THE

SUBMARINE REVIEW

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FROM THE PRESIDENT

As this will be my last communication to you as the NSL President, I thought I might reminisce these past eight years a bit, and review some NSL occurrences which will never make the history book. Built into the By-Laws is a provision that a NSL Director can only serve a maximum of 8 years at a time and to be President, one must have been elected as a Director.

Early on I approached Shannon Cramer, Chuck Griffiths and Jack Williams (then OP-02) with the latent idea to emulate the Association of Naval Aviation and start a similar Submarine Supporters Association. All agreed and off we went. I was employed by Woody Ramsey of American Systems Corporation at the time and he gave considerable resources and support for the endeavor. As a submariner, Woody believed as firmly as I that a Submarine Association was long overdue and could play an invaluable role in the future. An initial Submarine Supporters meeting was held on 26 May 1981 with 37 retired submarine officers in attendance in a conference room provided by Jack Fagan. Throughout the next 18 months, with the gracious help of Prudy and my daughter Beth, we learned how to make flyers, hand address envelopes and lick stamps! There was a lot of midnight oil consumed just to get a mailing ready. The first funds received was $50.00 from Gordon McGarry of Gould, Inc. The next Submarine Supporters meeting was held on 4 May 1982, at the Washington Navy Yard with 111 people in attendance. A draft Articles of Incorporation and By-Laws was approved and the name "Naval Submarine League" proposed by Phil Beshany, was accepted.

The Naval Submarine League was incorporated on 30 June 1982. Al Whittle was elected as Chairman. The other Directors were Shannon Cramer (President), Chuck Griffiths, Jim Keane, Sandy Levey, Woody Ramsey, Red Ramage and myself. Lou Urbanczyk was the Charter Incorporating Officer. The Directors authorized the NSL professional magazine, *The SUBMARINE REVIEW*, on 14 September 1982, with Bill Ruhe as Editor and Jim Murray as Publisher.

Pat Lewis was the first NSL employee. She was retained as

NSL Office Manager on 8 November 1982. The NSL office was established in Pat's basement and remained there for over 7 years. With Pat's pleasing voice and determination as a hallmark, the NSL has grown and flourished. We all owe Pat our gratitude for the untold hours of work she has devoted to the NSL.

Jason Law, a certified CPA, set up the superb NSL accounting system. Jim Keane, acting Treasurer, had been using a battered notebook and a shoe box. The first annual NSL Symposium was held on 3 May 1983 with 205 members in attendance. The NSL was underway and growing. Admiral Bob Long was elected Chairman of the NSL Directors on 21 May 1984, a position which he currently retains.

Some of the NSL Accomplishments are:

- Attained over 4200 members and 103 Corporate Benefactors
- SUBMARINE REVIEW distributed to Submarine Force Ships and Stations
- Five NSL Chapters organized
- 186 NSL Complimentary memberships given to Congressional members
- NSL Cruise Program for Corporate Benefactors
- Publishing NSL SUBMARINE FACT BOOK
- Sponsored PBS Submarine Documentary ***Submarine: Steel Boats - Iron Men***
- Sponsoring an annual classified Submarine Technology Symposium with APL/JHU
- Sponsoring NSL NROTC Accession Awards Program
- Sponsoring NSL Complimentary membership for SOAC graduates, and Medical, Supply, and Engineering newly qualified Submarine Officers
- Established Bill Purdum Memorial Award at Enlisted Submarine School
- Sponsoring a USNA and NROTC Literary Awards Program
- Sponsoring an active duty Submarine Literary Awards Program
- Co-sponsored a NSL/ASNE Submarine Maintenance and Applied Technology Symposium

- Established NSL Speakers Bureau
- Sponsoring Submarine Service Selection night at USNA
- Sponsoring Submarine Heroes reception at USNA
- Raised over $95,000.00 for Dolphin Scholarship and Iowa Memorial Fund at *Hunt for Red October* Premiere
- Purchased NSL Office Building for National Headquarters
- Established Submarine Reference Library

The NSL's Charter is clear. Our mission is to educate people about and support the Submarine Service. I believe the NSL has held true to its Charter and its value increases every day.

There are many more people, not mentioned above, who have devoted time and energy to the NSL and to them I also give my appreciation.

Now it is time for a new watch to be posted, for a new hand on the helm. Through this process the League will reach even greater acclaim and be even more effective.

Finally, I wish to thank our 4200 members and 103 Corporate Benefactors who believe in the Submarine Service and its deterrent value to this great country. Through you the NSL has made a difference. It has been a real privilege for me to have been granted the opportunity to continue to contribute to the Submarine Service. I am very grateful for the opportunity to have participated in this moment of history. God Bless.

Al Kelln

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FROM THE CHAIRMAN

It has been sometime since I have used this column to communicate with the NSL membership, but in view of several major developments I feel justified in doing so.

First off, let me state how pleased I was with the overall results of our 8th NSL annual Membership Symposium. The speakers were top drawer and the entire affair was again, an unbridled success. The participation of Secretary of the Navy Larry Garrett and the Chief of Naval Operations, Admiral Carl

Trost was, of course, the high point of the Banquet. I continue to be most pleased that the NSL staff can organize and execute this splendid affair year after year.

On 10 July 1990, the NSL Board of Directors will meet to welcome three new Directors, Jon Boyes, Bill Crowe and Skip Orem, and bid adieu to Chuck Griffiths, Al Kelln and Russ Bryan. Al Kelln's departure from the NSL Directors will be a significant change and loss of senior leadership. Chuck and Al have labored hard and long to make the NSL dream a reality and their product (the League) will be a strong factor in support of the Submarine Service for years to come. I hope to keep both of these founders involved in the NSL in some capacity.

Finally, after six years as your NSL Chairman, I pass along the baton of leadership to that person elected by the Directors to succeed me. I believe so very strongly in the mission of the NSL and I also believe as strongly that this organization and its membership have made and continue to make a real difference. The NSL continues to expand on its education mission and each year a more discernible impact is made. I am very proud and pleased to have been part of the NSL team and to have represented you, the membership. The road ahead for the Submarine Service will be extremely difficult. A new watch has been posted and they have been entrusted with the NSL. Please join me in supporting this team just as you have supported me in the past.

Bob Long

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ADDRESS TO NAVAL SUBMARINE LEAGUE ANNUAL SYMPOSIUM 14 JUNE 1990

by Vice Admiral Daniel L. Cooper, USN
ACNO Undersea Warfare

First, I would like to express my appreciation to the Naval Submarine League for the many activities it has undertaken as it has matured over the last four years, in particular. From the normal strong support of the Submarine Force, to the impressive annual technical symposium out at APL, to the release of **SUBMARINES: Steel Boats, Iron Men.** As most of you are aware, NSL was responsible for working with paramount studios for the **Hunt for Red October** premiere. They raised close to $100,000 which was then equally divided between the Dolphin Scholarship Fund and the IOWA fund.

We attempted to raise the cognizance level for the NSL at our last submarine ball, by honoring the NSL and having some of the original mafia be recognized. The same thing was done at the submarine balls at the Submarine Base Bangor, Washington. As you may have read, NSL is working again with varied directions to produce a movie like **SUBMARINE: Steel Boats, Iron Men,** this time emphasizing the SSBN strategic deterrent.

To say that this last year has been stimulating is the grossest of understatements. Living in Washington, DC is fascinating, doing it in 1990 is stimulating and being in the military while justifying big programs is humbling.

The schedule of the Symposium provides a strong variety of speakers, as well-rounded a schedule as any I've seen here. I would expect Dr. Herzfeld, although fairly new in OSD, to give a good overview of the ongoing DOD workings. You'll probably get your price of admission's worth from representative Norm Sisisky who is as skilled and as knowledgeable as anyone in Congress. My guess is that his view will be not only straight but also relatively pessimistic. Without going down the rest of the list, I think you should leave the seminar with a fairly good understanding of the

force, that is, as much as can be gained in the Washington atmosphere.

As we look back over the last year, many unusual events have occurred. The one point of agreement in all the editorials and speeches is that no one could have predicted those changes or anything resembling them. It leads one to conclude that the primary stability in the world today is the relative instability of most of the various components.

Similarly, we see in the papers that the bi-polarity of the international scene is rapidly diminishing and economically the Soviet Union has very real problems. These perceptions, along with the changing military structure of land forces in Europe, then, has presented the major conundrum, that is: since the so-called threat is obviously decreasing, why do we need (blank)? You can fill in the blank with terms such as a navy, people, tanks, bombers or submarines. Obviously, the question I get is why do we need submarines?

What I plan to discuss is in the context of today's atmosphere. What do I see as reality -- what are the threats, the missions, some of the attitudes. Every subject is related to the budget and fiscal policy.

There are many more questions than answers -- we have a lot of smart people looking for truth -- and some who honestly do not agree.

Anyone who arrived in Washington in the last couple of years could have written a book using the title of one of the current best sellers, *It Was On Fire When I Lay Down On It.*

Threat

Over these two days, you have heard or will hear of the Third World submarine threat which is real and growing, and of the Soviet Submarine Force which will reduce in number while decommissioning their older HEN class submarines. These first classes of Soviet nuclear submarines are old, noisy and maintenance nightmares. Simultaneously, the Soviet Union is building submarines at the same or a greater rate than it has even in the 80's. Last year, the Soviet Union built nine submarines -- four diesel, two strategic and three attack (SSN or SSGN). This high construction rate will probably continue in 1990.

Modern Soviet nuclear attack submarines such as AKULA,

VICTOR III, OSCAR and SIERRA are very quiet, well-outfitted and operated very professionally. It is the realization of these new classes that caused Congressman Aspin 18 months ago to convene a study group to look at ASW. That study reiterated that ASW must be our highest priority -- and the SSN-21 must be built.

So my statement wherever I am allowed to make it, is that I do not know the ruble to dollar exchange rate -- nor do I know the GNP percentage for defense in the Soviet Union: I do know the facts which I see or which have been reported:

- The submarine threat of the Third World is increasing.
- The quality of Soviet submarine is much superior to earlier years (the total numbers will go down).
- The number of nuclear attack submarines they are building per year is greater than we build by one or two each year.
- Fleet Admiral Chernavin has stated the submarine is the principle ship of the Soviet navy.

My conclusion is that the threats discussed in the media and the threat with which I am professionally concerned are different and trending in opposite directions. A side argument has been that Soviet submarines are no longer deploying far from their bases. That is true to an extent. But the Soviets' large highly capable submarine potential is and will be there. The U.S. cannot build up to match that potential in one or two years. The submarine threat has not abated.

John Chancellor last fall stated in his TV editorial,

> *Walter Lippman once said the Soviet Union was a bear but not a whale.*

Chancellor then continued,

> *The Soviet Union became a bear and a whale -- and it is a whale still today.*

Missions

The attack submarines, as most of you know, are now fully capable of multiple missions. Each of our SSNs are capable of almost all of the missions the navy must execute. With the submarine's inherent characteristics of stealth, mobility,

endurance and firepower it can:

- o Collect valuable intelligence, covertly - providing real-time surveillance, indication and warning
- o Remain on station anywhere for months undetected (no refueling or mail runs)
- o Respond quickly to tasking in far removed areas and then withdraw
- o Provide strike capability with TASM and TLAM
- o Work with Special Operating Forces
- o Plant mines
- o Create leverage out of proportion to its size

No one knows when one is present -- or if one is there; are there others?

General

As far as I am concerned the threat of foreign submarines and the capabilities of our submarines now are facts. What will happen in the next ten to twenty years is pure conjecture. What I expect to see in general terms is a smaller navy and, therefore, a smaller submarine force. The size of our Defense Department, our Navy or our Submarine Force, will not be driven primarily by the threat or the missions or the perceived need, but by the budget. Any one can read today's paper and come to the conclusion that the cost of everything is going up and the fiscal problems of our country are not diminishing.

Right now, SECDEF, having had an aircraft study, has commissioned a major warship study to look at the DDG-51 and the SSN-21.

It is in that atmosphere that we in the Submarine Force are valiantly discussing the TRIDENT and the SEAWOLF classes of submarine. They are the submarines of the future; as George Allen stated, in this case, the future is now.

TRIDENT

The TRIDENT missile and OHIO-class submarine compose the most modernized and fully capable leg of the triad. Last year you saw the picture of the concentric circles of our first sea launched D-5. Since then SP and Ken Malley and his

people have completed a herculean task of correcting that problem -- no member on the hill really thought it would be done or at least in the nominal time. In March of this year, TENNESSEE went to sea with a full load of TRIDENT D-5 missiles. And last month, the Strategic Systems Program was given the Navy Unit Commendation at a ceremony attended by the Secretary of the Navy and the Chief of Naval Operations. In the next two months, the second D-5 submarine, PENNSYLVANIA, will deploy on its first deterrent patrol.

That class of submarines and that class of D-5 missile are on station now operating from the Submarine Base, Kings Bay, Georgia. There has never been a more successful strategic program, and I fully expect it to be our primary deterrent for many years to come.

We have the two newest bases in the Defense Department and the most survivable, dependable and modernized strategic system in the world.

This year in the budget we are asking for the 18th TRIDENT submarine and advance procurement for numbers 19 and 20.

There are, of course, several subjects which arise in testimony and in the press.

- First is START, which we read could be signed by the end of the year. Navy has stated it desires 21 operational SSBNs which would count under START plus 2 or 3 which would not count since they would be in the shipyard in various stages of disrepair.
- Second is Rocky Flats. Their production status affects our MARK 5 RV on our D-5 missile. We have the necessary plans to adjust as necessary to any delay in Rocky Flats and will need to make the initial decision late this calendar year. Since the 18th TRIDENT which we are requesting will not be commissioned for 5 to 7 years -- Rocky Flats should not be a consideration in its authorization.

One final point which I have made at each appropriate hearing is that several years ago, when the triad was

philosophically justified (after already "in being"), there were two drawbacks allocated to it by any detractors: namely, communications and accuracy. Neither of those are germane now. We have solid, survivable, reliable communications, and our accuracy has proven equal to any missile in the world inventory today.

Given our natural plans for deactivation of our POSEIDON and TRIDENT I, pre-OHIO class submarines -- at the end of this decade, we will have 18 to 20 operational strategic deterrent submarines.

SSN-21

Turning now to the program which, in my opinion, is vital to this nation's undersea superiority and power projection capability, I want to discuss the SSN-21.

Let me point out some facts on the general status of our attack submarine force. Right now, today, we have 92 submarines of which one is a diesel. Included also are eight 594s, two 608s, thirty-seven 637s, one NARWHAL, and forty-three 688s.

Last year we were authorized the last of the 688s which will give us 62 total; we had, at one time, planned for 69. Of the 62, 39 are straight 688s and 23 will be the improved 688Is. When the question is asked, what have we given up -- a partial answer is the seven 688's we will not now buy.

In this year's budget, you will note we are retiring eight submarines somewhat early; that includes two 637 class. (This decision was made late in the process of the 1991 budget) that decision was based on the economics or costs of overhauls and inherent personnel savings. Each of these platforms scheduled for retirement is a highly capable submarine which will continue front-line operations, up until returning to port for deactivation.

Given all the unknowns over the next few years and the present climate and thinking, I would expect us, in the year 2000, to have about 80 or so attack submarines. The large majority will be the 62 688s and I-688s with a few 637s and the remainder being the SSN-21. Obviously, then, the level will depend on the rate of authorization of this most capable platform.

As you can see, we will not reach 100 operational attack submarines. Given the present fiscal atmosphere, the cost of building a submarine and the long building period for a nuclear submarine, the effect of any decision we make this year will not be seen for six or seven years; then, if, in fact, world tension increases, it will take another six or seven years to get more submarines out -- if industry is still sufficiently vibrant to respond.

When questioned about how many submarines we need, my statement has been: in 1984, we did a study based on the threat, the national maritime strategy and having 688Is in the inventory. That study calculated a need for 140 plus submarines. In 1988, we again did a study based on the updated threat and having some number of SSN-21s. That study justified 104 to 106 attack submarines. The national maritime strategy has not changed; the threat has changed to more Third World and more capable Soviet submarines. So I cannot justify the need for a number less than the level our study developed. Budget constraints I understand, but please do not ask me to justify those numbers operationally.

The SSN-21, SEAWOLF, is the submarine we need to execute the national maritime strategy against the projected threat with its known advanced technology. I emphasize advanced technology is vital -- that has been our cornerstone for years, but it has eroded as we have used the same design for 20 years, and the Soviets have progressed to close the gap. The SEAWOLF will have:

- o The ultimate in submarine stealth technology.
- o Double the firepower of the latest operational Soviet attack submarine
- o The highest tactical speed of any submarine in the world
- o Sufficient design margin for growth in future technology advances
- o Advanced design to allow efficient modernization and maintenance throughout its life. The effort will result in reduced operating and support costs.

It is meeting or exceeding every one of its top level warfare requirements specifications. SSN-21 is the key to this nation's

undersea superiority and power projection capability in the 21st century.

The primary questions which have arisen are about concurrency, costs, schedules, the complicated BSY-2 system and testing. So far, we have answered all of the questions with forthright, straightforward answers. Obviously, many of the answers are difficult, since the SEAWOLF is only into the second year of a seven-year building program. Be advised, however, we are in year 8 of a 13-year total program and have to date spent about $5 billion on the research, design and building.

A discussion which is more mind-boggling than it should be is the one which starts by saying the 21 is too costly and then says you could build a cheaper one and get a lot more. Later in the same conversation, the interrogator will slip into the discussion of do you think SSN-21 is advanced enough to meet the threat?

There are several answers to that line of questioning. To wit:

The SSN-21 will have every improvement we can make in the time given. As a matter of fact, the improvements have allowed other detractors to come on line with the questions of concurrency. Concurrency basically means that at the time, the 21 (or any system) goes to sea or operates the first time, there will still be many components which will not have been fully tested at sea under operational conditions. To say we've always done it that way is true, but inappropriate. The fact is that more of the SEAWOLF equipment will have been tested, reported and stressed before insertion in the hull than ever before. However, the question still lingers. SECDEF made a report to congress on concurrency and declared both SSN-21 and BST-2 as moderate risk. (Interestingly, both were low risk in technology.)

A further answer is that, in my opinion, we cannot afford two attack submarine building programs. We must be able to go against the best possible adversary in the world and also against the third world threat. The SSN-21 will do that. Our high-low mix is the SSN-21 and the others. The margin for necessary major improvement of the 688 is gone. We can make no more major improvements.

Nunn

Finally, I would like to discuss briefly Senator Nunn's speeches on "new military strategy." He delivered a series of lectures on the senate floor in April. His suggested strategy revolved around the following five points:

- o **Maintaining nuclear deterrence** at lower levels with great stability.
- o **Reduce forward deployed** forces, increase specialization and emphasize reinforcement
- o **Greater utilization of reserves**
- o **Flexible readiness**
- o **Resource strategy - "think smarter, not richer"**

The submarine can be a major component in four of his five points. I grant that we cannot have a greater utilization of reserves, but the submarine is a major factor in maintenance of nuclear deterrence, rapid response when the forward deployed forces are reduced, high flexible readiness and the maintenance of technological superiority through both modernization and building new platforms.

There are still many questions which keep appearing in the questioning of national defense -- to repeat my earlier statements, the U.S. has national priorities, national debt, health, education, drugs, S&L, START and occasionally the subject of naval disarmament.

Let me emphasize two important points:

- o The TRIDENT is **the** modernized leg of the triad -- we are fortunate.
- o There is no programmatic or scheduling reason to reject the SSN-21. Fiscal decisions may be made at a higher level, but no one should hide behind some wrong perception of decreased threat or program problem.

Both the TRIDENT and the SEAWOLF represent **the future of our navy as well as our force.**

Because of all these, I repeat, life in this arena is invigorating and the challenges stimulating. The ability and professionalism of our submarine force is recognized and appreciated. Any help the NSL can render in our quest will certainly be appreciated.

Finally, even though Voltaire in 1789 wrote, "an Admiral must be put to death now and then to encourage the others,." today, just testifying on the hill provides lots of encouragement "for the others."

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SOME THOUGHTS ON UNMANNED SUBMARINES (UUV)

by Captain R. B. Laning, USN(Ret.)

Worldwide increases in political uncertainty, decreasing numbers of U.S. SSNs (to about 70 in 2000), and the presence of 505 submarines in 38 navies (other than the Soviet and U.S. Navy) soon to number 44; all point to the need for force multipliers in the U.S. Navy.

Of these submarines, the non-nuclear boats are increasingly powered by air independent quiet systems such as fuel cells and Stirling engines.

As in air and surface systems, such force multipliers may become available through unmanned systems. In my opinion it is most fortunate that DARPA has taken on the job of initiating the effort with a most sophisticated technological leadership involving such powerful organizations as Draper Labs, Bell Labs, Lockheed, Raytheon, and others.

The initially planned 36-foot UUVs are aimed at a classified list of missions. An expanded future list may demand a diversity of sizes and types just as has the list of aircraft missions, while some promising technologies may expand the missions by increasing: run or loiter time; control fiber length; stored energy; navigation accuracy; and control range by satellite communications.

The GPS positioning system which could be sampled periodically can provide position to meters. Commercially available sets are about the size of a pocket calculator and reasonable in price.

Advances in fuel cells have been rapid, most promising, and well understood by DARPA. There is yet another source of energy worth considering. About 20 years ago I managed for the National Institute of Health the main artificial heart program -- until the Viet Nam War took all the money. We

needed a power source which could fit into a human body for years. The best potential source turned out to be Plutonium 238 which is produced as a byproduct of power reactor operation. The AEC became interested and went so far as to develop the Pu-238 energy source for a heart pacemaker. This technology applied to a UUV might do wonders in expanding run and loiter time and therefore mission envelope. The constant emission of heat would require suitable waste heat disposal in non detectable ways. (*Note: Pu-238 is not the bomb material Pu-239.*)

Squirt transmission by microwave radio or laser to and from control via satellite seems a future feasibility which could be programmed into a suitable sampling system and perhaps involve a trailed surface-breaking antenna. The development of antennas of minimum detectability might further lead to a variety of electronic warfare missions.

Increasing sonar effectiveness may lead to the mission of detecting the loudest machines made by man -- high speed aircraft.

A fascinating possibility seems to exist in the lasing optical fiber which might extend control to hundreds of miles; this combined with some of the above could vastly expand the variety of missions. This could be particularly important to a system where teams on the surface of arctic ice operate the UUVs.

The possibility seems to exist that satellites and aircraft may at some time be able to laser-scan the ocean to detect submerged submarines at shallow depths. Such an eventuality might make valuable UUVs designed to lay the analog of a smoke screen over the submarine.

