the lights on LEWIS AND CLARK and was the last man off. I had said my last goodbye to a proud submarine. The darned thing is—she followed me home.

Charleston at one time was a bustling submarine port. Submarine Squadron 4 took care of the fast attack end, shuffling ships around and training their crews. Submarine Squadron 18 handled the FBM side of the house running the FBM refit site. SUBGRU SIX kept us all off each other, ran the training facilities and orchestrated one of the most successful submarine ports the Navy had ever seen. Then along came BRAC.

Charleston Naval Shipyard is now closed. The ominous economic predictions for the Charleston area have not come true; remarkably the economy of the area is booming. The Naval Base has been chopped up into private enterprise pieces. The Immigration and Naturalization Service is making good use of the old FBM training facilities and other companies and various government entities are involved in a bidding war to carve up these once excellent facilities. The warships that do arrive are all ex-USS something or other and are repaired in one of several local civilian

yards before being transferred to another country. The only submarine overseeing Charleston Harbor is USS CLAMAGORE moored next to USS YORKTOWN at Patriots Point, South Carolina's Maritime Museum. She now is getting ready for some company.

South Carolina has amassed a nice little flotilla in its Maritime Museum at Patriots Point in Charleston Harbor. YORKTOWN dominates the harbor and has become a landmark in its own right. Naval Air always needs a balance and CLAMAGORE does a fine job of representing the WWII diesel submarine Navy. The Surface Navy and the Coast Guard are represented by USS LAFFEY, a veteran of both the Atlantic and Pacific campaigns of WWII, and by the cutter INGHAM, the proud recipient of The Presidential Unit Citation for service in the Vietnam War. The Vietnam Naval Support Base exhibit honors the Vietnam War with its compound, 31 foot River Patrol Boat, bunkers, helicopters and facilities. The Medal of Honor Society with its museum has found a home here and has truly sanctified the name of Patriots Point.

With all this, the Cold War, an epic battle of nerves that cost the United States vast treasure and military effort and which dominated our foreign policy for nearly decades, is not represented. This, a war that we won without every firing a shot at our main adversaries, nonetheless took its toll. The price was paid by the personal sacrifices of many service men and women and their families. The history of the Cold War will be written of those whose lives were put on hold by long deployments, and of those who never came back and whose loss will never be tabulated as contributing to the victory in some glorious single battle. Like it or not, we submarine sailors are part of this history, and before we become a faded part of that history, we now have the opportunity to leave a small legacy to stand alongside some of the truly great monuments to our Navy's accomplishments. This is why my old ship followed me back to Charleston.

After eventually retiring and settling in Charleston, I, like many others, remained active in various organizations, remaining in some with a military affiliation and joining other strictly civilian ones. The Naval Submarine League being among these, I had the pleasure of getting to know fellow member Rear Admiral Jim Flatley, CEO of Patriots Point Development Authority. Patriots Point Naval and Maritime Museum made it possible for my ship to

follow me home and be part of the Submarine Memorial at Patriots Point. What will constitute the memorial, how big will it be, where? The last part is answered: it will be ashore at the base of the pier facilities leading to YORKTOWN. How big—full scale 640 class SSBN. We have spent too much of our time hiding in the ultimate stealth platforms to keep on doing so. This memorial will be far more than a periscope sticking out of the background or a submarine sail by its lonesome in the middle of a parking lot. We are talking full size, full scale, riding on the surface.

The memorial will be for all who found the Cold War underwater. Charleston is the appropriate location for such a memorial since more SSBN crews deployed out of Charleston than from any other port. Charleston was truly a leader in the Cold War battle. It would be wonderful to be able to bring anyone of our decommissioned submarines next to a pier and open it up to the public. A training aid of this magnitude would be unsurpassed in educating the American public as to the complexity and difficulty with which the Cold War was fought underwater. For many reasons this is both impractical and unattainable. The rebuilding of the entire superstructure ashore is not. This is the hub around which the memorial will be built. While the sail, fairwater planes and rudder (those pieces of LEWIS AND CLARK which I discovered had followed me home) are from a specific boat, the goal will be to memorialize the entire Submarine Force with no specific identification being assigned to the hull form to be put in place as a memorial. While the ship will be representative of all the submarines that participated in the Cold War, the SSBN hull is considered appropriate for the memorial because of the unique role these ships played during that era. The scale chosen will allow for the incorporation or representation of the widest scope of participation possible and will provide an imposing central core of sufficient size for the memorial. We will be seeking individual contributions in addition to large corporate sponsorship. There will be room for the names of sponsoring individuals to be once again engraved on the plaques representing their ship, or as in the case of many of us, ships.

Trying to give the illusion of motion and magnificence to a static display is always difficult but from the initial architect's plans we have shown that this can be done. The memorial will incorporate appropriate landscaping which will be designed and colored to

represent the rolling of the bow wave and the foaming of the wash. The location immediately adjacent to the harbor will provide the view and the salt breeze with which many of our sailors are well familiar. The balance between a memorial and an interactive exhibit was crucial in the initial planning stages. The static display of the hull and superstructure will be balanced with contributions and displays representing the contributions of all those submarines and associated organizations that participated in the undersea effort of the Cold War.

