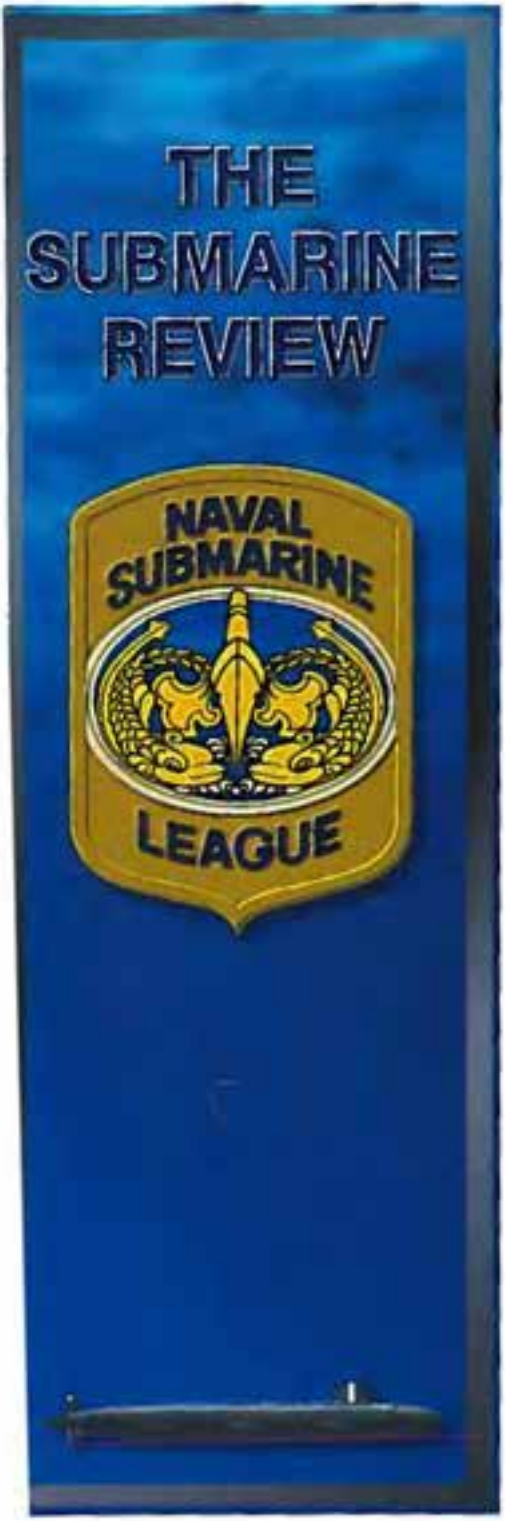

JANUARY 2003

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Undersea Dominance for the 21st Century

EDITOR'S COMMENTS

Let us stipulate, at the beginning of this edition of our regular discussion of the magazine's Features, Articles, Sea Stories, etc., that there are several pieces here which are a fair bit longer than our usual offerings. Normally we strive to hold down the length of articles to less than 3000 words, or about 6 or 7 pages. The reason we have some significantly longer pieces here is that they **are** significant. It might also be noted that all four of our Features in this issue are **not** appearing here for the first time, but originated under separate auspices.

First among the Features is from Commander Naval Submarine Forces at the Annual NDIA Clambake at New London in the Fall. Vice Admiral John Grossenbacher graphically recalls in that presentation the opening gun in our War on Terrorism with all the shock felt both nationwide and within the nation's national security. He goes on to set forth the determination with which the Submarine Force is meeting the challenge.

Admiral Jerry Holland's "Globalization Under the Sea" warrants special attention by all advocates of submarines in US security considerations simply because he very succinctly covers the spectrum of submarine utility today—and tomorrow. It has been suggested by some who previewed Jerry's work that it should be required reading throughout the Submarine Force. As beneficial as that might be, there is something of *preaching to the choir* about doing that and most of us realize that our real problem is getting out the word about submarines to the rest of the Navy and to the general public. It is apparent that we have not been successful enough in doing that over the years, even with all the positive publicity which has been generated from past achievements. Jerry has managed to put into one place almost all the important things which need to be said to all Americans about the potential which their Submarine Force, competent in size and capability, can exert in this complex and unforgiving world which we will face for the foreseeable future.

The third Feature, also a reprint here, is of a specialized interest from one who has long experience submarining in *narrow waters*.

Captain Bo Rask is the Commander of Sweden's submarine squadron. He was asked by a Taiwanese defense magazine to use his Baltic experience to comment on the use of submarines in the Taiwanese Straits and, as a member of the Naval Submarine League, he offered that work to us as well. There is a lot of food for thought within Bo's commentary and all *deep water sailors* can gain a sharpened litoral perspective from it.

Rear Admiral John Butler also forwarded on to us for wider distribution his *Leadership Lesson* to the Submarine materiel community. Naturally, there is great deal of excellent, and even innovative, information about *leadership* in John's piece but there is a great deal more. The entire process of generating and introducing useful, even transformational, technology into the already elaborately sophisticated world of submarine design and building can be seen with a new appreciation when looked at from his vantage point.

In addition to the Features, of course, there is a full complement of Articles, some poignant Reflections and a very interesting Book Review (the book is about Rear Admiral Dick O'Kane of WAHOO and TANG with some great insights about WW II in the Pacific and submarining in general). Then there is a section for Sea Stories. A general once said that every time he spoke to a sailor he heard Sea Stories. Since we all have them, and are always are ready to tell more than one at any given time, let's share them with all the rest of the folks. Everybody write down your favorite Sea Story and send it in to **THE SUBMARINE REVIEW**. Maybe we can even come up with some fancy prize for the best ones.

Jim Hay

FROM THE PRESIDENT

This issue of **THE SUBMARINE REVIEW** offers me the opportunity to acknowledge to passing of others who have gone before us, report on recent actions by your Board of Directors, and discuss the preparations being made for our 2003 events.

The passing of Admiral Bob Long, Rear Admiral John Coye, and Captain Ned Beach, Submarine Heroes honored at our 15th, 12th, and 19th Annual Symposia respectively, makes a strong statement that the torch is truly being passed to our generation for the care and preservation of the value systems and professionalism demonstrated by our Submarine Force. Our country has been well served by these professionals and we would do well to emulate their actions and initiative.

Your Board of Directors has been striving for the past year to improve the fiscal status of the League and in that role, they have approved a revised Corporate Benefactor Dues structure that will increase our revenue from this resource. Additionally, our Chairman, Admiral Kelso, directed the Finance Committee to review the approved budget to see where additional savings could be achieved in the operation of the League. In this review, the committee recommended that we save the cost of the 2003 Annual Directory and implement an on-line Directory through our web page (www.navalsubleague.com) in early 2003. This recommendation was approved by your Board at the November 6 Board meeting.

Board members were also asked to support other ways that they could support the League by underwriting some of the costs of our events and activities. This request has already received enthusiastic response from Lockheed Martin NE&SS through the provision of four new computer systems to replace our Pentium 166 MHz machines and Northrop Grumman Newport News has underwritten the Congressional Breakfast for the 2003 Corporate Benefactors Recognition Days. Raytheon Electronic Systems is providing some important networking support as we upgrade our office to a DSL internet connection. This service will support our on-line registra-

tions, membership and Directory applications. There are other ways that we can improve our service to members and save costs that are being explored with other companies.

Other savings have been achieved through reduced staffing, increased use of bulk mail for Chapter support, and increased oversight over required expenditures. The Finance Committee is committed to submitting a balanced budget for FY2004 in February 2003.

I am excited about the preparations already made for our 2003 events. As mentioned, the 2003 Corporate Benefactor Days help on 3-4 February will feature the Submarine Force Leadership, Congressman Norm Dicks (D-WA), and special talks by Vice Admiral Mike Mullen, DCNO for Resources, Requirements and Assessments, Rear Admiral Kate Paige, Ballistic Missile Defense System Technical Director, Missile Defense Agency, and Mr. Richard Haver, Special Assistant to the Secretary of Defense for Intelligence. We have also added several new Corporate Benefactors so we expect a record attendance at this event.

Admiral Archie Clemins has recruited a superb panel of Session Leaders for the 2003 Submarine Technology Symposium at JHU/APL on 13-15 May. The five sessions focusing on the theme "Submarine Operations and Missions: The Challenge for Technology" and incorporating the CNO's vision for Sea Shield, Sea Basing, Sea Strike and FORCEnet will also feature 12 keynote speakers from industry and the fleet in a new format. Registrations will open in early February on the League website that will link to the registration page. Remember, this is a SECRET forum and clearances will be required before you will be fully registered.

The 2003 Annual Symposium is working hard to include some new features to top the breakout sessions we had in 2002. We are seeking to add some featured speakers from other submarine communities as well as more exhibits by our Corporate Benefactors. I'll have much more information for you in April—about the time we send the registration packages.

Jan joins me in wishing you all a Happy New Year.

J. Guy Reynolds

THE SUBMARINE REVIEW IS A PUBLICATION
OF THE NAVAL SUBMARINE LEAGUE

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FEATURES

REMARKS AT 2002 NDIA CLAMBAKE

by VADM John J. Grossenbacher, USN
COMSUBLANT
17 September 2002

Thank you Ted Hack, New London Submariners, Admirals, Captains of Industry, Leaders in our Undersea Technology Acquisition and Warfighting Communities, Ladies and Gentlemen. At last year's Clambake, as I was giving my presentation, the terrorist attacks in New York, Washington and Pennsylvania began. When I sat down following my remarks someone handed me a note informing me that an airplane had crashed into the World Trade Center.

This past spring I was honored to speak at the Washington DC Submarine Birthday Ball and was presented a flag. It had been flown aboard USS PROVIDENCE and USS KEY WEST, the first submarines to launch missile strikes into Afghanistan after September 11th. It was also flown over the USS ARIZONA and the Pentagon. We have recorded this flag's history as well as the names of the three submariners killed in the attack on the Pentagon on the back of its case.

This, our Submarine War On Terrorism Flag, will remain in my office for as long as it takes to defeat the terrorists. It is and will be a constant reminder of September 11, 2001 and the depth of anger and determination the events of that day created within us. We have no illusions about the length, complexity or difficulty of this war. How long will it last? When will we know we've won? How long will this flag be a real and relevant reminder to our submariners? We don't know. To us, it appears that what we are facing is the beginning of a long-term effort like the Cold War. But while the end point is difficult to predict and progress not easy to measure, the path we must take is clear. We must create a constant crushing force that intimidates, inhibits, and interdicts the terrorists. We must make it hard, very hard for them to organize, equip, and execute a major attack. That is the effort to which your submariners have contributed, are contributing, and we promise to

apply every bit of the relentlessness, tenacity and boldness that are part of our submarine heritage in doing so. Mush Morton, the legendary Commanding Officer of USS WAHOO during World War II is quoted, while amidst a difficult pursuit of an enemy target, as having turned to his Exec Dick O'Kane and said "Tenacity Dick, you have to stay with the bastard until he is on the bottom." As in World War II, at different times and places and to different effect, American submariners applied the traits of relentlessness, tenacity and boldness to defeating the Soviet Union in a Cold War, and today, a new generation is applying them to the War on Terrorism.

Our submarines are being employed extensively in this war. Immediately after September 11th, constrained by an understanding of the scarcity of attack submarines, Combatant Commanders requested 30 percent more SSN presence to utilize in their theaters. An increase in demand that our force structure was insufficient to support. The number of places where Combatant Commanders now routinely request the authority to operate our attack boats (many places we've never been before) have increased by 130 percent in a year. Our submarines' principal employment, following the missile strikes and other key missions in support of the campaign in Afghanistan, have been intelligence collection surveillance and reconnaissance (ISR), intelligence preparation of the battlespace (IPB), and maritime interdiction operations (MIO). We have shifted our limited submarine assets to provide greater presence in the Central Command theater. As always, we have, been mindful of and attentive to our precious stealth. That said, submarine ISR today is not what it was during the Cold War when it was strongly influenced by responsibility for Indications and Warning. Intelligence Surveillance and Reconnaissance, Intelligence Preparation of the Battlespace, and Maritime Interception Operations today are fully interactive efforts, with submarine high-bandwidth communications facilitating timely and frequent reports to and direction from Naval Component and Joint Commanders. They are imminently tactical in conduct and content. The access and unique physical perspective submarines provide are also catapulting us into the business of Information Operations where

there is a great deal of experimentation and innovation on-going.

I remind you that U.S. and Royal Navy submarines account for 37 percent of the TLAMs launched so far in Operation Enduring Freedom. Additionally, the access facilitated by submarine stealth is fueling unprecedented experimentation and innovation in Submarine-Special Operations Forces (SOF) capability, and SOF-Submarine employment. In the post-Afghanistan war on terrorism, it is my view that locating the terrorists, their meeting places, activities, things they value, where they sleep, is key to our continued success. The unique access our submarines provide, combined with broader Naval, SOF, Joint and law enforcement capabilities, will make a substantial contribution to providing that critical targeting today. The delivery of converted Trident submarines as SSGNs, the SOF mini-submarine Advanced Seal Delivery System, and the further development and fielding of unmanned vehicles of all kinds, will help us expand that targeting capability in the near future.

Beyond the war on terrorism, our submarines are busy and challenged. In the Atlantic we've deployed 11 SSNs to Joint Forces Command, European Command, Central Command and Southern Command areas of responsibility so far. These boats are doing what deployed submarines do, improving their own and our Navy's collective anti-submarine warfare (ASW) capability, testing themselves, their equipment and weapons in real world environments, in strike, SOF missions and anti-shipping for long periods, stressing themselves so they're ready on an instant's notice. And, beyond the Global War On Terrorism, there is substantial ISR that needs to be done while also participating as part of our Navy team in events and exercises as a Battle Group member, and with allies in support of Combatant Commander engagement. They're busy. They're busy when deployed and at home. A significant amount of depot maintenance work, the associated testing and trials as well as vitally important modernization fills the period between deployments far beyond the demands of training alone.

Meanwhile our SSBNs continue their vigilant patrols, protecting us from weapons of mass destruction, while poised and ready for maritime interdiction operations off our coasts, and providing enormously important contributions to some of the fleet training,

tactical development, research development testing and engineering demands that our limited number of SSNs cannot support. The flawless conversion of Trident navigation and missile fire control systems to commercial off the shelf (COTS) hardware, conversion of submarines from the Trident I to the Trident II D5 configuration; all this continues quietly and efficiently at pace, with success demonstrated in rigorous end-to-end testing that leaves no doubt about system reliability. This is an unheralded success story of which we are very proud. Our SSBN leadership is also busy working on the substantial changes that the Nuclear Posture Review will cause throughout our Navy and SSBN forces, as a result of its implementation, and manifestations of its intent like the combination of Space Command and the Strategic Command.

Allied submarine cooperation and contributions to our mutual goals accelerated dramatically in 2002. Dutch, Danish and Norwegian submarines deployed to the Mediterranean to support NATO efforts in the war on terrorism, and to mitigate our attack submarine shortfall. Royal Navy SSNs, as always, have been by our side, deploying to the Indian Ocean, Mediterranean and Pacific regions in cooperation and support. French SSNs deployed to the Indian Ocean with their carrier force. Colombian and Peruvian submarines have provided us with valuable and mutually beneficial tactical development opportunities. The Peruvians have also done a beautiful job providing the opposition force for the HARRY S TRUMAN pre-deployment training and exercises. USS CONNECTICUT is making the second deployment of the Seawolf class, and demonstrating the terrific capability of the Seawolfs, the Ferraris of the attack submarine world. And we participated in and learned a great deal from our allies in a huge NATO submarine rescue exercise that involved four submarines, seven surface ships, and twelve nations.

The theme of this conference, Transformation and Innovation in Undersea Warfare is a topic with which we submariners like to feel we are comfortable. Why? From deck guns to rockets, to Regulus, Polaris, Poseidon, Tomahawk and Trident, submarine land attack has evolved through innovation and experimentation, and produced transformation. From raiding parties launched on the

surface, to submerged swimmer lockout, to drydeck shelters with Swimmer Delivery Vehicles, and the Advanced SEAL Delivery System, submarine Special Operations Forces capability has evolved through innovation and experimentation, and resulted in transformation. From basic radio and radar warning receivers and direction finders, to sophisticated antennas that can access huge portions of the RF spectrum, complex receivers, analysis and deciphering tools, plus the capability to transfer quickly and securely RF signals data to other platforms and facilities for exploitation, as well as fusing through networks with other data, the rest of the picture, submarine electronic signals intelligence collection has evolved through innovation and experimentation, and produced transformation. There are other examples in communications, stealth, anti-submarine warfare and of course submarine propulsion systems, propulsion systems that transformed our boats from fast little torpedo carrying surface combatants that could submerge for periods of time, to true submarines, long endurance undersea combatants that need surface only for refit and resupply. So, submariners are comfortable with the ideas of adaptation, improvisation, innovation and transformation. They are what we've done and always do. They are part of our remarkable 102 year history.

Today transformational policies, like the Nuclear Posture Review will reshape our Submarine Force, and to a degree our Navy. The war on terrorism may incentivize transformation of our undersea surveillance systems from a shield against submarines, to a shield against surface ships that terrorists seek to use as weapon delivery vehicles. The Trident SSGN whose stealth and payload volume allows us to deliver unmanned vehicles, special forces, and weapons in significant numbers by surprise, will clearly transform the way our Navy looks, and fights. Trident launched unmanned air, surface, undersea, ocean bottom, and terrestrial vehicles, combined with the most sophisticated of our sensors, SOF troops, will give us the opportunity to find, out-know, and out-think an adversary without his even knowing it. Trident-launched cruise and ballistic missiles, jammers, decoys and deception capabilities can destroy or render useless an enemy's most threatening capability, and deliver immediate access to our Naval and Joint Forces.

Trident payload experimentation and innovation will transform our Virginia class SSNs, and in turn Virginia technology insertion and development will alter the SSGN. It is a synergy we find very exciting. And of course, information technologies and the power of networks are sparking innovation and providing opportunities for transformation throughout our Submarine Force and our Navy.

Your conference working groups on Aviation, C4I and Combat Systems, Sensors, and Vehicles, have much to talk about, given the opportunities and challenges technology and our time are presenting us—opportunities and challenges to adapt, improvise, experiment, innovate and transform. As you conduct your discussions, I ask you to focus on the core businesses of undersea warfare, and certainly two of the core competencies of our Navy, Mine Warfare and Anti-Submarine Warfare. For several reasons, but most particularly because of the complexity and hostility of the undersea environment, mine warfare and anti-submarine warfare remain difficult and demand extraordinary discipline and effort, if we are to be successful. Discipline and effort that, in my opinion, we have difficulty sustaining.

Mine Warfare is my greater concern among the two, because it is in dealing with mines that we are farthest behind the power curves of mine availability and sophisticated mine technology. Mines are access-denial tools and, among other things, our Navy must ensure access for our Joint Forces. Our dedicated surface and airborne mine countermeasures capabilities are not what we'd like them to be, are better than nothing, but are very slow. I do not intend to be critical of the dedicated professionals who have made mine warfare their lives' work, this is simply my assessment of the capability our collective effort and priorities have delivered. In addition, the future of surface and airborne mine countermeasures systems, developed in part to support the concept of organic mine countermeasures, are faced with technological and programmatic challenges. It will take significant effort and discipline to manage those challenges and deliver real capability that substantially improves our position vs. enemy mines.

Mine Warfare in the Submarine Force is getting significant attention to provide that kind of effort and discipline, but, to

produce, they will have to be sustained over time. For example, in order to develop knowledge and experience we require all of our submarines in the Atlantic with under ice and mine avoidance sonars to run a practice minefield when we examine their tactical readiness each year. We are collecting valuable data on the performance of their equipment, but still do not know enough to be able to grade the performance of the people, given the variance in their equipment performance and the environment. Results of testing our new equipment, like Acoustic Rapid COTS Insertion tools, are promising, but promises aren't good enough in Mine Warfare. Capabilities to improve our Navy performance in Mine Warfare are frequently promised. We need to deliver. Our work indicates that effective mine avoidance and minefield penetration by a submarine with unmanned vehicles are not impossible. However, they are difficult. We need to maintain the effort, focus, and discipline in thoroughly testing and characterizing the performance of the equipment and crews we have, as well as for promising new tools we've identified. As our capability improves beyond the basic, we need a better and more sophisticated mine training range, we need to operate our submarines and UUVs in stratum with moored mines, and we need to test at full scale the performance of our boats and their countermeasures against modern mine sensors and logic. Largely, you here, are the talent we need to achieve those advances.

While mines are ubiquitous, submarines are the ASW challenge to our responsibility to deliver access varies in the different regions of our world. As I have testified before Congress, our ASW capabilities can best be described as poor or weak. It seems to me that, as a minimum, our Navy must have the capability and capacity, if required, to neutralize the potential undersea threats posed by China, North Korea and Iran, today. We must also maintain a close watch on Russia, who remains a high-end provider and exporter of undersea technology. While China and North Korea have a significant number of submarines (by and large individually unimpressive) their collective numbers and the environment where we would most likely have to engage them warrant taking them very seriously, and we do.

At the same time, the center of conventional submarine and

submarine weapon development is in Europe. Swedish, German and French Air Independent Propulsion (AIP) systems are, or soon will be, operational. The Russians have indicated an intent to follow suit. AIP will enhance conventional submarine survivability and lethality. Fortunately it is not here in numbers yet, but neither can we produce the capability and capacity to deal with it overnight. Concerns with China in the near and medium term should not distract us into reducing the number of assets, and our ASW activities, such that we become a one-ocean ASW Navy. Nor should our constant quest for, and the promise of an ASW silver bullet seduce us into forgetting that ASW is hard, force structure intensive, and a dynamic game of measure and countermeasure.

We clearly need four things to improve our ASW capability now and in the long term. These are not in order of priority, but efforts that must be synchronized and balanced.

First; platforms. The availability of ASW platforms, particularly maritime patrol and reconnaissance aircraft, ASW helicopters and the only effective large area cueing assets we have—fixed arrays and SURTASS ships—must be sufficient for the task. Additionally, our best submarine killer, our SSNs, must be present in sufficient numbers.

Second; sensors. So both our platforms and the sensors on their weapons can find and destroy submarines. Sensor limitations are a severe constraint in the employment of network centricity in ASW.

Third; training. We must know, with more assurance than we have today, how well what we now have in equipment and people can perform.

Fourth; disciplined data collection and analysis. All of our efforts in ASW must be underwritten by this, or they will not be effective. For example, we have today delivered an ASW system to the fleet that is based on proven phenomenology. It works. That capability cannot be employed effectively by the fleet operators, however, because insufficient rigor was used in characterizing system performance and reliability in varied environments. The operators simply do not know enough about its performance to use it effectively. Collecting standard sets of real world and exercise

data and subjecting that data to solid analysis based on proven first principles is necessary in the tough business of ASW, and must be implemented across the Navy so our experience and expertise are more than episodic, and so that corporately we learn from one ASW opportunity to the next.

We have started to address these four issues but have a long way to go. We need all of you here to contribute to improvement in our Navy's ASW capability and capacity.

Ladies and Gentlemen, leadership of NDIA, thank you for your interest and work toward improving our Navy's capability in the critical Undersea Battlespace today and tomorrow. We have a competitive advantage in the undersea world and we need to develop and exploit it to confound, disarm and incapacitate our adversaries. I think that's what we call transformation.■

GLOBALIZATION UNDER THE SEA

by RADM W.J. Holland, Jr., USN(Ret.)

Rear Admiral William J. (Jerry) Holland is an adviser and consultant on command, control, communications, computers, intelligence surveillance, and reconnaissance (C4ISR) matters, submarine warfare, and nuclear weapons policy for a number of individual clients, government agencies, and policy organizations. He retired after 32 years of naval service, including 13 years in command of nuclear submarines, submarine squadrons and group, and the Submarine School. He is currently Vice President of the Naval Historical Foundation and recently edited The United States Navy (Washington, DC: Naval Historical Foundation, 2000).