If ASW aircraft become more effective the UUV may make more feasible the shooting down of such air assets from positions not giving away the sub's posit.

Perhaps one can think of a SEAWOLF Class submarine escorted by a number of UUVs carrying aluminum burning underwater rockets of the type demonstrated by Cal Gongwer to ONR in the 50's which would destroy incoming torpedoes.

If submarine quieting really becomes so effective as to invalidate passive sonars, UUVs might be thought of as active sonar carriers or at least bistatic sources.

If coatings reduce active sonar detections the UUVs might be used to tow filamentous nets for zero range detections.

A very dangerous application of the small submarines envisioned might be the transport of UDT personnel, internally or externally carried. A UUV may also turn out to be the best counter to such activity.

It is my guess that the technology of UUVs will develop much faster than that of manned submarines and that much that is learned will be applicable to later manned boats.

If UUVs become viable systems for the U.S. Navy, the principles will soon be adopted by other Navies. Indeed a number of foreign UUVs are now in development. Their effectiveness against submarines, torpedoes and UDT vehicles would naturally spread to effectiveness against other UUVs.

A fascinating new vision now unfolds -- with a huge ocean containing large numbers of UUVs, each of limited detection range against the others and each looking for the capitol ship submarine guarded by UUVs. The scene becomes much like the air battles of the Pacific in WW II where decisions were determined by huge dog fights among fighting aircraft between the capital units. The parallel is made more striking as one looks at the numbers. Our 70 or so SSNs are of about the magnitude of the numbers of aircraft carriers in WW II. In that war the U.S. built 100,000 planes a year to win. The Grumman Corp., after a few months development, built 15,000 F6F fighter planes and these shot down 60% of the Japanese planes downed in WW II.

When the technology gets to the point where UUVs fight UUVs, numbers take on a new importance along the lines of Lanchester's Modern war. Perhaps some submarines become even larger to carry hundreds of UUVs. Submariners had best study the history of AIR WAR!

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BOOMER WIFE

by Pamela L. Van Oteghem

It is the "in-between" time. The time when you've had to check out of the hotel but it's still too early to leave "him" before he goes down into the black hole, into the belly of the

whale. Once he goes down into the black hole, it's months before he comes out again.

We sit in the town's gazebo sipping iced tea and watching the sun sparkle on the little waves that die on the rocks at the water's edge. It is the little town that isn't built yet, Kings Bay, Georgia. Three hours and twenty-seven minutes from Charleston -- from home. (If you drive the speed limit.) That's where they park the submarines. That's why you must drive down the swampy coastline and through the fabled antebellum low-country to be with the ones you love for the weekend.

Sometimes I think I can feel the ghost of Sherman marching that same route through the marshes and swampland. Generations of egrets and blue herons glide over the marshes and point the way. The rustling of the palmetto trees high above whisper the names of thousands of women who've made this trip, for a weekend stolen from the military machine.

There isn't anywhere to live yet, in the little town that isn't built. Only a heartless hotel and a long cement pier. The town will be built sooner or later. I guess it really doesn't matter. I'll follow him wherever they send him.

The bridge over the Savannah River is the halfway point on the drive. When I cross it to the southbound side, my heart starts to lift because the whale comes to the surface. The prodigals return.

When I cross it to the northbound side, I dry my eyes and begin to figure out how to make the upcoming months fly by without pain. Pain is useless against the black hole. Pain is useless against the whale.

"Want to get something to eat?"

"No, let's sit here a little longer."

It's a long drive back and I don't like to do it at night. There always seems to be a storm that comes up and it rains like hell for most of the trip home. It never fails. He holds my hand. We fritter away the rest of daylight and have a quiet dinner. The dread begins. Why can't we just separate and be done with it? Dragging it out like this only makes it worse.

I say, "Go and be gone so that you can come home!"

"I wish I could," he answers. This hanging around is awful.

There must be a better way to live. I never thought it would get this hard.

This is the way we live because he loves his job, his career, this adventure, and I love him. Neither of us would ever change it.

The spotlights shine out in the blackness of the coastal sky. They call it the wall of light. They hide the whale behind the ugly brilliance. They ruin the night for star-gazing.

He leaves the comfort of the car, (Corinthian Leather), and starts the long walk down the concrete umbilical cord towards the black hole. There are many whales to be filled tonight. The spotlights illuminate them all. There will be many new Jonahs before the week is out. My own beloved Jonah becomes a blurred shadow. I try to switch off the love but the switch is stuck and the love won't go away. It would be so much easier if it did.

There is a heartbreaking clash between love of country and freedom and the love between us. Why did I marry such a gentle man of war? It always seems that the love of country and freedom wins until the whale surfaces and the black hole returns in a distant, fiery dawn to disgorge its inhabitants into the arms of waiting wives and girlfriends.

The long ride home begins. They told me that it would get easier as the years vanish like the tides. That's what they said when it was my first time watching him climb down into the hole. It isn't my first time any more. It hasn't been my first time in a long time. I'm a "they" now. I'm a seasoned "Boomer Wife." I have to help out the new batch of first-timers; the new eighteen year-old brides from Kansas and Spokane and Two Sticks, West Virginia.

I tell the new ones everything. I tell them to start a hobby, learn to cook, see how much money they can save, tell them anything, but I don't tell them it gets easier. It doesn't.

Don't cry on my shoulder. I have enough to worry about now. I'm on the northbound side and it's raining like hell and there goes the Savannah River.

■

POLARIS AND "RED" RABORN

[Ed. note: An "In Remembrance" item in the April SUBMARINE REVIEW for the deceased Vice Admiral W. F. Raborn, USN(Ret.), suggested the following article which is developed from an interview with Admiral Arleigh Burke, and Admiral Raborn's oral history as recorded by John T. Mason Jr. for the U.S. Naval Institute's Oral History Project.]

The great importance of the Submarine Launched Ballistic Missile to today's Submarine Force along with the strategic role the SSBNs play in our national security posture place Admiral "Red" Raborn at a level with Admiral H. G. Rickover in determining the destiny of present nuclear submariners.

His Obituary says he was picked for the critical POLARIS assignment by Admiral Arleigh Burke, Chief of Naval Operations in 1955, "Because of his background as a naval aviator and an ability to get along with people under difficult and stressful circumstances."

It should be understood that Admiral Raborn was chosen for the POLARIS job, not because he was a naval aviator, but in spite of that background. How did it happen?

Admiral Arleigh Burke, when asked about why he selected Red Raborn from about six candidates -- suggested by the Bureau of Naval Personnel -- told this story. *"I asked for the records of at least six Captains or fresh caught young Admirals who looked like good bets to put this program into being. I specified that they need not be submariners, feeling that the job was too broad in scope for just experienced people. They couldn't have a broad enough base of technical expertise to cover the many problems involved. It seemed that first of all, a leader and not a technician was required. The submariners had not been enthusiastic about this idea although several of them had outstanding records, but would they be innovative and search for new ideas? I felt that an inexperienced person with a high quotient of curiosity might be the best bet.*

"Raborn's Fitness Reports were not all that glowing. I recognized that a man has to step on a few people to do what is right and best -- and hence will at times be unpopular with his

seniors and get less than outstanding marks. When I interviewed Red Raborn I found him a good listener and a man capable of evaluating the opinions of 'the experts' who he would have to choose to do each part of the job. I found that he was a very hard and apparently tireless worker. He was the sort who recognized what needed to be done. He liked people, and knew the names of his co-workers and had a reputation of being supportive of their efforts. His work in the Bureau of Ordnance indicated that he wasn't interested in something different but rather something better. And he was willing to get rid of people who couldn't 'hack it'."

When I asked if Raborn had a lot of close friends, Admiral Burke felt that he did have some very good friends. *"But I doubted that he collected his friends for the job. I think he recognized that close friends hinder the making of certain important decisions in which they might be involved. It's better to deal with people in such a project, uninhibited by the bonds of friendship."*

When Admiral Raborn was asked, in his oral history, what were the ingredients in a person's makeup which seemed necessary as head of the Special Projects Division, he confirmed much that Admiral Burke had identified as being necessary. *"For a job which takes dedicated effort, one needs a basic enthusiasm for life, a great amount of personal energy, and a thorough appreciation that a person doesn't do everything by himself, and that the collective efforts of those that are around him have to be utilized and brought to bear in an optimum way on the problem at hand. I suppose that the combination of enthusiasm, energy, and dedication just makes a person a better leader. When you dedicate yourself to your job, you learn about it, you become enthused, you enthuse other people, you get other people to dedicate their efforts, and the result is you have a buildup of ongoing efforts.*

"My early duties at sea were many and varied -- but principally in the ordnance end of the Navy. Five years after graduating from the Naval Academy, I entered flight training and became a naval aviator, and for the rest of my career in the Navy I <u>was</u> a naval aviator. I was a rated pilot until the day I retired in September 1963. In 1949 I was the assistant to the Admiral for R&D for all aviation ordnance and also of all ship

based guided missiles then being developed by the Bureau of Ordnance. That tour in the Bureau of Ordnance research and development heightened my interest in guided-missile work. It gave me additional visibility to people who were running the Navy. So in 1955 when it was decided in Washington that the Navy would join with the Army in an attempt to use, at sea, the Army's ballistic missile to be developed, the Navy looked around for a program manager, and I was chosen.

"Admiral Burke made it very clear, the high importance and absolute top priority within the Navy and on the national scene that this effort was to have, and I was, of course, to work with the Army who had set up a similar organization in Huntsville, Alabama, to build a large liquid-fuel ballistic missile which was later named JUPITER. This was supposed to be a 1500-mile bird and it was in direct competition with the Air Force's effort to build the land-based missile called THOR. The imposition of the Secretary of Defense on the Army that JUPITER had to be used on ships at sea, the Army felt, would be a hindrance to their missile work and impede progress -- and probably lose the race to the Air Force. But Admiral Burke persuasively kept the Navy in a joint project with the Army. However, most of the senior officers with the exception of Admiral Burke were not deliriously happy to embark on such a risky and costly venture as this. They felt -- and I think properly so -- that a large liquid-fuel missile aboard ship was a very dangerous thing. Solid fuels were far more safe and we had considerable experience handling them aboard ship. When Atlantic Research Corporation came up with some rather startling advances in the specific impulse that you could get from solid propellants and that it was possible to build large solid-fuel motors that could propel a large missile some 1,200 to 1,500 miles, we went in that direction. It was very obvious that putting ballistic missiles in surface vessels was not nearly as attractive as putting them in a submarine -- for the submarine was more difficult to find and a launch submerged would be from a very stable platform.

"Acceptance of this program was coming along not as well as we had hoped. So Admiral Burke called a meeting of all senior flag officers to ask their advice. Not one of them was enthusiastic about this program. Most felt that it would be a waste of money and a tremendous drain on the Navy's budget.

At the end of the meeting Admiral Burke asked me what I thought, and I said that 'if the Navy didn't go ahead with the project it would be making the biggest mistake it had ever made.' The Admiral then decreed that we would proceed, with top priority, and wrote a memorandum saying that I was to have absolute top priority on anything I wanted to do, and everyone in the Navy would be responsive to my requests. If anyone in the Navy felt they couldn't be, they were to come instantly to him with me and he would take it on himself to say no if he thought it was proper. Obviously this was a 'magic' piece of paper, which I carried in my shirt pocket for months -- and only had to use twice, apologetically. The thing that shook them up most of all was that no one had anything to say about the program except me. No one in the Navy could tell me 'what' or 'how' to do this. We had complete absolute authority and no one was to look over our shoulders and try to tell us how to do something or what to do.

"We worked with the Army for the best part of a year, but when we started using solid propellent motors successfully we got a go-ahead from the Secretary of Defense to develop our own missile -- POLARIS. We selected the contractors for the missile, the warhead, the missile-guidance, for missile-launching. A navigational contractor was needed because we had to know with great precision where the submarine was at all times.

"When a program as innovative as this is initiated it really doesn't make much sense -- if time is of importance -- to conduct a long drawn-out competition between contractors and then have the results flown to Washington to be studied for another year or so before the contractual family is selected. I consider this a very wasteful thing because the technical approaches finally selected will largely be obsolescent by the time of selection and a major part of the work will have to be discarded with the taxpayers money wasted and that program set back time-wise because of this unnecessary and over-cautious approach.

"So with our contractual family selected in my program office, and recognizing my authority, I wrote telegrams putting our selected contractors under contract, over my signature, and sent them out! When I told the Secretary of the Navy what I had done, he said 'I thought I had some responsibility for that.' I

said, 'Yes, Mr. Secretary, you certainly have, but, you recall, you delegated your complete authority and responsibility to me and I have exercised it.' The Secretary then said 'You sure made some good choices. They're all good people.' What a contrast to today's drawn-out, expensive to the taxpayers, 'Follow the Book' way of doing business. The idea of competition for competition's sake is time-consuming, expensive, and if you put award of contracts on the lowest price -- a very bad thing. It's one of the most wasteful things you can do.

"So the selection of the POLARIS team was that kind of a thing. We got the best we could for the country, in our judgement. I believe the POLARIS team had performance unequaled by any contractual family before or since. They consistently underran their performance-time schedules, as set for the program. And this performance was obtained by cultivating a real team-spirit and effort! Much money is being wasted by unnecessary competitive efforts and wasteful contracts to incompetent 'low bidder' people. Also we have procedural papers and procedural reviews and methodology which is the most wasteful thing that I know of in this country -- under the guise of efficiency.

"In the POLARIS program we knocked some three and a half years off the program schedule, and this was not a stereotyped program like building subways. We simply brought out the latent talent in people and gave them performance goals to reach without crippling them with excessive supervision. Sure it was expensive, but we were spending at a rate of 1.2 billion a year, so producing the system well ahead of schedule saved about six billion dollars.

"It was apparent to me that it was necessary that important people in government, science and industry, who could speak a good word for the program, had to be acquainted with this program and its status. So we had a very planned, methodical campaign which was carried on by a whole cadre of officers who always made themselves available to talk on POLARIS.

"The motivation thing was a very real effort on our part and it paid off in dividends far beyond anything that I can begin to express in a few words. We went right into the factories to talk to the workers and their families about what a great thing POLARIS was for our country and how important their work

was to national security. We got the idea across that we were all 'tigers' in this project and so the 'tiger' became our symbol. Everybody, everywhere had a little toy tiger on their desk. I also remember going to Hughes to see how well they were competing as a back-up for the submarine fire control and missile guidance work. My old friend 'Pat' Hyland said, 'Would you like to see your work?' At my agreement we went down to a very large floor where about 300 girls were working. They were in assembly lines making the electronics that were going an a small inertial table in the missile guidance. All the girls at the work benches were dressed in red, white and blue middy blouses and skirts. I asked "why is it that they're all in this patriotic uniform?" The supervisor then said, 'We are so proud to be a part of the POLARIS family that we decided on our own to buy these outfits and wear them every Wednesday.' I said, 'Gee, but this is Thursday.' So she said 'Well, we heard you were coming and wore them to show you how proud we are to be a part of the POLARIS program.' It's people who do the job. People turn out their best efforts if they're properly motivated and managed. Then you've got an unbeatable team.

"Of course we were responsible for putting the weapon system into the submarines -- responsible for the submarines and everything that went into them. We worked directly with BuShips, but at first we were not working very well because we didn't have good lines of communications with them. So I saw Rear Admiral Al Mumma, Chief of BuShips and suggested that he get a rear admiral naval constructor, and name him 'Mr. POLARIS' and give him 'your authority in writing to go ahead and build the POLARIS submarines.' This way we utilized BuShips' management team to do the job, as we had done in industry -- rather than going in and trying to tell them how to do the job. It was a pet saying of mine that I would never do anything if I could get somebody else to do it for me, and I really used this principle. I would never do anything if somebody else could do it. The other fellow probably knew how to do the job far better than I, and so it gave me time to do the things that only I could do. It gave me time to think. It gave me time to look at the soft spots -- the soft spots in performance, or in part of our military-industrial team, or soft spots in protecting our political lines in Washington, It gave me time to go and do

something about it. That's why I had a good deputy to run my show. We had a Board of Directors of the deputy, the chief civilian and the technical director. Do you think I attended a Board of Director's Meeting? Hell no! I didn't want to get into minutiae.

"When I left the program they had a luncheon for me and gave me a silver plaque containing a couple of silver spurs mounted on the plaque. Somebody said they wanted to put a little blood on it, but they thought better of it.

A letter to the Editor from one of Red Raborn's team said, *"I was under 30 then and I can recall him hailing me as I ran down a corridor. He was pleased to see me running. The in-house joke was that to succeed with Admiral Rickover you had to speed-read and with Admiral Raborn you had to run a three-minute mile. Admiral Raborn stayed faithful to all his SP members, never failing to recognize one or take a moment to share old memories, even after his unhappy CIA tenure. Nuclear deterrence was his life's great triumph."*

POLARIS was a weapon system developed free from excessive bureaucracy in an unprecedented short time, fully operational and on station, in a little over four years! There's a lesson in this program for someone today

■

SONAR TRANSDUCERS: A HISTORY

By Frank Massa

[This article is digested and reprinted by special permission from Sea Technology, November 1989.]

Little progress was made in sonar transducer development during the period 1915-1940. The 1940 U.S. Navy sonar used a 24 kHz magnetostriction transducer comprising an array of nickel tubes driving a 1-foot-diameter steel plate mounted back to back with a Rochelle salt transducer inside a spherical housing. The latter was attached to a pipe that penetrated the ship's hull. During operations, the pipe was manually rotated and a pulse of sound was initiated at various selected bearings. If a submarine was nearby, a reflected echo would show up as a flash on a circular neon tube to indicate the range. The Rochelle salt transducer had a low Q and was less reliable

than the magnetostriction unit, which was used as a substitute to maintain sonar operation during frequent periods of failure of the Rochelle salt tranducer.

In World War II the Navy's underwater Laboratory in New London, Connecticut, Harvard, NEL San Diego and Brush of Ohio undertook the development of magnetostriction transducers. An initial project was to protect individual slow moving ships from torpedo attack. The plan was to tow a streamer along each side of the ship with a small charge of TNT explosive at fixed spacings along its length. A hydrophone was placed at each explosive location to pick up noise from the approaching torpedo and automatically fire the charge nearest the hydrophone over which the torpedo passed before reaching the ship. Using the only available piezoelectric material, a Rochelle salt hydrophone was designed to solve the problem.

A stream of new transducers were developed and put into production. It was soon apparent that Rochelle salt was a very unreliable material for sonar transducer applications. A search for something better indicated that ammonium dihydrogen phosphate (ADP) crystals had the desired stability. A transducer was developed using experimentally grown ADP crystals, and tests showed it to be far superior in power handling capacity and reliability.

Many tons of ADP crystal were used in the manufacture of tens of thousands of the many new transducers that were developed for use in new applications created by the rapidly advancing sonar system developments to meet the country's urgent ASW efforts.

Acoustic Mine Hydrophones:

One of the earliest applications of ADP was in a hydrophone design for use in acoustically activated mines. The hydrophone specifications included flat response in the low audio and subsonic frequency region; a low-frequency cutoff below 5 Hertz; ability to withstand water entry shock when air-launched from 10,000 feet; and ability to withstand shock from neighboring mine explosions. Most important was a uniform sensitivity requirement within one-half decibel of a reference standard, which was easily met because ADP has zero aging characteristics and remains stable during many years of storage.

Acoustic Torpedo Transducers:

The earliest acoustically guided torpedoes made use of passive sonar. Four identical high-frequency directional hydrophones were located symmetrically on the nose of the torpedo; one pair was located in the horizontal plane with their axis inclined at equal angles to the left and right of the torpedo axis, and the second pair was similarly located in the vertical plane. At the cross-over point of the beam patterns along the axis of the torpedo, the sensitivities of the hydrophones are equal; therefore, if the acoustic noise generated by the submarine indicates the same output level on each of the four receiving channels, the axis of the torpedo is aligned with the target. If the target is not aligned with the torpedo axis, the relative levels of the detected signals in the hydrophones will change and the course correction is automatically adjusted until the signal levels in both pairs of hydrophone channels are equal. This simple acoustic homing system worked well until a countermeasure neutralized its effectiveness. The target submarine discharged an effervescent chemical and abruptly changed course where it remained undetected while the torpedo pursued the fizzing decoy.

However, the countermeasure was neutralized by converting the torpedo homing system to active sonar.

Passive Long-Range Submarine Sonar:

The high reliability and uniformity of ADP crystal made possible the development of a passive submarine sonar system for indicating the bearing of submerged or surface vessels at very long ranges. Several ADP crystal assemblies were precisely mounted inside a steel tube to form a high precision line hydrophone. A rubber boot and mounting flanges completed the hydrophone assemblies, after which they were vacuum filled with castor oil and mounted in parallel arrays.

The scanning sonar transducers developed during the late stages of World War II operated at relatively high frequencies, which meant that the transducer assembly was rather small, consisting of an array of ADP crystal staves attached to the perimeter of a tubular frame. A single rubber boot enclosed the assembled structure. With the progressive lowering of sonar frequencies, transducer dimensions became larger, and it became necessary to fabricate the transducer as a large

structural array employing hundreds of modular transducer element assemblies. The use of a modular design in the transducer configuration imposed severe requirements in uniformity and reliability among the individual transducer element assemblies that were non-existent in the earlier high frequency sonar systems.

Ultra-Long-Range Sonar.

During the past two or three decades, considerable effort has been expended in the development of high-power transducers for use in the low audible frequency region to meet the requirements of future ultra-long-range sonar systems not yet fully defined. Some examples:

Magnetostrictive Ring Transducer: A large-diameter ring comprising a cemented multiple layer scroll of nickel strip (over which is wound a toroidal coil of insulated wire) will vibrate in the radial resonance mode when an AC current is superimposed on a DC biasing current supplied to the winding.

Ceramic Ring Transducer: Large-diameter ceramic rings fabricated from wedge-shaped ceramic sections cemented together to form the ring have also been built for use as high-power low-frequency sound generators. However, they are subject to high risk of structural failure when operated at high-power levels.

During the mid-1950s, a ceramic transducer design was used on the SQS-23 sonar.

Megawatt Low-Frequency Electromagnetic Transducer Array: Electromagnetic transducers that operate by electromagnetic forces have shown the most success. The forces are generated in an air gap between the magnetic laminations attached to the vibratile structure and the magnetic laminations attached to the massive inertial non-radiating structure. The world's largest transducer array -- a 300,000-pound array, 1500 square feet in area -- was designed and manufactured by Massa for the Office of Naval Research as a replacement for a magnetostriction scroll array that failed while operating at high-power levels. The large array operated at a measured 60% efficiency and could be driven with up to 1 megawatt of audio power in the 400 to 500 Hz frequency band.