The location at the Patriots Point Maritime Museum provides all the facilities and associated support a project of this size needs. The land is available and more than suitable in both size and location. The museum facilities and all they entail already exist and do not need to be duplicated. Combining the Memorial with the existing ships and displays will so fully complement each other that the visibility we will receive can be duplicated at few other locations in the country.

Charleston also has one other draw for the submarine community that will demonstrate the history of submarines as not other location will. Located due east of the Submarine Memorial, not much more that a long Mk 48 torpedo run away, lies the Confederate submarine H.L. HUNLEY—the first submarine to ever have sunk a warship. HUNLEY was officially identified in 1996 lying in 30 feet of water just outside Charleston Harbor. She will soon be raised and brought ashore for honoring and for display. The history of submarines will then be exemplified better no place in the world. Available in one location, the Charleston area, will be HUNLEY, the oldest existing submarine in the world; CLAMAGORE, representing the most successful submarine campaign ever conducted; and the SSBN Memorial, symbolizing the most powerful weapons platforms ever built by man.

There is still a lot of work that needs to be done but the parts are coming together. This is an opportunity in which all organizations wishing to support a submarine memorial are invited to participate. For those interested in participating, contact: Submarine Memorial Committee, Patriots Point Naval and Maritime Museum Foundation, P.O. Box 309, Mt. Pleasant, SC 29465. ■

SILVER DOLPHINS + GOLD DOLPHINS

May 23, 1997

BRAVO ZULU and ATTABOY to Denver McCune's letter in April's **THE SUBMARINE REVIEW** regarding the need for three vibrant retired submariner organizations working more closely together to support common goals. The undersigned sees these goals as support of our current and future Submarine Force programs including the annual Congressional budgetary process, as well as the advancement of the proud tradition of submarine professionalism and excellence established in World War II. As a proud member of all three organizations almost from the inception of each, I offer a proposal to initiate McCune's suggestion for establishing a joint annual meeting of the top national officers of all three groups.

I propose establishing at an early date a joint program for major national and regional celebrations of the 100th Anniversary of Submarines in the year 2000 including the issuance of a Post Office Submarine memorial stamp. I understand that a Post Office stamp committee has rejected Submarine Memorial stamp efforts to date on the basis that *the SS Force 100th Anniversary is a regional thing* and because of self-imposed 3 year lead times. The April-June U.S. Submarine Veterans, Inc. (USSVI) American Submariner issue has an article by their former National Secretary Pete McGuire (p22) stating that former President Bush supports this effort. Surely we can mount a joint political effort to cause the Post Office to reexamine their refusal.

The Naval Submarine League has professional, technical and defense industry strength. The Submarine Veterans of World War II and the USSVI have people and potential political strength in their many chapters throughout our country that the NSL does not reach. We are all retired submarine shipmates with a proud tradition of professional excellence and accomplishment. Let us BRING IT ALL TOGETHER for a memorable national regional celebration in the year 2000 and let us have fun and camaraderie in doing it.

The above effort should be nationally and regionally coordinated

with the plans of our active duty submariners to celebrate the 100th Anniversary of our Submarine Force in the year 2000.

John M. Barrett
RADM, USN(Ret.)

SUBSCOL 2000

March 24, 1997

Lieutenant Thompson's thought-provoking article about Subscol also touches briefly on PCO training. **The lack of approach and attack training in the proposed PCO curriculum is alarming.** This the single most important facet of training for a PCO. The time listed in Table 1 of the article to learn the bureaucracy is excessive. Rather, the PCO curriculum should be heavily weighted to approach and attack training in the attack trainers, followed by exercise torpedo firings at sea in ASW and ASUW tactical situations which are as realistic as possible. Short of factual combat, seldom will the CO have the opportunity to conduct this training for himself, and be objectively evaluated, once he reports to his ships. He is then too involved in teaching this fine art to his subordinates.

Sincerely,
CAPT Jack McDonald, USN(Ret.)

MORE ON THE MK 14 TORPEDO

April 20, 1997

I read with great interest the articles about torpedoes written by Frederick J. Milford and published in recent issues of **THE SUBMARINE REVIEW**. The Great Torpedo Scandal, 1941-43 was of particular interest. Mr. Milford's description of flaws in the Mk 14 torpedo (including the Mk 6 exploder), and of steps taken to correct these flaws, is written with clarity and technical expertise. As he notes, the worst part of the scandal was the reluctance of BuOrd or the Newport Torpedo Station to accept or investigate criticism of the weapon by the operating forces who were trying to use it.

One statement by Mr. Milford is misleading. In concluding his discussion of the three most aggravating deficiencies in the Mk 14

(running 11 feet below set depth and design flaws in both the magnetic and contact exploder mechanisms) Mr. Milford states, "Once these and other less significant problems were solved, the Mk 14 torpedo became a reliable and important weapon." As a matter of fact, by late 1943 when these problems were resolved the torpedo was much improved, but still had significant residual faults.