This essay is a chapter in Captain Sam Tangredi's book, "Globalization and Maritime Power". Captain Tangredi's overview, the first chapter in that book, was the lead essay in the October issue of THE SUBMARINE REVIEW. Admiral Holland's essay is that chapter of the book that deals with the issues related to undersea warfare.

The new realms of space and under the sea are the hallmarks of the globalization of the U.S. Navy that began after the end of World War II. These elements differentiate today's maritime reality from that experienced by the Royal Navy in the previous two centuries. Submarines, nuclear power, and mines make today's world much more problematical than the one the Royal Navy ruled. When coupled with Earth orbiting satellites, nuclear submarines make the current and future global maritime environment substantially different than even that which existed in the first part of the 20th century.

While distance has yielded to technology, the ocean's complexity remains challenging. Scientists who deal with the ocean attest:

> The ocean is not transparent. This bold, flat statement, eminently testable and tirelessly tested, carries a truth that has far-reaching, even global implications. Both a blessing and a curse to undersea warfare, it may, indeed, be the

preeminent *Catch-22* of geopolitical strategy today.[1]

The opaqueness of the ocean to light and electromagnetic energy make it a singular environment. Operations in this medium have a character unlike any other. Invisible from all but the most sophisticated sensors, which have to be based in the same medium, ships operating inside the ocean generally disclose their presence only by leaving their adversary "a flaming datum," a sinking or severely damaged opponent. No technology is even forecast that will change this situation.

Thus visibility in the ocean is asymmetric in two ways. The ocean is more visible to advanced powers than to others. The combination of space-based sensors, sea-bottom sensors, wide area mobile sensor arrays, and long-range acoustic detections by submarine sonars make the oceans vastly more visible to the United States than to any other country. This visibility extends even into the littorals of other countries.[2] Submarines, the other facet of this asymmetry of visibility, like space-based sensors, are expensive and require skilled work forces to operate. This is not a description of systems likely to be available to Second and Third World nations. While the interior of the sea will remain a challenging environment for all, the asymmetry in this global environment will likely continue to favor the United States for years to come. The proliferation of anti-access sensors and weapons systems that may be a characteristic of military globalization has not penetrated the open ocean.

The Nuclear Powered Submarine—Queen of the Seas

The foremost change in maritime warfare since World War II has been the appearance of a new capital ship. Operating as a true submersible with an endurance of months at high speed, submarines propelled by nuclear power have the ability to go to every part of the ocean. No place is too far. Forces need not be dispatched far in advance of a perceived need, nor is a global infrastructure of logistic ports necessary. The nuclear powered submarines dominate the maritime scene to an extent never before seen. This

situation has few precedents and thus far only one war, the Falkland Islands campaign, to demonstrate this change to maritime affairs. This war demonstrated that other forces can operate in the vicinity of nuclear powered submarines only with the submarines' acquiescence.[3]

Properly operated, a nuclear submarine wishing to remain undetected is undetectable by any surface- or space-based platform except for chance encounters.[4] Submarines are not now and for the foreseeable future will not be subject to attack by cruise or ballistic missiles, chemical or biological weapons, or electromagnetic pulse. This characteristic makes these submerged platforms ideal bases for strategic weapons and allows them to conduct operations in areas otherwise denied or sensitive. (Emphasis by Editor.)

In 1988, the editor of *Jane's Fighting Ships*, a world authority on the subject, declared that the mark of a first-class navy was possession of nuclear submarines.[5] So pervasive is the ability of the nuclear submarine to dominate the sea that the first and most dramatic effect has been disappearance of surface warships in other than the dominant Navy and America's allies. Just the existence of the American fleet of nuclear submarines makes surface warships of all other nations poor investments. American nuclear submarines deter naval arms races more effectively than any line of battleships has in the past. The size of this modern fleet and its continuing improvement set a standard that no one else can reach or sustain and so few try—the so-called dissuasion effect.[6] Even in the United States, surface warships are not designed to fight other surface warships and have abdicated most antisubmarine warfare (ASW) capabilities, making little pretense that they can operate in the vicinity of submarines.

This inherently stealthy platform, unlike a surface ship or aircraft, can operate with impunity in a high threat area without the need for self-defense. Invulnerability is inherent in the medium. This remarkable feature, available in any submarine and demonstrated in every maritime theater since 1914, becomes truly formidable when coupled with advantages of high speed and unlimited endurance. Nuclear submarines have long been used for

sensitive operations in littorals because of their ability to operate undetected and to remain unsupported for long periods of time. These kinds of operations, cloaked in much secrecy and double talk, are sufficiently important that, according to public pronouncements and documents, the time devoted to them has increased since the end of the Cold War.[7]

Nuclear power enables submarines to deploy to the ends of the Earth without dependence on any infrastructure for months. This precludes the need to preposition stocks in theater, provides the flexibility to go to whatever area is deemed advisable, and allows the ship to stay as long as necessary. Submarine deployments can be conducted in relative obscurity if desired, and forces can be in place in any littoral of the Atlantic, Mediterranean, or Pacific within a week.[8] Coupling routine operations in areas of interest with this ability for rapid deployment of reinforcements of forces gives the United States great flexibility in shaping the battlespace. Undersea assets are particularly effective in sensing enemy intentions, observing ports and lines of communications, laying the basis for the sensor grid, negating the effect of antiaccess preparations—including sinking minelayers. While submarines are unlikely to field antiaircraft weapons, the ability of their weapons to interdict airfields is excellent. Versions of the Tomahawk missiles that are designed for just such efforts are particularly effective against unbunkered aircraft. With their short time of flight to target and the launch from unsuspected locations and azimuths, missiles from submarines can be crucial weapons in the first days of operations against an enemy land-based air force, missile launchers, and air defenses.

High speed, unlimited endurance, and logistic independence allow massing of weapons in a theater before an engagement, at the first outbreak, or later as desired. Because submarines can so swiftly close the area of operations, they can bring large numbers of weapons to bear—not in a single platform—but in a number of platforms. During the Cold War, the Navy demonstrated the ability to sortie virtually the entire Submarine Force not in the shipyard in 2 or 3 days. As a result, this whole Force is an available reserve that can mass weapons on scene very quickly and totally independ-

ently of political considerations or overseas infrastructure. In a world punctuated by unexpected and unanticipated crises, speed of response and the ability to manage risk become highly sought commodities. These are the forté of nuclear submarines that possess the stealth and agility to deploy without fanfare, adding nothing to media pressures to heighten tensions or shorten time lines.[9]

Future submarines will be expected to carry "countermine capabilities, unmanned undersea vehicles, [and] strike weapons," as well as all the necessary weapons and sensors to conduct antisubmarine warfare.[10] Such hulls will not be smaller or less costly until some technical breakthrough such as direct conversion of fission to electricity comes to fruition, reducing equipment size.

Diesel Boats Forever . . . but Not For Us

As Paul Scully-Powers states, ocean opaqueness is a double-edged sword. While not every country with a navy can build or operate nuclear powered submarines, conventionally powered submarines are a realistic mechanism for many nations without an otherwise functioning navy to challenge, locally and for some finite time, the dominance of the United States. While the piston engine and the biplane are anachronisms in the air, conventionally powered submarines represent a weapon system that can be thwarted only after substantial investment of resources and time by even the most advanced navy. Though lacking the mobility, endurance, and sensor suite of modern nuclear powered submarines, conventionally powered submarines operate in the same opaque medium and, at least for a time, can be as stealthy, difficult to detect, and lethal a threat to surface ship operation in their vicinity. The obvious disadvantages of slow speed, time limitations to their stealth, and restricted endurance severely inhibit the utility of the conventional submarine. But where the area of conflict can be predicted or is geographically constrained, these submarines are a substantial challenge to even the most dominant maritime power.[11]

However dangerous in their areas of operations, conventional submarines are essentially "mobile minefields" lacking both the

endurance and the speed to be useful in maintaining forward presence or power projection. With a speed of advance of 10 or 12 knots when stealthy (and that is very wearing on the crew) or even 18 to 20 knots surfaced, conventional submarines are slow to reach station. Once on station, they cannot be easily moved or quickly reinforced. For the United States, a country that expects to fight in distant oceans or deep seas, conventionally powered submarines are expensive anachronisms. The fate of the Royal Navy's Upholders class (fine conventional submarines constructed under the rubric of "more conventional is better than fewer nukes") is a lesson in economics. These submarines served for a very short time before being laid up and offered for sale, cheap, to any buyer. Those who advocate that the United States should buy or build conventional submarines are heirs to the traditions of Thomas Jefferson's gunboats or the coast defense battleships that served no purpose. Though less costly to build than nuclear powered submarines, with no utility these ships are very expensive.[12]

ASW is Still Job One

The only serious threat to America's sea lines of communications/commerce (SLOCs) comes from submarines. With the Navy's emphasis shift to strike warfare, antisubmarine warfare has died as a matter of priority in every warfare community. Only the Maritime Patrol Air and the Submarine Forces pay more than lip service to ASW. Maritime air faces a problematical future as its aircraft, the venerable P-3C, begins to reach the end of service life in 2005 with no evidence of a program to replace the aircraft. [13] This leaves submarines as the primary Navy ASW vehicle and the only carrier of a reliable and proven ASW weapon.

This deficiency in naval capability bothers few in the Navy and even fewer leaders in the Government. American dominance at sea has been unchallenged for so long that most are dazzled by the illusion of instantaneous and total American naval hegemony. However, no navy can cope in a short period with even a few diesel submarines, particularly if they are positioned along a SLOC before a crisis. With no ability to confront the U.S. fleet directly,

the only recourse that nations have in trying to oppose this country at sea is either to attempt to interdict the SLOCs or to make it difficult to establish a blockade or strike the homeland from close ashore.

Antisubmarine warfare is as much a matter of time and endurance as of technology and operational procedure. The conventionally powered submarine can be thwarted, but only through patient endurance and careful use of resources on the side of the dominant navy.[14] One observer comments that "Even if the U.S. Navy can detect and destroy enemy submarines it is unlikely that it could do so before they inflict unacceptable damage on both the U. S. fleet and allied shipping."[15]

Should a forehanded enemy choose, deployment of conventional submarines to chokepoints or harbor exits distant from the area of conflict can be devastating as the Germans proved in 1942 and 1943. Properly operated and adequately armed, two not unsubstantial or easily satisfied requirements, conventional submarines could be major deterrents in flow of forces out of the United States and into theater. Karl Doenitz did not defend his littorals by holding his U-boats in the North Sea; he did it by sending them to the east coast of the United States and the middle Atlantic. Sooner or later an opponent with submarines, probably conventional ones much like those used by the Germans 60 years ago, will challenge U.S. maritime dominance off Savannah, Sandy Hook, the Straits of Gibraltar, the channels into the Straits of Malacca, or any one of a dozen other sites where trade routes pass. When that occurs, the calls for ASW forces will be frantic, and no one will respond but the Submarine Force and its auxiliaries, the Integrated Undersea Surveillance System's towed array ships. The ability to counter submarines depends on training, equipment, and weapons. Such investments are being made only in the Submarine Force of the U.S. Navy.

The Fleet Ballistic Missile Submarine: Invulnerable Base for Strategic Arms

Nuclear submarines are the ideal bases for strategic weapons

and will remain so as long as nuclear weapons exist and the oceans remain opaque. Undetectable and invulnerable, they offer no incentive for an enemy to try to strike first because the ocean provides complete concealment. Equally important, by basing missiles in an invulnerable mode, any enemy is assured that the owners of such forces will be able to strike back after an attack of any kind. Now that the characteristics of the missiles carried on submarines (for example, range, accuracy, readiness, and communication connectivity) are as good or better than those based on land, there is little reason to support other weapons systems. Able to attack any point on Earth from their operating areas, fleet ballistic missile submarines (SSBNs) will continue to provide the most effective disincentive to the use of nuclear weapons.[16]

The British have led the way toward rationalization of national nuclear weapons forces by moving all of their deterrent weapons to sea, never having seriously considered land-based weapons and retiring their bombers as strategic weapons delivery systems. Land-based missiles are natural targets both for missiles and terrorists while no longer having any attribute superior to their sea-based brethren. Every country having nuclear weapons that can build and operate nuclear powered submarines will probably imitate this British initiative except perhaps Russia. Because of its continental mentality and vast space allowing land-based missiles to be mobile, Russia may remain an exception.[17] There the ratio of land- to sea-based weapons will be as much a matter of cultural heritage as any military or political analysis. China has been trying to make a sea-based missile system work for a number of years and will, eventually, deploy an operative missile on a submarine. Both India and Pakistan have nuclear weapons and missiles, operate conventional submarines, and have hopes of someday being able to operate nuclear submarines. It is not unreasonable to assume that they will eventually achieve the goal of putting their strategic nuclear weapons on a submarine platform.

The extent to which one country is seen as being able to hold at risk another's seaborne strategic weapons is a major issue in this equation. While this is a matter of perception as well as expertise, there is no question that the United States believed that it could

threaten the sea-based strategic forces of the former Soviet Union. At the same time, the United States also believed that its SSBNs were absolutely secure and invulnerable to interdiction by any foreign power. Exercises at sea under real conditions indicated both of these beliefs were well founded.[18]

Unless there is an abolition of nuclear weapons, a most doubtful scenario, the next fleet ballistic missile submarine will be designed in the coming decade. As the total number of weapons deployed decreases, questions about the number of needed ships will be in the forefront of this design. Part of the equation that makes up the invulnerability of these weapons is the number of platforms at sea at any time and the difficulty inherent in trying to threaten all of those simultaneously to create a convincing first-strike scenario. Ten submarines is generally accepted as the very minimum to deploy an untargetable mass while allowing some maintenance.[19]

Scouting: Watching Without Being Seen

Submarine ability to conduct surveillance and reconnaissance has long been veiled in mystery—as any good intelligence operation should be. But the present emphasis on design of hull number 5 of the Virginia class as a platform dedicated to intelligence gathering and reconnaissance gives some indication of past successes and future expectations. While the exact nature of the modern submarine's intelligence gathering, scouting, and reconnaissance functions remains closely held, a current statement of the capability by Commander, Submarine Force, U.S. Atlantic Fleet gives some indication of the capability: "We now have the ability to collect information in ways that no one else can ... stay on station a long time ... [and] integrate what they collect at a level of sophistications that you just can't do with a machine."[20]

Submarine sensors complement space-based sensors and in some cases can detect activities that space-based or air-based sensors cannot. The synergism between space sensors and the sensors carried on and deployed by submarines grows as their complementary abilities are exploited and respective limitations recognized. While some space-based systems will become more capable in

detecting emissions of interest on Earth, detections will continue to depend upon a cooperative target, that is, one big enough, loud enough, in the frequency being watched, and so forth. The presence of a space-based system sensor can be predicted well in advance of its arrival. The submarine on the other hand operates without notice and even when suspected to be in the vicinity is often ignored by those targeted. In addition to finding information on manners and mechanisms that would be concealed if their operators were conscious of the presence of an observer, the submarine can detect and act upon data found in real time. Low power communications, for example, are more likely to be intercepted by small antennae close aboard than by a large antenna hundreds or thousands of miles away.

Some submarines, USS JIMMY CARTER for example, will have a flexible ocean interface that will allow submerged launches of a number of various kinds of payloads. Special Forces unmanned and manned underwater vehicles are part of these. Other capabilities that hold great promise in the globalized world include sensor devices on the ocean bottom, communications links using fiber cable laid on the seabed, and ocean engineering machinery for retrieving and planting equipment.

Submarine Reconnaissance: Forward Node of the Expeditionary Sensor Grid

Submarine intelligence gathering and scouting, normally started long before the battlespace has begun to blossom, are not the same as serving as a node of a sensor network providing near-real-time data. Submarines can bring a synergistic combination of on-board sensors, manned and unmanned deployable vehicles, off-hull land, sea, and air sensors, and special forces that can become the forward elements of the theater's expeditionary sensor grid. Unlike space-based sensors and long-range airborne assets, submarine sensors have agility and staying power. Submarine sensors form a segment of this sensor network that can be moved wherever needed with little regard to threat or logistics considerations. In the Falklands campaign, for example, a submarine operating close inshore off the

Argentine airbase served as the air early warning sensor.[21]

In addition to on-board sensors and analytical personnel, the submarine promises to bring a number of sensors to the preparation of the battlespace by deploying families of unmanned devices. Exploitation of the undersea environment and coupling to space-based assets promise to make any part of the globe as visible as home waters. Among the future prospects are unattended ground sensors to detect radio frequency transmissions, particularly low-level personal communications, acoustic and seismic sensors to indicate movement, and thermal sensors to indicate presence of people or machinery. Increasingly sophisticated small unmanned undersea vehicles for mine detection and oceanographic survey are projected. Unattended sensors on the sea bottom and afloat will become key sensors in observing enemy maritime operations in areas of potential conflicts, important to cue ASW actions and countermining. With lives of hours or days and refurbishment without risk to the delivery platform, these devices can be covertly laid to allow preparation of the battlespace in near real time without alerting the enemy.

Improvements in signal recognition, data stowage, knowledge-based comparison, data compression computer processing, and communications will allow sensors to be deployed in small packages yet be able to describe where they are and much of what they detect without transmitting data for analysis. Such capabilities will open a new realm of tactics. Combining data from both space and submarines in near real time is a technique perfected years ago when the targets were the Soviet surface fleet and the weapon was the anti-surface Tomahawk Attack (Sea) Missile. The same techniques can provide inputs to the expeditionary sensor grid. Since the platform doing the sensing is also capable of launching weapons and supporting Special Forces operations, the reaction time to developments sensed is reduced to a minimum.

Special Forces: Getting In and Out Without Being Seen

No more avid proponent of exploitation under the sea exists than the Special Forces that use the submarine as a delivery system for

surreptitious entry ashore. The submarine provides adequate space, sufficient communications for planning and execution, and assured access to the area of employment. This capability will be more important in areas where land bases within aircraft operational range of targets is unavailable or is denied by political considerations. The ability to place Special Forces near targets, without exhausting the physical condition of the forces and without alerting the enemy, is likely to grow in importance. Where operatives provide intelligence from ashore, low probability of intercept (low power spread spectrum) communications directly to the submarine and then to the special forces is realistic and particularly attractive.

With the advent of advanced swimmer delivery vehicles, a small battery-powered submarine, accomplishing these tasks is easier because the submarine can remain further from shore while putting the special forces close to the beach before having to swim. The limitations of past miniature submarines are addressed by the mother ship—a stealthy source of electrical charging, air, and equipment space.

Beyond the well-recognized special forces operations against land targets, submarines can also bring ocean engineering techniques to exploit the ocean bottom. Particularly intriguing for these diver operations are schemes to exploit enemy sensors or to move enemy mines.

Thwarting Antiaccess Strategies—Penetrating the Defended Littoral

Much of the current promotion of short wars through rapid attack assumes the United States will control the air and sea before the conflict begins. But access to a defended littoral—like most battles—will be sequential, not simultaneous. The United States and its allies will have to fight their way in, sometimes against heavy odds. Countries intending to defend themselves against attack will create perimeters fortified by submarines, mines, land-based over-the-horizon sensors, antiship cruise missiles, theater ballistic missiles, antiair defenses, tactical aircraft, and command and control systems secure from distant interception. Eventually

technologies already identified will allow defense to seaward of 100 miles or more by any moderately adept country. In this environment, the survivability of surface ships in the littoral becomes problematic at best.[22]

Submarines and their associated underwater vehicles offer the necessary mechanisms to overcome an anti-access strategy. The advantages of the stealthy nature of the submarine in this situation cannot be overstated. Development of a capability to detect submarines, let alone classify and attack them, is immensely expensive and difficult. Few countries have mastered it and then only for limited periods of time and after great expense. It does not exist today.

Stealth permits submarines to act as the key that unlocks the door when opponents adopt antiaccess strategies. With no ability even to detect a submarine, an opponent is helpless to defend itself against the threats that such a vehicle can present. "Pushing back entry points and interdicting forces"[23] have no meaning for submarines. The stealthy aspect of the submarine allows it to operate with impunity in areas that are too hazardous for other forces. The strike weapons that the submarine can bring to bear raises the assured cost of opposition limiting the effectiveness of an antiaccess strategy. Further, open literature demonstrates that the presence of U.S. submarines can be inferred in any country that has a littoral, and the threat from submarine launched strike weapons will be limited only by the time to deploy a number of submarines into the threatened area and to reload them after their initial salvos are expended.

Strike from Inside the Defended Perimeter and the Real Arsenal Ships

The current Navy vision document, Forward ... From the Sea, recognizing that there is no competition on the high seas, emphasizes strikes against shore targets. The combination of the strategies advocating early strikes of great precision and concerns for surface ship operations in defended littorals give weight to providing such strikes from secure vehicles (that is, submarines).

Unlike surface ships, the submarine needs no antiair/antimissile protection and, against likely maritime opponents, few torpedoes. Almost every ammunition stowage, certainly every missile space, can contain a strike weapon. The advantages of nuclear power, enumerated earlier, allow these ships to be deployed, redeployed, or held in readiness, able to transit to any theater quickly. No matter where these ships may be located at the beginning of a crisis or how well defended a littoral may be, any potential enemy will have to consider the weapons that these ships carry will be delivered on their territory and from locations well inside the horizon line of their shores.

The greatest benefits arise when the submarine platform operates for some period of time in a littoral area during crisis buildup and before conflict begins. Conducting clandestine surveillance of the enemy coast and littoral, coupling information from on-board sensors to data from space and air sensors directly with intelligence from databases on board and information supplied from theater headquarters, the submarine and, if embarked, special forces can plan optimum missions well before shooting begins. Should a crisis develop into a conflict, the submarine can approach close to shore ready on D-Day to deliver the initial salvos to shock enemy command systems, to overwhelm and suppress the enemy air defenses enhancing the effectiveness of air strikes, and to destroy surface sensors and anti-ship weapons enabling entry of surface ships into the defended littoral.

Submarines can enhance the effectiveness of other forces in several ways. Attacking air defenses (for example, suppressing them) makes air strikes more effective because fewer planes need be devoted to force protection. Destruction of the enemy theater cruise and ballistic missile weapons, launchers, arsenals, and planes reduces the sizes of subsequent salvos with which the anti-air/anti-missile forces must contend and reduces the demands on the theater inventory of anti-air/anti-missile weapons.

Missile inventory is one of a theater commander's major concerns, particularly in the early stages of conflict. Today, attack submarines bring a significant contribution to the land attack capabilities because 80 percent of the magazines of missile-armed

surface ships contain anti-air/anti-missile weapons. In any crisis in which a potential enemy can field ballistic or cruise missiles, this ratio is likely to tip toward more anti-air/anti-missile weapons. Magazine spaces in surface ships will be most important in defending the ports of entry and in-theater forces logistics bases. Land- and air-based missile defenses are likely to be limited or absent in the opening days of a campaign and during the flow of air and ground forces to the theater. In such cases, missile and air defense will have to be exercised almost completely by the Navy. The most important mission of the Aegis and its follow systems will be defending the movement of follow-on forces: there will be few missile spaces available for strike in air defense capable ships.[24]

With submarines furnishing much of the land attack missile capacity needed, surface ship design can be optimized for anti-missile defense or other purposes. Furthermore, with submarines clearing the littoral for follow-on forces; suppressing first any enemy warship operations and then air defenses; and attacking land-based sensors, command and control facilities, and missile launchers, the design requirements for surface ships operating in the littoral are greatly eased. Stealth is advantageous, but the expense of design and construction of stealthy vehicles is exponential; cost increases by several orders of magnitude for each incremental gain in target cross-section reduction. For a submarine, stealth is provided by the medium, and while reduction in noise levels to improve stealth is expensive, the order of expense for vehicles operating on or above the surface of the ocean is much greater. No surface ship can ever be as stealthy as a submarine no matter the expenditure, but using submarines to crack open a defended littoral, no surface ship needs to be.