Polarized Ceramics Developments: At the end of World War II, the standard U.S. Navy scanning sonar transducer used an

array of ADP crystals operating at 18 kHz. With increased knowledge of sound propagation in the sea, it became evident that lower frequencies would improve the range of detection. The practical size limitation of ADP crystals prevented their use at lower frequencies; therefore, magnetostriction and barium titanate ceramic designs were developed during the early 1950s for low-frequency use. Both these materials had limitations that prevented achieving uniform impedance characteristics among the separate stave assemblies, which in turn deteriorated the beam pattern during the operation of the sonar. Barium titanate was eventually replaced by more stable lead zirconate titanate and the scanning sonar frequency was progressively lowered from 19 to 5 kHz, which became the standard AN/SQS-23 sonar in widespread use for several decades throughout the U.S. fleet.

The magnetostriction transducer designed for the SQS-23 sonar used several tons of nickel, which was expensive and consumed enormous quantities of what was considered a critical material. The magnetostriction design was eventually replaced by a lead zirconate titanate ceramic design.
All designs, however, developed serious problems in the fleet and required frequent transducer replacements due to various mechanical and electrical failures.

The inability to control the uniformity and reliability of the ceramic transducer was accepted by the Navy until a replacement was found.

High-power Electromagnetic Transducer for Very Great Depths: A spherical low-frequency transducer element assembly approximately 2 feet in diameter and driven electromagnetically, push-pull, from opposite sides of a circular disk that lies in the equatorial plane of the sphere. The spherical shell oscillates as a dipole. When rho-c loaded, it delivers from 2 to 4 kilowatts of sound with a Q between 3 and 4 depending on the frequency range of operation and the thickness of the spherical housing, which in turn depends on whether the depth of operation is 20,000 or 2,000 feet. An underwater horn was designed for increasing the radiation resistance on one face of the spherical dipole by more than an order of magnitude over the loading on the rear face of the sphere, thus eliminating the need for a pressure-release baffle.

Electromagnetic Transducer for High-power Low-frequency Arrays: A very recent development is an inertial mass-loaded electromagnetically driven vibrating piston. The vibrating piston is a rigid 17-inch-diameter plate, spring-mounted to the inertial mass portion of the vibrating structure. The heavy copper coils and E-laminations which comprise part of the magnetic circuit are bonded to the massive steel plate and contribute to the total inertial mass. The lighter I-laminations that complete the magnetic circuit are bonded to the inner surface of the vibratile plate. A circumferential row of springs separate the vibrating plate from the inertial mass and the spring stiffness determines the resonance frequency of the transducer. The transducer design achieves a low Q of less than unity for the rho-c loaded array. Each transducer element can deliver 2-3 kilowatts of sound at approximately 50% efficiency over an octave bandwidth within the low-frequency region below 1 kHz.

Lightweight Sonar Systems.

The continued lowering of sonar frequencies for achieving greater range has resulted in very massive sonar transducer arrays weighing many tons. A conventional scanning sonar transducer for operating in the 3-4 kHz region weighs approximately 20,000 pounds. A novel modular high-power transducer weighs only 10 pounds and generates 3 kilowatts of sound in the 3 kHz region when used in an array for a radically new sonar system.

Two conically tapered pistons are driven at opposite ends of a lead zirconate titanate ceramic stack. Both pistons move in phase and a stationary node is established at the center of the stack, equivalent to an inertial loading for each piston of infinite mass but zero weight. The tapered pistons form a radial underwater horn at the junction of each pair of modules when a number of modules are aligned along the vertical axis of a tubular housing. The increased resistance loading due to the circular horn structure results in a Q of 2 which achieves 1/2 octave broadband response. A line array 9 inches in diameter by 50 inches long weighs 125 pounds and generates 20 kilowatts of sound in an omnidirectional horizontal beam with a vertical beam angle of 25°.

In the mid-50s Massa developed the PRS-208 transducer of

the SQS-23 sonar system.

An engineering prototype of a portable long-range sonar system includes the new lightweight transducer mounted axially within a 9-inch-diameter housing. The unit also contains the power supply and a very high precision nine-element line hydrophone receiving array that achieves a target bearing accuracy of 2°. The complete underwater portion of the Model M-1002 long-range 3 kHz portable sonar system weighs 250 pounds. The new portable sonar system has a range of 20,000 meters and a bearing accuracy of 2°. Preliminary tests conducted in Massachusetts Bay have located targets at ranges of 5 to 10 miles. ■

SUBMARINE POWER -- THE FINAL ARBITER

by Brooks J. Harral

"God help any nation which neglects to study its past."
Admiral Arleigh Burke

The one major area of naval conflict in World War II that was the preserve of United States submarines was the sea area most prized by the Japanese -- the South China Sea. It was this area which was the highway for the wealth of oil and raw materials from the Dutch East Indies and Indo China, which also made possible the seizure and exploitation of these two land areas. In fact, the need for these land areas led the Japanese into war. And, it was to protect and develop this area that three defense perimeters were structured. Worthless coral atolls and tropical jungles were occupied and defended to the death by patriotic Japanese on land and sea -- in order to keep control of the Empire's bread basket and oil barrel of Southeast Asia and the Dutch East Indies.

Nevertheless, in 1945, the Japanese Fleet abandoned the entire area without ever having fought a carrier battle! This withdrawal was forced upon the Japanese by virtue of the entire area becoming untenable. For the first time in naval history, a submarine fleet, acting entirely without surface ship or air support, established and maintained control of the sea over a vast area -- by making it too dangerous for the enemy

to operate there.

Since loss of Southeast Asia and control of the China Sea meant loss of the war and defeat of the Empire, the achievement in that area can be considered the crowning victory of the U.S. submarine war. It is worthy of note that the Joint Chiefs of Staff in 1944 predicted victory over Japan no earlier than the spring of 1946. It can therefore be fairly said that U.S. submarine mastery of the South China Sea shortened the war in a material way. But there are other major facets of the submarine Pacific war in other areas which contributed to this victory at sea.

In any event, victory in the South China Sea was not achieved by submarine sinkings of Japanese supply shipping. It was achieved by the sinking of Japanese warships. Helpful though merchant-maru sinkings were, no nation can be defeated by such an interdiction campaign alone. Mahan has told us that. Historians, moreover, seem unable to understand that a sunk MARU loaded with merchandise, was not the same as a sunk navy-maru transport loaded with troops and their equipment. It should be recognized that transports loaded with troops are part of a strictly military operation; likewise tankers loaded with aviation gasoline are equally a part of a military operation. They are "war-ships" and not part of a merchant-train for support of a warring country's economy. Classification of them as merchant-marus hides the fact that their sinking had caused an immediate tactical effect on an enemy's fleet. In fact, the sudden loss of the ability of the Japanese fleet to act offensively after the Battle of Guadalcanal on November 15, 1942, must be largely attributed to the shortage of fleet and air fuel in the Truk-Kavieng area, caused by submarine sinkings. This was a military sting applied mainly by submarines which crippled enemy fleet operations.

Thus, submarine anti-MARU ship operations, wherever carried out, from the home waters of the Empire, to the South China Sea, to the areas of Truk, the Marshalls and the Carolines, were always on two levels against: (1) the merchant-economy marus and (2) the fleet-train marus. Consequently, the U.S. submarine war in the South Pacific was always on two levels: a pervasive and unremitting blockade of merchant shipping and an equally pervasive and unremitting series of

attacks on military units of the Imperial Japanese Navy, wherever found.

The War of the South China Sea was on so vast a stage and over such a protracted period -- December 7, 1941 through the spring of 1945 when the Japanese Battleships ISE and KYUGA retreated from Singapore -- that it is often difficult to point out the strategic impact of specific submarine victories, even in recognition of the cumulative depletion of the Japanese fleet in the area. In areas of less vast extent, such as the operations connected with Guadalcanal, we may often pinpoint cause and effect. However, it is evident that submarine operations in the Sulu Sea, in opposition to the rendezvous of the First Mobile Force in Tawi Tawi, had very evident and telling effect on driving out the forces of Admiral Ozawa. In the process, U.S. submarines totally disrupted planned tactical training of ships and green carrier pilots. Let Paul Dull tell the story from the Japanese viewpoint:

> *"Ozawa's forces were already being depleted, even before he sailed from Tawi Tawi for the Battle of the Philippine Sea. On 14 May, Tom Hogan in BONEFISH sank the destroyer INAZUMA. Then on 5 June, Sam Dealy in HARDER sank the DDs MINAZUKI and HAWANAMI. On 8 June, Dealey sank the TANIKUZE. And then on 14 June, the DD SHIRATSUYO while dodging a submarine's torpedo, collided with the tanker SEIYO MARU and sank when her depth charges detonated. Additionally there were other sinkings mainly of tankers loaded with bunker fuel and avgas."*

In other instances, later on in the war, as when Claggett's DACE and McClintock's DARTER sank or damaged three heavy cruisers in one day, there was memorable direct damage done to the Combined Fleet, sailing out to fight in the Battle of Leyte Gulf. But mainly it was the increasing erosion of fleet strength that finally caused the Japanese to abandon the South China Sea to U.S. submarines, and thereby lose the war.

As an overall measure of submarine strategic effects, by virtue of seeking out and sinking or damaging units of the Imperial Japanese Navy, the period from December 1941 to March 1943 is chosen as being the most distinctive and illustrative. By that time the "worm was in the apple" and by

then the Japanese were no longer capable of mounting offensive attacks. During this period -- despite poor technical torpedo performance -- a total of some fifty-three Jap combatant ships were sunk by U.S. submarines and an equal number damaged.

Examples of U.S. sinkings of Japanese navy-marus and warships during this period, which played a major role in the U.S. South China Sea victory were:

- the sinking of the large minelayer OKINOSHIMA on May 10, 1942, by Ollie Kirk's S-42 -- while it was enroute to Ocean and Nauru Islands. It was loaded to accomplish an occupation and fortification of these islands to solidify the Outer Defense Perimeter, stretching from Guadalcanal up through the Gilberts and then the Marshall Islands. The loss of the OKINOSHIMA, and next day that of the navy salvage vessel SHOEI MARU to Dinty Moore's S-44 when it was sent to assist, left a gap in the outer chain of islands which was never filled.
- On August 8th, Hank Munson's S-38 sank one of six troop-laden Jap transports headed for the relief of Guadalcanal. This caused the other five to return to Rabaul -- which helped ensure the loss of the key island in the Japanese perimeter defense.
- On August 10, with a Japanese Cruiser Force closing its home base of Kavieng, Moore's S-44 sank the heavy cruiser KAKO and as a result kept the Japanese fleet in harbor for a critical two-week period -- with no follow-up of their Savo Island victory, and a respite for Guadalcanal.
- On January 24, 1943, Mush Morton's WAHOO badly damaged a Japanese destroyer which was to escort a 4-ship resupply convoy to New Guinea. Consequently, Morton sank all four of the unescorted ships a day later -- a troop transport, 2 naval supply ships, and a naval tanker -- which were enroute to solidify New Guinea as the anchor of the Inner Defense Perimeter stretching from New Guinea up through the Carolines and further up through the Marianas and Bonins. With New Guinea in jeopardy, the defense of the China Sea area began to unravel.

The fleet attrition became increasingly serious as the war progressed. This should have caused the Japanese to bend

every effort to correct the situation, because warships of whatever class are not readily replaced. This failure was fatal.

Fortunately for the United States, Japanese naval policy was so engrossed with the concept of the "great fleet battle" that was to win their war by defeating the U.S. surface fleet, that it neglected to replace and train their lesser ships -- their ASW ships and submarines -- which might have given them their only chance for victory. The Japanese shipyards continued to concentrate their major effort on building battleships, aircraft carriers and cruisers, right up to late 1944.

In particular, the Japanese did not wish to cancel their big ship programs in favor of building submarines to fight the U.S. Fleet. Had they done so, and had the Japanese sent out the numbers of submarines which the U.S. had -- to seek-and-destroy U.S. combatant ships -- the war would have proved much more difficult.

In 1944, American submarines sank a total of 603 ships plus many more damaged and succeeded in strangling the Japanese economy. Concurrently their double-barreled campaign, sank one battleship, seven aircraft carriers, two heavy cruisers, seven light cruisers, and no less than 35 fleet destroyers -- plus a substantial number of troop transports and navy tankers. Tens of thousands of troops were drowned at sea, along with all their equipment sent to the bottom of the ocean.

No historian appears to comprehend the extent of the benefits conferred on other and much larger operations by widely scattered submarine operations. They fail to note how the mere presence of a submarine tended to be magnified into a general "submarine menace" which stultified thought, as well as action. This effect is pure strategy in action. One submarine becomes magnified into several lurking submarines and the result is only too frequently one of retreat by the enemy. The imminent threat of being torpedoed by an unseen foe is impossible to ignore. Rare indeed is the task group commander who orders "Damn the torpedoes -- full speed ahead." This ripple effect, based largely on fear and personal concerns of the Tactical Commander who may see himself being blown up, is impossible to reconstruct in war games where every decision is cerebral -- untinged with emotions and concern for the safety of self and task group. This is an

example of why ASW is readily played out on the game board and still fails so utterly in actual combat.

As the War drew to its close and the Japanese Navy was defeated, was there a realization by the U.S. high command of the importance of the submarine's strategic role in victory?

A major lesson is that the U.S. submarine war in the Pacific achieved strategic results rarely recognized in full. It is an obvious fact that submarines alone and largely unassisted, established control-of-the-sea over the vast areas of the China Sea and Java Sea, and in the absence of effective ASW efforts, could do so again in other large sea areas.

The fighting submarine skippers of the last war were pointing the way to the next war. We had better stop, look and listen. That is perhaps the prime part of Admiral Arleigh Burke's advice to which we should harken.

Defeat the enemy submarine campaign, or lose the war. This is the message from the past two wars.

■

SSN'S AND LOW INTENSITY CONFLICT

by James C. Hay

There are at least four main parts to current discussions regarding special emphasis on attack submarine missions other than ASW or ASuW. First, a new mission has to be understood so it can be determined what has to be done. Next, the question will arise concerning who is going to pay for whatever that special emphasis will cost. In addition, at some point an objective assessment has to be made about the ability of submarines to take on the given task. Lastly, the leaders of the Submarine Force have to question whether a particular new mission should be given special emphasis.

It probably should be recognized that almost everyone involved in any discussion of low intensity conflict has their own definition of just what that means. Opinions vary as to the type of action (or level of violence) which constitutes such conflict, the size and capability of the countries which are potential targets, and the appropriate kind of U.S. force which should make up our national response capability. To the extent that national policy makers see the 1990's future mainly

in terms of Special Forces, such as the Green Berets or the Seals, conducting low level operations in third world countries, the general purpose forces may well have trouble acquiring new systems tailored to enhancing their effective involvement in Low Intensity Conflicts. Achieving wide understanding of the submarine mission in this case, therefore, may be more than usually difficult and the discussion itself may be critical to ensuring that the funding is obtained so that the Force is ready for all the action which is called for.

The Presidential definition is that "...low intensity conflict typically manifests itself as political-military confrontation below the level of conventional war, ..., and ranging from subversion to the direct use of military force. These conflicts, generally in the Third World, can have both regional and global implications for our national security interests." The President's Commission on Integrated Long-Term Strategy concluded that to help protect U.S. interests and allies in the Third World, we need "Versatile, mobile forces, minimally dependent on overseas bases, that can deliver precisely controlled strikes against distant military targets." This suggests that general purpose forces are needed and meant to be included in our national planning. By the same token, nothing in any of the authoritative discussions by the President, the Congress, or special commissions would seem to rule out the use of submarines when appropriate. Moreover, those specifications appear tailor-made for the Submarine Force.

The general view, however, seems to hold with the position of the Regional Conflict Working Group of the Strategy Commission that because the emphasis of U.S. forces engaged in low intensity conflict in the third world should be put on nation building tasks, "... U.S. General Purpose Forces are usually too heavily or inappropriately equipped, and too elaborately manned, for probable third world missions ...". That group also construed the Grenada operation of 1983 as beyond low intensity conflict. The point here is not to argue with the authorities but to note that there is a significant gap between what might have to be done and what is being prepared for in this arena.

Several broad principles of operation for low intensity conflict can be deduced from a consideration of the past

decade of U.S. experience. First, it can be inferred that there is a real need to carry out any operation with a minimum cost in U.S. men and material. That means the avoidance of any possibility of leaving behind American servicemen as hostages to the regimes being operated against. Second, and as a corollary to the first principle, whatever covering force is sent in support of the operations should not be put at the risk of unacceptable damage -- which is a political rather than a military consideration. Third, those who direct such actions have to realize that almost all military operations are Combined Ops and much more is involved than just the basic operation. Also, since submariners are arguably the leading experts in covert operations, they can appreciate as a principle that covertness can be very important to some of these low intensity (but high importance) affairs, because it lends itself to plausible deniability. Lastly, it may be worthwhile to observe that not all low intensity conflicts, i.e. "political-military confrontations below the level of conventional war", take place in the third world. The blockade of Cuba during the missile crisis of 1962 is a case of deliberately non-violent military action with extremely high stakes. It is thus postulated that the submarine equipments which could make a similar operation a U.S. success in the future are the same as those which could be used in third world situations.

If we now see that Low Intensity Conflict (LIC), as practiced by the U.S., might have a job for modern nuclear attack submarines, the question is, who is going to pay for developing mission-unique systems, and the additional force level numbers to make up for distractions from primary missions. The problem seems to be two-fold: (a) that general purpose force sponsors now have more priority requirements on their plates then they can handle in an era of very real budget constraints; and (b), the new SO/LIC organization, specifically established by recent law and composed of the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict and the new specified Special Operations Command, appears focused on the needs of Special Force components. Because of the latter, acquisitions to enhance general purpose force contributions to low intensity conflict probably will not be considered from that special part of the

defense budget. In that regard, it should be noted that the Regional Conflict Working Group estimated that the strategy of selective involvement which it recommended "...could be underwritten by $12 billion per year." That's a big number and one that should not be discounted too quickly.

The next question has to do with the credible potential for equipping submarines to take an effective low-intensity conflict role. Perhaps the cleanest way to look at that is from the aspect of exclusive use rather than as a competition with other types of military force; i.e. the employment of a submarine is necessary when the application of other forces is clearly inappropriate. By reviewing three 1980's operations with a view to improving the effectiveness and/or significantly reducing risk, this can be appreciated:

- First, the 1986 operation against Libya -- a pure strike action with clearly defined objectives. The forces of choice were, appropriately, Navy and Air Force strike aircraft. Had Sixth Fleet submarines however, been equipped for such an independent selective strike, the risk and cost could have been reduced. Perhaps fewer weapons would have been needed had cruise missiles been used instead of bombs, but in any case the necessary strike loading probably could have been carried in two, three, or four boats. What was missing from the submarine inventory that could have permitted a lower risk operation is a submarine-launched, unmanned air vehicle capable of covert approach for immediate pre-strike reconnaissance, real-time targeting, and post-strike damage assessment.
- The Grenada operation of 1983 apparently could have been improved in many ways but for illustration the covert insertion of Seals sometime prior to the main assault can be examined. There are many reasons for getting a small force ashore without alerting the enemy, but to do so means that ships or aircraft would have to drop insertion teams far enough off shore to avoid detection. Obviously, there are limits to the distance swimmers can cover on their own. Sea temperature and surf conditions can further constrain movement to the beach. What is needed is a swimmer delivery system that protects the Seals from the environment anywhere, and has enough range to permit the mother unit a sufficient stand-off.

That's a recognized requirement and it is being worked on. What may not be so well recognized is the desirability of using a submarine as the base unit and launching platform for the swimmer delivery vehicle. In an area other that the Caribbean it might be difficult to mask the approach of a U.S. Task Force to within the 50 miles or so that might be required even for the transit of a new swimmer delivery vehicle. In addition, any equipment acquisition for special force insertion should take into account the possibility of conducting an operation without a subsequent full force landing. For that type of covert insertion it means that such a swimmer delivery vehicle would have to mate with the submarine and perhaps the submarine would require some special communications to perform as an on-scene command post.

- A third example of a low intensity conflict situation in which a properly configured submarine might have been of great use to national authorities was the anti-terrorist effort subsequent to the highjacking of the cruise ship ACHILLE LAURO in October of 1985. Again, any approach to the ship itself would have to be covert to avoid triggering unwanted action by the highjackers against their hostages. It would have been desirable to stop the ship and immobilize it so that it could not proceed to a safe haven for the terrorists -- like Benghazi or Tripoli. Today one can envision a submarine using a remotely operated underwater vehicle to attack the ship's propulsion means and leave it dead in the water without causing any other damage that would impair seaworthiness or involve loss of life. Then Seals launched from the same submarine could make a night boarding of the highjacked ship. A ship-stopping capability would certainly have been most welcome during the Cuban Missile Crisis of 1962.

Another potential use of SSN's in low intensity conflict situations has to do with the covert mining of waters to be denied to others for some reason. The mines themselves might be self-propelled, but there is a practical limit to the distance from which they can be delivered. That practical stand-off probably always will be within the perceived political risk-range for surface ships used in these types of actions. Direct delivery of today's mines by the SSN may similarly not present an acceptable risk for the benefits to be achieved.

However, it is possible to postulate some type of submarine launched undersea autonomous vehicle which could make the desired transit, lay the mines in the proper place, and return to the mother ship without calling any attention to the seeded area. Such a vehicle probably should be fairly large to carry enough mines to be effective. It has been estimated that a DSRV-sized UUV could carry, and lay sufficient mines to cause the closure of most third world ports.

The four different systems suggested above could be developed for enhancement of the submarine's contribution to the U.S. Low Intensity Conflict posture. A short look at each should demonstrate their feasibility, or at least prompt a deeper examination. A strike-aiding, sub-launched autonomous air vehicle could actually be a modification of one of the current submarine cruise missiles. It stands to reason that other folding wing designs could be tailored to meet whatever specifications of endurance, speed, and payload can be packaged into the volume dictated by a torpedo tube or vertical missile launch tube. If the airframe has to be too fragile to take the submerged launch, then some canister system can be devised. A workable communications link between bird and boat is clearly possible in the same manner in which SSN's talk to manned aircraft. Obviously, mission information needs which expand bandwidth, data rate, and long-range, real-time requirements will complicate the link/sub covertness problem, but no real stoppers are apparent.