In a footnote to his article Mr. Milford makes reference to U.S. Submarine Operations in World War II by Theodore Roscoe, and to Silent Victory by Clay Blair, Jr. Both books are chronologies of the submarine war in the Pacific. On page 263 of U.S. Submarine Operations in World War II Mr. Roscoe states, "the torpedo trouble was well cured by the end of 1943". On page 20 of Silent Victory Mr. Blair tells us that, "...it was not until September 1943, 21 months after the attack on Pearl Harbor, that all the torpedo defects were corrected". These claims are incorrect and may have misled Mr. Milford.

Mr. Blair drew heavily on submarine patrol reports for his accounts of specific submarine operations. In Part V of Silent Victory he describes selected submarine operations during 1944. Included are 15 separate incidents involving torpedo malfunctions, seven of which were circular runs. Two of the circular runs caused the destruction of those U.S. submarines (TULLIBEE and TANG) that fired them.

Torpedo performance may have improved in the latter two years of World War II, but neither the Mk 14-3A nor the Mk 18 could be considered safe or reliable.

Sincerely,
H.H. Caldwell
Box 11, Niantic, CT 06357

A RESPONSE ON MK14 RELIABILITY

May 3-4, 1997

Captain Harry Caldwell's letter raises an important and interesting issue. How does one resolve the conflicts that exist among various data about torpedoes in WWII? Recollections of people

who were there are a very important contribution to understanding what happened and, one would hope, avoiding similar problems in the future, but the formal reports of submarine commands cannot be dismissed. I completely agree that any statement such as "...all the torpedo defects were corrected" is wrong in principle, but by the end of 1943 the main systematic defects had been identified and fixed. More subtle erratic faults remained and probably could not have been fixed without a complete redesign. My main reservation concerns Captain Caldwell's charitable suggestion that I might have been misled by Blair and/or Roscoe. If I have been misled, I have done it to myself with a very small assist from SubPac. That said, there is a little more about torpedo failures in 1944 and 1945 that may be worth reviewing.

The basis for my statement about Mk 14 reliability after December 1943 is ComSubPac "Submarine Operational History: WW II", pp. iv-1428 and 1429. (This is the originally SECRET report compiled by Dick Voge who was the SubPac operations officer from August 1942 through the end of the war.) Those pages contain the data reproduced in Table I. In particular, SubPac submarines achieved 477 (44 percent) hits out of 1090 Mk 14 torpedoes fired in 1944. The improvement in the percentage of hits, 30 percent in 1942, 37 percent in 1943 and then 44 percent in 1944, is also worth noting. If I remember correctly, a perfect four torpedo spread produces two hits (50 percent) and a miss ahead and a miss astern. In my opinion, 44 percent hits qualifies the Mk 14 as reliable in 1944 and, in spite of the well known problems, the data for earlier years seem to indicate that it was not terribly bad even then. I hasten to add, however, that this in no way mitigates the *scandal*.

SubPac produced other data on torpedo failures some of which is reproduced in Table II. (This data was apparently produced on a monthly basis, but I have not yet found copies of the reports.) This data is for all Mks and shows that, for the entire war, a remarkable 35.5 percent of 8474 torpedoes fired by SubPac submarines hit their targets while only 3.74 percent of the torpedoes fired failed. This too leads me to describe WWII U.S. Navy torpedoes, more generally, as relatively reliable.

These data reveal other anomalies in the WWII operational history of torpedoes and resolving them, if that is possible, will require not just numerical analysis of summary data or the study of

first hand accounts, but very careful efforts to obtain and reconcile all available data.

Sincerely,
Frederick J. Milford

Table I
Torpedoes Fired by U.S. Submarines During WWII

	1941			1942			1943		
Mark	Fired	Hit	%	Fired	Hit	%	Fired	Hit	%
SubLant									
All	0	0		19	4	21	24	8	33
SubPac									
14	6	0	57	669	202	30	2150	796	37
18	0	0		0	0		101	24	24
23	0	0		0	0		0	0	
Spec	0	0		0	0		0	0	
Oth	3	0		306	105	34	249	76	31
Total	9	0		975	307	32	2500	896	36
SubSoWestPac									
14	29	0	0	378	96	25	751	255	34
18	0	0		0	0		0	0	
23	0	0		0	0		0	0	
Oth.	66	13	20	573	151	26	510	147	29
Total	95	13	14	951	247	26	1261	402	32
All Commands									
All	104	13	13	1945	558	29	3785	1306	35

Table I (Cont.d)