Among the advantages that submarine launched strike weapons bring is their short time of flight. Able to attack from relatively close inshore, these weapons can respond to urgent targets—those that may move or disperse—or highly valuable, strongly defended ones. Weapons launched from submarines inside the perimeter of a defended littoral have the shortest distance to travel, can come from a wide azimuth, and so provide little warning to the defender.

The ultimate shore strike vehicle is, of course, the fleet ballistic

missile submarine. With the end of the Cold War, 4 of the 18 Trident hulls were declared excess to American's strategic needs. These redundant hulls, each with about 20 years of ship life left, offer the opportunity to convert them to tactical land attack platforms. The advantages offered by this kind of platform now and even more in the future suggest that these Tridents will be the model for future submarines designed specifically, although not exclusively, for this task. With a crew half the size of Arleigh Burke class destroyers and no requirement for fueling or other logistic support until the magazine is exhausted, the submarine embodies all the attributes desired for the arsenal ship plus invulnerability and sustainability not possible in a surface ship.[25]

Finally, the very existence of the submarines capable of entering any littoral and attacking targets afloat and ashore with powerful weapons should serve as a deterrent to construction of littoral defenses. Like the dominance of the nuclear submarine on the high seas, little can be done to prevent these submarines from accomplishing their mission; discouraging endeavors to fortify the littorals.[26]

Command and Control of Stealthy Forces: Works in Progress

Today's passion for jointness contains a danger in employing stealth vehicles. Submarines, the prototype stealth vehicle, are best employed independently, not tied tightly to the movements of other forces. Submarines can enhance the effectiveness of joint operations (for example, improving the efficiency of tactical air by suppressing enemy air defenses or by countermine operations enabling access by follow on amphibious forces), but even in doing so need not, indeed *should not*, be maneuvered as units to remain fixed on station or in constant communication. Invariably, attempts to employ submarines by officers not familiar with their attributes are limited by unnecessary requirements placed on operation so that they look like surface ships or communicate like combat air patrol units.

Direct downlink from space-based sensors will inevitably link the sensitive on-scene sensors deployed on and by the submarine

with the big picture from overhead. Together, these inputs can confirm or contradict, allow immediate on-scene analysis of data, and provide a basis for immediate action. Rules of engagement for vehicles with these kinds of capabilities will eventually need to incorporate directions to fire on indications at predetermined types of targets and to maneuver without further orders to improve the probability of successful accomplishment of their mission. Development of the tactical concepts for use of these kind of vehicles, whether under the sea or airborne, are still being developed. This development, though, is hindered by the traditional concepts of hierarchical command and control in spite of the doctrinal advocates of decentralized execution.

Space was not the only place where wide area sensors were developed during the Cold War. The threat from the Soviet submarine fleet led the United States to discover and exploit the phenomenon of low frequency sound propagation in the sea, wiring the North Atlantic and North Pacific for sound. Then came movable arrays for use in areas that the fixed detectors could not reach because of geographic shielding or that were outside of the coverage of the fixed arrays. The combination of space-based and in-the-sea sensors created a new information habitat that permitted near-real-time direction of the fleet to avoid or engage likely opponents both on and under the sea. Maritime patrol aircraft and nuclear powered submarines can move rapidly to any area and remain there for long periods unattended became a potent combination that could over time classify and attack, sanitizing an area to allow surface forces to operate there. The Integrated Undersea Surveillance System was the Navy's first sensor grid. This command showed the way to develop remotely sensed data into tactical procedures for others to exploit.

The difficulties of optimizing naval fires with tactical air and coordination with the Air Tasking Order have been identified even in leisurely campaigns.[27] In a major campaign, where weight of explosive, inventory, and target mobility become important issues, the difficulty in trying to optimize utility of individual platforms and weapons will have to be addressed. Not all cruise missiles are equal. In a defended littoral, for example, submarine weapons will

have a shorter time of flight than those from surface ships or aircraft that launch outside the defensive perimeter. For small salvo sizes, weapons in a submarine torpedo room should be preferred over those in other ships because they can be reloaded. Presently no mechanism or process takes these considerations into account. As the numbers and types of weapons proliferate, and as total missile inventories decline because of resource constraints, these considerations will complicate weapons allocations and strike command and control.

One of the challenges for operating a fleet that includes dispersed and stealthy forces such as submarines and special forces will be development of command and control processes that optimize the use of each component and coordinate individual capabilities to maximize the total effort. Even within a single service, understanding the contributions and limitations of individual arms is sufficiently parochial that coordination of employment is a skill set hard to develop. As yet, the mechanics of developing the broad understanding for application of force among components while maintaining the necessary skills in the specific warfare specialties have not been achieved. The difficulties are not only related to submarines (though especially acute there) but also to other stealthy vehicles, independent operators such as special forces, and network information systems. Procedures to optimize fires from a variety of platforms on a variety of targets and to employ stealthy vehicles in a centralized decision/decentralized execution mode remain to be created.

Mines and Countermining

Thwarting of amphibious attacks by mines at Wonsan in Korea and off Kuwait in Operation *Desert Storm* demonstrated the effectiveness of mines in the hands of even primitive powers. Proliferation of mines into the hands of many is a well-identified problem for the dominant navy. Mining is not a trivial undertaking, regardless of mine availability. Far less complex or costly than other anti-access strategies, unless the field is very thick or defended by other forces, mine utility is limited, and it will

eventually be breached. The essence of the problem is *time*.

The most successful and efficient countermining operation is to sink the minelayers. As Admiral Stan Arthur stated, "First of all, you should never let the other guys lay mines if you can prevent them."[28] Laying mines in international waters is an act of war. While obtaining political permission to execute such action may be difficult, submarines have a particular value in their ability to linger, observe, and act. By lying inshore, alert to moves of a potential enemy, linked to space-based or air-deployed platforms that are able to conduct wide area surveillance and thereby able to direct the submarine to the appropriate area, and then to act with short time of flight weapons to sink or totally disable a minelayer, the submarine forms the first line of offense against minelaying.

To make this tactic effective, however, the mindset of the Navy and Department of Defense (DOD) political leadership needs to recognize that laying mines in international waters is an act of war. Attempts to get permission to sink the minelayers during *Desert Storm* failed at high levels of government.[29] Establishing the conditions necessary for offensive action against minelayers before a hostile environment exists is vital. The rules of engagement to be implemented when minelayers are detected must be widely advertised in order to lay the groundwork for a timely decision that may have to be made in the heat of battle—something upper-level leaderships do particularly poorly. The United States should seize the very first occasion in the future when someone lays mines in international waters as an opportunity to demonstrate that such actions are acts of war and will be responded to immediately as such.

Next to sinking the minelayers, the next most effective countermining tactic is sanitization (that is, the process of finding where the mines have or have not been laid). Not entering mined waters is the best defense against an existing minefield. Combinations of space assets, airborne observers, and submarine surveillance can observe the laying of mines with some precision so that major fields can be avoided. Finding and avoiding covertly laid mines that are sparsely separated or drift mines is more challenging. In the presence of minefields with known characteristics but

unknown dimensions, approaching from seaward takes time to locate, disable, or move the defenders' mines. Submarines can start covertly before D-Day or even in the absence of a conflict or crisis. Among their advantages, submarines are built to withstand great pressures. Also, operating in the sea rather than at water interface (half in, half out), submarines are not as vulnerable to pressure mines as surface ships.[30]

Mine reconnaissance by covert vehicles keeps the enemy in the dark or at least confused as to the location of an intended landing or penetration. Scouting by unmanned vehicles will be vital, and their entry into suspect waters will be an early priority task in any operation against a defended littoral. If the fields can be mapped, attackers can maneuver rather than having to attrite the mines. Using the sea as a maneuver space requires early detection so avoidance paths can be established, gaps can be exploited, and countermining plans can be developed. Finding poorly mined areas may require a multitude of sensors—here small, unmanned underwater vehicles will be at their best keys to preparation of the battlespace. This reconnaissance is best conducted in a clandestine manner so as not to alert the enemy of the proposed penetrations. Unmanned vehicles, covertly launched from submarines, are now being proposed to examine the near shore, surf zone, and beaches. The procedures and processes to permit follow-ships to penetrate enemy minefields have still to be explored when submarines scout waters.

Mines present a number of interesting tactical opportunities when covert resources are used to exploit them. Ideas are in a fledgling state as to how countermining conducted by stealthy activities can contribute to U.S. control of a defended littoral. Moving an enemy mine from where it was planted into an area that the enemy plans to use, for example, complicates not only enemy use of the area but also confounds the command and control system that laid the mine in the first place.[31] Permutations for this sort of mental warfare are large and can be effected using covert and overt methods.

The submarine offers great potential as a minelayer in its own right. To mine into port an enemy's seagoing assets is a stroke of

great worth when the enemy needs harbor egress or littoral access for military or economic reasons. Covert mining requires only a few mines to be effective, and the ability to resow the field after minesweeping operations have begun can demoralize a countermine force. The capability for covert mining by submarines is present today and does not require unique skills or expensive technology.

The Potential Enemy Under the Sea

No submarine force has ever gone to war with a torpedo that worked. This sorry history is particularly embedded in the ethos of the American Submarine Force. Armed today with the best torpedo in the world, the MK 48 ADCAP, the Submarine Force continues the practice of expending real torpedoes on real targets at regular intervals expressly to provide confidence that if this torpedo is to be used in war, it will explode when it is supposed to. Expensive underwater ranges and regular exercise by every submarine guarantee that capability in each unit of the American Submarine Force. Few nations have the resources or are willing to afford the expense involved with this kind of program. That expense marks the difference between owning a submarine and having a Submarine Force.

Similar practices with other weapons are necessary to achieve the assurance that weapons, when employed, will accomplish the tasks necessary. This historic track record must be considered when deciding what sort of threat is represented by a nation possessing submarines. Simple possession of a hull is no more than the first step in acquiring the ability to use submarines and other undersea resources.

In addition to having an adequate platform and useful technology, the ability to employ submarine platforms relies on the competence of the operators, intelligent command and control processes that have been practiced, and familiarity with the sea, particularly its internal environment and the geography of the area in which they are operating. These are not casual skills gained by schooling or sitting in port. A submarine that does not go to sea regularly and for reasonable periods of time is a monument, not a

military asset. This description applies to most of the submarine forces of the world.

The performance of the Argentine Navy's submarines in the Falkland campaigns indicates the truth of these descriptions. The Argentine Navy was well regarded before the war, and in some other respects, particularly strike aircraft, it performed well against the Royal Navy. But of the submarines that got under way, only one reached a position where it could take action, and of the many torpedoes fired, none ran true. To find that the fire control system is wired improperly only after going into action is indicative of the obstacles in the way of creating effective undersea forces.[32]

Interactions With Other Navies—Unifying Under the Global Seas

Similar to other parts of the U.S. Navy, submarines have contributed to globalizing functions. A unique application arises in operations under the sea: the prevention of collisions by submerged submarines. Over the past five decades, the Navy has developed careful and elegant procedures to prevent such accidents. Cooperation with other navies operating submarines to share these processes has expanded steadily.

In the Cold War battle of the North Atlantic, the Royal Navy's Submarine Force became a total partner with the U.S. Atlantic Fleet Submarine Force. In the Mediterranean, Italian, Greek, and Spanish submarines managed their operations in close cooperation with the U.S. Sixth Fleet submarine commander. Similarly in Japan, the Imperial Japanese Maritime Self-Defense Force submarine operations outside their local immediate operation areas were conducted in close association with the Seventh Fleet submarine headquarters in Yokosuka. For almost 20 years, a major fleet exercise in the Pacific annually has brought together ships from the Pacific Rim, including submarines from Japan, Australia, Canada, and Chile, under the operational direction of the Pacific Fleet submarine force. The annual UNITAS cruise around South America has included submarines of most of the littoral countries for more than 30 years. The resulting interoperability of the

submarine forces and recognition of strengths and abilities of each country's navy is enhanced in these relationships.

Hammers and Mosquitoes—Submarines in Operations Other Than War

The submarine's roles in counterterrorism and operations other than war are fairly minimal. Scouting and reconnaissance are performed in many circumstances and have been declared very effective. The perceived need has grown as more operations take place in the immediate vicinity of other naval forces. "Now that lots of people know what submarines do, everybody wants one!" declared then Vice Chief of Naval Operations Admiral Arthur. But as the number of submarines has declined, these less central operations have been suspended, indicating their value is less important than other ongoing missions. In general, submarines, like bombers and armored divisions, have only marginal relevancy to operations other than war, but, like a tuxedo, when you need one, hardly anything else will do.

Summary

Control of the sea has been American for so long that it is taken for granted. Few officers on active duty have actual wartime experience and then only against enemies with very limited capabilities. One could wish for this condition to last forever, but history suggests it will not. Someday this control will not be given but will have to be earned or taken. In that fight, warfare under sea surface will play a major role. British historian John Keegan characterizes such a war and the ability of nuclear submarines to so dominate the sea and throttle surface forces as "An Empty Ocean."[33] While conventionally powered submarines do not pose the same threat, the concentration of movement into superports offer tempting targets for any nation bent on interdicting a general trade route. Submarines are not restricted to the dominant navy, the defended littorals, or supporting anti-access strategies. They may be most effective by operating as offensive systems deployed

off the coast of their opponent, read *the United States*, or along the sea lines between ports of embarkation and debarkation. Control of the sea in the future will involve dominating the depths before being able to exploit the surface as the broad commons described by Mahan. **Submarines will be the primary vehicles in this endeavor, the first requirement upon which all else follows.** [Emphasis added by Editor.]■

ENDNOTES

1. Paul Scully-Power and Richard J. Stevenson, "Swallowing the Transparency Pill?", U.S. Naval Institute *Proceedings*, 113, No. 12 (December 1987), 149-152.
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SUBMARINE OPERATIONS IN TAIWAN WATERS

by CAPT Bo Rask, RSwN
CO 1st Submarine Flotilla

Ed. Note: During the Royal Navy submarine centennial Captain Rask held a briefing in Lancaster, England about submarine operations in The Baltic Sea. He was later asked by Taiwan Defense Affairs to write an article about submarine operations in Taiwanese waters. It was printed there in Volume 1, No. 3, Spring 2001. It is reprinted here with permission of Taiwan Defense Affairs.

Captain Rask states he has never been to Taiwan but the shallow area of the Taiwan straits is, in many ways, similar to the situation in The Baltic.

The Strategic Framework

A quick look at the map or at a chart covering the western part of the Pacific immediately shows the observer the strategic position of Taiwan.

Taiwan is located almost on the Tropic of Cancer, separated from the Chinese mainland by the very narrow and shallow Straits of Taiwan. The straits are just some 80-100 nautical miles wide. The important sea line of communications between Europe-Singapore and Japan runs through the straits. The straits and undisturbed shipping along that sea route therefore have a high strategic value for many countries. The straits have in that respect a worldwide interest. A conflict in the straits, due to the high interests at stake, will immediately draw attention from several strong maritime nations in the area and elsewhere.

The straits also have an important operational and tactical value for the People's Republic of China (PRC). Chinese military and civilian coastal shipping along the eastern coast of China has to run through the straits to connect the southern and northern parts of China. Taiwan is located almost on the middle of the eastern seaboard of China. From Taiwan, it is possible, at least temporarily, to threaten the shipping along the coast of China, and thereby cut the PRC sea lines of communication. Taiwan could

easily be a military platform (similar to a carrier) from which a serious air and naval threat to the PRC can be established.

Finally, the free access to the high seas and a free navigation along the sea routes to and from Taiwan are essential to the national survival of Taiwan due to Taiwan's needs as an export-oriented economy.

The Straits of Taiwan therefore, in many respects, represents a classical *Maritime hot spot* on the globe. That hot spot can easily be the spark in the powder-barrel that threatens the stability in the region. Naval presence in such an area is paramount for nations that rely on shipping along the sea lines both for their survival and for the increase in their economy. A strong naval presence from many countries with different interests at the same spot of ocean can be a stabilising factor, but can also rapidly increase the tensions in the area.

On paper, the PRC maintains a strong navy with a strong submarine force. A look at the order of battle tells us that many of the ships are of older origin and not especially suitable for operations in shallow water. The strength of the PRC Navy lies mainly in the large number of missile attack boats and its substantial amphibious capability. That naval force can easily disturb the free navigation to and from Taiwan with a naval blockade if PRC decides to do so. The possibility of an invasion lies also at hand. The PRC submarine force consisting of a range of different boats; SSBN, SSB, SSN, SSG, SSK and SS all have their different roles to play, not necessarily against Taiwan in case of a conflict. Several boats are of an older design with a low battle potential. The SSBN and SSN needs normally deeper water than the straits can provide.

Submarine operations with small submarines in such an important area can be very successful. From the U.S. submarine attrition war against Japan during WWII, there are numerous examples of successful submarine attacks against the Japanese shipping in the Straits of Taiwan (Formosa) and along the eastern coast of China. Legendary is the eleventh war patrol of USS BARB (Commander Fluckey) in December 1944-February 1945, the third war patrol of USS TANG (Commander O'Kane) June-July

1944 and the fifth war patrol of USS TANG (Commander O'Kane) September-October 1944. On that last patrol the submarine operated in the southern reaches of the East China Sea; specially the reach between Northwest Formosa and the China Coast. That area was dangerous due to minefields to the eastward and a hostile coast to the west. The famous USS TANG was lost on that patrol, due to a circular run on one of her own torpedoes.

The U.S. submarine war of attrition successfully choked off the supply of food, crude oil, rubber and other vital industrial raw materials, thereby strongly contributing to Japans ultimate unconditional surrender.

The main defence strategy for Taiwan obviously has to be to avoid being choked by a PRC threat of war of attrition or that such a war breaks loose. An important part of the strategy must therefore be to build strong relations to important naval powers that can come to assistance in case of an increased tension in the area. The only country with a true naval capacity and base facilities in the vicinity (Okinawa) for such a conflict, is the USA. Another important part of the strategy must be to build up an air and naval force capability that can take the first blow in case of a conflict. Such a strong force could easily increase the defence planning difficulties for PRC.

A strong submarine force can be the cornerstone in such a force structure. Modern submarines can take the war to the enemy along the whole China coast, which is a very valuable asset. They are unpredictable in their operations and extremely difficult to detect and destroy. Modern submarines can therefore change the whole strategic situation in the East China region in favour for Taiwan and it's security Policy. Modern submarines must therefore stand at the top of the Taiwan shopping list.

Operational Conditions—Implications on SM Warfare

When looking at the coast and the surrounding waters of Taiwan from a submariner's point of view, it is important to recognise the following features:

Taiwan has, since 1949, been the focal point between two strong

military opponents; USA and China. In this respect, the strategic situation of Taiwan is very similar to the one that Sweden faced during the Cold War. Sweden was in between NATO and the Warsaw pact, with the Soviet Union just some hours-sailing time away. Taiwan's immediate proximity to China makes it difficult even for U.S. forces to constantly control the waters surrounding Taiwan. Therefore Taiwan has to have military forces that are strong, so they could take the first blow if PRC decides to attack Taiwan. Now and then, China has increased its naval presence and thereby the tension in the area, by conducting exercises in order to show naval strength and to threaten Taiwan. At some stages this has caused the U.S. to increase its naval presence in the area, and as a result, the tension slowly decreases. But the message from PRC is crystal clear: we have the capabilities to threaten and disturb your import and export shipping! The threat and the PRC exercises can, if not calmed down by U.S. naval presence, easily take the world to the brink of the Third World War. The Taiwan strategy must therefore be clear, foresighted and from the PRC side, predictable. A firm appearance from Taiwan in every military aspect concerning the PRC is absolutely necessary. Otherwise the PRC may think that Taiwan is soft and will not use its military forces and/or hesitate to call for military (naval) assistance.

The PRC is the well-identified threat to Taiwan. It is an easy guess that the great military potential so close to Taiwan, is causing the Taiwan military planners a severe headache. Lack of adequate and too few naval forces increase the problem further. The unstable situation in the China region is also causing a moral dilemma to many other countries that want to help Taiwan, but are faced with the economic realities of their commercial exploitation of the enormous Chinese market.

The strong Chinese fleet and its Air Force have both the range and precision in its weapons to threaten the Taiwan naval forces simultaneously on both sides of the Straits of Taiwan. We have to estimate that PRC units most likely have radar contact with all ships and aircraft over the whole Taiwan region. We also must assume that all Taiwan naval bases could be exposed to enemy air attacks within the hour from the outbreak of a conflict. But the PRC fleet

can not handle a situation where it is faced with serious naval threat in joint operations from many directions along the whole East Coast of China.

A submarine force that can take the war to the enemy, tie up PRC naval escort and minesweeper resources and that could operate hidden from the Chinese air threat is therefore of key importance to the Taiwan Navy and of course a main threat to the PRC. Such a submarine force doesn't have to include a lot of boats. I think that six to eight modern boats are enough to increase the PRC uncertainty. The possibilities of a Taiwan submarine war against the PRC coastal shipping are a serious threat to the PRC control of the nearest and most important waterways along the coast of China. Of course a Taiwan well-trained submarine force also could be an especially valuable asset in case a PRC invasion fleet starts to navigate across the Straits. Before such an invasion starts good intelligence, collected by Taiwan submarines, of the PRC force build up in the Chinese harbours is also of a high strategic value. The PRC desire to secure the control of these important waters will require well-trained and equipped naval forces that are able to work together in combined operations over a wide area. The Straits of Taiwan as well as the East Coast of China are very favourable for submarine warfare, so the PRC task is not an easy one.

The first operational factor to consider when looking at the Taiwan Straits from a submariner's point of view, are the short transit distances to the operation areas. Within two to three days after sailing, a Taiwan submarine can safely be in its assigned area along the coast of China and from there collect important intelligence or establish a severe and long time submarine threat to the PRC possibilities to move its coastal shipping and naval forces.

The short ranges between the Taiwan bases and the Chinese mainland, also make it possible for the Taiwan submarines to operate in their assigned areas for considerably longer periods than for other navies in the vicinity with longer transit time to their operational areas. Naturally the demands on high transit speeds to reach the assigned areas in due time are also reduced.

At the same time the risks increase. It is difficult to find safe

snorkelling areas free from shipping, enemy patrol areas (search areas) and airborne ASW. The limited geographic areas and short distances mean that large parts of the Straits of Taiwan can be under constant naval surveillance by coastal, ship and airborne radar systems. The risk of detection and danger close to the surface is therefore great. The Swedish solution to this problem has been to drive the technical development towards an operative AIP system based on the Stirling principles. Such a system allows the submarines to operate practically without snorting when on low speed in their assigned areas. Sweden is today one of few countries in the world with an operative non-nuclear air-independent propulsion.

The AIP system gives the CO the tactical flexibility he needs to penetrate in to the enemy's coastal waters and to stay hidden for an extended period of time. My suggestion is that Taiwan seek a technical solution to this important tactical problem. Today the Stirling engine is the most favourable system. In the future the fuel cell will be a better solution due to the higher energy output.

The next factor to consider is the depth and other conditions of the sea in the area of operations. The depth in the straits and along the eastern coast of China is very shallow. To the Northeast, to the East and to the Southeast of Taiwan, there are great depths, and the deep water outside the continental shelf lies just some miles out from the Taiwan coast. Many submariners don't like shallow water. They think that the boat can be trapped without any water to manoeuvre. That is partly true, but the shallow water also gives a lot of advantages to a boldly handled submarine. Normal spherical spreading does not exist in shallow waters, instead a channelling effect is the normal. That means that the energy is absorbed both in the seabed and in surface reflections, and that passive detection by using towed sonar arrays is very difficult due to the fact that the interesting low frequencies can't spread because the wavelength is too great. A low or medium frequency active sonar has equally great difficulties to find a small target in the bottom reverberation. The limited depth causes reverberation between the bottom topography and the surface. The bottom also reduces the efficiency of depth charges, and an active homing antisubmarine torpedo will

have severe problem to find the target and to discriminate it from the bottom reflections. The relatively flat muddy bottom gives few bottom bounces. High frequency sonar can detect a submarine sitting on the bottom, but the range is just measured in some hundred meters. For a submariner the knowledge and possibilities to avoid detection by utilising the whole water volume from the bottom to the surface are therefore essential for the survival of the boats. This demands a deep and thorough understanding of hydrography and hydroacoustics in the Straits of Taiwan.