The swimmer delivery vehicle suggested earlier might be nothing more than a small, mateable submarine optimized for carrying men. We've done that before with our DSRV's. Propulsion, navigation, and life support are considerable engineering challenges, but they are not insurmountable. Since the payload is human, the control can also be by a live crew, thereby reducing the reliability problems inherent in unmanned offboard vehicles. The soft-kill remotely operated vehicle suggested as a ship stopper, also minimizes the potential control problem because it can be tele-operated over some hard link, such as a fiber optic cable -- putting a man in the real-time loop. Endurance should not be a big problem because mission duration would probably not exceed a few hours at most. It seems very likely that the ship stopper can

be carried internally and launched through a torpedo tube when needed. The covert mining vehicle, however, has been stipulated as fairly large to accommodate its required load. Its very size, however, should guarantee the propulsion and energy storage space necessary for a considerable round-trip mission. The navigational accuracy required might be met with periodic near-surface excursions for GPS satellite updates.

In consideration of the above observations, it may be concluded that the development of special systems for submarine Low Intensity Conflict is both feasible and practicable. There is a special caveat that has to be emphasized, however; these systems are all proposed as submarine systems, and they will all affect the safety and operational effectiveness of the submarine. Therefore, their development has to be conducted accordingly.

We have left only the question of why submariners should want to take on such developments outside their mainstream missions. First, there's a national need and submarines offer a natural solution. On a more practical level, all of the systems suggested can be used in big confrontations as well as little ones -- particularly when it is considered that there are areas in big wars where normal forces can't operate because of enemy dominance, rather than just political preference. Moreover, if the budget crunch gets any tougher, one suspects that national acceptance of the need for submarines in Low Intensity Conflicts should help validate current force levels.

To bring about meaningful participation of the Submarine Force in Low Intensity Conflicts, through proper development of appropriate systems, all interested parties are going to have to pull together. The submarine community can not do it alone; but they probably have to be the ones to lead the charge. Those in Congress who see the need will have to support specific add-ons to the budget and should be shown that the cost of this work should not come from basic platform money. Most particularly, Special Ops leaders will have to be convinced that it is in their best interests to support submarine Low Intensity Conflict enhancement so that their own operations have a more complete base.

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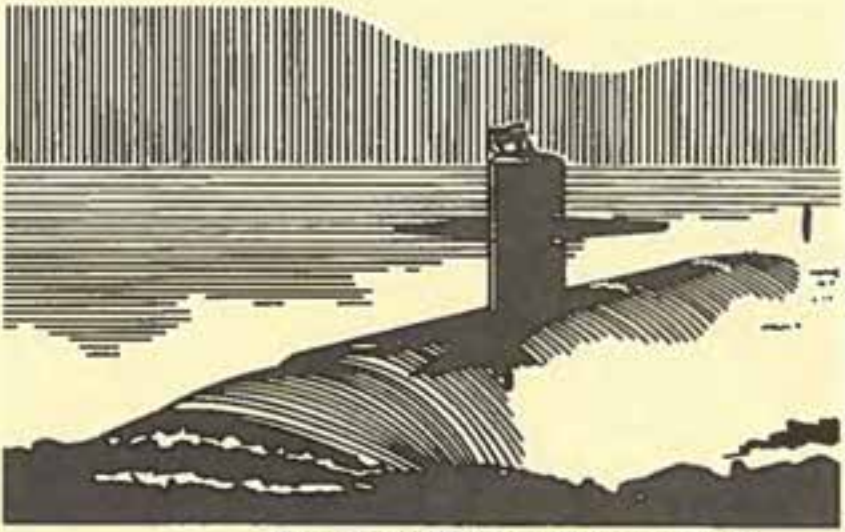

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THE MORALITY OF WAR

by Captain P. R. D. Kimm

[The following article is excerpted from the remarks of Captain P. R. D. Kimm, OBE, RN, in his Nelson Memorial Address on Trafalgar Day, 1983, shortly after "The Falklands War."]

Nelson was first and foremost a man of action. He was also a man of peace. He himself said as much in his maiden speech in the House of Lords. *"I have seen much of the miseries of war,"* he said, *"and therefore, from my inmost soul I am a man of peace."* But he went on to qualify this. *"But for that peace I would not sacrifice one jot of England's honour."*

I have been deeply concerned, especially in recent years, at a tendency -- apparently a growing tendency -- to think that it is somehow immoral to stand positively for our freedoms to the point, if need be, of upholding them with armed force. Of course nobody wants war -- particularly those who, like Nelson *"have seen much of the miseries of it,"* and any Christian must hope and pray that aggression can be put down by peaceful and diplomatic means. But our Lord never taught that one must turn the other cheek if, by doing so, one avoids the blow and allows it to land on somebody else; quite the opposite. He said *"Greater love hath no man than this, that he lay down his life for his friend."*

The question I want to address today is whether it can ever be right for a Christian to go to war. It is not a question which can be left to the serviceman or the politician. In a democracy, it is one which must be faced fairly and squarely by the electorate: by all of us.

The views of Pope Pius XII

I am a Catholic, and what I shall be saying is based on Catholic teaching; but I hope you will not find that objectionable. Every Christian denomination is doing its best to interpret how Our Lord taught and to live by *His* teachings.

You might be excused, from what some Catholic leaders said during the Falklands crisis, for thinking that Catholics believe that war is never morally justified. Let me read you what Pope Pius XII said about it in his Christmas broadcast to

the world in 1956 when the threat of Soviet aggression against Europe was particularly grave.

A good course of action can never be had by mere sentiment. [Might that not have been Nelson speaking?]

Present day conditions, which find no counterparts in the past, should be clear to everyone. There is no longer room for doubt concerning the aims and methods which rely on tanks when they crash over borders, sowing death in order to force a civilian people into a way of life they explicitly detest; when, destroying as it were, the stages of possible negotiation, the threat is made of using atomic weapons to gain certain demands, be they justified or not.

It is clear that in the present circumstances, a situation may arise in a nation wherein, after every effort to avoid war has been exhausted in vain, war -- for effective self-defence and with the hope of a favourable outcome against unjust attack -- could not be considered unlawful.

If therefore a body representative of the people, and a government -- both having been chosen by free elections -- in a moment of extreme danger decide by legitimate instruments of internal and external policy on defensive precautions, and carry out the plans they consider necessary, they do not act immorally; so that a Catholic citizen cannot invoke his own conscience in order to refuse to serve and fulfil those duties the law imposes. On this matter we feel we are in complete harmony with our predecessors.

There are several points in that statement which I would like, with diffidence, to underline. First, Pope Pius emphasized and re-emphasized that war could not be contemplated until every effort to avoid it had been exhausted. But he did *not* teach that it was immoral under every circumstance. And he left the decision, on whether war was necessary 'to avoid a civilian people being forced into a way of life they explicitly detest', to the freely elected government of that people. He also said that, in the circumstances he was describing, democratically elected governments do not act immorally if they carry out the plans *they* consider necessary. Please note that very carefully. One might have been excused for thinking during the Falklands conflict that the degree of force to be used was a matter for the political commentator to decide, or

the retired Admiral, or the Bishops, or anybody. But in the mind of Pius XII it is a decision to be exercised by 'a body representative of the people, and a government -- both having been chosen by free election --'.

And did you note that the Pope taught that a Catholic citizen 'cannot invoke his own conscience in order to refuse to serve and fulfil those duties the law imposes'? If the law allows, as ours does, for conscientious objection, fair enough; but there is no doubt in my mind that Pius XII was teaching that if a man or woman wishes to have the benefits of a free society he or she should be prepared to stand for that society.

The teaching of the Second Vatican Council

The Council was directed towards the maintenance of peace by peaceful methods; and again and again it urged world disarmament. But it had its feet firmly on the ground and faced the facts with the same realism as Pope Pius XII had faced them. "War", it taught, "has not been eradicated from human affairs. So long as the danger of it persists and we have no international authority equipped with adequate force, it may not be possible to deny governments the right of legitimate self-defence, given that they have exhausted every peaceful means of settlement."

What did the Council have to say about the soldiers, sailors, and airmen of today? Again I quote: *"Those who are serving their country in the armed forces should regard themselves as servants of the peoples' security and liberty. While they are fulfilling this duty, they are genuinely contributing to the establishment of peace."* Not, I think you will agree, a quotation one hears very often nowadays.

As for disarmament, *we all must work to achieve disarmament; to see, moreover, that this disarmament proceeds not unilaterally but by equal stages and by agreement and protected by adequate guarantees.* In coming out so firmly against unilateral disarmament, the Church was showing deep strategic as well as spiritual wisdom. Unilateralism creates international imbalances, both of capability and of resolution. Both are profoundly dangerous in that they tempt aggression.

These quotations will have shown you why I, as a Catholic serviceman, have never had a single qualm of conscience about being in the Navy. I hope too that they may have helped any

of you who may be uncertain as to the moralities of war, to clarify your own minds on those vital issues.

Christ himself said very little about the sort of things I have been discussing. *Render unto Caesar* has perhaps some bearing. *Put your sword back, for all who draw the sword will die by the sword* is another text used most frequently in a strictly pacifist context. But I have read the four Gospel accounts of His arrest in the Garden, the occasion on which Our Lord used that phrase, very carefully indeed in the course of preparing this address, and have had some surprising thoughts about it.

According to Matthew: *Put your sword back, for all who draw the sword will die by the sword.* Luke puts it this way: *His followers, seeing what was happening, said "Lord, shall we use our swords?" and one of them struck out at the high priest's servant and cut off his right ear.*

A most remarkable thought -- new to me and perhaps new to you -- which came to me while I was thinking on this address. There is absolutely no doubt that the Disciples of the Prince of Peace were armed. Listen to St Matthew: *At that, one of the followers of Jesus grasped his sword and drew it.* Jesus didn't say *"Throw that thing away."* He said *"Put your sword back."* And just listen to what St Luke wrote: *His followers, seeing what was happening said* (and note the plural) *"Lord, shall we use our swords?"* Surely if the bearing of arms had been immoral in itself, Jesus would have told them to throw them away when first they became His disciples. But he quite apparently hadn't.

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DISCUSSIONS

THE SEAWOLF (SSN-21)

Enclosed is a copy of the white paper we have developed for the SSN-21. I am sending a copy to each of your chapter presidents for them to use as they see fit, including showing or giving to their various members so that we can get as many people as possible to understand that the SSN-21 submarine is the submarine we need and that we need it now.

Although the threat in Europe may, in fact, be decreasing, the capability of the Soviet submarine force is not. The Soviet submarine force, as we physically observe it, is building about nine submarines a year; that is, in 1990 and expected in 1991. Of those submarines, four are KILO class diesel submarines and the other five are one or two SSBNs and three or four nuclear attack submarines. A second data point that I would make was that when Marshall Akharomeyev was in town testifying before Senator Kennedy's committee in early May, he stated that he expected the Soviet Union to build at a rate of four to five nuclear submarines per year. Everyone should understand that the United States authorized three SSNs in 1989 (one SSN-21 and two 688Is), one SSN-688I in 1990 and we are asking for two SSN-21s in 1991.

Again, it is my most strong professional opinion that we must have the SSN-21, and we must have it now. Hope that this paper which we have also distributed on the Hill, will help everyone to realize the importance of this program.

Vice Admiral D. L. Cooper, USN
ACNO (Undersea Warfare)

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REQUIREMENT FOR THE FY91 SEAWOLF (SSN-21) SUBMARINES

The execution of our national military strategy, the projected threat, and the advance of submarine technology continue to substantiate the absolute need for the FY91 SSN-21s. It is essential that we build the SEAWOLF because:

- **Despite a changing world, our far-forward national military strategy has not changed**
  - Based on our dependence as an island nation
  - Requires early response to broad range of possible conflicts with sustainable, survivable, far-forward presence
- **Attack submarines are required to execute this strategy -- providing significant flexibility and power projection capability**
  - In a regional crisis, SSNs can covertly gather intelligence and provide strike, mining, and special forces insertion capability
  - If conflict escalation control fails, SSNs can seize the initiative and quickly neutralize enemy forces.
- **Threat capability will continue to improve by all intelligence estimates**
  - Soviet submarines in production today are far superior to early classes
  - Rate of Soviet submarine production and research has not decreased
  - Over 40 countries, some unfriendly to the U.S., have submarines with capable weaponry that are potential ASW threats to our battle force
- **There is no reasonable alternative to the SSN-21**
  - I688 cannot physically accommodate the improvements required to counter the significantly improved projected threat
  - A more capable and cost-effective submarine cannot be built
  - SSN-21 can be procured within Navy resources
- **The SSN-21 program is eight years into execution, is on schedule, and has met all requirements.**
  - Lead ship has been under construction since October '89
  - Over $5B invested in SSN-21 R&D, design, and construction
  - SSN-21 pre-operational testing is unparalleled in submarine program history
  - BSY-2 software development on schedule
  - BSY-2 combat system will be fully capable at lead ship delivery
  - Recent independent analyses have concluded that SSN-

21 will be superior to the projected threat
- SECDEF Risk/Concurrency report concluded SSN-21 & BSY-2 risk moderate

o **Delaying authorization of the FY91 SSN-21s will increase program cost, erode the already fragile submarine industrial base, and jeopardize U.S. undersea superiority**
- Delaying FY91 SSN-21s one year would result in a unit cost increase of $160M
- Submarine vendor base is unique national strategic asset -- only source capable of producing state-of-the-art nuclear and quieting components. SSN-21 production delays will cause irrevocable damage to this vital industry

SSN-21 IS THE KEY TO THIS NATION'S UNDERSEA SUPERIORITY AND POWER PROJECTION CAPABILITY IN THE 21ST CENTURY

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SEAWOLF (SSN-21) WHITE PAPER

PURPOSE

To discuss the requirement for the SEAWOLF submarine in light of recent changes in the world, and, more specifically, how the execution of our national military strategy, the projected threat, and the advance of technology continue to substantiate the absolute need for the SEAWOLF (SSN-21) Class of submarines.

BACKGROUND

There is no question that the recent events in the Soviet Union and Eastern Europe have altered the social and political makeup of the world. These changes have served to remind us of the rapid and unpredictable nature by which political circumstances and intentions can change. Although dramatic reforms have taken place in the world, the maritime component of our national military strategy, which is fundamentally based on our dependence as an island nation, has not changed. This strategy requires us to maintain the capability to provide an early response to a broad spectrum of possible conflicts and to be able to project naval power with

a sustainable, survivable, far-forward presence. The fundamental characteristics of our attack submarine force -- stealth, mobility, firepower and endurance, are essential elements of the sustainable, survivable, far-forward naval presence required by our national military strategy.

As the world shifts from a bipolar to a multipolar system our involvement in regional crises can be expected to increase. With the continued proliferation of advanced technology weapons to Third World nations, the mission of regional crisis containment will become more difficult. Attack submarines provide invaluable options in executing the mission of conflict containment in our national military strategy. In a crisis, SSNs can rapidly be deployed to any ocean of the world, gather intelligence and surveillance information covertly, and remain on station unsupported in hostile waters for long periods. While on station, covertly gathering intelligence, the SSN can also provide the Battle Force Commander with significant strike capability, mining and special forces insertion capability -- all while remaining completely undetected. When no longer needed, the submarine can quietly be withdrawn. If conflict escalation control fails, the far-forward covert presence of the attack submarine force can "seize the initiative" and quickly neutralize enemy forces before they leave home waters or inflict harm to U.S. and allied forces. The submarine force creates leverage out of proportion to its size because an adversary never knows whether or in what number submarines might be present.

Since the need for attack submarines to execute our national military strategy has not changed, the requirement for the specific type of submarine needed to implement that strategy is driven by the projected threat capability and the missions which we will execute. Although the threat of nuclear war and the invasion of Europe may have decreased, the threat from the Soviets rapidly modernizing and increasingly capable submarine force has not. Recent intelligence reaffirms that the Soviets are firmly committed to attack submarine development and production. Some projections may indicate that the Soviet attack submarine force level will decrease. This quantitative reduction in force would be solely due to the retirement of their oldest, less capable classes of submarines.

Simultaneously, the Soviet's are continuing to produce markedly improved submarines at an unwavering pace assisted by the acquisition of western technology and a dedicated, well funded research and development program. Thus, the Soviet's projected force reductions, coupled with their building rate, will produce a 21st century submarine force that is significantly more capable, although slightly smaller in size.

The United States Submarine Force has maintained its historic edge in undersea superiority and absorbed a growing role in power projection capability because our force has consistently been superior in quality. We have never had equal numbers. We have achieved this qualitative superiority through the systematic modernization of our force in the three vital areas of submarine performance -- weapons, sensors, and platform capability. This modernization of force capability has been centered mainly around the Los Angeles (SSN-688) Class of submarines. To keep pace with threat technological advances, this class has incorporated over 25 major and 2000 minor improvements in the last two decades. This has resulted in nearly a complete redesign of the interior spaces of the original submarine and a substantial improvement in its capability. In the process of installing all of these improvements, however, we have exhausted the design weight margin of the original 688. The I688 cannot physically accommodate the changes necessary to incorporate the next generation of technology to face the projected threat of the 21st century.

DISCUSSION:

With strong Congressional support, the SEAWOLF program was begun seven years ago to meet the projected ASW threat and to provide a balanced power projection capability option in the execution of our national military strategy in the 21st century. When SEAWOLF joins the fleet in 1995, she will take to sea:

- o The ultimate in 20th century stealth technology - The SEAWOLF will be the quietest submarine in the world at any speed. In fact, SEAWOLF will be over 30 times quieter than our original 688 Class of submarines.
- o Double the firepower of the most advanced operational Soviet submarine - SEAWOLF's torpedo room will carry

TOMAHAWK (sea and land-attack) missiles, HARPOON missiles, MK-48 ADCAP and CCAPS torpedoes, mines, and when developed, remotely operated vehicles.

- Highest tactical speed of any submarine in the world, providing greater search effectiveness and lower probability of counterdetection.
- Sufficient design margin for growth to incorporate future technology advances. We have utilized advanced technology design procedures to construct SEAWOLF to allow efficient modernization and maintenance to take place throughout the ship's life. This well result in reduced operating and support costs throughout its lifetime.

During these first eight years of the SEAWOLF program, close Congressional and DoD oversight has resulted in numerous reports, audits, reviews, analyses, and hearings which have probed every aspect of the program. Every problem and issue raised by these inquiries has been or is being resolved by the Navy to ensure that the SEAWOLF will meet all of its Top Level requirements. (Enclosure (1) addresses SSN-21 and BSY-2 issues.)

One of the specific issues currently being raised is the effectiveness of the SSN-21 against the projected threat. The Congressionally directed initial operating capability (IOC) plus-ten-year dynamic mission analysis, completed by DoD early this year, clearly showed that the SEAWOLF will be superior to the projected threat at IOC plus-ten-years. This mission analysis was conducted using the same modeling techniques as previously accepted studies and a threat which was approved by CIA, DIA, and the Navy intelligence community.

Another issue being raised is the status of the development of the SEAWOLF's AN/BSY-2 combat system. This program, after initially experiencing difficulties in software development, is on schedule and is complying with all applicable DoD directives. Learning from previous ship combat system design integration, we have established a team of top shipyard, Navy, and contractor personnel to ensure the timely integration of the BSY-2 into the submarine. The SEAWOLF will be delivered with a fully capable BSY-2 combat system.

Over the past eight years, the Navy has invested over two billion dollars in research and development to design, develop

and test shipboard prototype components. The component testing conducted to date on the SSN-21 equipment is unparalleled in previous submarine programs. The Navy's success record of delivering submarines which meet all design requirements is clear, stretching all the way back to the NAUTILUS shipbuilding program. The SEAWOLF will meet all of its Top Level requirements when delivered in May of 1995.

The SEAWOLF program is on schedule and meeting all of its requirements. As a result, there is no valid justification to delay authorization of follow-on SEAWOLF class submarines by concluding that additional time will somehow provide us with a more capable and cost-effective submarine. In fact, delaying the award of additional SSN-21s until the lead ship completes post-delivery testing would be catastrophic to our nation's undersea superiority and would result in greatly increased program cost. Without a continuing new construction workload, the shipyards would experience voids in key construction trade work as early as 1992. In addition, the base of submarine vendors which produces the critical components required for submarine and nuclear safety would be irrevocably damaged.

CONCLUSIONS:

- o Despite a changing world, the far-forward national military strategy has not changed
- o Attack submarines are required to execute this strategy -- providing significant flexibility and power projection capability
- o The threat is projected to continue to improve in capability by all intelligence estimates
- o Current classes of submarines cannot incorporate the improvements necessary to meet the projected threat
- o The SSN-21 program is eight years into execution, is on schedule, and has met all requirements
- o There is no reasonable alternative to the SSN-21
- o Delaying authorization of follow-on ships will increase program cost, erode the already fragile submarine industrial base, and forfeit U.S. undersea superiority.

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ENCLOSURE 1: SSN-21 & BSY-2 ISSUES

SSN-21 SCHEDULE AND COST

Issue: SSN-21 delivery slipped six months.

Navy Response: Do not concur. The initial SEAWOLF completion date was estimated to be November of 1994 during the early stages of the program. During contract negotiations, however, the Navy determined that this completion date was one of the factors driving higher than expected lead ship bids. As a result, the Navy allowed the shipyards to set the most economically feasible delivery date of May 1995. There was no slip in the schedule. The Navy made this decision to reduce cost and optimize shipyard performance.

Issue: Design contract cost overran $38M at Newport News and $7.5M at Electric Boat.

Navy Response: Partially concur. The SSN-21 design is not complete. Initial design costs were underfunded. Many factors have increased the scope of the design effort since the SSN-21 is the first submarine to incorporate modular design. This experience, however, should have significant benefits in reducing recurring construction program costs of future ships.

Issue: Navy has issued contract to Newport News to design a new submarine.

Navy Response: Do not concur. There is no plan or a requirement for a follow-on submarine. The contract was for development studies and for the design, fabrication, and integration of engineering development models and prototypes and design improvements in direct support of the SEAWOLF. The contract also includes funding for studies related to the transition of the Congressionally directed Defense Advanced Research Projects (DARPA) advanced submarine technology effort into Navy submarine technology development. It is standard procedure for all such changes to be evaluated to determine their feasibility for installation on current and future submarine classes. The SEAWOLF is the Navy's only attack submarine under design. There is no design work being done on a follow-on submarine.