	1944			1945			Total		
Mark	Fired	Hit	%	Fired	Hit	%	Fired	Hit	%
SubLant									
All	4	0	0	0	0		47	12	26
SubPac									
14	1090	477	44	306	722	24	4221	1547	37
18	1515	497	33	1121	293	26	2737	814	30
23	827	355	43	84	30	36	911	385	42
Spec	4	2	40	87	25	29	92	27	29
Oth	8	5	62	0	0		566	186	36
Total	3445	1336	39	1598	420	26	8527	2959	35
SubSoWestPac									
14	1259	467	37	319	72	23	2736	890	33
18	325	108	15	373	57	15	698	165	24
23	1072	413	39	75	24	32	1146	437	38
Oth.	7	5	72	0	0		1156	316	27
Total	2665	993	37	799	164	21	5769	1819	32
All Commands									
All	6114	2329	38	2397	584	24	14343	4790	33

Table II
Recapitulation of Torpedo Failures Reported by SubPac

	Through 30 June 1943[1]		Through 30 September 1945[2]	
	Number	Percentage	Number	Percentage
Total Fired	1811	100	8474	100
Hits	633	35	3007	35.5
Misses including failures	1178	65	5467	64.5
Failures	123	7	317	3.74
Duds	10	0.5	62	2.06[3]
Prematures	52	2.8	92	1.09
Erratics	36	1.9	141	1.66
Magnetic	25	1.4	25	–
Certain failures only	75			
Total hot, straight and normal (except for deep running	1687	93	8157	96.26

[1] This is SubPac data, but it was taken from a letter from Blandy to Lockwood 11 August 1943. The data is reproduced in Gannon, "Hellions of the Deep", p.174. The text of the letter is somewhat acrimonious.

[2] Figures from ComSubPac Report FF 12-10(s)/S75-1/A16-3 of 9 October 1945.

[3] This is the number reported. It is clearly the percentage of hits that were duds. Duds Comprised only 0.75 percent of the total fired.

A RESPONSE TO THE RESPONSE

May 28, 1997

Dear Dr. Milford:

Thank you so much for your letter of 4 May and for the copy of your reply to the Editor.

You said that the issue of World War II torpedo performance is very difficult to rationalize. I could not be in more hearty agreement. I was embarked in DACE for its last four war patrols so tend to view torpedo failures from the operator's perspective rather than that of the logistician or the operational analyst. During this period DACE fired approximately 75 war shots of which at least four misbehaved. Though not a statistical sample, this experience is reasonably consonant with the overall results for 1944 and 1945.

I think operators view torpedo failures more subjectively than command staffs or other non-participants. For example, an operator would not lump circular runs in with cold shots, other gyro failures or prematures either at the enabling range or near the target. Boomerang torpedoes are potentially lethal to the firing submarine; other torpedo failures result in a miss and so may be grouped with fire control errors—frustrating for the attacker but not deadly. I believe that by 1944 there existed sufficient evidence that circular runs were a recurrent problem to warrant a serious investigation and corrective effort. Such program could have saved ships and lives.

I was interested to read in your letter of TRIGRONE's circular run in 1963. Although I served in submarines for several years after World War II, this incident had not previously come to my attention. In fact, I don't remember any torpedo failures after we took the war heads off, perhaps because such failures did not seem as important as they had during the war.

Let me comment briefly on the statistics in Table I and Table II which accompany your letter to the Editor. Table I is purely a record of the number of torpedoes expended and the number of hits obtained. It provides some insight into the efficiency of the submarine weapon system, but is of little value in measuring torpedo performance. As you pointed out, this is very difficult to assess. The basic source documents for torpedo performance are

individual submarine war patrol reports. Comments on torpedo malfunctions appear in the narrative and are supported with details in appropriate appendixes. While information on hits versus misses could be imprecise since it often depended on an accurate range to the target at the time of firing, the submarine usually could tell at once from sonar tracking if the torpedo failed to run *hot, straight and normal*. Torpedo hit percentage doesn't tell much about torpedo performance when a significant number of fish were (under existing spread doctrine) aimed to miss, and many more missed due to fire control errors and target maneuvers.

Table II speaks directly to torpedo failures but, as you note, brings its own biases, and is limited to SubPac experience. Also, it appears to exclude misses attributable to failure of the torpedo to run at set depth. Further, there are discrepancies between Table I and Table II in the total number of torpedoes fired and the number of hits obtained.

The improvement in torpedo hit percentage from 1942 to 1944 is, as you say, worth noting. My belief is that the improvement owes more to better fire control training and the advent of new equipment (surface search radar, the Mark IV TDC, Dead Reckoning Tracer, etc.) than to improvement in torpedo reliability, though that of course is an added factor. I suspect that the 1945 drop in hit percentage can be blamed on improved Japanese radar and a higher percentage of escorts per target as the number of merchant ships dwindled.

I suppose this all boils down to how you define reliability and what percentage of torpedo failures is acceptable. A 3.74 percent failure rate (augmented by those which ran deep) is not acceptable to me, particularly when it includes recurrent potentially lethal circular runs. I hope our modern weapon systems are held to a higher standard.