But submarine command must also give the commanding officers the possibilities to utilise the depth and not hamper them by too short timeframes on the VLF traffic list. The information from the submarine command always has to be kept at a minimum just with the absolutely necessary signals. Timeframes too short have the results that the COs will be hugging to the dangerous surface to wait for radio signals instead of avoiding being detected and searching the depths for sonar contacts. Let the COs explore the depths—and they soon will be masters of the oceans.

I have already said that the eastern coast of China and the Straits of Taiwan are not deep. This creates good possibilities to avoid detection from long range sonar. But the shallowness increases the mine threat. During WW II, most of the Straits of Taiwan were declared dangerous for mines. The Japanese shipping hugged to the Chinese coast and took cover from the minefields in order to avoid the aggressive U.S. submarines. In a conflict between the PRC and Taiwan, I think that the mine threat in the area can be considerable. In sensitive areas, for example outside bases, harbours and at some choke points, where the shipping is channelled, the threat can be even more severe than in other places. The mine threat demands a good thorough knowledge of the differences in the earth's magnetic field and an effective three-dimensional degaussing system to minimise the magnetic signature of the boat.

The water surface temperature doesn't vary much during the yearly seasons in the zone of tropics. The water is generally around and above 20 degrees Celsius. This factor creates a need for a battery cooling system, otherwise the battery will not give its

maximum during extended submarine patrols. A system to circulate the battery acid is also favourable for increasing the time between snorting.

As a result of the relatively steady temperature, there is no large seasonal and geographical variation in the sound velocities. The possibilities to search for a rapid change of speed of sound to find cover is therefore limited. However on the Northeast and on the East Coast of Taiwan, where the water is deeper it is possible to find lower temperatures at depth.

I have a feeling that visual distance under water is quite low on the East Coast of China. This increases the difficulties in intelligence gathering.

To summarise; the East Coast of China and the Straits of Taiwan offers several opportunities for a submarine to avoid detection, and at the same time creates a severe submarine threat to the PRC possibilities to use the coastal shipping lanes.

Tactical and Operational Demands on a Taiwan Submarine

To stay hidden in such a hot area as the Straits of Taiwan, demands a very quiet submarine with long tactical and operational endurance and that the boat is equipped with modern sonar and other passive sensors. A variety of weapons such as torpedoes, mines and possibly ground attack missiles should be a strong requirement. Extremely good manoeuvrability will be needed in order to take full advantage of the shallow operational environment.

A modern submarine has several sensors. The big difference between Commander Fluckey's and Commander O 'Kane's submarine war in 1944, and submarine operations today, is that the periscope (or radar on the surface as in the U.S. case) is no longer the primary sensor for surveillance. The periscope demands a tactic where the submarine has to work close to the surface while transmissions with radar reveal the presence of the submarine. The periscope can see to the horizon, maybe 10 to 15 kilometres depending on height of target, periscope height, wave height and visibility. The periscope easily reveals the presence of the boat if not operated tactically correct—with short mast exposures, low

mast height and with slow boat speed. Still the periscope doesn't give that much information that it is worth the risk of being detected. Modern sonars can detect cavitating ships at distances five or ten times as long and is therefore the most desired sensor onboard.

Today there are many types of sonar that can be of great help for the CO, when fulfilling his important task to establish a severe and prolonged submarine threat to PRC. Low frequency passive sonar for long range detection together with LOFAR and DEMON technique will be of great help when establishing the surface picture. I think that a combination between Circular and Flank Array Sonar is the most favourable in the Taiwan area of operations. There is no need to install Towed Array Sonar due to the shallow water and that such sonar needs to be straight in the water to solve the bearing ambiguity. This creates a need for a tactic where the boat has to move at slow speed all the time. That consumes more energy than needed. High frequency sonar for mine avoidance is important when navigating in areas known or presumed to be dangerous because of mines.

Modern ESM with the antennas either in the periscope for close range work or in a separate mast add a lot to the intelligence gathering capabilities. Such a sensor is also of importance when establishing the surface and air threat picture in the area around the submarine.

The differences in the earth's magnetic field have a significant importance to submarine warfare. Modern submarines are today protected by a degaussing system taking care of the three-dimensional magnetic field. The degaussing system is controlled through a sensor (probe) and a computer. The probe measures the magnetic field of the earth and the interaction from the submarine and automatically, by a computer, adjusts the current in the coils of the three-dimensional degaussing system. A good degaussing system decreases the risk of being detected by MAD systems and at the same time decreases the risk from magnetic bottom mines.

Submarines operating in mine infected waters have to face the risk that the boat causes a mine in the near vicinity to explode. Therefore such a submarine has to be designed to resist the shock

from a standard mine-explosion at a distance quite close to the submarine. This is achieved by floating platforms where the crew and the important machinery are mounted on rubber mountings or steel springs.

I said earlier that the boat has to be quiet to be able to stay hidden in such a hot area as the Straits of Taiwan. The fight against noise transmitted from the submarine is a fight that never ends. The crew has to be well trained to understand what can be achieved with a quiet boat in terms of better own sonar performance and shorter enemy detection ranges. The crew must also be well aware that what has been achieved during months of hard work with technical innovations, can be destroyed in a minute by an uninterested crewmember.

A look at the chart covering the East Coast of China reveals some places with geographical constraints—choke points—where the PRC shipping is naturally concentrated. Such choke points could provide a lot of targets and good possibilities for intelligence gathering. However the targets are normally escorted and therefore bold and skilled submarining is needed to get the job done. But with good passive sensors, long-range wire guided and homing torpedoes, it is often possible to hover, to sit at the bottom or to move very slowly, and still achieve a good reconnaissance or attacking position. This patient tactic saves energy and limits the time needed to recharge the batteries. It also enhances sonar performance and reduces the risk of detection.

A lockout capability for special operations has been more and more important in today's submarines due to the high value of intelligence collected by Special Forces.

A weapon load with a mix of torpedoes, mines and surface to surface missiles can increase the COs choices a lot and at the same time, increasing the difficulties for PRC to predict how the Taiwan submarines will be used in case of an armed conflict.

A submarine operating in the Straits of Taiwan must be able to utilize the whole water volume. That means to be able to operate in depths of water that varies from just some 20-25 meters down to 300-400 meters east of Taiwan and also to operate from or close to the bottom to the surface.

The submarine therefore can use the background topography fully to its own advantage by operating as close as possible to the vertical or horizontal bottom, or try to be in a position on the bottom, but still be able to use its sensors and weapons.

This demands extremely good manoeuvrability both in the vertical and horizontal planes as well as a good weight compensating system. The Swedish solution to this problem has been to design the boats with X-rudder configurations and a one-man steering console. The one helmsman operates both the compensating water as well as the trim water and steers the boat in course and depth. This solution makes it possible to get a short turning radius and quick rudder reaction when operating near the bottom. For example it is no problem to go backwards with the submarine submerged. Due to the shape of the submarine's hull and their rudder configuration, a turning radius less than the boats own length, can be achieved, in even at low speed. This is a desirable feature when operating in shallow waters near the bottom. The control-system makes it very easy for the one helmsman to control the submarine both in course and depth at the same time, regardless of the speed of the submarine.

A submarine designed to operate in shallow waters has to be designed and built to be able to safely hit the seabed at low speeds without sustaining any substantial damages. The X-rudder configuration mentioned above makes it possible to sit on the sea-bottom with very little risk of damaging the rudders and the propeller. The sonar arrays (even the flank array sonar) will continue to function even if the submarine is sitting on the bottom.

Another important factor to consider for a successful submarine warfare in the Taiwan water, is that a submarine is safer at sea than in the base area. The PRC have the capability to strike at the Taiwan naval bases from the air. In case of a higher tension in the area, I think it is of outmost importance that the Taiwan submarines immediately leave their normal bases. To spread the boats and possibly to sit on the bottom awaiting replenishment, is a better solution then to wait in the harbour for a PRC air raid. When the replenishment arrives, the submarine can surface and be at anchor when the replenishment comes by boat. This will support the need

for a strong and flexible logistic support organisation, but it will pay off with a reduced threat against the valuable submarines. The Swedish solution has gone even further. Our submarines are capable of using the seabed while conducting repairs or recharging the main batteries between missions. The submarines own generators are capable of charging the main batteries to full capacity even with low current in the later stages of the charging process. The submarines can be fully stored, including weapons, within one night, just by using small tenders.

When carefully considering the operational possibilities in the area around Taiwan, it is clear that a boldly and skillfully handled submarine will have many advantages over the ASW forces. There are technical solutions to overcome the problems with the shallow water and the absence of a protecting change in speed of sound. A submarine operated near the bottom will be extremely difficult to detect and attack by using sonar.

The conclusion is obvious, in view of the threats, that if a submarine is used in a correct tactical manner, the opportunities for submarine warfare are considerably better than the possibilities for successful ASW.

Conclusion

A strong submarine force can be the cornerstone in a new modern force structure for Taiwan. Modern submarines that can take the war to the enemy along the whole China coast, is very valuable and will create severe problems for the PRC to gain the necessary control at sea before the start of an invasion across the Straits of Taiwan. Such aggressive operational use of the submarines will also reduce the risk of a naval blockade against Taiwan because it will be dangerous for the major surface PRC ships to leave harbour. A change of operational concept forced upon PRC to a more defensive role will turn the tide in Taiwan favour. Modern submarines can change the whole strategic situation in the East China region in favour for Taiwan and its security policy. They are unpredictable in their operations and extremely difficult to detect and destroy. Modern submarines must therefore stand in

the front of the Taiwan shopping list.

The East Coast of China and the Straits of Taiwan is very shallow. This is normally considered to be a strong negative factor for submarine warfare. I think that this is not the case for the Taiwan submarine force which in case of war needs to take the submarine war close to the enemy. The PRC has on paper a strong navy and submarine force. Many of the ships are of older origin and are originally not intended to operate in these shallow waters. But if they do, the PRC submarines are equally hard to detect and destroy for the Taiwan ASW forces. The PRC ASW forces are not well suited for shallow water ASW. The low and medium frequency sonar in those ships will not be to their advantage when operating in waters with an extremely high bottom reverberation. The modern PRC submarines of the Russian Kilo type are technically advanced and quiet submarines. However they will have severe difficulties to detect small or medium sized submarines operating very shallow. As a result of my studies of the operational factors and the PRC ASW ships, I strongly recommend that the Taiwan submarine Force stay out of the deep waters east of Taiwan and concentrate its efforts along the coast of China. There are mainly two reasons for that. The PRC ASW forces will be better adapted to detect and destroy Taiwan submarines in the deep water and it will be much easier for Taiwan to find valuable targets on the coast of China. In case of higher tension in the area, I therefore recommend that Taiwan immediately establish a submarine threat along the East Coast of China. A closer study of the PRC weak points and valuable operative targets will be needed and will then give guidance concerning which areas to assign to the boats.

The shallow waters demand special technical solutions as mentioned earlier. The most important part is to overcome the primary disadvantage of the conventional diesel electric submarine - the need to come to periscope depth to recharge the main batteries. This is a substantial tactical drawback especially in shallow and confined waters. Furthermore, continued advances in the development of airborne radar and infrared sensor capability, have increased the threat against a snorting submarine.

In order to reduce the time required to snort, and thereby

improve the *indiscretion ratio*, the Swedish Navy has sought to identify an AIP technology that best suited our needs. In 1988 an AIP prototype system was installed in the Näckenclass (A 14) submarine for trials at sea. Subsequent tests, trials and refinements to the design resulted in the decision to install Stirling engine plants, in addition to the normal diesel engines, in all three of the new Gotland class (A 19) submarines (operative 1999). And recently a decision was taken to install the same type of machinery in two of the Västergötland class (A 17).

By using AIP, the submarine commander can select his operational profile. When the threat against the submarine is acute, the battery is used. For lesser threats, the AIP is used and with even lesser threats, the regular diesels are used while snorkelling. Today's AIP system supplies sufficient energy to keep the battery loaded (floating the load) and still run the submarine at normal submarine speeds. This means that operating on AIP can cover 80-90 percent of the time in the patrol area. For greater speeds the battery is used and is automatically charged when the speed is reduced.

The Stirling system is inherently silent due to the fact that the combustion takes place in continuous and controlled manner. The low noise is further reduced by the double-elastic mounting arrangements and an acoustic hood reduces the airborne noise. In addition, the exhaust gas is let out into the sea in a controlled way through a unique arrangement that leaves, in practice, no trace of bubbles or heat.

An AIP capability improves the indiscretion ratio significantly. With Stirling engines onboard, underwater tactical endurance can be increased from a few days to several weeks. This supports an increase of operation times and minimises the time spent in base areas. But it also demands large stores of fuel, carbon dioxide absorbent, oxygen, supplies and/or auxiliary engines alongside the usual diesel—electric propulsion. An extended patrol time will increase the burden on the logistic support organisation.

Operations in the littorals also demand that the passive sensors give you a high bearing resolution in a multitarget environment (high background noise). They should cover a large part of the

frequency band to make it possible to avoid interference from strong active transmitters. Wide frequency coverage is also important for good recordings when collecting acoustic intelligence.

Other demands are the usual ones, when constructing and building submarines—low target strength, low noise level and an efficient degaussing system. The need to sit on the bottom now and then, is an important requirement. The x-rudder configuration and one-man steering console has been very reliable for Sweden.

The weapon development follows the construction of a modern submarine closely. I believe in a combination of heavy and lightweight torpedoes, mines and ground attack missiles. The Taiwan naval commanders have to have optimum flexibility when facing a multitarget crisis. Flexibility in the submarines' weapon load will increase the PRC uncertainty how the Taiwan boats will be used. That will increase the factors for success in case of an armed conflict.

Finally I am convinced that a strong modern Taiwan submarine Force of six to eight boats boldly operated in the shallow waters on the east coast of China can change the strategic situation in the east China region. Such a submarine force will increase the PRC uncertainty of Taiwan intentions and thereby tie up naval resources. This will minimise the risk of a PRC naval blockade as well as minimising the risk for an invasion across the shallow Straits of Taiwan.

Due to this fact, is it important that Taiwan continues to build strong naval relationships to countries that could provide the modern submarines and that could come to assistance in case of a conflict as well as a to give continued support in many fields of naval warfare. To identify a prospective submarine design and building country will be of outmost importance for the long-term security for Taiwan.■

LEADERSHIP *IS* YOUR FUTURE

by RADM John Butler, USN
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Based upon a presentation given to the Engineering Duty Officers School, April 2002.

The military, more than any other profession, looks toward leadership as the most powerful key for opening the door to success. History gives us many examples of strong military leadership. Examples that span the time from before the written word all the way through the conflicts of today. In ancient times, Alexander the Great inspired both the conquerors and those whom his armies conquered. In our grandparents' time, Winston Churchill's inspirational leadership helped win the Battle of Britain. Later, our parents admired Marine Corps General Chesty Puller's superb leadership as he pulled victories from extremis during the Korean War. And now, in our time, I ask you to think about the Navy officer who has had the most significant impact upon you personally. I bet you will say the trait you most admire in that individual was the person's ability to inspire and lead others—lead others, as you would like to lead those who work for you.

As one whose experience precedes yours, I cannot bestow leadership on you. Nor can I teach you how to become a leader. That, you have to achieve on your own. But, I can give you some ideas, some direction and point out some traits, challenges and leadership examples that will help you reach down into yourselves so that you can pull up your own, innate leadership abilities. So, you too can develop the leadership qualities that will be your personal key to success and continuing future growth.

The Leadership Triangle

Leadership skills must be consciously honed and continuously used. To do this well, leaders have to understand the difference between good leadership and good management. You need to recognize these differences because developing skills in one area

will not automatically lead to the development of skills in the other. Moreover, leaders need to develop both skill sets throughout their Navy career.

The first concept that I want you to understand is this: good leaders *are successful* and good managers merely *achieve success*. *Being successful* and *achieving success* are not the same thing. *Being successful* evokes a sense of self-fulfillment. *Achieving success* marks the accomplishment of someone else's sense of self-fulfillment.

To be a good leader or to be a good manager are both lofty goals. Unfortunately, too often, the leadership part of this balanced equation becomes hazy and unfocused. Do not let that happen to you. Understand the differences between leadership and management and you will be better able to keep your focus on being a good leader while also being a good manager.

Leaders step out front and grab the reins, they guide some, they direct others, and sometimes they just pull others along. A leader's mind develops a vision. This is much different that the manager whose mind focuses on implementing someone else's vision. A leader's eyes are always fixed on a goal. Too often, the manager's eyes are fixed on the process. The leader's heart produces a lusting desire to exceed even the leader's own expectations, whereas the manager's heart hopes to meet another's expectation. Granted, the manager hopes to perform better than others challenged to meet those similar expectations, but that goal is not enough for the leader. And, while a leader's soul is his or her work, the manager's soul draws its strength from the process—Management by Objective, or whatever is the current business school philosophy.

To be a leader, three things are needed. These are an ability to create a vision, the skill to inspire others, and a desire to realize the thrill of solving seemingly impossible problems. Like the Fire Triangle we all studied during damage control training, I want you to think of these three skills as being the three legs of my Leadership Triangle: develop vision; inspire others; and resolve problems —all three legs of which are necessary to be a good leader.

Be a Visionary

The first leg in my Leadership Triangle is Vision. Leaders are visionaries. They develop their vision by dreaming, by using their imagination, by developing a thorough knowledge base, and by seeking the wisdom of others.

A true vision is futuristic. It is farsighted. To help you understand how a true vision is futuristic, examine a couple of visions and then assess why they were originally important and how they are relevant today.

- My first vision is the American TURTLE, David Bushnell's vision. Bushnell drew his design for this early submersible concept presented by William Bourne, a British mathematician, in 1578. TURTLE was successfully launched in 1776 as the first truly submersible craft. Bushnell's vision preceded two other innovative visions, HUNLEY and HOLLAND, by 88 and 122 years.
- Another submarine vision comes from the author Jules Verne. His vision, presented in his classic book 20,000 Leagues Under the Sea, introduced the submarine both as a scientific research platform and as a naval warfare weapon. His book was published 65 years before submarines earned their battlestars as effective weapon platforms during World War I.
- John Holland is considered the visionary Father of our U.S. Navy's Submarine Force. The U.S. Submarine Force began with the commissioning of USS HOLLAND shortly after we entered the 20th century. John Holland's submarine was small, underpowered, and could not operate in the open sea—but HOLLAND was the first U.S. submarine.
- Admiral Rickover's vision was to prolong the undersea operational endurance of the submarine. His vision was to develop the submarine as an *undersea* weapons platform and not just a weapons platform that spent some of its time under the sea.

Each of these visions built upon and then moved beyond the previous vision. Something that leaders do consciously or subconsciously to achieve success. David Bushnell's vision imagined the

existence of a submersible. Jules Verne saw missions submarines would eventually perform. John Holland established a new maritime force, the U.S. Submarine Force. And, Admiral Rickover expanded the capability of the submarine platform so that it could more efficiently perform its warfighting missions. In other words, each vision was revolutionary. Each vision moved submarine development and submarine technology in a different yet advancing direction. And, each vision was significantly more complex than its predecessor.

My Submarine Technology (SUBTECH) vision expands submarine development to achieve the total inclusion of future submarines as participants in the complete maritime warfare theater of operations. It presents a vision that includes the insertion of technologies that provide for the gaining and sustaining of battle force access, the insertion of technologies that develop and share knowledge, the insertion of technologies that project power with surprise from close-in, and the insertion of technologies that deter and counter weapons of mass destruction. To do this, the SUBTECH vision moves us outside of the submarine hull. It seeks off-board and onboard solutions to create enhanced battle force interoperability and war fighting capabilities.

Most of you at the Navy's Engineering Duty Officers School have been focusing on near-sighted visions dictated by your previous assignments. These visions were not yours. They were someone else's vision presented to you so that you could develop the skills needed for the accomplishment of your required tasks. After you leave this school, you will have the opportunity to become involved in developing your own far-sighted visions. You will still have the choice to focus your efforts on *near-sighted visions* as you have done in the past—or, you may choose to readjust your focus toward developing the ability for far-sightedness. In either case, you will be successful—at least initially. However, if you choose the comfortable, near-sighted pathway, you will limit your potential. This will assuredly cause you to evolve into becoming more the manager and less the leader.

So, how is a leader's far-sighted vision developed? It's not really that hard, and there is a lot of help available along the way.

Basically, all a leader has to do is develop an understanding of what has gone on before arriving on the scene; analyze what has happened, why it has happened, and think creatively about how it may be done better; project into the future to see where a divergence between the two visions occurs; and then arm himself or herself to do battle.

Understanding the past requires the leader to become familiar with the vision of previous leaders. This is usually fairly easy, as that vision is normally provided when the leader first takes over a new job. Becoming familiar with the old challenges and the old solutions is likewise fairly simple. Once again, it is normally part of the turnover process. Regardless, no matter how well problems have been defined in the past, a leader redefines the problems in personal terms and then independently develops personal solutions.

Redefining challenges and reinventing solutions may sound difficult, but it is not. The leader looks at challenges as if they were being addressed for the first time. This helps the leader confront the challenges from a fresh perspective. This phase of practicing leadership is when the visionary's imagination, knowledge developed through education and professional experience, along with the visionary's talent as a dreamer become important. These qualities of the visionary, coupled with the wisdom of others who present fresh ideas, should provide an alternative definition of the challenges, as well as insight to innovative approaches for achieving solutions to those challenges. But, good leaders don't stop there and think they are done. Leaders know they must compare the old with the new. They recognize that the combination of the two is probably more likely the proper baseline of *where they are*, so they can then determine *where they need to go*, and *how they can get there*.

After developing their baseline perspective on where they are, leaders next determine *where they want to go*, and *how they can get there*. To do this, leaders project themselves into the future. Once again, the visionary's imagination and ability to dream of *what could be* guides their direction. When leaders project their minds into the future, visionaries will identify an idealized image of the future, waypoints through which they can progress to reach that idealized image, problem, that may surface in the path toward their

ideal image, and detours or workarounds that resolve projected stumbling blocks. Then, all that is left for the leader to do is to establish some telltale warnings to alert the leader to the need for redirection, and to prepare some preliminary responses that will reduce the risks should those stumbling blocks surface.

The leader must know the *Big Picture*. The *Big Picture* paints the landscape of the past and prepares the leader so the current new vision can emerge. This understanding is critical when the leader is developing strategic concepts.

After gaining an understanding of the *Big Picture*, the leader redefines challenges and refines independent solutions. This redefinition springs from current challenges and solutions. More importantly, it solicits new ideas from key players—readjusting accordingly—to provide the guidance and framework that channels everyone's attention and thoughts toward a new common vision and a new pathway that will be followed to reach the emerging future vision.

Until the leader reaches the pinnacle position in his or her profession, the leader's vision must flow from the more senior leaders. The Navy's mission statement for the 21st century is to "Directly and decisively influence events on land anywhere and anytime". The Chief of Naval Operations strategy for implementing this mission includes the four pillars of net centric operations—Knowledge, Access, Speed, and Sea Basing. All of which combine to create the baseline from which our Submarine Force visions spring.

As tomorrow's leaders, you will be called upon to develop our future strategic concepts. Probably, you will only become involved in one of these areas during your next assignment. In time, you will assuredly be required to develop visions for each of these strategic areas. Therefore, tomorrow and in the years to come, involve others in your thought process and leverage off other studies at all program levels. If you find yourself alone without others, stimulating your thoughts; or if you find that your predecessor has not discovered related problem studies, establish those linkages as one of your first priorities.