Issue: SSN-21 met only two of six goals established by the Navy in 1982.

Navy Response: Do not concur. No goals were established for SEAWOLF in 1982. An ad hoc committee, established by the Chief of Naval Operations in 1982, was tasked with assessing the predicted threat to a new SSN in the mid-1990s, summarizing the requirements for a new SSN in that time frame, and establishing a range of parameters for a new SSN. Six parameters were selected: speed, depth, torpedo tubes, arctic capability, broadband and narrowband radiated noise, and hull sonar sensitivity, each with a range of values. These values were never intended to be SSN-21 requirements; instead, they were viewed as a range of technologically and fiscally feasible possibilities. Using these ranges as a guide, in 1983 the Navy conducted a second in-depth study to determine what specific value of the six Group Tango parameters could be attained in an actual platform from an engineering standpoint, using present or near-term technology, and within fiscal constraints. Using this study, after careful consideration of the tradeoffs associated with optimizing different mission performance goals, the CNO established the SSN-21 top-level requirements in 1984. SSN-21 will meet or exceed all top level requirements when delivered in 1995.

AN/BSY-2 COMBAT SYSTEM

Issue: AN/BSY-2 Design Changes resulted in $5M cost to redesign SSN-21.

Navy Response: Partially concur. "Design changes" were due to differences between early engineering estimates and final contract design specifications. Cost increase is estimated; the final cost not yet been negotiated.

Issue: Although Navy Operational Test and Evaluation Force stated the AN/BSY-2 has the potential for improved effectiveness over prior systems, this cannot be demonstrated until the system is operationally tested. Also, no alternative system is planned.

Navy Response: Partially concur. Full operational testing will not take place until June 1995. Prior to that event, however, significant testing will take place. The BSY-2 combat system modular design allows parallel development, with incremental testing and delivery. Incremental testing allows early identification and correction of deficiencies which reduces design and schedule risk. A fully capable land based testing facility will be constructed and will be used for interim operational testing commencing in September 1993. This combination of modular development, incremental testing and extensive use of land based testing will allow accurate assessments of AN/BSY-2 development progress and makes an alternative system for the AN/BSY-2 unnecessary.

Issue: AN/BSY-2 program is behind schedule. Two Navy design reviews were delayed about five months.

Navy Response: Partially concur. AN/BSY-2 will be completed in time for delivery to the first SSN-21 on schedule. The Preliminary Design Review (PDR) and Critical Design Review (CDR) were rescheduled to allow more maturity in design specification. The Executive Sessions for the PDR were held 3 October 89 and for the CDR 30 January 90, as rescheduled. Delaying these reviews is expected to pay large dividends downstream through the reduction of engineering changes that frequently result from pre-mature freezing of design specifications. The contract with General Electric requires delivery of the first BSY-2 system four months prior to the date the Government must provide it to the shipbuilder, providing additional schedule margin. A design coordination working group has been established to ensure that all parties are sharing design concerns and issues. This group, consisting of the SSN-21 and BSY-2 program offices, General Electric (GE) and Newport News, will act to further mitigate schedule risks.

Issue: The first AN/BSY-2 will not be fully capable when delivered to the Navy

Navy Response: Partially concur. SSN-21 will commission in May of 1995 with a fully capable BSY-2 combat system. The combat system delivered to the Navy in November 1993 will

include all hardware and the software necessary to provide full end-to-end combat system capability on all arrays except the medium frequency active and the towed array ranging program. The final increment of software to provide full capability will be delivered in November 1994. This staggered delivery schedule was selected to reduce software development cost and schedule risks.

Issue: AN/BSY-2 software has development risks due to lack of retained code from prior systems.

Navy Response: Do not concur; the opposite is true. Retaining code from prior systems would increase risk due to differences between the BSY-2 and past systems in the areas of architecture and partitioning, depth and quality of documentation, interface definition, standards and conventions used, and language and operating systems compatibility.

Issue: Tests of critical AN/BSY-2 system items have been delayed.

Navy Response: Partially concur. While the start of some testing was deferred up to four months, all tests were completed within original schedule time frames. Tests were scheduled early to allow time if problems arose. Key tests such as beam former integrated circuit performance, wide aperture array flow noise, and cathode ray tube reliability, have been successfully completed. Remaining critical item tests are on track to support systems deliveries.

Issue: Institute for defense Analysis (IDA) report stated that GE was "interpreting the DOD-STD-2167 literally and is producing excessive amounts of non-informative documentation."

Navy Response: Partially concur. The initial documents reviewed by IDA did indicate excessive, non-informative documentation was being produced. The Navy's implementation of DOD-STD-2167 has been heavily tailored, (as encouraged by the DOD Standard), to reduce the amounts and types of documentation required. The Navy is continuing to work with GE to further reduce program documentation to that necessary for efficient program management.

Issue. **DOD 3405-2 requires use of Ada programming language unless waivers are granted. AN/BSY-2 use programming languages other than Ada. Are all required waivers granted?**

Navy Response: Four different programming languages, in addition to Ada, have been used in the development of the AN/BSY-2. Two are required by the use of the EMSP which was mandated by Congress. They are:

- o ECOS - Used in the Enhanced Modular Signal Processor (EMSP) (SEM B Version),
- o CMS-2 - Used in the UYK-44 interface to the EMSP.

Waivers were requested in both cases but are not required since Ada was not available for the EMSP. The other programming languages being used are:

- o C programming Language - Used in the Database Management System to permit the use of commercial software, a specific exception allowed by Dod Directive 3405-2. A waiver has been granted.
- o Assembly Language - Used when Ada is too slow to meet requirements for system operation, a specific exception allowed by Navy TADSTAND C. A waiver is not required.

Issue: **IDA study reported that GE is not using the Ada Program Design Language (PDL) for AN/BSY-2 software design.**

Navy Response: Do not concur. General Electric is using the Ada PDL, as required by their contract with the Navy, and is requiring it's use by all subcontractors.

Issue: **IDA study criticized the initial training program set up by GE for it's newly hired yet inexperienced Ada programmers.**

Navy Response: Concur. GE's Ada training program was initially weak. Significant improvement has been achieved through the use of standardized training program among GE and it's subcontractors, mandatory lab work-shops, and frequently monitored testing. Independent testing by outside organizations places GE students in top third percentile of the programmer base. Ninety-seven percent of the required programming staff is in place.

Issue: **IDA study states that "GE is modifying both the Ada compiler and the Ada run-time system." This raises the question of requirements to revalidate the compiler.**

Navy Response: Partially concur. GE discovered a "bug" in the validated compiler which the manufacturer, VERDIX, corrected. VERDIX is revalidating their compiler and is contractually bound to provide updates of this compiler to GE. The AN/BSY-2 Program Office is closely monitoring all efforts in this regard to ensure full compliance with DoD requirements for Ada programs.

Issue: **IDA study notes that GE planned to develop a library of re-usable Ada components to speed software development but GE had not yet specified their exact plan.**

Navy Response: Do not concur. GE has a defined plan for a reusable software library. It is in accordance with required reference documents and was developed after studying previous efforts.

Issue: **IDA study questioned the fact that NUSC is being used as both Independent Verification and Validation (IV&V) and Technical Direction Agent (TDA), doubting that NUSC can maintain the separation necessary to adequately perform it's role of IV&V.**

Navy Response: Partially concur. The AN/BSY-2 Program Office is closely monitoring the ability of NUSC to perform it's duties of IV&V. The program manager has contracted with an independent firm (MITRE Corp.) to conduct appraisals of software development. Additionally, NUSC has hired additional personnel to strengthen their ability to fulfill this vital role. This area requires close attention and is receiving it.

Issue: **AN/BSY-2 cost was reported as increasing by $140M between the end of 1988 and 1989.**

Navy Response: Concur. $122M of the $140M was the result of changes due to inflationary indexes. The remainder was

due to the Navy shifting all EMSPs to the SEM "E" version. ■

DARPA PUSHES SUBMARINE AUTOMATION IN THE FUTURE

*[This digested article by **Edward J. Walsh** is reprinted by special permission from the **Armed Forces JOURNAL International**, February 1990]*

Automated control of the U.S. Navy's submarines -- a great technological challenge, is the goal of a new DARPA contract for a submarine operational automation system (SOAS). The contract will begin Phase 2 of an effort to use advanced computer software, including so-called artificial intelligence and neural networking techniques, to achieve a "new dimension" of automated control of submarine systems and subsystems. It is aimed ultimately at helping submarine commanders cope with an increasingly complex tactical environment.

Unlike the UUV program which will prototype existing technology in a new application for near-term transition to the Navy, the SOAS program reflects DARPA's traditional approach of focusing on cutting-edge, high-risk technology that may offer new payoffs far into the future. With its decision to focus on a "framework for the future" that would look beyond today's technology, DARPA rejected arguments of experts in submarine technology and advanced software, both in industry and government, that a variety of currently operational systems can meet the Navy's need for a totally integrated command decision support system.

The initial step towards SOAS development was DARPA's award -- in January 1989 -- of Phase 1 contracts for a technology development plan and demonstration of capabilities, on the BSY-1 control system for newer LOS ANGELES-class attack submarines, and a closer integration of weapons and sensors aboard both attack and OHIO-class TRIDENT ballistic missile submarines.

Automating Submarine Control

DARPA's approach to SOAS is based on the recognition that the integration of the hardware, software, and the skills of the human crew of the submarine is of paramount importance. Automating submarine control is necessary in order to enable submarine commanders to get "better decisions quicker," to cope with the vast complexity of both external and internal submarine operations. Overall submarine control requires a level of situation awareness beyond that needed by any other weapons system. A submarine is like a giant factory, consisting of more than 400 subsystems within the specific areas of acoustic and electrical systems, machinery, hydrodynamics, control surfaces, weapons control, and weapon systems that are monitored by many kinds of sensors. Systems employing high-pressure compressed air, nuclear power, and sophisticated electronics operating within the closed atmosphere of the submarine, and the normal isolation of submarines on patrol, out of reach of emergency assistance, underline the urgency of making the commander's job easier.

Additionally, thousands of elements of so-called "historical data" on ship systems, sea conditions, geography, and other areas that reside in sensors scattered throughout the submarine must be reconciled with "emergent" data that are received continuously by acoustic, communications, and other systems.

Tactically, submariners must be able to respond to threats posed by quieter, faster Soviet submarines with more capable weapons as well as to rapid changes in the tactical environment caused by more sophisticated U.S. Navy weapons and sensors. Sub commanders and their crews must be aware of weapon and ship system status while attempting to evade the enemy and be prepared to operate in a degraded status in case of flooding, fire, and equipment failures. Combat is an added load on the commander, who must simultaneously both "fight the ocean" and be aware of all continuous changes in the condition of internal systems.

Meanwhile, continuous improvements in the access to data, for example, by the Navy's development and deployment of: the BSY-1, (the BSY-2 is planned for next-generation, SEAWOLF-class attack submarines), the CCS Mk 2; and other incremental improvements in system control -- result in a

dramatic increase in data available, which nonetheless may still be ambiguous in the submarine environment. Two of the primary challenges of submarine control that form the basis for the SOAS requirement are the uncertainty of the data provided to the submarine crew and the need to develop a precise understanding of the external and internal "worlds."

Access to massive amounts of information -- often incomplete or ambiguous -- from many different sources, requires the commanding officer and his team to "paint a picture" of the composite tactical and system situation by assimilating the output of multiple sensors and computers. The task of assimilating data is made more challenging by the distribution of submarine control responsibilities among a command structure -- the CO's team -- whose members are at stations in different parts of the ship.

Among the long-range goals of SOAS are a tenfold reduction in tactical scene description errors, a two-thirds reduction in target classification time, and a doubling of weapons effectiveness.

Several similarities exist between decision-support systems for aircraft pilots and submarine officers, such as the requirement for artificial intelligence-based expert systems that integrate data of subsystems and provide the pilot -- or sub commander -- with sets of options he may elect to take. Three key differences exist:

- The level of uncertainty is greater in a submarine than in an aircraft;
- The time frame is more compressed for the pilot than the submarine; and
- While a decision support system will serve as a "ghost backseater" to the pilot, the sub commander has a team of skilled officers with whom he consults on decisions.

In an AI (Artificial Intelligence)-based decision support system, the sub commander would have access to -- in addition to the tactical and ship system data provided by dedicated computers and displays -- a comprehensive, real-time analysis of the tactical situation and all ship control operations that provide decision choices based on available data. The commander will decide whether or not to take the system's "advice" -- which automatically will be revised accordingly.

DARPA declines to comment on the precise scope of the submarine automation system which remains in a concept exploration stage. However, officials say, the system could initially be introduced "in parallel" with existing systems and augmented with an "advisory" function.

Rather than follow the conventional approach to developing an AI-based automation system, in which experienced sailors are quizzed about their operational requirements by software engineers who then try to transform the "real life" anecdotes into AI-based programs, the company teaches AI principles to the submariners, who then are able to produce programs that incorporate a greater depth of experience, and a truer reflection of their requirements.

A company developed a series of software algorithms that translates AI developed rules into geometric forms which permit real-time calculations of submarine system data, including operational data on range, bearing, and motion, and display decision options to the submarine commander in the form of geometric images.

Submarine Automation Systems "could employ a significant AI element to help with decision-making." It could also include more modest goals, such as speeding up the operations of individual systems by making them more "user-friendly" -- for example, by assisting crewmen in loading and presetting weapons.

Another "near-term" program submitted as a SOAS candidate is a so-called "generic shell" that is designed to serve as the foundation for a variety of command decision support systems.

As a generic system, analogous to a computer "spreadsheet" program that can perform a wide variety of tasks, the architecture "represents a way you can cast a large number of [command decision support] problems." The shell "would be applicable across the Navy's command hierarchy and across warfare areas." Several elements of the system -- tactical picture generation, tactical forecasting, and part of the situation assessment function -- are "up and running."

"Evidentiary" reasoning is the process of drawing conclusions based on available data, or evidence on specified problems such as the status of ship systems or tactics. Rule-based

reasoning is the reflection of established Navy doctrines of operations -- for example, "If the enemy takes a certain action, shoot him." Spatial rules are based on locations of objects, such as ships, and distances between them. Statistical reasoning employs conventional mathematical or probability calculations.

A key technology challenge is development of an "explanation facility" that will provide a coherent rationale for the decision recommended by the decision support system. "The commander isn't going to be satisfied with 'The computer says so' as the explanation."

A Long-Term Program

DARPA's development approach to SOAS is to "carve off the hard parts and do them first." In the initial year of the contract, focus will be on designing the high-level architecture of the decision support system, which will manage such task-oriented functions as system assessment, tactical planning, mission planning, and mission execution, among others. Subsequently, in the out-years, individual sub-systems such as weapons and sensors will be simulated in order to test the design concept and performance of the system architecture. Additional subsystems will be added in a step-by-step process, and subsystems also will be "coupled" within the system.

Initially, the DARPA SOAS program is expected to last four to five years, allowing the government and industry to "make inroads" on the problem. Meanwhile, the complexity of the submarine, the threat environment, and the demands on manpower and training all are changing. The entire scope of the program is still in a conceptual study stage. DARPA is looking into the future, at the hard, long-term problem. "The program is basically software -- hardware is changing too fast." But "you don't do automation for the sake of automation. You do it in order to gain something in terms of performance. DARPA [with SOAS] isn't interested in upgrading existing systems -- it's trying to establish a context for future thinking for a total system."

■

SOVIET VIEWS OF THE U.S. SUBMARINE ROLE IN CARRIER GROUPS

by LT Paul W. Siegrist, USN

Occasionally, to stimulate the thinking of their officers, the Soviet Defense Press publishes open literature and official reviews of selected Western systems and tactics. A recent publication titled "Winged Rockets in Naval Combat" described Soviet perceptions of modern winged rockets technology, tactics, ship's defense against winged rockets, and the Soviet conclusions, in four sections. The third section contained a chapter "Ship Defenses Organization", describing the U.S. fleet AAW and ASW organization improvements between 1975 and 1985.

Apparently, the integration of LOS ANGELES class submarines with the surface fleet impressed them. They compared the 1975 "weak" organization of the U.S. carrier groups, and the 1985 improved organization in Figure 1. The Soviet description of these organizations follows. In this translation and review, "let the Soviets speak for themselves," with the reviewer's comments in brackets to clarify Soviet jargon and context.

Against a severe threat of long-range winged missiles, they (the U.S.) placed at great ranges from the aviation-carriers early detection special 'dangerous' (armed or supported by armed platforms) anti-submarine defenses and long-range radar detection -- warning aircraft, and ships with powerful sonar and radars. Some gain in effectiveness was expected with the addition of surface based aircraft, particularly with long-range warning and control aircraft systems -- AWACS -- used as patrol aviation, and substantial oceanic and continental systems of air and antisubmarine defense.

In the thinking of foreign specialists, air and antisubmarine defenses of aviation carrier multipurpose groups had to be organized in four zones: self defense, near, middle, and far. The zone of self defense (at distances 3 to 6 km from the defended central objects -- carriers) used surface to air missile complexes, artillery or guns, and ship based radio-electronic combat equipment.

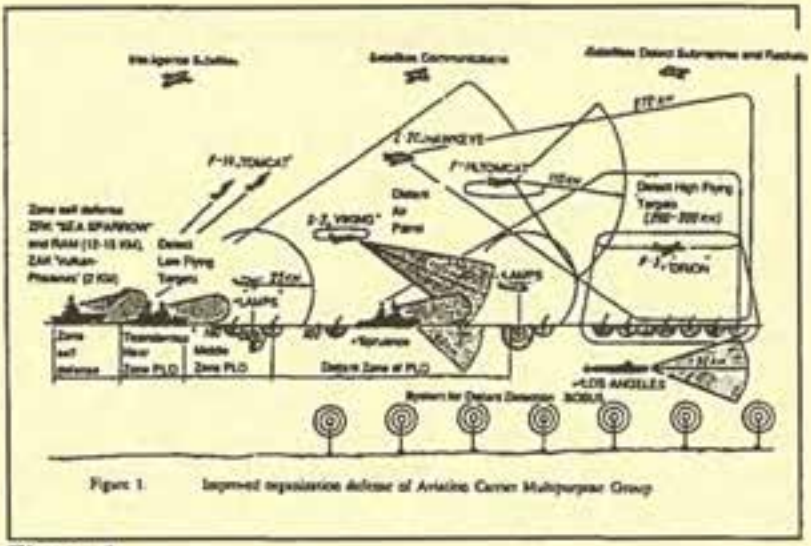


Figure 1

Escort ships and helicopters acted in the near zone to 37 km. Inside the escorts, the central ships formed a circular screen at distances of 7 to 9 km from the carrier, where they could about equally well detect distant torpedo firing submarines, bombers, and low flying antiship missiles. Helicopters were stationed ahead on the course of the carrier at 18 to 28 km. In the middle zone (to 140 km), the fighters, anti-submarine aircraft and anti-submarine shock group ships were stationed. In the far zone (to 330 km), the anti-submarine defense was guaranteed by ship groups of radio-location (radar-ESM) cruisers, aircraft patrols of long-range aircraft and fighter patrols.

In the improved organization of defense against anti-ship missiles and their platforms (Figure 1, 1985), the far zone of anti-submarine defenses extended to more than 460 km. The far zone was larger because multi-mission submarines (independently and cooperating with surface ships) could launch attacks at very large distances from the center of the battle order.

Even if there was a reliable zone of defense (experience in the second world and local wars showed exceptions to the complexity of the improved organization) self defense by the ships was still valuable. *[Comment: Narrow waters such as*

fiords, straits, or the Baltic may lack room for the full deployment of the 1985 style organization's near, middle and far zones.]

Reviewer's comments:

The Soviet depiction of a submarine detection satellite was puzzling, since the satellite class was not identified by the Soviets. Clearly the 1985 USN battle groups with the LOS ANGELES class submarines was seen as an improvement by the Soviet Ministry of Defense.

A Soviet officer's training teaches the importance of weapons deployed in depth (both vertically and horizontally), with dense cover on the main axes. The USN fleet organization of 1985 gave deep active protection supported by sensors found in space and down to the seabed.

From discussions in other Soviet publications, Soviet planners want to kill the USN submarines, carriers and other cruise missile platforms before the U.S. missiles are launched. Soviet staff planning doctrine for attack on a defended, distributed complex requires avoiding the strong points by maneuver, and penetration along weaker axes. The strong points of Figure 1 are the LOS ANGELES class submarines and the F-14, TOMCATs, working with the E-2C, HAWKEYE. A Soviet fondness for maneuver tactics would suggest preferential attack against the ORION P-3s, and LAMPs helicopters as the keys for the Soviet submarines to penetrate to weapon-launch range. Soviet radio-electronic combat doctrine to degrade target data collection and delay data transfer would call for attack on the SOSUS and satellite systems links to the USN battle control center.

As a humorous aside, when the Soviet text and figures were directly translated, they were still nearly unreadable, with 32 acronyms of their own plus the acronyms SOSUS, AWACS and other U.S. nomenclature. The burden of Soviet and U.S. acronyms in the official ponderous prose was too much even for them in this book. As an aid to the readers, they put two pages of Soviet acronyms in the front of the book. The readers were left to struggle with the USN acronyms and nomenclature.

■

SLCM DILEMMAS: FORESIGHT AND FOLLY

by Dr. Alton Frye

Submarines and cruise missiles are an awesome pair -- a stealthy platform coupled with a potent weapon for long-range attack. The recent analysis by Jon Boyes and William Ruhe (Submarine Review for January 1990, pp. 14-23) makes clear how versatile the combination can be.

Yet the very features that make SLCMs technically exciting tend to make them politically baffling.

Technological enthusiasm may be distorting our judgment about the balance to be struck regarding SLCM deployments and diplomacy. The United States has been so taken with the military advantages of SLCMs that it has given far too little weight to its own vulnerabilities to Soviet SLCMs. The Boyes-Ruhe study highlights both the complexity of the tradeoffs and the urgency of a new approach to negotiated limits on such weapons.

- Even older, shorter-range Soviet cruise missiles hold at risk the highest value American targets along the coasts and at sea, including our ports, carriers and other major surface ships.
- It is the Soviets who seem to enjoy relatively easy options for warhead interchangeability, meaning that their cruise missile inventory poses a substantial capability to break out large numbers of nuclear delivery systems unconstrained by arms control.
- It is the Soviets whose large-payload, high-speed cruise missiles with conventional warheads could become long-range nuclear threats by going subsonic with adjustments in warheads and tankage.