Very truly yours,
H.H. Caldwell

EVEN MORE ABOUT MK14s IN LOW POWER

Rear Admiral Metcalf's explanation (**THE SUBMARINE REVIEW**, April 1997) of why few skippers chose to fire Mk 14 torpedoes in low power brought back a memory that I'd rather

forget. In 1965 I was Weapons Officer on SWORDFISH (SSN 570), commanded by Commander Frank Adams. At the time Frank was regarded as one of the top SSN skippers in SUBPAC; there was no doubt in my mind then or now that he was the best. Frank liked to shoot torpedoes, as many as he could get his hands on. Between predeployment workups and taking the Prospective Commanding Officer classes to sea, SWORDFISH fired about as many weapons as the rest of the squadron put together. During the period of a year the ship deployed to WESTPAC twice, and I personally witnessed the preparation of about 120 torpedoes, both exercise and warshots. Needless to say, I thought we were pretty hot stuff.

The humbling event took place during a combined ORI and predeployment certification with the DIVCOM, Commander Hugh Murphree, embarked. The surveillance operations went well to the point that the crew was showing off for the DIVCOM. Near the end of the ORI a Mk 14-5 was launched and seemed to run hot, straight and normal, but passed astern of the target. SWORDFISH surfaced and ran down the torpedo track, but when 4500 yards from the launch point failed to sight the orange exercise head as expected. The ship continued down the track until a lookout spotted the torpedo still some distance ahead. As the Weapons Officer who had prepared and loaded the weapon, my concern was building.

As SWORDFISH pulled alongside the bobbing torpedo the CO called down to the Navigator in the control room asking the distance to the launch point. The Navigator replied "9000 yards sir". Once the torpedo was aboard the retriever Captain Adams asked its crew to check the Hi/Lo speed setting, which on the electrically set Mk 14-5 was mechanically preset to Hi or Lo prior to tube loading. Of course, the answer was "Lo, Captain!" I vividly recalled standing inboard of tube #1, checklist in hand, watching the Mk 14 slide into the tube, asking the Chief Torpedoman standing outboard to "check speed set Hi", and getting the expected response, "speed set on Hi". But, I hadn't crawled under the torpedo to check the setting myself! By this time, the end of my submarine career was looming up in my mind as a real possibility. Fortunately, that dire consequence was never mentioned, but I learned a lesson I never forgot.

Considering the collective lack of enthusiasm for firing in low

power reported by Rear Admiral Metcalf, it occurred to me that perhaps this torpedo launched from SWORDFISH in the Spring of 1965 represents the last operational firing of a Mk 14 set on Lo. So, after 30 plus years of living with this event, maybe I can at least lay claim to a *last*. Can anyone recall a Mk 14 low power firing at a later date?

CAPT Thomas C. Maloney, USN(Ret.)

HOMING TORPEDOES

April 26, 1997

The following additional information regarding the development of homing torpedoes during WWII may be of interest. The SORG compilation of submarine torpedo firings lists the Mk 27 Cutie only as CUTY and the Mk 28 as DOGY—no mark numbers indicated. The first Cutie was fired by SKATE (SS 305) on 21 September 1944. Submarines claimed 33 hits for 24 sinkings, but few of the victims (mostly small craft) have been identified since the war.

The first DOGY was fired by PADDLE (SS 263) on 8 June 1945. I count 17 DOGY firings in the SORG report with five claimed hits. It would be interesting to know the origin of the name DOGY or Dogie; could it have been patterned after the Mine Mk 14 FIDO?

Sincerely,
CDR John D. Alden, USN(Ret.)

BOOK REVIEW

THE UNIVERSE BELOW
Discovering the Secrets of the Deep Sea
by William J. Broad
Illustrations by Dimitry Schidlovsky
Simon & Schuster
New York, NY 1997
ISBN 0-684-81108-1

Reviewed by Daniel A. Curran

"Bill Broad's new book, The Universe Below, is a must read", John Craven remarked as we sat down for a recent meeting in Honolulu. Craven, the first chief scientist for the Polaris Program and the program manager for both the Deep Submergence Rescue Vehicle and the NR-1, is right (as usual). William J. Broad, the New York Times technology reporter, has compiled a captivating account of the world's oceans. With more than a reporter's recap, he adds several insights that focus the reader on this frontier, one we submariners presumably know. We don't know the half of it, as I found out.

Those who read Broad's articles, usually in the Technology Section of the Tuesday Times, are familiar with his grasp of maritime matters. He also has interviewed many of the principals involved in the exploration and exploitation of the sea and the sea bottom. His research on undersea warfare, particularly on submarine intelligence operations in the '60s and '70s, has brought him close to secrets still under wraps in the Navy archives. Broad's treatment of the sinking of both THRESHER and SCORPION reflect the information from the fairly recent declassification of the inquiry reports. John Craven, involved in the SCORPION incident reconstruction, provided Broad with a background on the accident.