If your background and training result in your future assignment

to submarine and undersea technology development, here are some of the visionary strategic concepts and guidance from which you can draw. Many organizations and study groups have contributed valuable inputs toward the conceptualization of the Naval Sea Systems Command SUBTECH vision.

The Defense Science Board projected the next generation of submarines in 2020 to be large, nuclear powered and with a concentrated effort on developing the *front end* technical capabilities. The Defense Science Board also called for improved on-station time and suggested DARPA and the Navy sponsor a combined effort to take a *wide open look* at the prospects for the future 2020 submarine. They also suggested this combined effort specifically investigate the enhancement of submarine undersea and information technology areas and the improvement of ship performance measurements.

The Submarine Future Studies Group (FSG) was chartered in 1998 to develop future concepts with the emphasis on revolutionary capability. It was designed to provide needed focus to industry, DARPA, ONR, and government laboratories to enable them to invest in the technologies that will provide military capability from under the sea—needed in the 21st century. The strength in the FSG lies in its smallness, its closeness to Submarine Force leadership, and its ability to communicate these thoughts and ideas. As such, it develops future concept statements for the Submarine Force of the future, obtains a wide variety of opinions both from within and outside the submarine community, generates statements of future goals for submarine Research and Development R&D and Science and Technology (S&T), submits statements of future concepts and goals to the Submarine Force Flag Panel through NAVSEA for formal validation, provides validated statements to the Flag Chaired Integrated Program Team (FCIPT) and the acquisition community to guide long-term technology development and acquisition planning, and conducts studies and reviews as required to coordinate and leverage SUBTECH efforts.

The Alternative Future World Study established a team of senior submariners with significant operational experience, non-submariners who would provide us with a broad view of naval operations, and other independent reviewers. In the Alternative

Future World Study, a top-down, capabilities-based approach was used. It considered political, economic, social and military factors, and it examined submarine tasks across future worlds.

The alternative worlds presented in this study are broad in context and were adopted by the National Defense Panel Worlds to circumscribe the vector of an uncertain future. The projected common challenges of the alternative worlds in the 2020 timeframe have five basic characteristics. Those characteristics are: a proliferation of weapons of mass destruction; the existence of geographical and physical access challenges; our primary adversaries will be quiet, long-endurance, coastal submarines; the competition for information advantage in cyberspace will proliferate; and submarines will predominantly operate in littoral areas.

Leaders in SUBTECH understand the Operational Forces are our customers. We know they are the knowledge base on *what works* and *what is broken*. We appreciate being included in discussions about their experiences of how easily or poorly submarines meet their current mission requirements. And, we are sensitive to the fact that the operational forces have their own vision on how current missions will evolve in the future.

Accordingly, the highest priority submarine tasks for 2020 build upon the existing capabilities of today's Submarine Force. They represent the tasks in which submarines can provide a compelling contribution to joint and naval forces across the spectrum of operations and within the context of the Joint Strategic Concepts. Along with strategic deterrence and forward presence, typical high priority tasks of the submarine type commanders include: clandestine Intelligence, Surveillance, Reconnaissance, and Targeting; Special Operations Force Deployment; Mine Reconnaissance; underwater environmental characterization; rapid attack against time-critical targets; attack against hard or deeply buried targets' interdiction operations; and the suppression of enemy coastal defenses.

Future submarine strategic concepts, based upon the anticipated 21st century environment and the evolving naval maritime concept developed by those supporting groups and studies, are gaining and sustaining battleforce access, developing and sharing knowledge,

projecting power with surprise from close-in, and deterring conflict and countering weapons of mass destruction.

To gain and sustain battleforce access, submarines leverage their enduring attributes of stealth, endurance, agility, and firepower to gain access and develop the conditions that will enable access for follow-on forces. In peacetime and during the transition to conflict, as the first arriving military asset, submarines can provide non-provocative presence in what might be termed *politically denied areas*. Or, if necessary, the submarine can be overt and while it's there it can gain and gather information characterizing a theater of operations. Finally, as combat is engaged, submarines that operate in collaboration with other forces will be key elements of battle-force protection, aggressively seeking out adversary challenges, sending required warning, and eliminating threats. Throughout the spectrum of operations, submarines will employ the expanded reach of offboard systems and vehicles as a force multiplier, further sustaining battleforce access.

Future submarines need greater capabilities to develop and share knowledge. Knowledge is the underpinning for battlespace awareness. Joint and naval forces harnessing revolutionary capabilities for information collection and processing will achieve an unprecedented visualization of the future battlespace, which will enable collaborative simultaneous efforts to solve the most complex battlespace problems. To do this, submarines need to have timely access to this knowledge. New onboard and distributed sensors and offboard vehicles are needed to vastly expand the submarine's reach. New and improved system capabilities are needed to collect, synthesize, use, and share information and knowledge of the battlespace. This will enable submarines to become active nodes in the larger battleforce network.

Submarines provide the ideal platform to project power with surprise from close-in, complementing other power projection forces. They will attack from close to land and with relative invulnerability. During peacetime and the transition to conflict, submarines will execute deterrence through assured devastating response as we have for so many years. The submarine's ability to surprise and attack from close-in, will provide a force multiplier and increase uncertainty in the mind of the potential adversary.

With dramatically improved payload capabilities, including information, attack submarines will provide the Joint Force Commander with a wide range of power projection options. During combat, submarines will operate in areas not otherwise accessible to other members to the Joint Force, augmenting these forces by providing survivable, prompt, precision striking power. In particular, embarked Special Operating Forces, fielded with an array of equipment, will conduct clandestine direct action ashore against targets that demand their specialized capabilities and absolute surprise.

The final submarine Joint Strategic Concept is to deter conflict and counter weapons of mass destruction. The proliferation and potential use of weapons of mass destruction is considered to be the greatest threat to U.S. security in the future. The ability to deter and counter weapons of mass destruction enhances the security of our allies, and reduces the threat of the asymmetric employment of weapons of mass destruction against U.S. and Allied forces. In the face of proliferation and non-state employment of weapons of mass destruction, as components of Joint Forces, submarines will offer a clandestine solution to gathering information and executing attacks necessary to counter the threat of the use of weapons of mass destruction. Submarines will deter with a credible and assured threat of devastating response should weapons of mass destruction be employed against the U.S. or its allies. But, submarines will also be key players in developing the knowledge of adversary efforts to develop and use weapons of mass destruction. This will allow the U.S. to counter, through exposure and sanctions against the offenders, as well as disrupt or compromise their capabilities for use of weapons of mass destruction. They could also attack to eliminate the capabilities fielded or in development.

Once the SUBTECH leader understands the *Big Picture* and has developed the future submarine strategic concepts, the SUBTECH leader creates a framework that provides the boundaries within which the SUBTECH vision can be expressed. At SUBTECH, we have created three revolutionary tactical thrusts to focus our vision and our energies. Those tactical thrusts that constitute our Strategic Concept Framework are to extend the submarine's tactical horizon,

to fully network with National and Theater command centers, and to provide the ability to reconfigure the submarine for changing and time-critical Joint force missions.

We see several major areas of technology that are important in this revolution. One of the most important is this whole idea of getting offboard. We're talking about sensors in the water, on the bottom, on the sea, on the surface, on the land, all off-hull, away from the submarine. And why do we do this? Because it gives us an order of magnitude more coverage in the Intelligence, Surveillance, Reconnaissance, and Targeting arena. It allows us to use sensors that are quite different from today.

Today, we talk about SIGINT and visual sensors, but for the future we also talk about acoustics, vibration sensors, and perhaps chemical and biological sensors for weapons of mass destruction. The concept of this sensor network is that it's covert—it defeats enemy efforts of denial and deception against our satellites and against today's other assets that they can see and avoid. Importantly we think in the future that it fits into targeting. The whole idea is that this sensor network can be used not only to provide information about what's going on, but also to provide localization information for follow-on targeting either from ourselves or follow-on forces.

The next revolution is offboard vehicles. Offboard vehicles are the way we buy extended reach. Vehicles that swim, that fly, and that walk on the ground. Doing this covertly with a wide range of payloads enhances the stealth of the submarine. Submarines do not have to operate close to shore and at periscope depth in order to make these things possible. And when we need a man in the loop for high priority missions such as when you need a guy on the ground, we have the Advanced SEAL Delivery System and our SOF forces.

To make all this work, we need dramatic improvements in processing back on the submarine. The submarine needs to be able to monitor the networks we put in; it needs to react to the information that comes from them; it needs to move the sensors around when necessary to cover the right areas; and it needs to do this in near real-time. In this vision, we will have to react in seconds, and minutes, and provide the information back to follow-on forces.

Not all the processing will be done onboard, but enough processing will be done to send the relevant nuggets back to the follow-on forces. All of these things are also available to the follow-on forces when they arrive, particularly the ground sensor network.

Platform modularity is an important centerpiece of the future submarine. The payload modularity concept provides the ability to reconfigure submarines for changing, time-critical Joint Force missions. The concept is that the submarine itself would be made up of modules. When payload or sensor changes to one of these modules becomes required, instead of laying the ship up in a major overhaul, submarines could change out payload modules overnight—this is our goal.

Modularity increases adaptability to address emerging tasking in an uncertain future. It facilitates the incorporation of new technologies. It accommodates the development of sensor and payload technologies that are more rapid than the development of new submarine platform designs. It allows for upgrade of payload only designs rather than the construction of new platforms or modernization of existing ships. And, it can be tailored to the force tasking requirements to provide the right payload when and where needed.

All this comes together into a single vision. A vision that presents a new hull configuration, new onboard and offboard sensors, the deployment and employment of offboard vehicles, expanded communications connectivity between the battleforce and shorebased command centers, and the involvement of the submarine in a comprehensive battlefield environment that includes sea, air and land.

Be Inspirational

This second leg in my Leadership Triangle is Inspiration. Our best leaders inspire others to succeed when success is beyond their apparent grasp. Provide guidance, create challenge, develop competition, redirect when needed, recognize progress, and reward achievement. Unfortunately, too often these words are not practiced. Leaders do not forget any of them. Remember, good

leaders consciously make the effort to guide, to challenge, to develop competition, to redirect, to recognize, and to reward. Remind yourself daily consciously to seek opportunities when you can apply these leadership attributes.

When leaders begin a new job, they become a member of an already existing team. Good leaders do not automatically accept the organization of this team as being the right recipe for success. Almost always, new members on a team bring new perspectives and fresh ideas to the team that can make the team more effective—to help the team progress one more step ahead. Furthermore, as a new member on the team, the leader often can see obstacles that have become accepted when in fact they can really be overcome. Sometimes to do this, the leader may need more help than is already in place, or the team's new leader may need to reorganize it for more efficiency or to better direct its effectiveness. Once the leader's new organization is in place, the new team leader's next challenge will be to continuously motivate the team's support structure so that those supporting elements do not fall victim to a common pitfall, sub-optimization of goals.

Good leaders stimulate support from other organizations so that it becomes easier for the leader's team to achieve their goals. Finding sources of funds and other resources to support team projects is the best result the leader can achieve to stimulate his team. In today's funding environment, and during even more conservative budget years, this skill may be essential. When the leader assumes the funding burden and is successful, team members are inspired and particularly motivated toward achieving success. This is because they have been relieved of having to deal with this tiresome, albeit necessary, burden.

Good leaders can motivate their people through a technique called *self-speak*, sometimes known as *self-talk*. This technique is derived from the concept that words define the image we carry of ourselves. It presupposes that much of the image we have of ourselves, and what we do, is regulated by our unconscious mind where words continue to impact on our beliefs, attitudes, and behaviors.

This technique asks us to watch our language to notice which of our thoughts are positive and are working, and which thoughts are

negative and working against you. Then, by changing our language, we can begin to change our thoughts and attitudes.

The use of positive *self-talk* has been linked to the reduction of stress. Less stress, in turn, can effect other positive changes. A positive mental attitude and the development of optimistic thought patterns can harness the positive energy for the greater good of the leader, the leader's team, and the eventual achievement of the leader's vision.

Applying these concepts to the real world, look at my Navy Undersea Warfare Center (NUWC) commands, and my NAVSEA and SUBTECH organizations. As NAVSEA's Deputy Commander for Undersea Technology and the Commander of the Naval Undersea Warfare Centers, I lead several teams. The Advanced Submarine R&D Office researches and develops emerging technologies, and the Submarine Technology Integration Office transitions proven technologies into operational systems. In addition to these individual organizational units, my deputies, the Technical Director at NUWC and the Deputy for Undersea Technology at NAVSEA, manage additional specific programs such as the joint DARPA/-Navy Payloads and Sensors initiative.

Other NAVSEA codes also interact with and have an impact on the SUBTECH process. Some of these include NAVSEA's Deputy Commander for Integrated Warfare Systems, the Program Executive Officer for Submarines, and the Program Executive Officer for Mine and Undersea Warfare. Bringing them all together under the SUBTECH umbrella and the Flag Chaired IPT has been a critical leadership challenge and has resulted in a tremendous feeling of accomplishment as we develop open lines of communication and common goals.

To motivate, stimulate, and inspire all these players, the SUBTECH leadership must communicate a clear 2020 submarine vision, promote a dialogue between the fleet, acquisition managers and the various S&T and R&D communities, provide guidance and a path that implements the submarine vision, and develop a creditable *best value* investment strategy that provides funding results.

A clear 2020 submarine vision is communicated by SUBTECH

leaders through the presentation of various relevant future concepts. To develop and express these future concepts clearly and in a manner that is meaningful, five attributes are important. Leaders must discriminate between ideas and concepts. Both need to be expressed, discussed, and evaluated to determine which *brain-storming* thoughts are appropriate. Unconstrained ideas are good to stimulate the imagination so that greater, higher-level concepts emerge.

Creative concepts should flow naturally from these nebulous ideas. None should be dismissed without open discussion in a collaborative, constructive environment. Remember, however, the consensus should set high objectives and be revolutionary. Evolutionary concepts are likely to set targets that fall far behind the leader's footsteps. Revolutionary future concepts envision an order-or-magnitude impact. Leaders know it is acceptable to implement future concepts through incremental steps, but they also know the concept itself must not be an incremental change. The leader's next, and possibly most difficult task, is to capture the concept in words that communicate the essence of those discussions in simple, high-level, and memorable terms.

Once future strategic concepts are articulated, the leader needs to prepare a roadmap on how the team will investigate, develop, test, and implement efforts to achieve each of the strategic concepts that support the overall vision. SUBTECH's path to the future is based on the four strategic concepts that result in the identification of the submarine tasks for 2020. These 2020 submarine tasks require various capabilities that can only be achieved through the development and insertion of new technologies. And finally, the evolution of science from which these technologies emerge and the cost to create these technologies drive the timeline and the cost that then become our long-term investment strategy. Leaders know that by defining this path, the leader reinforces validity of the team's vision and builds confidence within the organization that the vision is achievable.

Most motivational psychologists recognize that money is a strong driver for achievement. Most managers think about money in terms of personal salary. That is what Maslof and Hertzberg taught. Leaders think of money as funding support, authorzations

and appropriations, and a necessary tool to motivate a *self-actualized* work force. Therefore, leaders understand the importance of having a comprehensive familiarity with the funding cycle. Leaders know the intricacies of the basic Planning Programming and Budgeting System (PPBS) and each individual organizational component of the PPBS system, such as SUBTECH's S&T cycle. As leaders assume positions of greater responsibility, their sensitivity and understanding of the funding cycle becomes much more detailed as it also becomes broader in it scope.

When speaking about money, everyone is aware that the competition for appropriated funds is keen. The Department of Defense competes with all the other departments for its portion of the President's budget. The Navy competes with all the other services for its part of the DOD budget. And at every leader's command, just like at NAVSEA, each command competes for its portion of the Navy budget.

Leaders develop an acute awareness for recognizing important budget issues. This awareness comes in part from reviewing the President's guidance to OMB. It can be derived from congressional testimony and documents that present *the sense of Congress*. It can be assimilated from government reports such as those prepared by the Government Accounting Office or the Congressional Office of Technology Assessment. And most significantly, it can be enhanced from reading the newspapers, listening to the news reports, attending public meetings and by developing an awareness of what the general civilian public is thinking. This is important because the general public's influence on political thinking and political thoughts, represented by their elected officials, drive budget authorizations and appropriations. Good leaders develop this awareness of pending change far in advance of others.

The Department of Defense is looking for new ways to do business. Many call it*Warfare Process Re-Engineering*. Knowing this can help leaders develop future capabilities that provide this *Warfare Process Re-Engineering*. Leaders not traveling down the re-engineering path should redirect their efforts so their programs will compete favorably for scarce budget dollars. Another tactic is to seek dual use opportunities. *Dual use* is synonymous with *Seize*

the moment and run or *Strike while the iron is hot.* Leaders recognize when the nation is in crises. They see *dual use* opportunities when they open up—particularly in the area of technology development. Leaders take advantage of these opportunities while they are still available. Too often, the manager also sees these opportunities, but fails to act quickly enough to *consummate the marriage* before the opportunity evaporates.

Dual use technologies that are necessary for your program and which benefit other governmental organizations are ideal candidates for supplemental and participative funding. Intelligence, Reconnaissance, Surveillance and Targeting technologies are important to other government agencies fighting the War on Drugs, the War on Terrorism, and to Homeland Security. Being connected with non-DOD agencies that also desire capabilities and similar technologies, helps the leader create partnerships and gain funding support for decisions that are more favorable to the leader's program.

Leaders promote public-private partnerships to reduce overall government costs. Efforts where the government develops a technology and then hands it off to industry to produce the system reduces both the government's costs and the investment needed by industry—both win.

Leaders leverage their efforts on other programs. This is very similar to developing dual use technologies, because new technologies evolve that support two or more different programs. Some good examples of leveraging include the S&T and R&D programs to produce new batteries, or the investigation of a new computer chip design that significantly enhances the power of computers to process data. Leaders will seek out partnerships with DARPA and other Navy laboratory programs to provide fertile opportunities for leveraging technology advancement efforts.

The government provides many vehicles to stimulate the evolution and expansion of technologies. Federal Research and Development Laboratories are required by law to promote and enter into Cooperative Research and Development Agreements, or CRADAs, with other government agencies, private industry, and individuals. The Department of Energy sponsors the Federal Laboratories Consortium and has established offices at each of its laboratories to facilitate technology transfer. Leaders take advan-

tage of these opportunities.

Small Business Innovative Research (SBIR) agreements and other government grant programs are also available to provide funds to support technology development or technology transition. Becoming involved with those who seek SBIR funds and grants is important for building the interest among those industries and research institutions, so that they become the promoters of a leader's technology needs.

And finally, leaders provide an inspirational setting that can be used to promote their vision. This setting also provides the solitude to refocus thoughts when the pace gets too fast. SUBTECH's technology center has been established to provide such a creative space. It is located within the NAVSEA building at the Washington Navy Yard. It contains multiple visual presentations that help the visitor understand the SUBTECH vision. It also helps the visitor develop confidence in the viability of SUBTECH to reach that vision.

Seek Out and Solve Problems

The third side of my Leadership Triangle expresses the thrill of the hunt, the satisfaction of the catch. Nothing can be more challenging or more satisfying than solving complex issues, particularly if others have tried and failed. The visionary leader thrives on the *What if* and shuns the *If only*.

Appreciative Inquiry is an intervention technique good leaders can use to solve problems. Appreciative Inquiry attempts to create new theories, ideas and images that aid in the development of change. The key innovation of Appreciative Inquiry is that it collects people's stories about something at its best. It shifts the emphasis from *What problems are we having?* to *What is working?* These two questions clearly underline the difference between the traditional change management approach and Appreciative Inquiry.

Appreciative Inquiry is based on dialogue. The first step is to collect opinions and observations of everyone involved through telling stories about what has been and is successful. These observations are then shared in a workshop format to identify the

themes and topics that run through the stories. Finally, a selection of the most important of these themes forms the basis for building a series of provocative propositions that describe how the problem can be resolved.

The leader's first task in solving the apparently impossible is in understanding the challenge. The leader's comprehension of the challenge begins to form while the leader progresses through the vision development phase of the Leadership Triangle and continues in parallel with the motivation side of the Leadership Triangle. It is important that a leader be aware that, without a properly defined far-sighted vision and motivated people, the leader can never really solve the *impossible*. In essence, he or she fails as a leader and can only hope to be a good manager.

The leader must define problems in practical terms. Leaders dissect problems into their lowest component parts and address each one separately. This creates opportunities for many small successes that will eventually achieve the overall goals of the leader's vision. The pitfall here is sub-optimization. Leaders will not forget the *Big Picture* when seeking solutions to each of the component challenges. Likewise, if you find yourself as the person charged with developing solutions to a component challenge, as an aspiring leader, do not sub-optimize, emphasizing your project at the expense of jeopardizing the more senior leader's overall vision.

Another important consideration, needed to solve the impossible, requires the leader to maintain an open mind to the suggestions and ideas of others. Leaders must *really listen to* and *understand* what is meant to be heard when others speak. Leader *want-to-be's* who are unable to solve the *impossible* often fail, not because there was no solution, but, because they were too busy listening to themselves talk, or too busy defending their own position. Instead, they should have been asking themselves: "Would this different approach I am hearing work? Could it be as good or even better than the one I thought of?"

Others who fail may hear the words but don't really understand what it is they heard. Leaders who solve the *impossible* often restate other's positions in their own terms. This reinforces to the speaker that key points are understood by the leader, and reassures the leader that he or she correctly understands what was said.

And finally, never use or accept the term *un-executable*. This terms expresses an acceptance of inevitable failure. A leader will always present options and consequences, alternatives or compromises, and solutions or choices.

To resolve complex problems, SUBTECH has created a technology organization that provides leadership direction. It has defined technology management missions for its leadership cadre, and it has designated technology leaders in charge of Technology Task IPTs to promote and sustain a common vision and to prevent the emergence or organizational sub-optimization.

The SUBTECH technology management organization's mission is to provide a central focus and a guiding hand in the coordination of submarine R&D, to develop a consensus for R&D goals, and to develop an investment strategy that supports those goals. It has three tiers of leadership—The Flag Chaired IPT, the Integration Working Group, and the Strategic Concept IPTs.

The Flag Chaired IPT provides the top-level guidance that directs the actions of the SUBTECH technology management organization. It recommends priorities for technology investment and how to leverage submarine-related research and development programs. The Flag Chaired IPT also acts as the interface between SUBTECH and other Navy programs to assure SUBTECH is supporting the Navy's *Big Picture* vision to directly and decisively influence events on land anywhere at any time.

The Integration Working Group oversees the coordination efforts of others within NAVSEA and elsewhere, who are developing solutions for each future strategic concept. Its mission is to assure that proposed solutions and technology development initiatives remain *on-track* toward achieving the overall vision that I have presented today.

The Strategic Concept IPTs focus on technologies in each of the four concept areas plus a fifth area of ship architecture. This fifth SCIPT is responsible for addressing technologies needed for the future submarine platform strategic concept. SUBTECH technology management direction focuses the SCIPTs so that technologies are driven by capability needs—not that capabilities become developed because technologies are available.

SUBTECH leadership gathers the requirements and the mission needs from the fleet, strategists, and future studies and promotes those visionary requirements to the S&T, R&D, and Acquisition communities.

SUBTECH integrates programs and coordinates efforts by producing roadmaps to achieve desired capabilities through balanced investment recommendations. The emphasis is always on transitioning a fielded capability through a *best value investment* strategy.

As you know, technology transformation moves from concept development, to proof of concept and scientific investigation, through research and development, and eventually results in fielded capabilities. Wargames and seminars, modeling and simulation, and field experiments support concept development, S&T, and R&D. Throughout this process, costs to the Navy increase. SUBTECH's role in technology transformation is to promote exploration of options to meet emerging challenges, and facilitate the enabling of innovation and transformation in a fiscally constrained environment.