Clearly, the United States has a real need for conventional SLCMs, particularly to reduce exposure of pilots and aircraft in many scenarios where modern air defenses are thick and deadly. Protecting the right to deploy such a force should remain a diplomatic priority. One may reasonably ask, however, whether a flat refusal to negotiate SLCM restraints of any sort serves the national interest. In an unregulated cruise missile competition:

- How will the United States keep Soviet cruise missiles out of range of vital American targets? Perfect ASW is not in

the cards and it did not take an EXOCET attack or Mr. Rust's unarmed flight to Red Square to demonstrate that air defenses are porous.

- What confidence can the United States have that the Soviets will not exploit the flexibility of their cruise missile force to circumvent pending reductions in strategic nuclear weapons? Moscow evidently worries that the United States will do just that, even with its "wooden weapons" that are relatively hard to convert to nuclear warheads; the United States should be at least as concerned to devise guarantees against easy convertibility of conventional SLCMs to nuclear payloads -- and to capture in the control regime the hundreds of nominally short-range Soviet SLCMs that could grow very long legs overnight.

No doubt verification requirements are intimidating. No doubt in-port monitoring of cruise missile loading would be a nuisance. No doubt spot checks of an intrusive nature would disturb operational procedures at storage and maintenance sites, not to mention vessels at sea. No doubt conversion barriers to prevent interchangeability of SLCM warheads would go against the grain of tradition and service preference for maximum latitude to configure forces. Yet there is also no doubt that failure to contrive some combination of measures to regulate SLCMs jeopardizes the conclusion and implementation of meaningful strategic arms reductions, an objective sought by every U.S. administration for the last quarter century.

Is it not the responsibility of Navy leadership to address these problems diplomatically, rather than to insist on a totally free hand in SLCM deployments? Demanding absolute discretion to field all shapes and sizes of SLCMs guarantees more than a robust American capability. It is a surefire prescription for a massive, unconstrained Soviet threat against the American people and all their ships at sea.

■

OUR CONGRESSMEN MUST EXPLAIN SUBMARINES' ADVANTAGES

by A. T. Mollegen, Jr.

[This letter to the editor of the New London Day is reprinted here with special permission of the author, who is chairman and president of Analysis & Technology, a company whose work includes submarine technology.]

Your May 26 editorial, "The sky isn't falling," raises the issue of how the senators and congressional representatives of Electric Boat's employment area might help the area's economy.

Your recommendation was that they help hurry up the defense budget decisions so that the economic uncertainty will be over with quickly. Your position is incredibly short-sighted.

While part of the budgeting delay may be due to sound-bite-grabbing aspects of the political process, there is also a very serious debate going on as to what our country's future defense and arms policies should be.

As a generation which has benefitted substantially from the foresight of our predecessors, we should have higher goals than rushing through major decisions to prevent minor disruptions in the local economy.

Many of our country's past leaders must be resting uneasily in their graves if thoughts such as yours are typical of today's citizens. Among those who would be distressed, I suspect, would be: the people who designed wiser peace treaties after World War II than after World War I, so that the mistakes of the past weren't repeated; the people who set up the Marshall Plan to help revitalize Europe; the people who set up and have maintained NATO (and installed a tactical nuclear deterrent that worked), causing the longest European period without war in 400 years; and the people who set up the strategic nuclear deterrent, so that in the late 1950s the overt military spread of communism was brought to a halt (to name only a few.)

Perhaps a more farsighted set of suggestions could be made to the congressional delegation which represents the Electric Boat employment area. (I count the delegation as including

at least six people: two Senators each from Connecticut and Rhode Island, plus one representative from eastern Connecticut and one from western Rhode Island.)

This delegation could serve us and the country better if they were all to become highly vigilant watchdogs, to make sure that submarines are given appropriate consideration in the strategic planning debate that is going on now at the highest levels of our country and its allies.

This is not just a matter of regional self-interest, it is a matter of creating a better future for the world.

In the last few years, submarine capabilities have been changing so rapidly that the proper role of submarines in the U.S. defense lineup is no longer well-understood by many of our leaders. Because of the special importance of submarines to this region of the country, our delegation has a special role to play in making sure that the nation's new strategies reflect the new realities of the 1990s and beyond.

Some of these realities are as follows:

Because the U.S. and many of our allies are so dependent on sea-surface trade, the U.S. must maintain the strength to guarantee freedom of the seas almost anywhere.

This fact is of course not new, but much of the debate still ignores it. Anyone who remembers the gasoline waiting lines of the 1970s should have a very good feel for how dependent our country is on trade, using ships for transportation.

The principal threat to U.S. control of the seas, world-wide or in many local regions, comes from submarines. (The next most important threat is from mines.) The fundamental reason for the importance of submarines (and of anti-submarine warfare) is that submarines are far more cost-effective than other kinds of ships.

Submarines are a very attractive way to build seapower for anyone who has budget constraints -- and who doesn't?

At the end of World War II, 45 years ago, six countries had submarines. Today, 43 countries have submarines. How many more countries will have submarines 45 years in the future, when the last ships of the new SEAWOLF class will be reaching the end of their life?

The highly attractive cost-effectiveness of the submarine derives principally from the fact that the submarine regularly

goes into dangerous areas alone, carrying a crew on the order of 125 to 150.

Other kinds of ships normally go in groups, with a combined crew of 6,000-7,000 when there is a carrier involved.

While it is certainly true that there are some important jobs that can be done a lot better by a carrier task group than by a submarine, it is well to consider that some of the old decision rules may need updating.

For instance, all the ordnance that a few years ago was dropped in the vicinity of Mr. Khadaffy's tent -- by fighter-bombers dependent upon many in-air refuelings on the way to and from Great Britain, plus aircraft from a carrier positioned a safe distance offshore -- could today be delivered by one attack submarine, using long-range missiles.

Mr. Khadaffy has perhaps been thinking that he can breathe more easily when the local carrier isn't within attack range of his tent; if so, he should update his thinking.

Perhaps also the Medellin drug cartel should wonder if there is a U.S. attack submarine off their shore, with cruise missiles that could reach their strongholds. (U.S. submarines thus can be seen to have potential roles in situations involving developing and/or Third World countries.)

The congressional debate about submarines is not taking place at a very high level of sophistication. For instance, the purchase price of a new nuclear submarine is often compared disparagingly to that of oil-fired surface ships.

However, the nuclear submarine comes pre-fueled, with about 15 years' worth of fuel. This fuel not only has a present economic value, but since the fuel is built-in, you can be sure that the nuclear submarine will be able to go to work when you need it.

In contrast, during the oil problems of the 1970s, some U.S. Navy surface warships couldn't participate in readiness exercises because their fuel was rationed. Among surface forces, the term "hollow Navy" was heard at the time.

In much of the budget debate, the SEAWOLF class is being talked about as though it will be just another group of submarines -- and gold-plated ones at that. Nothing could be further from the truth.

The SEAWOLF is an important leap ahead.

SEAWOLF's magazine capacity will be immense, in submarine terms. With cruise missiles, one SEAWOLF will be able to mount an attack with effects that compare to a bombing attack by all the fighter-bombers on a supercarrier.

This attack can be against land targets within a few hundred miles of shore, as well as against ships. (Of course, the carrier can support repeated attacks, which one submarine cannot, but as can be seen by the examples cited above concerning Mr. Khadaffy and/or the Medellin drug cartel, not all scenarios require sustainability.)

Further, it is being argued by some that construction of the SEAWOLF class should be delayed because its combat system may not be ready. Even if the SEAWOLF class were to have to operate for a year or two with only a portion of the total capability of its new combat system (a matter being debated), it will still be the most formidable submarine at sea.

SEAWOLF's highly sensitive sonars, augmented by SEAWOLF's unique rapid localization capability, will make it the best type of ship for hunting down enemy submarines of all types: modern nuclear submarines built by the Soviet Union (and sold or leased to who knows whom in the future); modern non-nuclear submarines such as those being built today by private industry in several European countries; or modern non-nuclear submarines built by the Soviet Union or Red China, and being sold to people that you and I don't want them to be sold to.

In the Falklands War, when British ships were destroyed by Argentinean-launched French-made cruise missiles, and in the Persian Gulf, when a U.S. ship was put out of action by Iraqi-launched French-made cruise missiles, it was demonstrated beyond any doubt that one does not have to be a superpower country to make effective use of modern, high-tech weapons.

Since the same principles will apply in the future, doesn't it make sense to place high emphasis on building the one kind of ship that even the best capabilities of the highest-tech nations can't counter?

Another misguided notion showing up in the debate is the idea that it might be smart for the U.S. to start building diesel-powered submarines.

It is true that a diesel-powered submarine can be a very

formidable opponent when it is loitering on battery power. It is, then, in a lot of respects, like a manned mine field. However, against modern sonar systems, a diesel submarine is extremely vulnerable when it must move to another location.

Put differently, diesel submarines today can be useful close to home, but are much less useful for assignments in faraway locations. (Such was not the case in World War II, because in those days there were no long-range sonars.) Does it really make sense to switch U.S. emphasis from ships of world-wide applicability to ones which have high value only near our coastlines?

Still another misguided notion has to do with the morality of nuclear weapons, and of nuclear submarines.

Of the thousands of nuclear weapons that have been built, only two have ever been used to attack people. The effect was to end within about 10 days what was already the world's most tragic war.

For nearly 45 years thereafter, nuclear weapons have deterred war. For a weapon, what could be a greater success story?

The success story of the nuclear weapon is rivaled only by that of the nuclear submarine. In the 35 years since the launching of the first nuclear submarine, only one has fired a weapon in anger -- when a British nuclear submarine fired a World War II-style torpedo and sank an Argentinean warship during the Falklands war. The rest of the world's nuclear submarines have effectively deterred large-scale war at sea, not to mention helping deter global thermonuclear war.

However, it is only with great care that the lessons of the past can be applied to the future. We cannot count on the future's being very much like the past.

We must do our very best to recognize what may be different in the future, and then also resist becoming overconfident that we have predicted the future correctly. (The Maginot line mentality was also one of the contributors to World War II, because the Nazis understood better how things would really happen than did the French.)

An extremely important characteristic of any strategy is thus its robustness: how well will our strategy work, if future events are not what we have assumed? Clearly the most

robust armament strategy is to build the least-counterable weapons and weapons platforms. This clearly includes nuclear weapons (as well as conventional weapons) and the modern nuclear submarine.

Even then, the history of the last 70 years testifies that strength alone is not enough. In the years preceding World War II, Axis leaders did not doubt that the U.S. could make a dangerous and perhaps overwhelming opponent. However, both Hitler and the Japanese leaders made the same mistake: they misjudged our will to fight. (The Argentinean generals made the same mistake about Margaret Thatcher.)

These identical mistakes about national will were not only tragic for the decision-makers' own counties, but for others as well. To prevent people from again making this mistake about the U.S., with possibly much more tragic results, we must continue to demonstrate our will, as well as maintaining our strength.

Maintaining our readiness through continuing modernization, as well as by maintaining adequate numbers of forces, is the only means of doing so.

These principles will be as valid in the multi-polar world in future decades as they have been in the basically bi-polar world of the last 45 years.

Our congressional delegation thus would serve well the peoples of the world, in addition to those of their own areas, by keeping the defense debate focused on the right issues, and using the most current concepts of submarine warfare.

Because of their special constituency, our delegation has a special calling to make sure that the debate is based on a proper understanding of the role of the submarine in the forthcoming multi-polar world, where our country will have potential regional conflicts to deter, as well as potential super-power conflicts.

In the world of the next 50 years, the nuclear submarine will probably be the world's most necessary, most cost-effective, and perhaps even most broadly relied-upon deterrent.

Its role as a deterrent to regional war and Third World conflicts is not widely understood and must be clearly explained.

In these times of radical geopolitical change, with so much

at stake, redesigning our nation's strategy is worth taking time over.

If nothing were going on, then I would agree with The Day in wanting to shorten our region's period of uncertainty. But a great deal is at stake, so let's call upon our delegation to help keep the debaters well-informed about submarines.

And let us ourselves keep the debating delays in perspective. The future deserves our patience as well as our diligence and our foresight.

■

SOVIET CLOSED-CYCLE SUBMARINES

by Norman Polmar

During the 1930s the Soviet Navy developed and constructed several closed-cycle propulsion submarines, i.e., capable of employing diesel engines while submerged to recharge their batteries, thus extending underwater performance. These submarines were constructed at the Krasnoye Sormovo shipyard No. 112 in Gor'kiy and at the Sudomekh shipyard No. 196 in Leningrad.

After World War II when the Soviet Union resumed warship construction there was renewed interest in closed-cycle submarine systems. Trials with some of these craft were continued after the war. The ten or more small M-class units completed in the late 1940s (most built at Sudomekh) were presumably experimental units, possibly of varying types, and some may have had closed-cycle propulsion plant prototypes. All operated in the Baltic from the late 1940s through the mid-1950s and appear to have been stricken in the 1950s.

This postwar effort to develop closed-cycle propulsion plants made use of captured German submarine technology as well as building on indigenous Soviet research. By the late 1940s the Soviet Navy simultaneously began building three new submarine classes -- known by the NATO code names WHISKEY, ZULU, and QUEBEC -- as well as several specialized research submarines.

The third submarine class produced in this initial postwar submarine program was the relatively small QUEBEC, known in the Soviet Navy as Project 615. This was a coastal

submarine intended to employ a closed-cycle propulsion plant to permit use of diesel engines to charge batteries while submerged without the need to raise a snorkel breathing tube. Details of the QUEBEC's propulsion plant are sketchy in the open literature. The design provided for three propeller shafts, apparently with the Kreislauf closed-cycle diesel system turning the center shaft. The QUEBEC's principal designer was A. S. Kassatsir, who had worked on closed-cycle propulsion designs in the 1930s and during the war.

In the Kreislauf process unburned fuel and unused oxygen were recovered from the diesel exhaust gases. These were recycled with small amounts of stored liquid oxygen (lox) being added to permit submerged operation. Developed by the Germans during the war, the Kreislauf system was one of several development efforts intended to permit underwater operation without the need to draw in air from the surface (with the snorkel envisioned by the German Navy as only an interim step in submarine development). On several occasions, while the QUEBECs were being built at the Sudomekh shipyard, ex-German tank trucks were observed discharging their cargo through pipes connected to buildings in the yard. The pipe connections became frost covered, a phenomenon that led to speculation that the trucks were off-loading lox or a similar oxidizer necessary for the Kreislauf or the Walter system.

The QUEBEC's closed-cycle diesel plant was not successful, with several accidents occurring. Some submarines were seen with flames coming from their engineering spaces and their crews were said to call them zazhigalka (lighters) or Zippos, the latter after the popular American cigarette lighter. The closed-cycle plant was to have provided an underwater burst speed of 20 knots. More significant, the submarines would be able to maintain high submerged speed with the Kreislauf system for longer duration than with electric batteries.

Subsequently, the QUEBEC submarines may have been modified to operate as conventional diesel-electric craft, and served into the 1970s in the Baltic and Black Sea areas. However, specialized support barges were said to have been observed near the QUEBECs until their demise, contributing to speculation that some units at least retained the Kreislauf

power plant until they were broken up.

The QUEBECs were in several respects the successor to the MALYUTKA coastal submarines built from the early 1930s onward. They had a displacement of 460 tons surfaced and 540 tons submerged, and a maximum underwater (electric motor) speed of 16 knots. Armament consisted of four 21-inch (533-mm) tubes in the bow plus four reloads for a total of eight torpedoes or 16 tube-launched mines. As in the M-class submarines, there was no torpedo loading hatch, with reloads being brought in through the torpedo tubes. The first units were completed with a twin 25-mm gun mount, making these the world's last submarines to be completed with deck guns. (Those with guns beached them in the 1950s.)

The first postwar-generation Soviet submarines, including the QUEBEC class, were intended primarily for the anti-ship role. The principal sonar installation of the period was the Tamir-5L High-Frequency (HF) sonar, mounted in the bow, which became operational about 1948. Apparently the last few QUEBEC-class submarines (those completed after 1956) had the Tamir-5L fitted in combination with the new, Medium-Frequency (MF) Feniks sonar. The active transducers or "projectors" for the sonars were fitted in wrap-around acoustic "windows" visible on their conning tower or "sail" structure.

A few variants of the QUEBEC were observed, although their exact purpose does not appear to be known in the West. For example, in July 1959 a strangely configured QUEBEC was photographed at Sudomekh with a large "shack" built around the after portion of the modified sail. This conversion -- called "shackback" by naval intelligence -- had a structure about 26 feet long, 14 feet wide, and 7 1/2 feet high, fitted aft of the sail. A 17-foot vertical pipe was fitted at the after end of the shack. Subsequently, in August 1960, a second "shackback" was observed at the nearby Kronshtadt naval base in the Gulf of Finland. That unit had an additional, smaller shack-like extension fitted aft of the main "shack."

The vertical pipes may have been exhausts, indicating that the "shackback" submarines operated as either auxiliary power or heating barges, or may have been experimental platforms for closed-cycle propulsion projects.

One other closed-cycle propulsion submarine design was

completed at Sudomekh about 1956, being first sighted by Western observers late that year. The one-of-a-kind craft was given the code name "WHALE" in the West; the Soviets designated her Project 617. She had a streamlined hull shape, a small sail structure, and an upper rudder, a feature not usually seen until the advent of nuclear-propelled submarines. The shape of the sail, upper rudder, coupled with the absence of a snorkel installation led to speculation in the West that this was the first Soviet nuclear propelled submarine.

The WHALE was observed to make high-speed runs, albeit for brief periods. This submarine, of approximately 1,500 tons surface displacement and some 250 feet in length, was propelled by the Walter hydrogen-peroxide turbine for high-speed submerged propulsion.

The WHALE apparently conducted trials in the Baltic for several years, with the last Western sighting reported in 1961. According to some sources, S. N. Kovolev developed the design for this submarine; some 30 years later Kovolev served as chief designer for the TYPHOON SSBN.

Soviet interest in closed-cycle propulsion continued parallel to nuclear propulsion. (In the West the U.S. and British efforts into closed-cycle propulsion halted after the successful development of nuclear propulsion.) There was periodic speculation in the West of other Soviet submarines having closed-cycle plants or "boosters," among them the triple-shaft ZULU and FOXTROT long-range submarines, the JULIETT cruise missile submarine, and, especially, the KILO SSK, which entered service in 1982. But proof that research has continued in this area came in 1987-1988 with the debut of the research submarine BELUGA.

Thus, the Soviets have demonstrated a long-term and continuing commitment to non-nuclear propulsion, with both conventional diesel-electric plants and closed-cycle propulsion or, as now labeled in the West, Air Independent Propulsion.

[This description of Soviet closed-cycle submarines is abridged from Submarines of the Russian and Soviet Navies, 1718 to 1990 by Norman Polmar and Lt.Comdr. Jurrien Noot, Royal Netherlands Navy, to be published later this year by the U.S. Naval Institute.]

■

IN REMEMBRANCE

Vice Admiral Lawson P. Ramage, USN(Ret.)

LAWSON PETERSON RAMAGE

The death of "Red" Ramage, a winner of the Congressional Medal of Honor in World War II, marks a sad occasion for all submariners who have respected and admired the proven greatness of this gallant warrior.

Admiral Ramage's obituary in the Washington Post describes the circumstances leading to his Medal of Honor award:

"As commander of the submarine PARCHE on July 31, 1944, he penetrated the screen of a heavily escorted enemy convoy, then engaged the Japanese in 46 minutes of surface combat operations, during which he sank two troop transports and two tankers and seriously damaged a freighter -- with 15 torpedo hits out of the 19 fired. At one point with enemy shells passing close overhead, he sent all topside men below but he remained on his submarine's bridge. When an enemy transport tried to ram the PARCHE, he swung her stern clear of the onrushing ship and although caught in the enemy's crossfire, sank her with four torpedoes."

Red Ramage was for many years a member of the Board of Directors of the Naval Submarine League. His warm, friendly persona and paternal regard for his cohorts will be sorely missed by the submarine community.

■

THE SUBMARINE REVIEW

by W. J. Ruhe

With this issue of the SUBMARINE REVIEW I bow out as the Editor -- being relieved by Captain Jim Hay. This ending to a seven year stint with the REVIEW generates a philosophical look backward to see how sound and useful was the effort.

As conceived, the SUBMARINE REVIEW was and is a "professional" magazine for the "profession of submarining." I believed at the outset that the submarine profession was the most important, satisfying, interesting, challenging and dynamic profession within the military establishment. It seemed to me that a high-quality, very readable journal for this profession would move the U.S. submarine force ahead in its evolution towards a particularly important national and world influence on military-political affairs. This was sound, providing that the submarine force would use this journal to test their ideas, introduce new ideas relative to submarines and submarining, learn from the past history of submarine activities, get the public more interested and get submariners in submarine matters themselves more interested in their profession.

Ensuring the production of high quality material for the REVIEW seemed possible even though too many in the Submarine Service, past and present, have seemingly subscribed to the idea that it's best to remain a "silent service" -- not recognizing that the silence of submariners has been for the most part in their written words, certainly not in their great amount of "quack-quack" whenever a few have been gathered together. Today, however, silence only too often seems to be generated by security concerns. In fact, it is possible that silence is placed well ahead of improvement of the profession. By not having a discussion of present-day problems within the submarine profession, the profession might be losing its dynamic and satisfying quality. But up to now there has been a sufficient dialogue of high quality, within the REVIEW to make those in the Submarine League who monitor this journal believe that a valuable service is being carried out by the REVIEW for the Submarine Service. I would note however, that contributions from the active senior submariners have

been for the most part lacking. Yet, it would seem that they should benefit most from such a platform for their submarine interests. Perhaps it is the younger officers who feel less constrained by past practices and who want to further their profession, who will become the major part of the dialogue in the REVIEW. There are certainly some excellent, articulate young submariner writers producing very good things for other magazines who might become more active in the SUBMARINE REVIEW. What is hoped is that this small, concise, informative journal can achieve some of the great success enjoyed by such professional magazines as the American Medical Journal, Electronics, and Foreign Affairs.