The Universe Below is divided into seven chapters covering most aspects of the seas. The lead chapter on the dimensions of the ocean reminds the reader of the fact that most of the mid-ocean ridge and the ocean bottom, some parts deeper than the highest mountains on land, are largely unexplored. Perhaps one percent of the ocean floor has been visited. People like Beebe, the Piccards, and Don Walsh pushed the edge of the deep ocean exploration envelope every bit as much as the early astronauts in space travel.

Submarine operations, particularly the intelligence operations of HALIBUT (see the novel, Spy Sub, reviewed in the April 1997 issue of **THE SUBMARINE REVIEW**) are highlighted, probably as much as Broad can write using unclassified sources. I suspect, however, he has worked out more details than he reveals. One source is the unclassified congressional testimony given by John Craven on these operations, including the differentiation of HALIBUT and Hughes' GLOMAR EXPLORER missions. I will leave it up to the reader to reach his own conclusion on the matter.

Other chapters deal with the ocean as a food source and the resulting problems with over-fishing; the discovery of TITANIC and other historic sunken ships, (Bob Ballard, another Broad source I suspect, and the Woods Hole team were deeply involved in several of the discoveries); the use of small robotic submarines (ROVs) as well as manned vehicles for ocean exploration; and the mining of sea mineral nodules, among other subjects. Broad covers both the technical and the legal aspects of many of the subjects.

Parts of the book reflect Broad's own experience. Broad has made dives in ALVIN, the Woods Hole Oceanographic Institution operated deep diving research vehicle, owned by the U.S. Navy. His observations of the newly discovered life forms and synthesis of life deep below the area of visible light is intriguing. Of particular interest to me was the discussion of the treasures of the deep. My first thought, reading the chapter, was *sunken gold* which Broad also covers in some detail, but the real treasure of the deep may prove to be the medical use of microbes from the deep volcanic chimney areas. These microbes survive at temperatures at which no land-based life can exist. The deep sea microbes are used in high temperature DNA splicing to avoid contamination by bacteria or other forms of life that thrive at *normal* temperatures.

The last chapter, *Tides*, examines some philosophical, legal, and practical problems of man's use of the oceans. Broad has managed to present the sides of the particular issues without exposing his own beliefs or opinions. In some cases, one can discern which way he leans. The other sections, the Prologue, the Epilogue, the Chronology of Deep Exploration, the Glossary, and the Bibliography are also valuable for aficionados of the ocean. The Universe Below is recommended for all who want or need some understanding of the current issues affecting the world's oceans. ■

NAVAL SUBMARINE LEAGUE
HONOR ROLL

BENEFACTORS FOR MORE THAN TEN YEARS

ALLIED-SIGNAL OCEAN SYSTEMS
AMERICAN SYSTEMS CORPORATION
ANALYSIS & TECHNOLOGY, INC.
APPLIED MATHEMATICS, INC.
BABCOCK AND WILCOX COMPANY
BIRD-JOHNSON COMPANY
BOEING NORTH AMERICA
BOOZ-ALLEN & HAMILTON, INC.
DATATAPE, INC.
CAE ELECTRONICS, INC.
CORTANA CORPORATION
DIAGNOSTIC/RETRIEVAL SYSTEMS, INC.
EG&G, WASHINGTON ANALYTICAL SERVICES CENTER, INC.
ELECTRIC BOAT CORPORATION
GLOBAL ASSOCIATES, LTD.
GNB INDUSTRIAL BATTERY COMPANY
GTE GOVERNMENT SYSTEMS CORPORATION
HAZELTINE CORPORATION
ELIZABETH S. HOOPER FOUNDATION
HUGHES AIRCRAFT COMPANY
KAMAN DIVERSIFIED TECHNOLOGIES CORPORATION
KOLLMORGEN CORPORATION, E-O DIVISION
KPMG PEAT MARWICK
LOCKHEED MARTIN CORPORATION
LOCKHEED MARTIN/ELECTRONIC SYSTEMS
LOCKHEED MARTIN FEDERAL SYSTEMS COMPANY
LOCKHEED MARTIN OCEAN, RADAR & SENSOR SYSTEMS
LOCKHEED MARTIN TACTICAL DEFENSE SYSTEMS - AKRON
LOGICON-SYSCON CORPORATION
LORAL LIBRASCOPE CORPORATION
MARINE MECHANICAL CORPORATION
NEWPORT NEWS SHIPBUILDING
NORTHROP GRUMMAN CORPORATION
PRC, INC.
PRESEARCH INCORPORATED
PURVIS SYSTEMS, INC.
RAYTHEON COMPANY, EQUIPMENT DIVISION
ROCKWELL INTERNATIONAL CORPORATION
SAIC
SIGNAL PROCESSSING SYSTEMS
SEAKAY MANAGEMENT CORPORATION
SIPPICAN, INC.
SONALYSTS, INC.
SPERRY MARINE, INC.
SYSTEMS PLANNING & ANALYSIS, INC.
TREADWELL CORPORATION
VITRO CORPORATION