One example of how SUBTECH facilitates this innovation in a fiscally constrained environment is our joint DARPA/NAVY effort. This joint technology initiative awarded two contracts to two large multi-corporate teams for the development of payload and sensor technologies to make future submarines more effective players in future littoral warfare conflict environments. This joint effort resulted in the demonstration process that is managed by SUBTECH through NAVSEA. The demonstration process managed by NAVSEA has transitioned from concept exploration into concept advanced development. It included the initial demonstration of candidate technologies and the down selection into a few promising programs that are most likely to achieve the *best value investment* for the Navy.

As technologies develop, they will be prototyped, tested, and installed on existing fleet submarines for eventual insertion into the SSGNs and the Virginia class of submarines. Successive Virginia class hulls will see continuing insertion of new technologies when they are developed and fielded as new submarine capabilities. The insertion plan considers technologies whose selection is driven by

RDT&E and SCN budgets, while, at the same time, it is consistent with fleet prioritized capability requirements.

The Virginia class submarine is being built for an anticipated life span of thirty-plus years. Technologies will transition into capabilities throughout the Virginia class hull production plan. These emerging technologies and newly developed capabilities must also be available for already constructed hulls. SUBTECH envisions modularity solutions which will achieve both the retrofit requirement and the SUBTECH vision's flexible reconfiguration goal—the vision that solves the problem of providing the desired capability *when and where needed*.

Leadership Principles—Arrows for Your Quiver

Seek Self-Improvement. Professional development is a continuous process. It is fundamental to understanding and achieving results in any organization. Through self-evaluation, a leader or commander is able to recognize his or her strengths and weaknesses in order to determine personal capabilities and limitations.

As a result, the leader can take specific actions to further develop strengths and work on correcting weaknesses, and we all have those. I have found that continuing education greatly enhances one's own level of self-confidence. In other words, the more secure everyone else around them will be. That feeling is crucial to fashioning a sense of trust with that individual and their co-workers. For the leader, it is essential. People want them to succeed. Trust in those who fill leadership positions allows the desire of the leader's people to become a reality.

Be Technically Proficient. Effective leaders are thoroughly familiar with the operations, training, and technical aspects of their assignments. They know that demonstrating technical and tactical competence inspires confidence and trust. This principle is related to the principle of knowing oneself and seeking self-improvement. Those who aspire to leadership must prepare themselves to assume the duties and requirements of leading at the next level.

While this may seem self-evident, ask how many people have

ascended to a leadership position and then suddenly found themselves *out of their league*? I am sure everyone knows someone like that. We commonly refer to this as the *Peter Principle* where, in a hierarchy "every individual tends to rise to his or her own level of incompetence". This principle demands that leaders take responsibility for staying abreast of current developments through training, professional reading, and personal study.

Seek and Take Responsibility. Achieving organizational results means accepting responsibility. While responsibility for portions of a project may be delegated, ultimate responsibility for success or failure is borne by the leader of the group or organization.

Leaders cannot be omnipresent and omnipotent, but they can exercise initiative, resourcefulness, and imagination along with being responsible. Responsibility is demonstrated by decisiveness in times of crises—not hesitating to make decisions or to act to achieve operational results.

Today's business world is dynamic in the extreme, and leaders act in the absence of orders to take advantage of fleeting windows of opportunity. Again, here is where the personality of the leader becomes a major factor.

Leaders see problems as challenges rather than obstacles. Leaders accept *just* criticism and admit mistakes. They encourage others to do likewise. Any efforts to evade responsibility will destroy the bonds of loyalty and trust that must exist between leaders and those they lead.

Seeking additional responsibility will assist leaders in preparing for duties at higher levels. Here is where consistency and predictability come into play. Leaders adhere to what they believe is right, and have the courage to accept the results of their actions.

Make Sound and Timely Decisions. Today's Navy demands rapid estimates of situations, sound decisions, and timely initiation of actions to accomplish those decisions. A person who delays or attempts to avoid making a decision may cause unnecessary speculation and second-guessing of the final decision, as well as causing the probable failure of the vision. Success hinges on creative, flexible leaders who can quickly adapt; anticipate opposing reactions; and then make, and rapidly execute, sound

decisions.

Adaptation and anticipation of what is coming down the pike is something on which we spend a lot of time within SUBTECH. It is the nature of our organization, and of our business partners. None of us could do our job if we did not take the long view. This is good advice for you as well. Take the time to step back from the pressures of the moment to look at the *Big Picture*. Always color your perspective this way. Believe me, it helps.

Set the Example. The power of example is great, but it forms only a part of what instills trust in the leader. Leaders win confidence and loyalty through their actions. Soldiers and sailors will always emulate the behavior of their leaders.

This is not an arena for wimps and wallflowers. Implementing this principle requires both moral and physical courage. Leaders set the example by maintaining high, but attainable, goals and standards and by ensuring that their own actions match what they require of others.

Again, this principle is related to all the other leadership principles, and it is essential that leaders share the dangers and hardships that their decisions may bring to the organization. Leaders implement their vision for change with a firm belief that if it hurts the men and women who work for them, it should also hurt them.

Care for Your Shipmates. Leaders know their Sailors and look out for their well-being. This principle focuses on instilling trust and confidence in the men and women who work for the leader. Trust and confidence develop and sustain loyalty and cohesion, thereby creating a better organization. This is important because cohesive teams are more successful than those that are not. Loyalty reinforces this confidence and is the foundation for motivating any subordinate.

Loyalty begins at the top—not at the bottom—and is two way. Men and women who respect their leaders expend more effort to ensure their tasks are accomplished to the best of their abilities. Leaders will take the time to know their crew in order to motivate and influence them to accomplish the mission. Cohesion then flows from loyalty and becomes the bedrock that keeps the group together

during the stress and chaos of change.

Keep Your People Informed. Military success is founded upon actions taken in the absence of orders. Informing subordinates supports the ability of subordinate leaders to make and execute decisions within the context of the established intent. Information also greatly reduces fears and rumors that affect the attitude and morale of your men and women. Keeping them informed enhances initiative, teamwork, cohesion, and morale.

Subordinates must understand their tasks and how their personal roles relate to implementing the leader's vision. It enhances their purposefulness, determination, and fortitude. This principle is directly related to establishing trust between the leader and the led.

Develop Subordinate Responsibility. The human emotions of pride and determination can be employed to develop a sense of responsibility through delegation. A truly effective organization will perform well in the absence of critical leadership. Delegation of tasks with commensurate resources develops subordinate leaders so they may be able to assume leadership roles at succeeding higher levels. Leaders are teachers and take responsibility for professionally developing subordinate leaders.

I have found the success or failure of this particular principle to be in lock step with the personality of the leader. For some, it is excruciatingly difficult to delegate authority and decision making. Sometimes, this may become impossible. For some, their personality just will not allow it. A person who falls into this category is doomed to fail.

Communicate and Supervise. Leaders ensure the task is understood, supervised, and accomplished. This principle is essential to accomplishing the mission and vision the leader is trying to implement. It is also a critical element of effective leadership and command. Understanding the task ensures that your people know what is to be accomplished, how it is to be accomplished, when it is to be accomplished, and who is to accomplish it. Since our environment is, by definition, dynamic and characterized by change, this enhances the ability of your sailors to accomplish the task, even in the absence of detailed orders or when adjustments to the plan must be made because of unforeseen circumstances.

As with developing a sense of responsibility in subordinates, the

right level of supervision must always be exercised. On the other hand, micromanaging is lethal to success. Care must be exercised in supervising. Excessive supervision stifles subordinate leaders and insufficient supervising leads to not accomplishing the task at hand. Yes, it is a balancing act that takes some intuitive sensitivity and great skill.

Build the Team. Cohesion is essential to success. People will jump through hoops to assure mission success when they respect and have trust and confidence in their leaders and co-workers. They will know that they are part of a good team.

Failure to foster a sense of teamwork can produce an ineffective organization. All the members of the team must be proficient in team skills so as to integrate those skills into effective team operations. Performance as a team provides the foundation for effective performance throughout the organization. An all prevailing unity of effort contributes to team integration.

We also believe that for a team to be truly effective, it must be diverse in its makeup. Achieving this diversity is something at which you have to work, no matter what kind of organization you have. In this respect, you have a luxury that I did not enjoy when I was a junior officer. There are a lot more women in the fleet now than then. This can be a powerful asset for you—take advantage of it.

Know Your People. Leaders employ their people in accordance with their capabilities. This principle combines all leadership principles and focuses on the precept of accomplishing the task, while looking out for the well being of your subordinates.

Obviously, all individuals have capabilities and limitations, regardless of race or gender. While it is necessary that the leader continually groom future leaders on tough and challenging tasks and drive them for improved performance, the *groomer* must make these tasks attainable to the *groomee*. Otherwise, the person who is being groomed for future leadership will lose confidence both in themselves, and in the leadership of the organization.

The obverse of this is true as well. Encourage and reward those who do good work. A simple, sincere "Well done!" or "Good job!" will work wonders. John Wooden, the famous basketball

coach at UCLA, recommended that a coach use two words of encouragement for every word of criticism. I have found that combination to be about the right ratio for leading shipboard people as well.

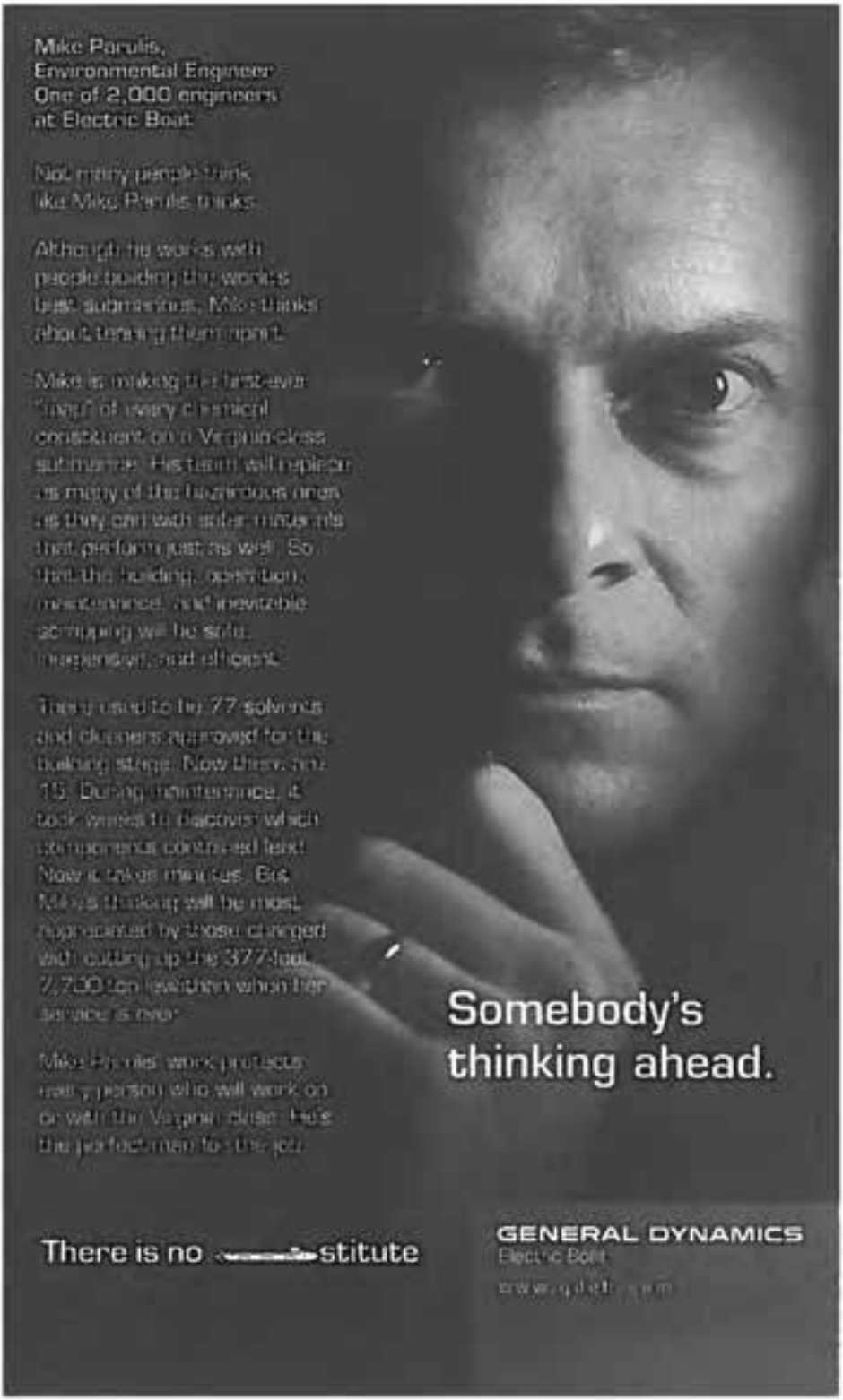
Hit the Leadership Target

The Leadership Triangle and these principles have worked well for me over the years. This list is not the *be all to end all* for successful leadership and implementing change.

I remind all of you that we have responsibility to the people who hold a trust in our leadership. We have a responsibility to show that we will conduct ourselves at all times as persons of honor, whose integrity, loyalty, and courage are exemplary. Trust your subordinates personally, and back them professionally.

It is important for you to remember that your people want you to succeed. It may not always be obvious, but it is there. Always remember that the road to success is a two-way street. Not only should you command your people, but you should also learn from them as well.

Work for the respect of your people, not their friendship. The friendship will indeed be there, and it will be genuine. But you will not have to work at creating that friendship. It will come naturally, and without strings.■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ARTICLES

PARTNERSHIP WITH RUSSIA TO PREVENT SUBMARINE PROLIFERATION

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This presentation was given at "The Enemy is Still Below" conference sponsored by the Lawrence Livermoore National Laboratory and the Naval Postgraduate School in Monterey, California on May 31, 2002. It is reprinted with permission of LLNL.

Partnership with Russia in preventing the diffusion of submarine technology and the sale of submarines will be difficult to achieve. This proposition may sound extreme, because, since the end of the Cold War, the United States and Russia have forged a number of partnerships to stabilize what appear to be similar problems.

For example, the United States and Russia work together in partnership to establish controls on the leakage of weapons of mass destruction and their associated technologies from Russia. Just to mention the activities of some of the people in this room, Ron Lehman has been involved with the *nuclear cities* initiative, aimed at keeping Russian weapons scientists working on peaceful projects at home; and Jay Davis worked with the Defense Threat Reduction Agency, which helps fund dismantlement of those portions of the old Soviet arsenal now restricted by treaty or other international agreement. Since September 11th last year, Russia and the United States have also worked in partnership to combat terrorism.

This is not to say that the United States and Russia do not have differences and difficulties. Each nation has characteristics and ways of doing business that the other finds irritating and even provocative. Nonetheless, the record shows that the two countries can work together to solve international security problems.

Yet, building partnership with Russia to reduce the diffusion of submarine technology or even to scale back its sale of modern

conventional submarines will be vastly more difficult, despite this established record of cooperation in other areas. In this presentation, I will be exploring four elements that would disincline any Russian government from responding to U.S. initiatives in this area:

- Popular Russian resentment at U.S. global preeminence
- Differing Russian and U.S. worldview on what constitutes an international threat
- The Russian need for weapons export revenues; and
- The Russian Navy's fear of the U.S. Submarine Force.

Before launching into these four elements, I want to give my personal assessment or bias of Russia as a political system. I see Russia as a shaky democracy. It is not a temporarily weakened geopolitical foe that is licking its wounds and waiting for an opportunity again to mount a global challenge to U.S. interests, nor is it the other, pathetic extreme, a *Haiti with nuclear weapons*. The implications of this are profound, and the most important of them is the fact that the Russian government today must be responsive to popular feeling in some degree and popular feeling in Russia today is very anti-American.

Popular Russian Resentment at U.S. Global Preeminence

One consequence of U.S. global preeminence is a suspicion by other nations and peoples that the United States is using or abusing its overweening power to impose its own views, values, and interests onto the rest of the world. *Hegemony* is the word most often used to express this suspicion. *Everybody* in the world feels this to be the case to one degree or another—even our friends.

Many in Russia are not our friends. I am not referring just to Communist or radical nationalist political figures—Russian public opinion polling routinely shows sizeable majorities of the population to be distrustful of and antipathetic to the United States. For example, a May 11-12 Public Opinion Foundation poll, surveying 1500 respondents, revealed that only 25 percent agreed with the

statement, "The United States is a friendly state." Over 54 percent found the NATO alliance to be "aggressive," in contrast with 38 percent in 1997 and 50 percent in 2000.[1] In sum, anti-American feeling in Russia is *rising*. This adds to the difficulties President Putin and other Russian leaders face in continuing and expanding the various Russian and U.S. partnership initiatives.

There is a factor in Russia that goes beyond the usual reasons found in other countries for suspicion of U.S. hegemony—many Russians believe that the United States has deliberately exploited Russian weakness since the collapse of the Soviet Union. This exploitation, in their view, can be overt and direct. Russians frequently cite the expansion of NATO, despite strong and repeated objections from their country, as an example of this. Another instance in which many Russians feel the United States acted in blatant disregard of Russia's interests is the U.S./NATO war in Kosovo, undertaken despite similarly voiced Russian objections. Although President Putin has chosen not to make an issue of them, the recent U.S. abrogation of the ABM Treaty and its stationing troops in Central Asia and the Caucasus as part of the *war on terrorism* are seen by many Russians as more evidence of malicious U.S. disregard of Russian interests, and exploitation of Russian weakness.

In addition to these overt examples of what they regard as U.S. exploitation, many Russians assert that the United States is subtly manipulating Russian politics and the Russian economy. The mismanaged privatization of Soviet industrial and commercial enterprises—bitterly punned on as the "*prikhvatizatsiya*" or *expropriation* by the new Russian financial oligarchy—is laid at the feet of the United States. The current clash with America over chicken exports—Russia is the world's largest importer of frozen U.S. chicken—is widely cheered by Russians. They see it as a long-overdue standing up against an America that callously dumps inferior product on a weak Russian market.

Perhaps nothing raises Russian ire more than memories of the blatant U.S. interference in the Russian presidential election of 1996, when we gave funding and expertise to the Yeltsin campaign in order to keep Communist leader Gennadi Zyuganov from

victory. Many Russians believe our real motive for backing Yeltsin was that his poor health and alleged dipsomania made him more open to U.S. pressure than any other potential candidate. Just yesterday a leading Russian political website ran an article with a title that says it all: "How a Drunken Yeltsin was Manipulated by the U.S."[2]

I want to emphasize that this Russian suspicion of U.S. motives in itself does not rule out cooperation with the United States over limiting the diffusion of submarine technology and its sale of submarines to states we regard as dangerous. However, it does make any cooperation—even in areas vital to the security of the two nations—much more difficult. It also adds strength to the other elements that would inhibit a Russian government from responding to such a U.S. initiative.

Differing Perceptions of Threat

A second element militating against any Russian partnership with the United States to limit diffusion on submarine technology is that Russia has cordial relations with many, probably all, of the *countries of concern* that the United States currently regards as threats to global stability. As Rear Admiral Ellison put it this morning, the United States sees a threat in "rogue nations operating submarines." Russia does not.

In fact, Russia by-and-large rejects the U.S. concept of "rogue nations" and has close relations, including weapons export contracts—with many of those states the United States regards as the most serious threats. In its diplomacy, Russia follows the traditional view that internationally recognized governments are legitimate governments. In the Russian view, unless a government is violating an existing international treaty regime or engaged in open aggression against its neighbors, its affairs are its own business.[3]

Russia has no intention of allowing the United States to dictate with which states it may have close ties. In January 2001 Russia gave a direct notice to this effect to the new Bush administration.[4] In the case of Iran and North Korea, especially, Russia openly

opposes U.S. efforts to isolate these two members of what we now term the *axis of evil* and is disregarding earlier pledges not to supply them with conventional weaponry and other materiel that Washington regards as destabilizing.[5]

Russia is not greatly concerned that the weapons it exports are often targeted against U.S. military forces. Russian spokesmen have exulted, for example, in the fact that Chinese purchase of Sovremenniy class cruisers and Kilo submarines with their Moskit and Yakhont weapons systems will prevent the United States from intervening in a future Taiwan Straits crisis. So there is an important strategic justification for Russian submarine sales: they serve the helpful purpose of keeping the U.S. Navy from intimidating legitimate governments friendly to Russia while at the same time blunting the U.S. Navy's effectiveness as an instrument of intimidation.[6]

U.S. efforts to lasso Russia into its system of *suppliers groups* arms control initiatives got off to a bad start. The Russian Federation, in its first flush of enthusiasm following its establishment as a democratic government in 1992, agreed to participate in the Missile Technology Control Regime. Almost immediately, it found itself in a confrontation with the United States over a proposal to sell cyrogenic rocket engines to India—a democracy with which Russia has close ties. Russia has itself been the target of U.S. export restrictions, and many Russian commentators have noted that the justifications used by the United States and NATO for intervening in the 1999 Kosovo crisis could be used against Russia for the way it prosecutes its war in Chechnya.

Put bluntly, Russia is not likely to view initiatives aimed at limiting acquisition of non-strategic submarines as a *global* issue. Instead, it is more likely to interpret such moves as U.S. efforts to use diplomacy to reinforce its military hegemony.

Russian Export Revenues

A third element we must take into account, in trying to involve Russia in initiatives to restrict its diffusion of submarines and submarine technology, is the desperate condition of the Russian

arms industry, and the relation of this industry to the Russian economy as a whole.

Russia needs export revenues to keep its arms industry afloat, since the Russian military itself is not buying armaments in any significant quantity whatsoever. Having no internal market for arms, Russia depends on its export market. In this market, the United States is the dominant player and Russia's biggest competitor. Russia unsurprisingly suspects that the United States is not above using arms control restrictions to hurt its rivals in this area.

Beyond this, weapons exports are a source of rich profits for the unscrupulous. Currently a great public scandal is occurring as Baltiyskiy zavod and the Severnodvinsk Northern Machine-Building Enterprise (Severomash) attempt to take production of export Sovremenniy class cruisers away from Severnaya verf' of St. Petersburg. China itself is satisfied with the relationship it has with Severnaya verf' and is resisting the switch in contractors. However, the two new arrivals have been able to demolish their rival through state intrigue. Severnaya verf' had a head start on producing the two Sovremenniy's it has build for China because it was able to use two uncompleted hulls left over from the Soviet period. It purchased them at nominal cost from the Russian government, but now is facing civil and criminal prosecution for fraud as the state has ballooned its evaluation of their worth and is demanding back payment of nearly a billion dollars.[7]

In an effort to curb such scandals, President Putin has abolished the former weapons holding company ROSVOORUZHENIYE and replaced it with a new structure, ROSOBORNEXPORT. [8] However, it may well be that the only effect that this reorganization has is to replace the Yeltsin-era appointees who were able to siphon off the profits from weapons exports with officials appointed by the new Putin administration.

In sum, Russia, or at least some Russians, are unlikely to see U.S. pressure for it to scale back or stop its exports of submarines and submarine-related technology as motivated by a genuine concern for arms control and global stability. Instead, it will probably be perceived as merely as an effort to remove the Russian Federation as a competitor from the world arms export market.

The Russian Navy's Fear of U.S. Submarines

A final factor effecting Russian willingness to back U.S. initiatives to restrict the proliferation of submarines and the diffusion of submarine technology was highlighted by a revelation of the KURSK tragedy—the Russian naval leadership is terrified of the U.S. Submarine Force. From the moment it made news of this disaster public the Russian Northern Fleet command insisted that its probable cause was collision with a U.S. or other NATO submarine.