As for readability, that's been more clear cut. By having a journal with articles no longer than about 2200 words -- because that's about the outer limit for holding the attention of today's technological man -- and by eliminating blockages to a continued "reading" of an article, it becomes likely that an article will be read in its entirety, and not speed-read (see Polaris and Red Rayborn). Thus, acronyms have been virtually eliminated since they only too often cause one to stall and search for their meaning. Footnotes are out because they interrupt one's reading-flow. Notations to a bibliography at the end of an article are also eliminated to check on the source, etc. And, by having the authors's name at the end of the article and no pedigree attached, it seemed that an article would be read, not for its authorship so much as for its subject matter. I did a good deal of checking with potential readers on who they would read and found that it was virtually useless to have a woman as an author of an article on submarine matters of one sort or another -- so I decided on the use of anonymity in articles. In addition, there were certain writers against whom strong biases were held. Again, recommended anonymity. And then there were writers whose pedigree wasn't sufficiently attractive to coax a potential reader into sailing through the article. As for the pedigree business, I had the thought that my only excuse for writing for the REVIEW was because "I was a life-long student of warfare." Who would read any further? So short descriptions of who the author might be wouldn't always help readability. Submariners are a strange breed of animal, it would seem -- but to cater to their

reading patterns was absolutely necessary. And having a journal which could be carried around easily in one's pocket helped insure that it would be read in spare moments. One will note in their reading of the REVIEW that there are frequent violations of good syntax, but these have invariably been in the cause of better readability. One must recognize that the submariner, as a generality, is rarely a great reader -- unlike those in the academic community. Submariners are men of action who want to read "what's necessary" and get it over with.

I have been distressed at criticisms of the REVIEW as to having too much historical input -- too many World War II submarine-patrol stories, and too much use of past submarine experience to validate present submarine matters. Going back over the last twelve issues, I find five articles on U.S. war experience and four on foreign submarine war activity. In all cases, these historical things were printed because your editor felt that they contained valuable lessons for today's submariners and today's likely submarining problems. Men like Admiral Arleigh Burke have stressed the necessity of understanding the history of one's profession (see the article in this issue Submarine Power - the Final Arbiter) in order to improve it -- and that has been the intent of such articles in the REVIEW. In World War II there was a torpedo problem for the submarine navies (except for the Japanese). Is it worth worrying about what went wrong in torpedo peacetime development before World War II or should one believe that with the introduction of nuclear-powered submarines this kind of history lost its meaning. The latter thought is worrisome because the young submariners who feel that they are living a new profession with little relation to the profession which I knew, are losing a sense of tradition and identity with "the old submariners" who proved their worth in war and who are today pretty much the backbone of the Submarine League with its hopes of building an even finer tradition for present submariners.

There is also a seeming belief that only technical articles in depth are of true value to the submarine profession. Broad generalities, philosophy, conceptual thinking, strategic thinking (strategic in the classical sense), following today's submarine

developments worldwide, posing present day scenarios, -- these are all areas where the SUBMARINE REVIEW can have a useful unclassified dialogue. Bringing the submarine military-industrial-scientific communities together through dialogue might be one of the most important functions of the SUBMARINE REVIEW and so far this objective has progressed.

Interestingly, I have found that submarine wives read the REVIEW and many report that they read each issue cover to cover. Perhaps they are proud of the submarine profession and like to identify with it, rather than with a society of nuclear-power engineers.

There's been some worry that the SUBMARINE REVIEW is insufficiently scholarly in its approach. More reliance on credible submarine "authoritative" writings, it has been felt, would generate more articles from the academic community and get the SUBMARINE REVIEW used a lot more as a reference for scholarly writings on submarine matters. That's still being held in abeyance. Ensuring the accuracy and reliability of matter discussed has been my toughest job, but rarely is any material in an article brought to task for being mistaken. It is certain that the SUBMARINE REVIEW is being referenced as an authoritative publication and that literally thousands of copies of specific articles from the REVIEW are being reprinted for use in service schools, for correspondence courses and for other publications, even in foreign navies.

A few final thoughts. It has been difficult to hold the line on being a strictly "submarine" journal. When one gets into ASW, for example, writers want to cover the whole business -- air, surface, submarine, mines, intelligence, etc. Hence to edit such submissions to apply only to the submarine contribution seems arbitrary and lacking in understanding of the total problem. It is. But setting this as a ground rule has, it is felt, been absolutely necessary. A further thought is that there should be no intent in the REVIEW to provide strong advocacy for any present specific submarine programs -- that's the job of the active duty professionals.

The SUBMARINE REVIEW is trying to make a valuable contribution to the submarine profession and should continue

to do so through its new editorship.

[Presidents' Note: I want to acknowledge here as I have done elsewhere Bill's major contribution to the NSL and the Submarine Service. He has masterfully played the role of Editor which we often conjure up from watching the movies. He has been stubborn, irascible, precise, inventive and persistent, but also he loves and believes in the role and destiny of submarines and the people who drive them. There have been many "ups" and a few "downs" these past seven years. He has tried to do a good job and he has succeeded. As he assumes his new responsibility as Editor Emeritus, I wish to convey my personal and the NSL's thanks. Well done, Bill!

Al Kelln

■

1990 SUBMARINE REVIEW LITERARY AWARDS

Congratulations to the winners of the 1990 Literary Honoraria for articles published in the *Submarine Review*:

First Prize: $200 each to Dr. Jon L. Boyes and William J. Ruhe for their article ***Tridents*** in the October '89 issue.
Second Prize: $250 to Dr. John M. Weinstein for his article ***Command and Control of Strategic Submarines*** in the January '90 issue.
Third Prize: $150 to Edward L. Beach for his article ***The Influence of the Submarine Upon Sea Power*** in the April '90 issue.

■

NSL ACTIVE DUTY PRIZE ESSAY CONTEST

- Win up to $700!!
- Separate prizes for Senior and Junior Active Duty Members.
- Judging occurs in January 1991.
- See April 1990 Submarine Review, page 102 for details.

■

ARTICLES FOR THE SUBMARINE REVIEW

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

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The content of articles is of first importance in their selection for the REVIEW. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the REVIEW.

A 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.

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.

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

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.

■


WESTINGHOUSE AND THE SUBMARINE NAVY
THREE GENERATIONS OF QUALITY AND DEPENDABILITY MAKE WESTINGHOUSE THE CLEAR CHOICE FOR SEAWOLF
Westinghouse makes them quieter, lighter, more powerful and cost effective. It's more than just a slogan; it's a fact, borne out by three generations of top quality submarine propulsion systems—GE/REP, PMP I and now, PMP II, the SSN-21 main propulsion unit ... the latest generation of quiet power designed for Seawolf.
To meet all the SSN-21 requirements, Westinghouse invested over $42 million to expand our manufacturing capabilities. We assembled a team of design, manufacturing and product support professionals second to none—a team whose abilities were proven on the successful GE/REP and PMP I programs. And we've continued to refine and improve the design and ensure the quality of our submarine propulsion systems. The result is a lightweight, low noise main propulsion unit that gives new meaning to the phrase "quiet power."
From design through manufacturing, to field support, you can depend on Westinghouse ... clearly the low-risk choice for Seawolf.
WESTINGHOUSE MAKES THEM QUIETER, LIGHTER, MORE POWERFUL AND COST EFFECTIVE

LETTERS

"SUBMARINERS OR NUKES"

LT Schmidt's article "Submariners or Nukes" is "on the mark, but he writes as if the emphasis on engineering to the detriment of operations and tactics is new.

I am sure it still exists, but I'm equally certain that it is not new. In fact, this has been with us since before World War II. Then, the annual competition in all phases of submarining was the big thing. Fuel consumption and other engineering aspects consumed an inordinate amount of time and effort. Torpedo firing occurred only periodically and involved but a small segment of the officers and crew, and played second fiddle.

Could it be that this attitude contributed to our inadequate weapons testing and woeful torpedo performance until World War II was well underway?

In the post-war era, those of us dedicated to fire control, tactics, and torpedo performance were but a small percentage of the Force.

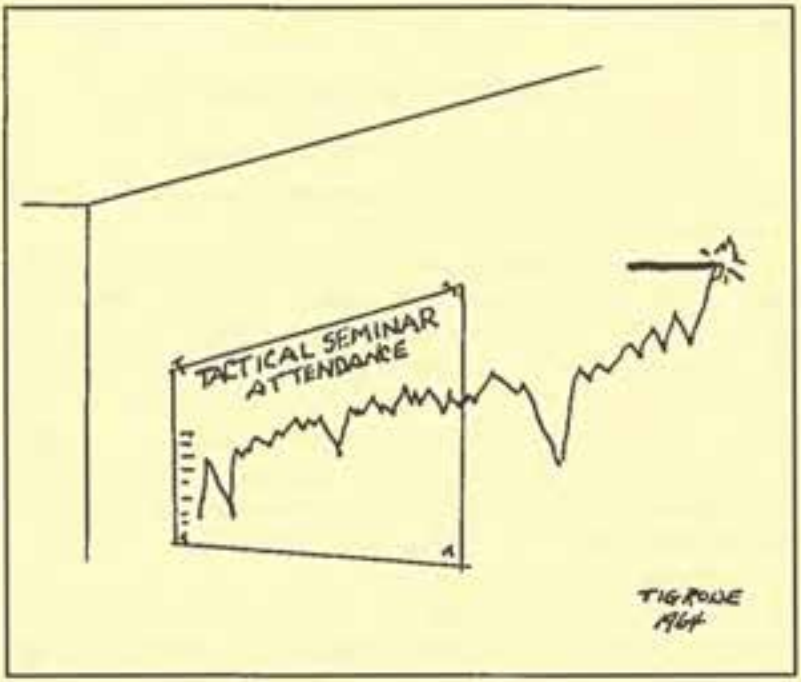
The engineering plant's task is merely to put the ship in position to carry out its mission -- weapon firing, or whatever else may be ordered.

Perhaps I can emphasize my concurrence with LT Schmidt by describing the attached sketch which is a portion of a clever TIGRONE cartoon summary of my year as COMSUBFLOT II/COMSUBRON 2 in New London in 1964. It suggests that the monthly tactical seminars were a smashing success with attendance off the chart.

These seminars brought COs, Execs, and Gunnery Officers together with Staff Officers and civilian fire control experts -- from those companies actively engaged in performing research or providing hardware for the Force at that time. Each and every one, friends of mine from BuOrd days, was honored to be invited to a day with the users.

In sum, we had a problem of priorities in the late 30s, in the post-war era, in the 60s, and apparently in the 90s. Let's not write the same tale at the turn of the century.

M. H. Rindskopf
OIC PCO School PH 1952 -- OIC Sub School NL 1958



SCRAPPED SOVIET SUBS

The April SUBMARINE REVIEW had an item relative to the Soviets scrapping twelve of their old conventional submarines, (probably WHISKEYs) and "reducing" 26 more this year. I note that Jane's Fighting Ships has in the past estimated that there are about 100 old submarines in a reserve status, manned by skeleton crews, usable in war after a short refitting. They are not counted as "operational." Are the 38 obsolete worn-out subs, noted above, taken from this reserve fleet -- thus not representing an actual drawdown of the Soviet's operational submarine fleet? Or will Jane's of 1990-1991 show the total Soviet operational submarine fleet as being less by 38 submarines than their latest figure, i.e. about 327 submarines instead of the 365 presently being used.

Ironweed

THE BRONZE STAR

[In reply to Bud Gruner's proposal in the April 1990 SUBMARINE REVIEW:]

As someone who earned a Bronze Star for handling a leadership position on a Navy Cross war patrol, I was taken aback by the idea that all holders of Submarine Combat Pins be awarded Bronze Stars. Who will write the citations and what will they say -- "Thanks for doing a good job 50 years ago and outliving your shipmates?"

There are still some of us who won our Bronze Stars the hard way -- would you suggest we all be upgraded to Silver Stars, and my Silver Star to a Navy Cross? You cite the infantry precedent, but when did our submarining pride sink to using Army justification for what we do?

Fundamentally, campaign medals, group awards and individual honors are different things and should not be confused. I am proud of those I have in each category for my 13 war patrols. The Combat Pin has its own special significance as a group award, and should be treated as such. If people are unhappy with its physical form, they should move to establish a new medal, not preempt an old, well established one from the individual award category.

Fred Spiess

■

CONVERTED FBMs

I feel that I must comment or respond to Captain Byron's recent article on the use of a converted FBM in the low intensity combat environment.

While this is a novel approach to utilize a defense asset over a longer term than that anticipated as a missile boat, I can't help but wonder about the cost factors and actual value derived from such an application. Okay, you have a situation where American or allied personnel or interests are being threatened in a foreign country. To use this converted boat on such a mission would entail extremely close-in support. How many skippers would be willing to sacrifice their boats to

a reef? What about extraction if the mission fails? There are just too many variables to consider in such an operation. Further, consider the sheer size of even the older FBM boats? Their size would be "dead" give aways in water shallow enough to provide close in-shore operations. Harbor penetration ... forget it! More than likely, just the perceived notion that the U.S. has converted one or more of its older FBM boats to such a use would be more than enough in terms of psychological orientation of a potential terrorist adversary.

Ronald L. Stem

■

THE D-5

Regarding the problem of nuclear deterrence in the Third World, I've got to say, at first I thought the idea was a bit wacky, but as I talked to some experts, there is definitely some merit to your idea.

The D-5 with one warhead may not be the best way to go. The Navy might need instead a new lightweight, single warhead missile. For high accuracy, we could recycle the Pershing II guidance packages, now in storage at the Pueblo arsenal. This is the only homing ballistic missile guidance package that I am aware of, featuring active radar guidance for the terminal stage of the flight. An accuracy (or CEP) of about 75 feet is theoretically possible, I am informed.

Such a weapon mounting a 1 kt warhead would, again, possess the theoretical attributes of a surgical weapon.

As a practical matter, I see a Navy so strapped for cash that the multimillion dollar development of a new missile is out of the question, especially given the immense difficulties surrounding other "theater" nuke systems, like the recently cancelled Lance follow-on and now the air-launched TASM missile that will come under very tough scrutiny.

I do, however, finally come down on the side of a non-nuclear response to the sinister machinations of Third World dictators.

David Evans
Chicago Tribune

■

AARON THOMAS

[Ed. Note: this is a follow-up on an article in the January 1989 issue of the REVIEW, "A SUBMARINE FAMILY NEEDS YOUR HELP." Aaron, the 10 year old son of FTBCS(SS) and Mrs. Edward J. Thomas, has leukemia. Fifty-eight NSL members responded to the plea for blood donors to help this child in his battle with the dreaded disease.]

Good news about Aaron! He had a bone marrow biopsy in February. The report was negative, thus the remission continues.

Several organizations have been very kind to Aaron's family. ***MAKE A WISH*** arranged for Aaron, his mother, brother and sister to fly to Disney World, Orlando, for several days of fun. ***SPECIAL LOVE*** gave the Thomas family a weekend of skiing in Pennsylvania and ***GRANT A WISH*** is scheduling a week sometime in the summer for the family to enjoy the beach at Atlantic City. This group owns a condominium there which they use to house families with ill children.

All of these organizations are maintained by donations. If anyone wishes to contact them or to mail a donation, their names, addresses, and phone numbers are given below:

MAKE A WISH, 10215 Fernwood Road, Bethesda, MD 20817
(301) 493-6777, Attn: Pat Fox
GRANT A WISH, P.O. Box 21211, Catonsville, MD 21228
(301) 242-1549
SPECIAL LOVE, Box 3243, Winchester, VA 22601
(703) 667-3774, Attn: Dave Smith

Helen Williams

■

THE VALLEJO WATERFRONT SHIP COMMITTEE

This letter is to advise you and the Naval Submarine League of a major project in progress here in Vallejo, California. After over twenty years of procrastination, the city is going ahead with a major redevelopment of the waterfront across the river from Mare Island Naval Shipyard. An excellent

developer (David Martin, "The Martin Group") has been selected and work should start this year. A maritime theme is envisioned and I have been named chairman of a citizens committee, "The Vallejo Waterfront Ship Committee," to secure from the Navy a historic ship that was built at Mare Island. This ship would be displayed on the waterfront as a monument to the contributions of Vallejo and Mare Island to the Navy and the Nation.

Our first priority is the USS MARIANO G. VALLEJO (SSBN 658), commissioned at Mare Island in 1966. I had the privilege to command the Gold Crew of that ship through new construction, shakedown and four deterrent patrols. I believe, as do most Vallejoans, that this ship is the crowning achievement of Mare Island in the over 500 ships built for our Navy since Mare Island's inception in 1854. As far as we know, VALLEJO is not yet scheduled for deactivation although we would expect her to go out sometime this decade. It is our plan to persuade the Navy to deactivate the ship at Mare Island and then assist in her conversion to a monument as was done for USS NAUTILUS at Mare Island a few years ago. It is envisioned that the ship would be placed on the waterfront and then surrounded by concrete to provide a permanent resting place.

The NSL support, advice and comments would be highly valued. There is tremendous local enthusiasm for this project and I believe we can generate statewide and even nationwide support for this West Coast monument to our Navy.

Captain John K. Nunneley, USN(Ret.)

■

ONLY 3 SUBMARINE CAMPAIGNS?

I really must take issue with one point in Edward Beach's article "The influence of Submarine upon Seapower" in the April 1990 edition of the REVIEW. In an otherwise interesting article he states that "twenty years later in World War Two there were essentially three submarine campaigns with three very different outcomes." His statement refers to the campaigns waged by German U-boats in the Atlantic and by Japanese and American submarines in the Pacific.

To begin with, I would question the description of Japanese submarine activity during the Second World War as a "campaign." Despite possessing a large submarine fleet, Japanese submariners accomplished little during the war being beset with restrictive orders and conflicting priorities. Japanese submarine thinking was dominated by the fleet submarine concept: the submarine was viewed as an integral part of the battle fleet -- with operations in support of the Army, such as stores carrying, coming a close second. Despite representations by Japanese submariners, the destruction of commerce was regarded as a secondary priority: thus the extended American supply line from the west coast to the Pacific theatre of operations went almost unmolested. Lastly in a desperate attempt to stop the inexorable American advance, Japanese attention focused on midget submarines which soon, though not initially, developed into suicide weapons.

Meanwhile across on the other side of the world there was a submarine campaign which appears to have escaped Mr. Beach's attention. In the Mediterranean a small force of British (including contributions from our Polish, Dutch and Free French allies) submarines, operating in waters which were heavily patrolled and extensively mined, succeeded in seriously interfering with Axis military operations in the desert by cutting their supply lines. All petrol for Rommel's panzers had to come by sea and allied submarines exacted a heavy toll of this traffic. Lack of petrol stopped Rommel's advance at Alam Halfa in 1942 and denied him freedom to manoeuvre at El Alamein. Rommel's chief of staff was moved to say *"we should have taken Alexandria and the Suez Canal if it had not been for the work of your submarines on our lines of communications."* This fulsome tribute is confirmed in the various official histories yet little public acknowledgement has been made to the submariners for their role in the desert victory. As Admiral Sir Andrew Cunningham, commander in chief Mediterranean, wrote to the Admiralty on 17 September 1941, *"every submarine which could be spared was worth its weight in gold."*

Paul Kemp MA.

■

IN THE NEWS

- The Washington Post of 3 April notes that the START negotiations are expected to be completed this year and that the agreed Treaty will not block much of the remarkable Soviet strategic modernization of their weapons. START will constrain the number of nuclear warheads on each side. The START accord "will count two submarine-launched ballistic missiles -- the Soviet SS-N-23 and the U.S. D-5 -- as carrying fewer than the maximum number of warheads which have been tested". Peacetime inspections will be allowed to verify the number of warheads installed on these missiles.
- In a speech by Admiral C. A. H. Trost, the Chief of Naval Operations, on 2 March 1990, he says that: *"The global situation is clearly aggravated by the proliferation of first world weapons among any number of nations that can afford to buy them, or have the technical capability to build their own. Figures, such as 100 countries with cruise missiles, 15 with ballistic missiles, over 40 with attack submarines, and 25 either with or developing chemical weapons, are alarming and have serious global implications. Economic and political competition among states can escalate quickly when it turns to military competition backed by arsenals of high technology weaponry. In short, while the security environment of the nineties may be characterized by a headline that reads 'Peace is breaking out', the text tells a more sobering story -- one of hope, but punctuated with a need for 'eyes wide open' pragmatism."*
- The Washington Post of 24 April digests a speech by Senator Sam Nunn to the Senate on April 19. In it he notes that with the *"scaling back of the Soviet Navy, out-of-area operations and other changes in the threat (the threat of a large-scale Warsaw Pact attack against Western Europe virtually being eliminated) the U.S. Navy policy that virtually all deployable Navy ships have to be at sea or be able to get underway within days becomes increasingly unnecessary and unaffordable. The Navy must get more serious about the use of reserves to handle a portion of the Navy's fleet ... the word 'reserve' must not be synonymous with the word 'mothball'."* Nunn doesn't see submarines as suitable for reserve operations. But he asks the question, *"Does the Navy want to shrink by substantially more,*

with all ships at high readiness levels, or would it rather maintain a somewhat larger Navy with major elements at high readiness and others at adjusted readiness?"

- NAVY NEWS & Undersea Technology of March 12 reports that the Soviet and Indian navies are mounting surface-to-air missiles on selected classes of their submarines. The Soviet's TYPHOON and the diesel-powered KILO-class sold to the Indian navy, all carry these kinds of missiles. The missile system is housed in a circular pressure-tight compartment about four feet in diameter and sits atop a periscope-like extension when deployed. The system contains at least 12 and perhaps as many as 18 missiles. The missile used in the TYPHOON is thought to be the Gremlin of 3.2 nautical-mile range and up to 18,000 feet altitude. It is a heat seeker, like Stinger. The KILOs use a Grail missile like the U.S. Redeye, of 2.5 mile range and 16,000-foot altitude. Hinged blast deflectors on the top of the sail of both the TYPHOON and the KILO are evident.
- Vickers Shipbuilding of Britain, according to a NAVY NEWS & Underseas Technology report, April 2, is assembling a solid-polymer fuel cell module to begin evaluation of this concept for an air-independent propulsion system for submarines. The fuel cells used in such a power system would operate at room temperature and convert hydrogen and oxygen into electricity and water. A plastic membrane, similar in appearance to Saran Wrap, holds a catalyst which produces the reaction. The liquid fuel is probably methanol, which must be passed through a device called a reformer to produce the hydrogen gas necessary for fuel cell operation.
- In the same issue of NAVY TIMES & Undersea Technology it is suggested that some of the D-5 missiles put into use will be armed with recycled TRIDENT I nuclear warheads (for C-4s) because the Department of Energy is unable to produce more D-5 warheads. "The C-4 SLBM normally carries eight W-76 thermonuclear warheads each with an explosive power of 90-100 kilotons of TNT and a 500-yard CEP. By contrast, the W-88 warhead for the D-5 has a CEP of 100-130 yards and an explosive power of 475 kilotons. Without the W-88 the D-5 will not be able to achieve its hard target capability." Last week the TENNESSEE began its

initial patrol carrying D-5s armed with W-88 warheads.