BENEFACTORS FOR MORE THAN FIVE YEARS

HYDROACOUSTICS, INC.
LUCENT TECHNOLOGIES/ATS
PLANNING SYSTEMS INCORPORATED
RADIX SYSTEMS, INC.
RIX INDUSTRIES
SARGENT CONTROLS & AEROSPACE
TASC, THE ANALYTIC SCIENCES CORPORATION

ADDITIONAL BENEFACTORS

ADVANCED ACOUSTIC CONCEPTS, INC.
ALLIED NUT & BOLT CO. INC.
AMADIS, INC.
ARETÉ ENGINEERING TECHNOLOGIES CORPORATION
BATTLESPACE, INC.
BURDESHAW ASSOCIATES, LTD.
CUSTOM HYDRAULIC & MACHINE, INC.
DIGITAL SYSTEM RESOURCES, INC.
DYNAMICS RESEARCH CORPORATION
ELS INC.
EMERSON & CUMING, INC.
HAMILTON STANDARD SEA & SPACE SYSTEMS
HOSE-McCANN TELEPHONE CO. INC.
HUSSEY MARINE ALLOYS
JOHNSON CONTROLS
LOCKHEED MARTIN TACTICAL DEFENSE SYSTEMS
LUNN INDUSTRIES, INC.
NOMURA ENTERPRISE, INC.
RAYTHEON E-SYSTEMS/FALLS CHURCH
SYSTEM PLANNING CORPORATION
VEHICLE CONTROL TECHNOLOGIES, INC.
WESTINGHOUSE ELECTRO MECHANICAL DIVISION

NEW SKIPPER

RADM J.M. Kersh, USN(Ret.)

NEW ASSOCIATES

C. Detwiler
ETC(SS) J.L. Kramer, USN(Ret.)
James B. Pitts
R.W. Wallace, P.E.
LCDR M.A. Zirkle, USNR

E-MAIL ADDRESSES

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

Ahlborn, Dick, synapse@pointloma.com
Archer, Daniel, Darcher885@aol.com
Barber, Jim, jbarber@usni.org
Barr, Jon, jonbarr@ix.netcom.com
Benson, Robert, bbenson@ebmail.gdeb.com
Berman, Alan, AlanBerman@aol.com
Booth, Rodger, RogerSSN@aol.com
Boswell, Charles, cboswell@bdm.com
Bowen, John, BOWENJD@aol.com
Browder, Ed, Edthebrow@aol.com
Bryson, Allen, Cbryson@prodigy.net
Burkhardt, Larry, lbiii@juno.com
Campbell, James, jcamp@cts.com
Campbell, James M., soupy@lmsc.lockheed.com
Candler, David, DavCandler@aol.com
Carmody, Bert, BCarmAtl@aol.com
Carothers, Zane, carothrs@uiuc.edu
Carroll, Alf, alf carroll@sippican.com
Cesco, V.A., CescoVA@aol.com
Cobb, Emsley, emcobb@mindspring.com
Cook, Larry, COOKLW@juno.com
Creedon, William, wcreed02@interserv.com
Crosby, William, crosone@aol.com
Cutler, Thomas, tcutler@usni.org
Davis, Jay, jk&mbdavis@netos.com
Davis, Mike, mcdavis@slip.net
Drugan, Jim, jim_drugan@compuserve.com
Duc, Bob, BobDuc@prodigy.net
Enkeboll, Rich, reenkeboll@iname.com
Enos, Ralph, numuqed@kpt.nuc.navy.mil
Farmer, Mike, ma_farmer@ccmail.pnl.gov
Floyd, Howard, GF4245@aol.com
France, R.T., RTFRANCE@aol.com
Gardner, T.A., TAG751@aol.com

Grojean, Charles, cdgro@texas.net
Guille, Les, slguille@erols.com
Haid, Terry, lildog@erols.com
Hardy, Paul, HardyPD1@jhuapl.edu
Hay, Jim, jimruthhay@aol.com
Hayes, William, William_V_Hayes@ccmail.orl.mmc.com
Heil, Bert, heil_bc@nns.com
Hunnicutt, J.A., mcpo-ss@juno.com
Jacob, Thomas, jacobt@wasc.egginc.com
Johnson, Aaron, JohnsonAB@aol.com
Johnson, Carl, carljohn@msn.com
Jones, Jerry, jej@mail.comet.com
Jurand, George, gjurand@erols.com
Lange, W. Gordon, GLANGE2983@aol.com
Lavender, Randolph, lavender_rc@nns.com
Lindsey, Robert, macropenn@aol.com
Logue, Thomas, tlogue@gses.com
Mau, Roger, mau_roger@georgesharp.com
Maurer, John, jmaurer@worldnet.att.net
McCaffrey, T., thomas.mccaffrey@smtp.cnet.navy.mil
McDonnell, Dave, dclomcd@ea.net
McElfresh, Donald, a0019874@airmail.net
Middleton, David, ddmphm@tscnet.com
Miller, Pete, petemiller@juno.com
Moore, William, moorew@apcorp.com
Murray, Diane, murray_dm@nns.com
Nuss, Jerry, nussjj@cofc.edu
Osborne, Bob, rosborne@electricity.com
O'Byrne, Mike, obyrne184@aol.com
Paddock, James, jrpaddock@anet.bna.boeing.com
Palmieri, J.J., jpalm@aol.com
Payne, Mary, mary@visi.net
Pelick, Tom, tpelick@psu.edu
Polmar, Norman, wordsmh@msn.com
Prosser, N., nprosser@compuserve.com
Reasor, Jerome, reasor_j@uno.com
Rees, B.G., BGR NAVRET@aol.com
Scherr, Michael, Scherr_Michael_ARL_PSU.atp-uswstaff@hq.-navsea.mil
Sencindiver, Jim, Sencindiver_Jim@hq.navsea.navy.mil