Moreover, the KURSK tragedy highlights the fact that Russia believes that the U.S. is behind other Russian submarine losses. When he appeared on *Larry King Live* President Putin stated that no fewer than 19 collisions had occurred between U.S. and Russian submarines.[9]

This leads to a vastly differing perception of submarines and undersurface operations between the U.S. and Russian navies. When, for example, in the START negotiations the U.S. pressed for the Soviet Union and then Russia to base a larger proportion of its strategic nuclear force on ballistic missile submarines, U.S. motivation was that this was the most secure basing mode. Some Russians saw this as motivated by a U.S. desire to have Russia place its most valuable strategic assets in a position where they were vulnerable to a stealthy U.S. preemption.

Finally, the Russian naval leadership is so fixated on this view that it is willing to make (and believe) absurd charges. It did so even after being long ridiculed even in the Russian press—and in embarrassing the military leadership and the Commander-in-Chief himself.

Russians holding this view are likely to see initiatives by the U.S. government to curb submarine exports as merely an attempt to preserve its unique unilateral maritime dominance. Why should they support any Russian government's willingness to acquiesce in this?

The Bottom Line

Many Russians are unlikely to believe that proliferation of modern conventional submarines is a global problem requiring concerted action. Many Russians *are* prepared to believe that the United States will make claims that such submarines are a global problem, in order to serve its own selfish interests. They incline to the view that, while the United States may have its own problem with nations such as Iran and North Korea—let alone China, these states are not *rogues* posing a threat to the entire global order. Instead, the United States opposes sale of submarines and associated technology to these states because we do not want them to be able to resist when we impose our will on them, or because we want to harm the Russian arms export industry, or because we want to maintain our naval supremacy cheaply and without modern technological challenges.

Unless there is a dramatic improvement in Russian-U.S. relations across the board, the United States has only two choices in this area. Either we must do a much better job of explaining why the spread of modern conventional submarines and submarine technology is a threat to Russia; or we must find offsets, concessions in other areas, so as to purchase Russia's backing for us in this area.

I want to close by raising a related issue—Russia may be an important source of submarines and submarine technology to adversaries of the United States. But some of our European allies, such as Germany, are at least as significant in providing these *countries of concern* with the means of complicating U.S. naval operations and threatening global maritime trade.■

ENDNOTES

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THOUGHTS ON SUBMARINE TACDEV FROM *DOWN UNDER*

by CDR David Nicholls, RAN(Ret.) and CDR Chris Donald, RAN(Ret.)

David Nicholls retired in 2001 after 31 years as a submariner whose tours included CO of HMA Submarines OXLEY and OTAMA. His final tour of duty was 3 years exchange posting on the staff of COMSUBPAC. Chris Donald retired in 1999 after 30 years as a naval aviator serving in VS and VP squadrons in his early life and working with and in submarines for the past 15 years, specialising in fast fits. He currently heads the Sonar and Ranges section of the Australian Defence Material Organisation. This paper represents the views of the authors and not necessarily those of the Australian Department of Defence.

On 10 Sep 2001 a Statement of Principles, for enhanced cooperation between the USN and RAN, in matters relating to submarines, was signed by Admiral Vern Clark, USN (CNO) and Vice Admiral David Shackleton, RAN (CN) in Washington, DC.

Amongst other issues, this SoP undertook to cooperate in research, development, and engineering projects as follows:

- Projects to improve the acoustic characteristics of submarines
- Projects to improve submarine combat systems
- Projects to enable submarines to achieve their full operational potential
- Projects to develop improvements jointly for software updates for a common combat system.

There are a number of areas of emerging technology in which Australia has demonstrated an ability to contribute in such a co-operative vein, perhaps via the ARCI/APB programs. These include:

- Data Fusion in tactical data handling, using Multi-Hypothosis algorithms
- Covert under water communications
- *Ping* Intercept Passive Ranging Sonar (PIPRS)

- Self Defence against ASW Aircraft attack.

The rapid acceleration in the development of modern technology has led to the advent of the COTS concept and the demise of the old legacy system design. The *Plug and Play* capability of COTS systems means that smart, new ideas can be incorporated into open architecture systems.

Millions of dollars can be saved in development and *legacy system* integration costs. It doesn't matter if it wasn't invented *here*—just get on and use it!

The Impetus for Self Help in Australian Submarine Sensor and Combat System Development

The current Australian Submarine Squadron was commissioned in 1967. The original six Oberon class boats were built in UK and fitted out with RN systems. Australian requirements for diesel submarine operations in the Pacific region led to a replacement digital combat system integrated with the U.S. Mk 48 MOD 4 torpedo and the sub-Harpoon missile in the late '70s/early '80s.

These requirements also led to the indigenous development of specialised sonar/combat system processing and the recent building of the Collins class submarines. Allied developments in the US and UK legacy submarine systems were focused on nuclear submarines—many were unsuitable for diesel submarine application and most developments were not releasable.

Diesel boat experience in shallow, tropical, littoral waters—with a high density of sensor contacts—has led to the development of specialist sonars and data handling/data fusion processors. The minimal levels of self noise in a diesel boat have led to the focused development of hull mounted sonar arrays (flank and distributed) and the associated ability to process passive ranging on active transmissions and transients using wave front curvature techniques.

Other initiatives included the development of a covert *Spread Spectrum* underwater communications system (Hydro Acoustic Information Link (HAIL)), now used in both submarine forces for the annual joint USN/RAN PCO Training exercises.

The lack of sustained power and speed has emphasised the

vulnerability of diesel boats to the expanding capabilities of regional ASW airborne threats. This led to the work by B. Ferguson and G. Speechley at Australia's DSTO[1] and later published in the U.S. Journal of Underwater Acoustics.

The following article addresses some personal Australian thoughts, on self-defence against airborne ASW.

Some Australian Ideas on a Defensive Submarine Anti-Air Capability

Background

In the January 1994 issue of **THE SUBMARINE REVIEW**, an article on *Defensive Anti-Air Warfare for SSNs* was published by Captain James H Patton, Jr., USN(Ret.). A *Comment* on that article by Ambassador Linton F Brooks (U.S. Chief START Negotiator) was published in a subsequent issue of **THE SUBMARINE REVIEW.**

The thrust of Captain Patton's article addressed a scenario in which a submarine was deployed on an independent mission, in a littoral area in which U.S./Allied forces did not have control of the air space. In such a scenario, if a submarine was unfortunate enough to be detected and localised by a hostile ASW aircraft, the submarine had no capability with which to defend itself against attack. Captain Patton then broadly addressed the likely tactics of both protagonists in such a scenario, together with the broad characteristics of a submarine launched air defence capability.

The *Comment* by Ambassador Brooks countered Captain Patton's case for an AAW defensive capability, asserting that "In littoral warfare, the first and most important characteristic is stealth". He next opined that "Fortunately, prospective targets for littoral warfare are not likely to be able to detect a submarine that wants to remain undetected". Later in his *Comment* he qualified that opinion with the observation that "The fact that there is no current need for submarine based AAW does not, however, mean that there never will be."

This article addresses some Australian developments that have taken place over the eight years since those earlier articles were

published.

Introduction

The Stealth Factor

The ability of a submarine to survive in a hostile environment relies predominantly on stealth to counter the efficiency of hostile Anti-Submarine Warfare (ASW) sensors by:

- reducing radiated acoustic signature to a minimum, to counter passive sonar systems
- reducing magnetic signature to a minimum, to counter Magnetic Anomaly Detection (MAD) systems
- reducing target strength to a minimum, to counter active sonar systems
- reducing any form of exposure above the sea surface to a minimum, to counter radar, infra-red and optical systems.

The aggressive pursuit of submarine missions, particularly in a littoral water environment, involves a calculated increase in the risk of detection through these factors.

Stealth and the Impact of Multi-Static Sonar

The best form of self-defence for a submarine in the face of an adversary, to date, has been to maintain a covert posture. Amongst other advances in battlespace ASW capability, the development of active multi-static sonar systems (MSS), in littoral areas, where national or allied coalition forces do not have control of the air space, makes the potential for long range active prosecution of our submarines a real possibility.

The ability of a hostile MSS system controller to maintain the localised position of the submarine (even when only a limited number of aircraft are available) may mean that prosecution of the submarine can be maintained for extended periods of time. This would allow hostile aircraft the option of returning to base to re-arm and conduct multiple re-attacks. Prior to the advent of MSS, the initiative in the underwater battle space lay with the submarine. The ability to gain, and maintain, localised contact with the submarine, via MSS, potentially shifts that initiative to the hostile ASW aircraft.

Self-Defence versus AAW Offence Against Hostile Aircraft

Sonar processing technology now provides the capability for submarines to detect, track and localise hostile ASW aircraft.[2] This provides the submarine with a heightened level of threat awareness and the *trigger* to reduce any risk of detection. However, the threat of MSS is difficult to counter—and the fact remains that a submarine localised/attacked by an ASW aircraft *still* has no intrinsic self-defence weapon.

In examining an option for providing submarines with an active *deterrent* against hostile ASW aircraft, it is recognised that sophisticated, high cost solutions involving homing/guided missiles are being developed. The capital costs of such systems, together with integration costs and the long time-scale for development, are all likely to be significant. Future justification for such systems may well involve extending the concept of operations for submarines—specifically where the submarine is undetected and holds the tactical initiative—to include aspects of *offensive* Anti-Air Warfare (AAW). Such a capability might have changed the role of UK SSNs in the Falklands campaign, from EW Picket, to AAW picket, with a consequent significant reduction in RN losses to land based Argentinian air attack!

Of major significance in the concept of a Submarine Launched Aircraft Countermeasure (SLAC) is the focus on the *self defence aspects* of submarine operations at a relatively cheap cost—*it has no place in extending the overall submarine concept of operations.*

This paper, therefore, focuses on a SLAC design derived from proven levels of engineering design and existing Submerged Signal Ejector (SSE) discharge systems (3 inches) to provide a low cost, fast-track development solution.

In one tactical concept for the use of SLAC, a parallel might be drawn with that of a defensive minefield used for area denial. Once the submarine CO has determined that there is a high risk of being localised, airborne ASW prosecution might be *deterred* by sowing the immediate submarine operating area with potentially lethal ordnance (multiple SLAC) munitions.

The Submarine Launched Aircraft Countermeasure (SLAC) Concept

Very briefly, the SLAC concept proposed here is a munition

store that is ejected from the submarine signal ejectors (SSE) and buoyantly ascends to the sea surface. Using organic sensors, any aircraft within close proximity to the SLAC munition is detected. Once the tracking sensor detects the aircraft approaching Closest Point of Approach (CPA), ie overhead or very close to overhead, the encapsulated munition is fired.

The primary aim of the SLAC capability is to cause the crew of a hostile ASW aircraft to recognise the potential threat and change their tactical focus from unrelenting pursuit of an attack on the target submarine, to that of survival from counter-attack. The individual (or combined) effect of such a change in tactical execution is likely to be:

- delaying the launch of the weapon and/or
- avoiding an attack profile for weapon launch, which passes over the top of the submarine target and/or
- aborting the mission.

Tactical Issues

The Decision to Deploy SLAC

A submarine being prosecuted by a hostile ASW aircraft will be very aware, from sensor analysis, that it has been localised by proximate sensors eg.by the fact that the aircraft has commenced executing Magnetic Anomaly Detection (MAD) runs prior to the commencement of an attack. *The decision by the submarine CO to deploy SLAC would be made only in the certain knowledge that the submarine is at grave risk of being, or had already been, localised.* Therefore from the submarine's point of view there was nothing to lose, but perhaps much to gain, by firing a pattern of SLAC munitions. The SLACs would deploy to the surface whilst the submarine commenced evasive manoeuvring.

Multi-Static Sonar - MSS

The development of MSS, as a proximate sensor, will change the manner in which the submarine CO determines the chain of events via which he predicts his vulnerability to attack. As tactical experience in countering MSS increases, he will recognise a *level of threat* from his intercept of one (of perhaps a number) of MSS

transmissions, e.g. certain angles on the hull, indicating that there is a high risk of detection and that an attack is likely to shortly ensue. At this point the CO should be shifting tactical posture to one of clearing the datum, employing evasion tactics and, as a deterring/diversionary tactic, consider deploying a SLAC munitions defensive *minefield*.

Recognition of MAD 'Runs' to Establish Target Datum

In the current use of MAD as a localising sensor, three close passes are normally conducted. Activation of a SLAC during one of these MAD runs would almost certainly force the aircraft to increase altitude and/or move away from the datum for weapon drop, if not inflict damage and cause the aircraft to abort the attack entirely. Even if the SLAC munition detonated behind the aircraft, the crew is likely to spend some time determining if the aircraft had sustained damage, offering an opportunity for the submarine to clear the datum and aggressively evade.

Weapon Launch—Significance of Datum Accuracy

Current tactics dictate that, once a level of confidence is reached, the aircraft drops to a low (< 250 feet) altitude, flies directly along the line of the established course of the target submarine, and drops the weapon at the *on-top* position over the target. Subsequent weapon 'splash' is a short distance ahead of the position of the submarine. The use of SLAC to deter the aircraft away from the datum will cause errors in accuracy of the weapon *drop* position in relation to the actual position of the submarine.

This would result in a commensurate reduction in the likely success of the weapon in detecting and acquiring the target submarine.

Genesis and Development of the SLAC Concept

In the mid '80s,an Australian operational requirement arose to improve the capability of submarine launched flares and markers. Australia's Defence Science and Technology Organisation (DSTO) were tasked to design and demonstrate a new flare.

This device, having been launched by the submarine, ascends to the sea surface and explosively discharges an aerial flare to an initial design height of 600 feet. It is fitted with a parachute to provide extended time in the air. DSTO also designed a surface floating marker variant. The two variants are designated Signal Illuminating-Submarine Launched (SISL-parachute); and Signal Illuminating-Submarine Launched (SISL-surface); respectively.

The designs of the concept demonstrators were passed to industry and the two variants were re-designated Submarine Launched Flare (SLF) and Submarine Launched Marker (SLM). Subsequent development of the SLM is not pertinent to this article.

The SLF had an initial design *bunt* height of 600 feet. This generated air safety concerns from the airborne ASW operators and this became the genesis of a concept, developed by the co-author of this article, Chris Donald, to re-design the SLF into a self-defence Submarine Launched Aircraft Countermeasure (SLAC). This was based on his experiences with submarine sonars and observed submarine CO reaction to the close proximity of ASW aircraft. Many of the initial design features of the SLF have remained pertinent to the SLAC concept. However, a significant technical risk in the development of SLAC has been an acoustic targeting and triggering system that works for different types of ASW aircraft, in combination with an appropriate payload.

System Design Challenges and Technical Risk

The challenge was largely one of analysing a number of proposed payloads and sensor devices. Such analyses were conducted to establish:

- the issues associated with these two critical components

- which combination might most effectively threaten the attack profile of an ASW aircraft,
- which options could be integrated into the physical design limitations of a 3 inch SSE launched store.

The fundamental tactical concept is one of self-defence for the submarine, to deter the aircraft from executing the preferred attack profile (flying over the top) and to reduce the probability of success of an air launched ASW weapon.

SLAC System Sensors

Currently there are two options available as devices to initiate the SLAC munition propellant and discharge the payload. The first consists of an autonomous sensor. This might be one of a number of devices: perhaps an infra-red laser diode or a frequency Doppler *trigger* using an *in-air* acoustic sensor (SLAC-1).

The second option (SLAC-2) incorporates the Australian developed HAIL covert underwater acoustic telemetry link offering a controlled *trigger*.

SLAC-2: 'In-Water' Acoustic Telemetry System

This system would use the submarine's sonars to track and localise the hostile aircraft. Accurate positions on all SLAC-2 munitions are maintained via time synchronisation (at launch) and subsequent display on the command tactical plot. A two way acoustic telemetry link determines the relative positon of each munition and proximity of the aircraft within the field of munitions. Once the SLAC-2 trigger system has been armed, the timing precision to initiate SLAC-2 firing at the coincidence of aircraft CPA may require TMA software automation. Command initiation should also be an option.

The SLAC-2 design has an *in-water* acoustic transmitter/ receiver and incorporates a microprocessor to send a time-stamped signal of its relative position to the submarine and to receive a *trigger* acoustic telemetry signal from the submarine. This system must employ complex wide band acoustic encoding sequences to avoid detonation or jamming by acoustic countermeasures. The Australian HAIL system has a range of 20nm, is currently used for covert acoustic communications during joint USN/RAN PCO

Operations.

The SLAC-2 system features the following capabilities:

- accurate aircraft tracking from organic submarine sonar provides triggering accuracy
- narrowband and broadband acoustic acoustic processing of airborne signatures encompasses all types of ASW aircraft
- evolution in ASW aircraft tactics and engine types can be accommodated via the development of submarine sonar processor algorithms and TMA algorithms.
- SLAC-2 is a controlled mine (can conform with Rules of Engagement)
- Controlled launch sequence from SSEs—pre-planned deployment to the surface in time to be effective
- Offers an option to create tactical confusion: for example, a submarine might seed its local operating area with SLAC-2 munitions that can be triggered up to 20 miles away from the datum, thus creating diversions when submarine-alerted ASW aircraft are close to localisation.

Probability of Hit Versus Deterrence

From the perspective of initiation, accurate timing of the trigger improves the chances of a hit on a MPA .

From the perspective of payload, the selection of the fragment dispersion angle is a trade-off with the horizontal and vertical CPA distances that can assure at least one hit. The optimum dispersion angle is also sensitive to assumptions about the minimum height at which MPA can make an attack. Further, the effectiveness of a fragment hit on a MPA depends on the number of fragments in a SLAC payload. This, in turn, is traded off against the spread of fragments and hence the exposure volume for which at least one hit is assured. Given the limited hit exposure volume of a single SLAC, as many SLAC devices as possible should be deployed to:

- Increase the probability of a hit
- Create the strategic effect of a minefield, and
- *Accentuate the psychological impact and tactical effect of deterrence.*
- With the proposed payload, the effective SLAC fragment

impact horizontal radius is about 200 feet, therefore the hit probability depends on how closely the ASW aircraft follows current tactics. If, however, attack tactics are changed from the optimum because of a SLAC threat, the value of SLAC as a deterrent would already have been realised.

SLAC Munition Store—Ship/Safety and Top Level Operational Requirements

SLAC is required:

- to be stowable in a magazine locker, compliant with national ordnance safety requirements, adjacent to the location of each Submerged Signal Ejector (SSE)
- to be in compliance with national ordnance safety requirements for all explosive components
- to be fully compatible with SSE discharge systems
- in conjunction with the SSE discharge system, to have a firing interval capability of NMT 60 seconds
- to be positively buoyant on discharge from the submarine, at the maximum operational depth and maximum speed of the submarine
- to be operational in sea states up to, and including, sea state 6 and be fitted with a stabilising system and an attitude sensor
- to be fitted with a suitable power source adequate for reliable system operation
- to be fitted with a sensor designed to trigger the fuze, which actuates discharge of the payload
- to carry a payload
- to be fitted with a scuttling device.

Conclusion

The development of MSS requires a revision of the dependency placed on submarine stealth in considering the risk of detection by a hostile airborne ASW unit. As a consequence, it resurrects the issue of self defence against ASW aircraft.

The development of a SLAC capability uses a large proportion

of engineering design techniques that have already been tested. It offers a relatively cheap option to force a change in airborne ASW tactics by offering a credible deterrence against airborne ASW tactics currently in place.■

ENDNOTES

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SHOULD SUBMARINE ADMIRALS LEAD FROM THE FRONT?

by William Tuohy

Mr. Tuohy is a London correspondent for the Los Angeles Times.

During World War II, some of the U.S. Navy's most successful admirals were those who led from the front, whose flags flew from their warships leading formations into combat. One thinks of such fighting admirals as William Halsey, Raymond Spruance, Marc Mitscher, Richmond Kelly Turner, Thomas Kinkaid, Daniel Barbey, and many others. They fought from the bridges of their battleships, carriers, cruisers, and amphibious ships. Five U.S. rear admirals were killed in action during the war: the first, Isaac Kidd, aboard ARIZONA at Pearl Harbor; the last, Theodore Chandler, on the heavy cruiser LOUISVILLE hit by a kamikaze in Lingayen Gulf in January, 1945.

There were several submarine flag officers in the Pacific, though only two admirals at any given time. Most tried their best to get into action—accompanying a boat on a combat patrol. The foremost submarine flag officer in the Pacific, Vice Admiral Charles A. Lockwood, was ComSubPac from February, 1943, until the end of the war. He repeatedly requested permission of his boss, Admiral Chester Nimitz, Commander-in-Chief of the Pacific Fleet, to ride a fleet boat into action. The requests were denied. Nimitz insisted that Lockwood's presence at fleet headquarters was essential and should not be jeopardized by risking a ride on a dangerous war patrol. Lockwood did, however, travel as a sub passenger between Pearl and Midway.

In the Southwest Pacific, the naval command structure was different. While Admiral Nimitz commanded the Pacific Ocean Area, with Lockwood his Submarine Force commander, General Douglas MacArthur was in charge of the Southwest Pacific theater. (The demarcation line varied as the war progressed.) The Southwest Pacific Submarines, later known as Submarines, 7th Fleet, were under the command of Rear Admiral Ralph Christie, and later Rear Admiral James Fife. They reported to the 7th Fleet commander, from late 1943, Vice Admiral Thomas Kinkaid, MacAr-

thur's top naval commander. The 7th Fleet boats were based at Brisbane on Australia's northeast coast and Fremantle, the port of Perth, on the southwest shore.

Ralph Christie was a flamboyant officer, determined to make a war patrol on one of his submarines. His first two requests were turned down by Admiral Carpender, then Commander 7th Fleet. With Carpender replaced by Kinkaid, Christie decided to act. As he put it, "There was only one way to do it, just go and report it later. If I came back, I would be congratulated—if I did not—well frankly that was never seriously considered although many of our splendid ships did not return to port."

Christie flew from Perth to Darwin on Australia's north coast, where subs sometimes put in to refuel and rearm and continue on patrol. On January 25, 1944, He picked up BOWFIN with its fine skipper, Walt Griffith, which had come in for a reload after a successful run. He went aboard and offered his services as a junior officer-of-the deck. At sea, Griffith scored hits on one ship and bored in.

"We were very close to him, too close, within machine-gun range," Christie wrote later. "I thought we would dive but the skipper chose to hold the initiative by remaining on the surface for another torpedo attack. Only my complete confidence in BOWFIN's captain kept me from suggesting we dive or put on full speed to put more distance between us and the enemy." One wonders what skipper Griffith felt with his force commander looking over his shoulder on the bridge. BOWFIN sank no recorded ships but damaged some and laid mines off Borneo. BOWFIN dropped off Christie at Exmouth Gulf in northwestern Australia, whence he flew to Perth, qualified for a prized submarine combat pin.

General MacArthur messaged Christie: "Congratulations! I cannot tell you what a thrill the magnificent service of your submarines gives me. Nothing in this war, or any other for that matter, can surpass it." Christie's reaction: "I had been on the firing line in combat with the enemy, a unique, invaluable, and thrilling experience."

Admiral Christie decided to go on another war patrol in June, 1944, when he again flew to Darwin and picked up HARDER which had just completed a brilliant but harrowing fifth patrol

sinking three Japanese destroyers. HARDER's crew was bone-tired, looking forward to a quick return to the rest camp at Perth. But skipper Sam Dealey agreed to Christie's request to go out on a second leg, specifically after a large Japanese nickel ore carrier.

Admiral Lockwood in his book on HARDER, Through Hell and Deep Water, said the news of the add-on patrol caused "bitter disappointment" among the crew. "They felt they had done a tough job and that a speedy return to the rest camps at Perth was indicated." He quoted a HARDER radioman: "Unfortunately, Admiral Christie wanted to go out with us. The crew was pretty sore."