Also, the planned retirement of the QUEENFISH (SSN 651) and the SEA DEVIL (SSN 664), years ahead of schedule -- to avoid costly overhauls -- "will serve as the Navy's model for future, force draw-downs. The limiting factor in such deactivations will be the disposal of radioactive cores, rather than the availability of dry dock space."

■ Vice Admiral Roger Bacon, Commander Submarine Force, Atlantic Fleet, in an address at the Change of Command aboard the USS EMORY LAND, on 24 March, said: *"The command of a submarine tender is an awesome responsibility and requires the best leadership the Navy has to offer. While the submarine tender might not seem as glamorous to some of you as a submarine, let me assure you, the submarine tender is just as critical to the success of our national security strategy. Our submarines depend on the tender to help them get ready and stay ready for sea. In a very real way, the submarine tender is a linch-pin of our force. It is an understatement to say that the ship and submarine upkeep and repair business is virtually non-stop. From motor rewinds and valve overhauls to equipment calibration, lagging repair and resupply of tended units, this submarine tender -- whether inport or underway -- has been working to keep not only the submarine force but also units of the surface force ready for sea. While many perceive the threat from the Soviet Union as receding and that this is a time for peaceful change, it is a simple fact today that the Soviet military capability is no less than when Mr. Gorbachev took the reins. Moscow's talk of reducing the Soviet armed forces, the world's largest, and adopting a defensive military doctrine, has not yet been fully implemented. In fact, the United States faces a more formidable Soviet offensive strategic arsenal today than we did when Mr. Gorbachev came to power. I believe the Soviet desires to help reduce world tensions are well intended and I hope they will continue. But history tells us to remain mindful that the best laid political intentions can change very quickly, while world geography can not."*

■ The Observer of the Naval Sea Systems Command notes that Rear Admiral Walter Cantrell will relieve Rear Admiral Mal MacKinnon as Vice Commander of the Naval Sea Systems

Command on his retirement. Admiral Cantrell, the Deputy Commander for Submarines since August 1984 will be succeeded by Rear Admiral Tom Evans, the present director of the Advanced Research and Development Division of NavSea.

- Armed Forces JOURNAL International/April 1990 tells of a videotape released by the Soviets in Canada which shows details of the sunken MIKE submarine. Reportedly, the tape showed titanium slabs on the MIKE's hull of about an inch of thickness. The distance between outer and inner hulls was between four and six feet. The submarine's main periscope was equipped with a radar-warning receiver. The tape also showed a hydraulic system for pushing the torpedo doors outward before firing -- a seemingly inefficient method for use of torpedo tubes. The tape also showed what appeared to be composite bulkheads in the submarine, and there were evidently sonar windows on the sail.
- Norman Polmar, writing in the PROCEEDINGS/April 1990, says that *"the SEAWOLF unit cost is supposed to decline to about $1.2 billion per submarine -- a 40% reduction from the Navy's stated costs for the lead submarine: this compares to the previous LOS ANGELES class, in which the unit cost dropped 19% for the second year's buy, but then averaged out at a production-run reduction of about 12% from the lead ship ... The SSN force strength is declining precipitously. The current force of 95 nuclear attack submarines will drop to 86 by the end of fiscal year 1992. Accelerated retirements of the older units in lieu of refueling will speed up the SSN retirements until the year 2000, when the attack submarine force could consist of the 62 LOS ANGELES-class boats plus a maximum of 12 SEAWOLF submarines if the planned construction of six submarines every second year is funded."*
- Aviation Week & Space Technology/March 12, 1990 has an article written by Admiral Thomas H. Moorer, former chairman of the Joint Chiefs of Staff in which he recommends the basing of MX missiles at sea. *"I disagree with those who oppose deployment of a modernized ICBM force. The problem is not with the missile, but with its deployment ... From a strategic standpoint there are three good reasons for taking the MX to sea -- geographic, geometric and economic ... There is no*

technical reason to preclude water launch of the MX by Air Force missile crews on board Navy ships."

- NAVY NEWS & Undersea Technology of February 19 tells of a new torpedo propulsion system in development by an English Company. "Using a closed-cycle Rankine technology, the fuel systems division of Dowty's Defense and Air Systems Group has developed a safe solution to the requirements for future torpedoes to have high speed, good endurance, high electrical power generation, quietness and insensitivity to operating depth. The system relies on lithium and sulfur hexafluoride as a power source, creating steam in a boiler to spin a turbine."
- In the March 5 issue of NAVY NEWS & Undersea Technology the Soviet anechoic tile is described. "The tiles on the SIERRA and AKULA-class Soviet attack submarines use a new technique to both dampen self-noise and reduce sonar reflections. The configuration consists of a two-layer tile system. The inner layer consists of tiles with many small holes of various diameters. The outer layer is solid. Both layers are made of a rubber compound. The outer layer is designed to absorb active sonar signals. The inner tile dampens radiated sounds at specific frequencies. The tiles are approximately 2.8 by 3.0 feet and four inches thick. Sources say the latest anechoic tiles reduce the acoustic signature of the AKULA between 10-20 dB -- causing a reduction in detection range of between 25% and 50% compared to a submarine without the new tiles. Part of the reduction in radiated noise from Soviet submarines comes from the use of skewed propellers -- which were first sighted on the VICTOR IIIs two years before the Toshiba sale of methods to quiet Soviet propellers. Prior to the VICTOR III class, Soviet quieting technology was considered 20 years behind the U.S. With the introduction of the VICTOR III, the gap closed to about five years. Now the new AKULA is only slightly noisier than the most recent American submarines."
- DEFENSE WEEK of 12 March, in commenting on ***"The Hunt for Red October"*** says that when a Navy official was asked if the movie would be a great recruiting bonanza, he laughed and said, *"There's no Kelly McGillis. What kind of message does that send to the potential recruit? Do you want to be stuck*

under the water for months at a time with just a bunch of guys?" What part of the service did the official hail from? "No surprise, he's a fighter jock."

- DEFENSE WEEK of April 9 reports the possibility of the first eight SSN-21s being constructed of HY-100 steel, rather than shifting to HY-130 after the first 3 SEAWOLFs. The article says the two shipyards building SEAWOLFs are having difficultly using the stronger HY-130 steel. However, as part of the HY-130 certification program, both shipbuilders demonstrated their capability to fabricate HY-130 weldments. But welds on the stronger steel have a tendency to become brittle and break. A report of the GAO said that the service is anticipating some trouble in finding HY-130 supporters. (The AKULA class submarines are constructed out of titanium, sources say). Six TYPHOONs use HY-130. This steel is able to withstand 130,000 pounds of pressure per square inch. Subs constructed of HY-80 steel have a diving depth of about 1500 feet, but the TYPHOON should go to 2,000 feet. The only other country presently using HY-130 steel in attack submarine construction is Japan.
- SEA TECHNOLOGY February 1990 tells of the Soviet construction of two 4,000-meter submersibles of the RIFT-class. Made of titanium, they are being built at a Soviet port on the Black Sea. In the spirit of glasnost, attendees at an International Conference on Underwater Vehicles held at Suzdal, near Moscow, were shown progress pictures of the two submarines under construction.
- Perry Technologies, the major U.S. builder of small submarines, according to Armada Magazine, is building a remotely operated submarine vehicle somewhat smaller than its pioneering TRITON. The new vehicle, the TRIUMPH, includes video graphics capability, a micro-processor-based control system and retains the 25 hp hydraulic unit of the TRITON. It has three horizontal thrusters providing six degrees of motion, and it has a 2,000 kg lift capability.
- The Wall Street Journal of April 19, says that Japanese shipbuilders are nearing the launch of "the world's first vessel powered by super-conducting magnets." The YAMATO I, a 100-foot long hull will serve as test ship. The magnetic propulsion ship will be tested at sea next year. Potential

advantages of such a power system are lower noise and higher speed.

- The NAVY TIMES of 26 March reports that "A sure bet to succeed (the submariner) Vice Admiral J. D. Williams as commander of the 6th Fleet is Rear Admiral William A. Owens, a submariner." Owens is a 1962 graduate of the U.S. Naval Academy and commanded the attack submarine CITY OF CORPUS CHRISTIE and strategic missile submarine, SAM HOUSTON.
- The Washington Post of 12 May tells of Admiral C. A. H. Trost's testimony before a Senate Armed Services subcommittee. Trost said he would support negotiations with the Soviet Union *"to eliminate tactical nuclear weapons at sea"* providing the Soviet leadership agrees to negotiate away all nuclear weapons that threaten in wartime the survivability of American carrier battle groups. Trost also pointed out that the Soviets have refused to discuss their short-range nuclear antiship missiles *"dedicated to attacking U.S. carrier groups,"* and that Soviet negotiating overtures were directed towards winning limits on the U.S. long-range Tomahawks, *"while excluding the short-range nuclear missiles predominant in the Soviet Fleet."*
- The NAVY TIMES of 7 May notes that "the Navy is retaining significantly more submarine officers, though long-term shortfalls still exist." The retention rate of junior officers rose dramatically in 1989 to 54% from the 39% in 1987 and 1988. The 54% is "for officers between their 4th and 7th year of service." Retention for 1990 is expected to remain above the 50% needed to meet requirements. The Navy, it is claimed, "is cautiously optimistic about maintaining the current high level of retention among junior submarine officers."
- The NAVY TIMES of 14 May says that LOS ANGELES class submarines are receiving a major upgrade to their sonar systems -- improving detection, classification and tracking of other submarines. The BQQ-5D "will include a thin-line array, about half as wide as previous submarine towed arrays. Both the towed hydrophone array and its towing cable will be thinner -- allowing a far longer array, towed at a greater distance from a submarine." ■

REUNION NOTICES

Organization:	USS CLAMAGORE Veterans Association
When:	October 25th thru 28th, 1990
Where:	Charleston, South Carolina
Contact:	George A. Bass P.O. Box 217 Melrose, FL 32666 (904) 475-1180

* *

USS SIMON BOLIVAR (SSBN 641) will hold a celebration of her 25th year of commissioned service on 31 August 1990 in Charleston, SC. All previous crew members and interested parties are invited to participate. Contact Chief of the Boat Ronnie Vandiver (Gold Crew) or Gary Olson (Blue Crew) c/o:

USS SIMON BOLIVAR (SSBN 641)
Building 646A, Naval Station
Charleston, SC 29408
(803) 743-2896

* *

USS BENJAMIN FRANKLIN (SSBN 640) will hold its 25th Commissioning Anniversary in Charleston, South Carolina, on 9 and 10 November 1990. All previous crew members and interested parties please contact Master Chief Harry Black or Master Chief Tom Lehman at (803) 743-0081, Building 646A, Naval Station, Charleston, SC 29408, for more information.

* *

REUNION:	**USS J. C. CALHOUN (SSBN 630)**
When:	August 23rd to 26th, 1990
Where:	Venice Inn, Hagerstown, MD
Contact:	Jack B. Ensminger P.O. Box 174 Waynesboro, PA 17268 (717) 762-9351

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1990 NROTC NSL AWARDEES

Congratulations to the following outstanding NROTC submarine volunteers who were selected as recipients of the Frederick B. Warder Award for Outstanding Achievement:

Name	Unit
Roland M. Castro	University of Arizona
Charles A. Hill	Auburn University
Scott D. Hogan	Boston University
James J. Quinnan	University of California
Sean Brosseau	University of Colorado
Robert Campbell Beaumont	Cornell University
Frank G. Bowman	Duke University
David A. Gibson	University of Florida
Robert Johnson	Georgia Institute of Tech.
Michael Forsythe	The George Washington Univ.
Joseph P. Reck	College of the Holy Cross
Jeffrey A. Halvorson	University of Idaho
Stephen J. Bohn	University of Illinois
Sterling D. Baldwin	Illinois Institute of Tech.
David McKinley	Iowa State University
Stanley L. Dunaway	University of Kansas
Mark A. Michelet	Marquette University
Eric J. Gaaserud	Massachusetts Inst. of Tech.
Charles Dunavant	Memphis State University
Edward A. Pittman	Miami University
Samuel C. Steiman	The University of Michigan
James L. Zimmerman	University of Nebraska
Michael J. Ringy	University of New Mexico
Mark W. Holsbo	Northwestern University
Lawrence P. Flannery	Norwich University
Robert J. Clark	University of Notre Dame
Kevin A. Swank	The Ohio State University
Edward J. Sallee	University of Oklahoma
Peter J. Bierden	University of Pennsylvania
Michael L. Miller	Pennsylvania State University
Matthew P. Shaal	Purdue University
Thomas P. Boegel	Rensselaer Polytechnic Inst.

Dennis C. Chang	Rice University
Joseph E. Landry	University of Rochester
Robert E. Sylvia	University of San Diego
Berry J. Foster	Univ. of Southern California
Samuel Harris	Southern Univ./ A&M College
Edward P. Delamater	State U. of NY Maritime Coll.
Eric Jones	The U of Texas at Austin
Paul D. Stukenholtz	University of Utah
John R. Scott	Vanderbilt University
Erik R. Fino	Villanova University
Paul B. Basola	University of Virginia
Paul D. Quinn	Virginia Military Inst.
Richard B. Alsop	VA Polytech. Inst.& State U.
Steven T. Muench	University of Washington
Darrin Allen Engelhart	The University of Wisconsin

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MOBILE SUBMARINE MODELS

The Naval Submarine League is considering providing each NSL Chapter with one or more models of modern submarines for use in their public affairs efforts. We envision a sturdy, 8 to 10 foot model with lightweight trailer which could be easily transported for use in parades, fairs, exhibitions and other events where the public will gather in numbers.

Unfortunately, our funds are very limited; thus, we need to find people with the capability and willingness to produce a submarine replica with little markup over the cost of materials. Our specifications would include construction to reasonable scale, proportionate and authentic enough in detail to attract the public. Actual materials could include sheet metal, plastic, wood or other lightweight materials not requiring excessive maintenance.

Our goal is to provide each of our five (and growing) Chapters at least one model. If you, or someone you know, is looking for some quality volunteer time, please drop us a note or call John Vick at (703) 256-0891.

■

BOOK REVIEWS

ANTI-SUBMARINE WARFARE

by Rear Admiral R. J. Hill, RN(Ret.), Annapolis, MD
U.S. Naval Institute, 2nd Edition, 1990

Reviewed by Paul R. Schratz

Admiral Hill completed the research for the first edition of Anti-Submarine Warfare in 1983, just prior to numerous important developments in ASW technology, changes in U.S. naval strategy, and wholly unexpected political changes in the Soviet Union and Eastern Europe exerting far-reaching effects worldwide. The purpose of the second edition is to project into the 1990s a number of aspects of ASW which may be expected to undergo substantial change. For example, because of the Walker spy ring, the assumption of a marked acoustic advantage over the Soviet Union submarines is no longer tenable.

The emergence of new policies was nowhere more prominent than in maritime strategy. The U.S. maritime Strategy may or may not mean that the Strike Fleet will advance into the Norwegian Sea at the first sign of tension. If, as some imply, such a move may be delayed until sufficient attrition has been imposed on the Soviet submarine force, then, in Admiral Hill's view, the brunt must be borne by the European forces in the area, "notably any amphibious forces reinforcing north Norway, the British ASW group escorting such forces, the NATO Standing Force Atlantic, other north European NATO units, shore-based maritime patrol aircraft..." Failure to bring Soviet submarines into action in the early stages could have two quite nasty effects -- i.e., allowing them to escape into the Atlantic shipping lanes, or to lie in wait for the Strike Fleet when it does come. In short, despite the confident and forward looking aspects, the admiral's enthusiasm for the Maritime Strategy carries some necessary words of caution.

Unfortunately for the author, the vast political changes in the Warsaw Pact nations, part of the reason for the new edition, had hardly begun when the edition went to press. Since no slackening had been noted in Soviet production of major arms, the only change suggested for the West is no

change. This is a prudent recommendation; it is still too early to evaluate the full effect of the major political changes still in progress.

The first edition of Anti-Submarine Warfare was well received as an enlightening contribution, primarily from the British view, to the complex art of ASW. The task of the book reviewer, however, as Admiral Rickover once told me, is to serve as an adjunct for the reader in evaluating both the strengths and weaknesses. For all its virtues, the first edition was somewhat short on hard analysis, which is perhaps one reason why the author belittled "so-called operations-analysis." Also neglected was the enormous Soviet geographic problem of wartime access to the sea, of a lack of support bases, repair and refit facilities and of a shore-based antisubmarine detection capability needed for a maritime war. It is also disappointing to see an experienced seaman using the Mercator projection for global charts. Cosmetic changes have been made in the new edition; the above are still with us.

The first edition, now out of print, cost $14.95; the second, $26.95. For the extra twelve dollars, the reader gets twelve additional pages, mostly illustrations which are uniformly excellent. But tabular data is unchanged from 1984 and one still can find only a limited bibliography, no footnotes, and no index.

■

SUBMARINE WARRIORS

by Edwyn Gray

Published by Presidio Press, 1988, 275 pages
LC 88-22065 CIP; ISBN 0-89141-325-1

Reviewed by Commander Philip F. Eckert, USN(Ret.), a U.S. submarine veteran who made 10 successful war patrols against the Japanese during WW II.

This book, written by an English author, provides an excellent sampling of diesel submarine warfare for World Wars I and II.

The first chapter contains a short historical overview of submarine warfare, highlighting the first modern submarine

attack, made in anger, against the Turkish cruiser Mejidieh off the Dardanelles on December 9, 1912; and the last torpedo attack, against the Argentine cruiser General Belgrano on may 2, 1982. This latter attack was conducted by HMS CONQUEROR, a nuclear submarine, during the Second Battle of the Falkland Islands.

Sixteen of the remaining 17 chapters are about submarine exploits as follows: Germany, three chapters on WW I and one chapter on WW II; United Kingdom, three chapters on WW I and two chapters on WW II; United States, four chapters on WW II; Italy, two chapters on WW II; Poland and Japan, one chapter each on WW II.

One chapter describes the use of a British submarine against Chinese pirates in Chinese waters in 1927. The Chinese, upon seeing a submarine for the first time, in this case the HMS L-4, immediately dubbed it "The Go-Under-Water-War-Junk."

By far the most controversial and perhaps least known submarine story is in Chapter 17. It is the Japanese commanding officer's account of the sinking of the USS Indianapolis, the cruiser that just a few days earlier had delivered the nuclear components to Tinian Island for the A-bombs that destroyed Hiroshima and Nagasaki on August 6th and 9th, 1945. Commander Hashimoto of the Japanese submarine I-58 caught the Indianapolis about one-half of the way between Guam and Leyte -- on course 260 degrees true, speed 16, and not zigzagging, at 11:30 P.M., July 29, 1945. His first torpedo struck the Indianapolis at two minutes after midnight. One or two additional torpedoes hit the Indianapolis during the next 30 or 40 seconds. The cruiser's officer of the deck could not ring up "all Stop" because all communications were lost immediately. There was no power for the high-frequency radio transmitter in the radio room, which meant that not one single distress message could leave the ship. In less than 16 minutes the Indianapolis planed down to a watery grave. Four hundred lives were lost immediately and another 480 men died from exposure and shark attacks over the next four days. A total of 320 men were eventually rescued, but that is another story and beyond the scope of this book.

The I-58 was equipped with six Kaiten torpedoes, called by

some "underwater Kamikazes." The Kaiten was a man-guided torpedo in which the Kaiten operator, on a suicidal mission, used a small periscope to hand steer the Kaiten with a 3,000 pound warhead toward the target. At its slowest speed, the Kaiten had a range of 38 miles. The Kaitens were moored to the main deck of the submarine and could be released only when the submarine was submerged. The state of the art permitted the Kaiten operator to leave the submerged submarine and wriggle through an access tube to get aboard the Kaiten without getting wet or flooding the submarine or the Kaiten itself. Once aboard the Kaiten with its access hatch closed, the operator was in a crouched position until death. (The diameter of the larger Kaitens, Types 2 and 4, was about 1.4 meters.) Commander Hashimoto avers that he did not use Kaitens against the Indianapolis, to sink what Commander Hashimoto identified as an "Idaho-class battleship." Furthermore, the accounting of the expenditure of the six Kaitens launched from the I-58 has never been satisfactorily explained. But that also is another story.

Edwyn Gray is truly a submarine aficionado. His sampling of submarine tales is a must for those interested in pursuing further study of the war-time use of diesel-electric submarines. ■

NAVAL SUBMARINE LEAGUE HONOR ROLL

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Captain and Mrs. Frank M. Adams, USN(Ret.)

Killed in a private plane crash
May 27, 1990

MEMBERSHIP STATUS

	Current	Last Review	Year Ago
Active Duty	987	956	931
Others	2979	2875	2885
Life	179	174	175
Student	32	28	22
Foreign	64	62	52
Honorary	25	20	8
Total	4266	4115	4073

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NSL SPEAKER PACKAGES

Updated speaker packages are now available from NSL Chapters and National Headquarters. We have updated the package through the latest 688's and included a section on SEAWOLF.

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STS 91

The 1991 Submarine Technology Symposium (STS 91) will be held on 7, 8 and 9 May 1991 at Johns Hopkins-Applied Physics Laboratory in Laurel, Maryland. Attendance is by invitation and is restricted to those having a Secret-NOFORN clearance and certified need to know.

The STS 91 theme is **SUBMARINE TECHNOLOGY FOR LOW INTENSITY & THIRD WORLD CONFLICTS.** The symposium will address those technologies which have the potential for enhancing the role of the submarine in limited objective/low intensity warfare, i.e., general warfare beyond direct involvement with the Soviet Union. These conflicts present unique operational and technical requirements, stemming from expanded and non-traditional mission requirements, the diversity of the adversary, stressing environmental conditions (including shallow water) and constraining rules of engagement. These requirements include strike support, surveillance, and special operations; ASW operations against quiet non-nuclear submarines; safe and effective operations in shallow water including mine avoidance; an increasing demand for more effective command and control, including robust, covert communications and the use of UUVs, RPVs and other off-board systems for mission support.

Members interested in applying for participation as a speaker should contact Mr. G. Richard Thompson, STS 91 Program Chairman, at (301) 953 5396.

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NSL SYMPOSIUM - 1991

Mark your calendar now: the 1991 Symposium will be on June the 12th and 13th, 1991 at the Radisson Plaza Hotel in Alexandria, VA. Program details will be announced in subsequent issues of the **Submarine Review** and registration packages will be mailed to the membership early next year.