Sexauer, Roger, RogerSSN@aol.com
Steele, Robert, chessieb@annap.infi.net
Stegon, Robert, stegon.robert@postal.essd.northgrum.com
Stewart, Joe, JOE.STEWART@mcdermott.com
Stolarz, Robert, stpoo@ssp.navy.mil
Taylor, Brent, taylor_brent@rgesvc.com
Teters, Tom, tteters@sps.globalus.com
Timothy, Oliver, olivert@bah.com
Ulrich, Ted, ulrich_th@nns.com
Wade, George, wade_ga@nns.com
Weeks, Bob, vt115@aol.com
Whelan, Jr., J.F., jfwusna60@aol.com
White, Robin, janierob@mindspring.com
Williamson, George, g.williamson@worldnet.att.net
Willis, John, jwillis@cdc.net
Woodall, Steve, steve.woodall@pobox.tbe.com
Woods, Larry, writeandspeak@worldnet.att.net
Worthington, Samuell, texaggie@gnatnet.net
Young, Charles, Young_Charles@hq.navseanavy.mil
Zechlin, Frank, fzech@aol.com

Changes
Bardsley, George, george.bardsley@jhuapl.edu
Buchanan, Thomas,thomas.buchanan@js.pentagon.mil
Crandall, Scott, crandall_rs@nns.com
Ervin, Russell, ervinr@sourcesvc.com
Garverick, Mickey, Mickey_G@juno.com
Manning, Jeffrey, jmanning@eagnet.com
Powell, Tim, tim_powell@nns.com
Stone, Steve, narwhal@zebra.net
Yarbro, Jr., John, yarbro@erols.com

Corrections

Cederholm Walter, walter.t.cederholm@ussev.mail.abb.com
Kennedy, John, j.kennedy@cdmnewport.sclsis.navy.mil

MEMBERSHIP APPLICATION

Individual Membership Rates:

Regular (including Retired Military)

- ☐ 1 year $25.00
- ☐ 3 year $68.00

Active Duty, students, and naval Reserve Active Status (Drilling)

- ☐ 1 year $15.00
- ☐ 3 year $41.00

Life Membership Rates: (ALL)

- ☐ 34 years and under $585.00
- ☐ 35-50 years old $475.00
- ☐ 51-65 years old $320.00
- ☐ 66 years and older $175.00

Corporate Membership

1 - 50 employees	$ 400.00
51 - 100 employees	$ 800.00
100 - 500 employees	$1,200.00
over 500 employees	$1,600.00

Donor/Corporate Contribution

(in addition to dues)

- ☐ Patron $1,000.00
- ☐ Sponsor $ 500.00
- ☐ Skipper $ 100.00
- ☐ Advisor $ 50.00
- ☐ Associate $_____

Persons residing outside the U.S. please remit an additional $15.00 per year for mailing costs

The Naval Submarine League is a tax-exempt, Virginia not for profit corporation.
Two-thirds of Memberships Dues and 100% of donations are tax deductible

NAVAL SUBMARINE LEAGUE
P.O. Box 1146
Annandale, VA 22003
(703) 256-0891

MEMBERSHIP APPLICATION

Date _____

I hereby apply for membership in THE NAVAL SUBMARINE LEAGUE. I certify that I am a citizen of the United States or a citizen of an allied country _____

_____
Signature

Name _____
Rank, Service, if applicable

Address _____

_____

Phone (Business) _____ (Home) _____

Employer and Address _____

_____

_____

Position/Title _____

I was introduced to the Naval Submarine League by _____

ENCLOSED MONIES

☐ _____ Membership Dues

☐ _____ Donation

See Reverse Side for Rates

Your membership will bring you ....

- The Submarine Review
- Avenue to keep current on submarine issues
- Ability to contribute to public awareness of submarine capabilities
- Association with a dedicated group of people
- Invitation to Annual Meeting
- Forum for Exchange of thought on submarine matters

Play the 688(I) Hunter/Killer submarine game and see if you're as good as you remember!

Electronic Arts and Sonalysts present the most realistic submarine simulation game ever...now available at a store near you.

Sonalysts Inc.

Waterford, CT 800-526-8091

NAVAL SUBMARINE LEAGUE
P. O. Box 1146
Annandale, Virginia 22003