Headed for the Celebes, Christie, acting as junior officer-of-the-deck at the periscope, spotted a cruiser and two destroyers. But the targets were too distant for a setup and moving away. Christie noted: "I said to Sam something to the effect that if he exposed his conning tower, they would close and he could knock them off. Later Sam asked me if I had really meant that. Of course I was neither criticizing nor directing, although the way we felt about Sam and HARDER, the risk was not great."

While close to the target, HARDER missed an opportunity to sink the nickel ship, "one of the rare instances where Sam was fooled," according to Christie. HARDER dropped off Christie in Darwin and proceeded to overdue R&R in Perth. Christie thought five patrols as skipper earned Dealey a long, needed rest. But, at Dealey's request, Christie allowed his skipper to make a sixth patrol. Mighty HARDER was lost with all hands on August 24, 1944.

According to Clay Blair Jr., Admiral Lockwood's staff believed that Admiral Christie pushed Dealey and his crew too hard with the second leg of the fifth patrol. And that Christie's actions smacked of being a "stunt" which needlessly strained skipper and all hands. Further, some thought Christie should have beached Dealey after five exhausting patrols. HARDER's sinking increased the friction between Admirals Christie and Kinkaid. The two flag officers got into a nasty disagreement over the medals to recommend for Sam Dealey. (He eventually received a Medal of Honor). In the end, Kinkaid had Christie transferred from his submarine command in Australia---much to his dismay.

Rear Admiral James Fife was named Commander Submarines 7th Fleet. When Fife transferred his command from Australia to newly liberated Subic Bay in the Philippines in March, 1945, he sailed aboard HARDHEAD making a war patrol en route. The submarine under Commander Francis Greenup sank a large tanker—after several torpedo misses with the admiral looking over the skipper's shoulder. Fife therefore qualified for the combat pin. Both Fife and Christie delighted in making their war patrols. How much their presence aboard contributed to the Submarine Force is questionable.

Meanwhile, Admiral Lockwood in Pearl Harbor developed Wolf Pack tactics for his Submarine Force, with special pack commanders or *commodores*. Lockwood had a special fondness for the small wolf pack, usually of three boats—two hitting Japanese convoys from the flanks; the third following to pick off stragglers or damaged ships. The packs were to be commanded by a senior officer, usually a division or squadron commander. The *commodores* flew their pennants. Much of the success of the wolf pack depended on good communications between the wolf pack commodore and the skippers. But such was not always the case with submarine radio communications. U.S. skippers distrusted sending many radio messages for the Japanese were adept at intercepting them. There was feeling that German Admiral Karl Doenitz endangered his U-boats by too many transmissions between ship and shore headquarters. Similarly, when Captain Jimmy Fife was in command of submarines earlier in Brisbane, his insistence on maneuvering his boats around—as on a checkerboard with the resultant increased radio traffic—was considered less than judicious.

The first senior officer to sail aboard a submarine on a war patrol was veteran Captain John H. (*Babe*) Brown, who was given tactical command of a four-boat mission. He flew his flag aboard NARWAL and remained outside the Sea of Japan, while PLUNGER, PERMIT, and LAPON entered that nearly landlocked sea for the first time in July, 1943. The boats operated independently and the results were disappointing.

Pearl Harbor's first organized wolf pack consisted of three boats, CERO, SHAD, and GRAYBACK, led by Captain C.B.-

(*Swede*) Momsen, inventor of the Momsen Lung who assisted in the rescue of SQUALUS survivors in 1939. The wolf pack results in October 1943, were unimpressive—only three confirmed sinkings. Afterward, Momsen recommended that the packs should be controlled from shore, a la Admiral Doenitz. The second wolf pack (PARGO, HARDER, SNOOK) was led by division commander Freddy Warder (ex-SEAWOLF) in November. It was plagued by poor communications but downed seven Japanese ships. Warder suggested that the commodore was superfluous and command of the pack should be left to the senior skipper.

Admiral Eugene Fluckey relates that on his first wolf pack with BARB, Admiral Lockwood acceded to the requests of the other two skippers that they, both on their first war patrols, not have the burden of carrying the pack commander, Captain Edwin Swinburne. So BARB was given the dubious honor. Skipper Fluckey was not keen on wolfpacking, believing luck was where you found it, and you had to go out and look for it. He later warmed up to the wolf pack idea, particularly when the senior skipper was someone as proficient Charles Elliott Loughlin in QUEENFISH.

However, when Fluckey won the Medal of Honor on BARB's dramatic 11th patrol, his exploits in Namkwan Harbor on the China coast were accomplished operating alone.

Sometimes there was friction between the pack commander and the skipper he was riding with. Lawson P. (Red) Ramage in command of PARCHE, found that the pack commander, the abrasive, experienced Lew Parks, rubbed him the wrong way, and they had words on patrol. Perhaps because of the friction, Ramage turned in a great patrol winning the Presidential Unit Citation for PARCHE and the Medal of Honor for himself. Lew Parks got a Navy Cross.

One drawback in having a senior officer command a wolf pack was tragically illustrated in the fate of Captain John P. Cromwell, in command of SCULPIN, SEARAVEN, AND APOGON in November 1943. With Cromwell aboard, Sculpin was skippered by Commander Fred Connaway. After a heavy depth charging, Connaway decided to surface, but the boat broached and was hit by shellfire from a Japanese destroyer. The skipper and exec were killed—leaving the engineer, Lieutenant George Brown, in

command. He ordered the crew to abandon the mortally-damaged ship. Captain Cromwell declined to obey the order, explaining that he had advance knowledge of plans to invade the Gilbert Islands (Tarawa) and chose to go down with SCULPIN rather than risk divulging vital information under torture as a prisoner. After the war, when the story was told by SCULPIN survivors, Captain Cromwell was awarded the Medal of Honor.

Some top skippers like Richard O'Kane, Slade Cutter and Charles Triebel believed that submarines could best be deployed individually, rather than risk the complications of operating as a team with the problem of haphazard communications and danger of firing at one another in a melee. O'Kane of top-scoring TANG thought that a boat under an aggressive skipper could do better on its own. He pointed out that many small wolf packs were really better designated as *group patrols*. Nevertheless, Lockwood persisted in forming wolf packs, at first with supernumerary commodores, but later turning command over to the senior skipper. (Some critics said Lockwood created the job of pack commodore to keep senior officers in his command busy: squadron and division commanders did not have a heavy workload when their boats were off on patrol for up to two months each.)

Similarly, 7th Fleet submarines in 1944 joined up in small packs to harass Japanese shipping in their areas. So, small wolf packs increased toward the end of the war, culminating in one grand effort—a nine-boat sortie into the almost landlocked Sea of Japan in June 1945. The *Hellcats* were divided into three-boat echelons, with Commander Earl Hydeman, skipper of SEADOG, in overall command. However, the boats operated individually with assigned sectors rather than in joint, coordinated attacks. The operation was a great success—though BONEFISH was lost.

Thus by the end of the war, there were no extra *commodores* going to sea at the head of wolf packs. To his deep chagrin, *Uncle Charlie* Lockwood never did made a war patrol, though Nimitz finally relented and promised him one. The war ended before the promise could be kept.

Did the presence of admirals or commodores aboard boats on war patrols contribute to success? Most skippers would probably say that they did not. The extra burden on skippers dealing with all

the problems of command would seem to outweigh any benefits the flag officer might provide, looking over their shoulders.

What of the concept of a fighting admiral in today's Submarine Navy? Senior officers tend to suggest that an admiral's place is not aboard a boat in combat. In World War II, Chester Nimitz accepted that his job as Commander of the Pacific Fleet was not on a flagship—nor did the Commander-in-Chief of the U.S. Fleet, Ernest J. King, fly his flag seriously from other than DAUNTLESS at the Anacostia Naval Station.

Retired flag officer Richard W. Mies, a former ComSubLant, said he was unaware of any recent plans to put a sub group commander (rear admiral) aboard a boat in combat. He added that the Navy had "experimented" with placing a squadron commander aboard a carrier in a battle group to assist in the employment of subs attached to the group. However, the practice was never "institutionalized."

Retired Admiral Frank Kelso declared that the Navy might or might not assign a flag officer aboard a submarine "depending on the circumstances." But Rear Admiral Paul F. Sullivan, Director of Submarine Warfare, believes the sub group commander should remain ashore, since his going afloat would "add little value" in future warfighting scenarios. In short, says Admiral Sullivan, echoing a widespread opinion, an admiral aboard an operational submarine "causes more grief than grace."■

UNIVERSAL MODULAR MAST (UMM)
Submarine Sensor Systems Program Office (PMS435) Fields New Sensor Lifting Mechanism

by Patricia Lawson
UMM/SUBIS Manager

The Submarine Sensor Systems Program Office (PMS435) announces the fielding of the first major design change to the submarine sail in 30 years with the introduction of the Universal Modular Mast (UMM). The new design approach addresses the high cost and labor-intensive installations of the current technology masts. This is accomplished by providing a hydro-dynamically shaped fairing inside a self-contained module that provides the hydraulic hoisting mechanism inside a self-contained structural housing. The result is a compact, self-contained cartridge type design integrating all hydraulic and mechanical parts in a design that allows size and weight to be minimized. This design will also meet the stringent structural, mechanical, and radiated acoustic noise requirements for submarine systems. The UMM provides the Navy with a drop-in/drop-out installation that can be carried out in a few hours compared to weeks for previous systems. The UMM has been installed on USS ANNAPOLIS (SSN 760) since 1999 for testing with the AN/BVS-1 Photonics Mast.

The UMM design incorporates an installation, overhaul and maintenance philosophy which uses shop alignment and testing to minimize the need for further grooming, adjustments, alignment of internal assemblies and testing shipboard after initial installation. The initial shipboard installation precisely aligns the UMM foundation to support this innovative approach. Four variants of the UMM have been implemented to meet the requirements of the submarine's sail sensors, using common parts to reduce overall cost of submarine sensor installation. The UMM design and maintenance approach will reduce installation, maintenance, and life cycle costs. Current submarine support activities will be used to maintain the mast and only minimal familiarization training will be required for the system.

The UMM will be installed on the Virginia class attack subma-

rines and is being incorporated into the SSGN submarine conversion. The Virginia class will use the UMM for all mast mounted sensors (a total of eight UMMs), while the SSGN conversion will only use the UMM for new and upgraded sensors (a total of four UMMs).

The UMM is being procured under a contract with Kollmorgen Electro-Optical located in Northampton, Massachusetts. Calzoni SpA,, a subsidiary of Kollmorgen Electro-Optical, designed and manufactures the UMM. They have provided similar designs to various navies around the world. Calzoni is located in Bologna Italy and has been providing engineering products and design innovation since 1843. Calzoni has embraced the government's desire for lean manufacturing by opening a new factory specifically outfitted and designed for efficient UMM production. In addition Calzoni is working within the Danaher Business Systems (DBS) to improve production and implement processes for manufacturing efficiencies.

With the introduction of the UMM to the fleet, PMS435 has provided the Submarine Force with a highly reliable, cost effective, modular system that will support rapid, cost effective integration of sensor upgrades for the Submarine Force.■

THE LOW FREQUENCY ACTIVE SONAR: A NEW LOOK

by Nader Elhefnawy

Nader Elhefnawy holds a BA in International Relations from Florida International University and is presently a doctoral student in Literature at the University of Miami. He has previously contributed several articles to ***THE SUBMARINE REVIEW.***

The end of the Cold War has changed the orientation of thought on submarine warfare from global, high-seas conflict to regional conflict along the world's littorals.[1] For instance, where the Seawolf class submarine was designed to hunt Soviet ballistic missile submarines, the Virginia class vessels were designed with an eye to shallow-water operations. Anti-submarine warfare has evolved similarly, the T-AGOS class sonar vessels currently being slated for equipment with a Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) for detecting quiet diesel-electric submarines in acoustically complex shallow-water environments. The Navy's argument for the system is that the LFA would give it the capability to locate submarines in these environments while they are sufficiently distant for its units to react effectively. However, the LFA sonar array generates a pattern of very loud noise reaching out to a hundred miles from the source, which has created concern over its environmental effects, particularly on marine mammals like whales.[2]

Consequently, a coalition of environmental groups led by the Natural Resources Defense Council sued the Navy and the National Marine Fisheries Service in Federal court in August 2002 to block the use of the LFA. Such claims, of course, can not and should not be taken lightly, but this article will not attempt to decide their validity. Its purpose instead is to examine facets of the issue that have been previously unexplored, some of which are hinted at by the recent lawsuit and are generally a consequence of this system, which must be seen as unique because of its intense, wide-area effects. Irrespective of the system's ultimate environmental impact, questions are raised about existing maritime law which can affect American relations with states friendly and otherwise.

EEZs and LFA Usage

The 1982 United Nations Law of the Sea Convention gives states the authority to regulate the maritime environment not only inside their territorial seas but their economic exclusive zones (EEZs), extending two hundred miles out from their shorelines. Specifically, they enjoy sovereign rights over the use and conservation of the natural resources in these waters under Article 56 of the Convention.[3] Sovereign rights over natural resources would extend to the discharge of "substances or energy" into the marine environment, a category that can include the sound produced by active sonar. This remains the case regardless of the environmental consequences of that sound, though municipal environmental law may present another complicating factor. In other words, using an active sonar within another state's EEZ may be legally comparable to flying through its airspace, and the system's sheer power will make it easy for states to detect the use of this sonar, and more likely to forward such a claim.[4]

Sovereignty aside, the exploitation of the seas is a matter of growing economic importance, and a principal cause of naval skirmishes in recent years, in the South China Sea and off the Korean peninsula to name two examples. Should Low Frequency Active Sonar imperil or merely be seen as imperiling the delicate ecological balances on which fishing or other economic activities depend, other states will have greater incentive to demand that LFA not be used inside their EEZs. Depending on how these areas are measured, they could comprise more than a third of the world ocean, meaning that the LFA may end up being usable in considerably less than the seventy-five to eighty percent of the oceans presently envisaged. Given the long range of the LFA, the system may become unwelcome in areas adjacent to EEZs, which would make it usable in an even smaller portion than the two-thirds presently outside state control. Even in those waters where the LFA does not outright become off-limits, its use could come to depend on the approval of states sovereign over the affected waters, permission which may often be denied even by friendly governments.

Since the sonar's purpose is to hunt submarines in littoral areas,

this would mean the system's being politically neutralized in the areas that are the justification for its existence. It could also mean the introduction of additional frictions into American relations with other states, regardless of the ultimate legal status of LFA usage. Difficulties of the sort the United States experienced with New Zealand in the 1980s when it banned nuclear-armed and nuclear-powered vessels from its ports, and was ultimately relieved from its defense obligations under the ANZUS (Australia-New Zealand-United States) Treaty, could be repeated in instances.

The Balance of Power

The avoidance of such legal and political complications aside, the United States may have a more direct security interest in supporting, or at least not opposing, an international regime of sorts forbidding the use of such sonars. The T-AGOS vessels towing the SURTASS LFA sonars are not without their shortcomings, chief among which is their physical vulnerability, a deficiency which helped to kill the arsenal ship in 1997.

The fact that these ships are being intended to deploy active sensors off the littorals of potentially hostile states dramatically increases the danger to them over what they saw in the Cold War period when they were passively tracking Soviet submarines in the open ocean. The reality is that any opponent sophisticated enough to operate a modern submarine in a littoral environment in the optimal manner that makes them so stealthy as to justify LFA will also have the capability to threaten an unarmed, offshore vessel with air, missile and surface assets. Given the widespread impression that these ships are uniquely valuable, a potential adversary would think such an action well worth the effort, though it must be noted that these vessels are expected to operate in conjunction with carrier groups.

More importantly the United States is the world's premier submarine power and for that reason may need to display more circumspection about the introduction of anti-submarine technology into use than any other power. The sheer power of the low frequency active sonar creates the risk that it will interfere with the operation of other nearby acoustic anti-submarine sensors, and the

operations of American submarines in the area. While the growing capacity of information technology to coordinate naval operations above and below the waves may mitigate such problems, the LFA will make for a far more complicated battle environment, posing potential risks for American units that do not appear to have been given much consideration to date.

It also should not be assumed that the technology will remain an American monopoly. Technology cuts both ways and it is necessary to remember that many, perhaps the majority of the submarines operating in a littoral zone in any likely conflict will be American submarines against which the active sonar described here could be turned. While this is not normally a question, it is one because of the political controversy surrounding the system, which raises the issue of its proliferation and in turn raises yet another question. Is the advantage gained by the anticipated heightening of American anti-submarine capability greater than the disadvantage incurred by having the same type of sensor trained on U.S. subs, particularly by an opponent unwilling to respect any restriction on usage to get the maximum possible benefit from active sonar? Given the offensive bent of submarines, and the defensive bent of anti-submarine technology, the net outcome of such a development may be the disadvantage of the U.S. submarines performing missions in the littorals for military and political reasons.

The growing demand for submarine reconnaissance and maritime interdiction operations, the rising import of special forces actions, and the increasing capacity of submarines to function as cruise missile platforms all suggest that America's reliance on submarines is likely to grow in the foreseeable future.[5] No other state can claim a comparable reliance on its submarine force, if only because they continue to lack many of these capabilities. While it is necessary, of course, for planners to err on the side of caution, unrealistically high assessments of an opponent's strength can lead to poor strategic and tactical choices as much as underestimation. There may be over two hundred submarines in the navies of non-allied nations by some counts, but the number deployed operationally, in any particular region at any given time, let alone the number that may be faced in any foreseeable scenario, will be far smaller. Such submarine-counting also neglects qualitative

differences, putting a North Korean Romeo class vessel on a par with an American Los Angeles or even Virginia class boat in terms of not only technology but infrastructure, training, logistics and readiness generally, all areas where the United States enjoys a vast margin of superiority.

The overwhelming quantitative and qualitative U.S. superiority in major weapons systems both above and below the waves, and in the industrial capacity that produces both, may make an asymmetrical approach by which other states counter the United States through an emphasis on submarines untenable for decades to come. The result is that likely opponents will have more to fear from American submarines than they can hope to gain from acquiring a submarine fleet of their own. Such capability as they will have will be one for very expensive "underwater terrorism" rather than a capacity for attaining a favorable decision in a naval conflict. The prospect of underwater terrorism can not be easily dismissed, but given the extraordinary technical and economic demands submarines make on a military, there is also a risk that the threat will be overstated in the case of cash-strapped or underdeveloped states.[6]

Recognizing this fact such states may opt for the easier path of the defensive rather than the offensive by seeking anti-submarine systems to prevent access to their coasts.[7] This could well include other states deploying Low Frequency Active Sonar systems of their own. Such a system would be cheaper and simpler to acquire and operate than a submarine, and so perhaps the more effective approach to coastal defense.[8] Installed in an oil rig or other relatively survivable offshore facility, it could greatly complicate the penetration of American submarines into their waters, particularly if the facility were configured as an anti-submarine command-and-control system capable of coordinating other assets. Also unlike the United States, which with its global responsibilities may find greater cost and smaller advantage in deploying the LFA than has generally been appreciated, the naval commitments of these other states will be limited to their own waters and so present fewer such legal or political difficulties. Rogue states without regard for world public opinion would enjoy a greater advantage still.

The low frequency active sonar must be regarded as a unique system because of its power, which may mean legal and political

complications quite separate from the environmental issues already widely discussed, as well as a relatively convenient way for rogue powers wishing to keep the U.S. fleet at bay to raise the risks for American submarines in their littorals. By making it politically more difficult for such states to also acquire and deploy low frequency active sonars, the United States could retain and extend its advantages not only in submarine, but anti-submarine, capability.

American anti-submarine efforts are also premised upon a broad spectrum of technologies rather than any single detection system, a spectrum that likely regional opponents would be much less able to pursue. Barring the use of this single type of asset will therefore be costlier to their littoral warfare capabilities than those of the United States. Even were this not the course taken, however, a greater emphasis on other sensor types with less baggage, such as passive sonar, magnetic and infra-red, and on improving data collection from sensors of all kinds through the continuing development of infrastructure, appear to be more promising solutions to the detection problems posed by littoral environments.■

ENDNOTES

1. Captain John Morgan, "A Phoenix for the Future: Anti-Submarine Warfare", *Undersea Warfare Magazine* Fall 1998; Naval Doctrine Command, *Littoral Anti-Submarine Warfare Concept*, 1 May 1998.
2. The Navy's argument for the Low Frequency active Sonar can be found at the system's website: www.surtas-lfa-eis.-com/index.htm. A response to the Navy's assessment of the sonar's environmental impact can be found at www.awion-line.org/whales/lfa/flawedconclusions.htm in Dr. Marsha Green's "Why the Navy's Conclusions About the Safety of LFAS are Scientifically Flawed", a conference paper presented by the Animal Welfare Institute at the 53rd Annual Meeting of the International Whaling Commission on July 24, 2001. Also see Jean-Michel Cousteau, "We Need Sound Sensibility on California's Coast" *Los Angeles Times* December 6, 2001.
3. The relevant portion of the Convention reads as follows: "In the

exclusive economic zone, the coastal State has: (a) sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the sea-bed and of the sea-bed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds."

4. The U.S. government presently holds that environmental law, in particular the National Environmental Policy Act, does not apply in the United States's EEZ. There is no certainty that other states will decide the question in the same way, and in fact it is quite unlikely that they will. New Zealand's move to ban nuclear vessels and weapons from its ports in the 1980s, and European reaction to America's rejection of the Kyoto protocol are both indicators that the United States frequently underestimates the significance of environmental policy for its allies.
5. In the 1991 Gulf War, submarines fired only four percent of the cruise missiles; in Afghanistan, they fired thirty-seven percent of them. Rear Admiral John B. Padgett, III, "Needed: Technology to Support the Pacific OPLANs", *Submarine Review*, July 2002: 15. The conversion of four Ohio class submarines into land attack systems capable of carrying 154 cruise missiles each makes this figure likely to rise in the future.
6. It is worth remembering that while HMS CONQUEROR scored a considerable success in the Falklands conflict by sinking an Argentinean cruiser, Argentina failed to get any such success out of its submarines. The same goes for Yugoslavia's submarines in 1999.
7. I discussed some possibilities for this in "Undersea Future Shock", *Submarine Review*, July 2002; 81-87.
8. A TAGOS-23 outfitted with an LFA sonar costs $60 million, less than a quarter the price of a Kilo class submarine.

USS BALAO (SS 285)

BALAO SAIL DEDICATION

Remarks by RADM John D. Butler, USN
Washington Navy Yard
September 27, 2002

On 27 September 2002 Rear Admiral John D. Butler was the featured speaker at the re-dedication of the newly-restored submarine memorial at the Washington Navy Yard. The memorial is the submarine sail from the ex-USS BALAO (SS 285) which had undergone a top to bottom overhaul and preservation through the services of Unidyne Corporation prior to its transport to its new location. The restoration project incorporated five and a half tons of steel, 4000 rivets, 1,900 feet of teak wood, and 7,100 manhours of labor.

The ceremony was held in NAVSEA Headquarters at the Navy Yard, the production of which was a joint effort between the Naval Sea Systems Command, Naval District Washington, the Naval Historical Center, the Naval Historical Foundation, the Naval Submarine League, Submarine Veterans of World War II, and the U.S. Submarine Veterans, Inc.

We are all participating in history today. What we have before us is much more than a symbol—it is a relic—a treasure—of our heritage. This structure represents so much more than just another artifact from World War II. Upon these decks stood the best our nation could offer in a war that began as a threat to our very existence as a free country. The skippers and the crews that leaned against these rails during World War II came from all walks of life, but were united in a common purpose—to defeat the Axis powers. Those who commanded BALAO displayed an uncommon courage needed to fight the enemy with brilliance. They inspired their officers and men to give their utmost, which they did, and more. Reading of their achievements and war record still inspires us today. I am in awe of their accomplishments.

It would be impossible to characterize BALAO as just another

fleet submarine—no such creature exists. Every submarine is unique, special, and remembered. One hundred nineteen Balao class boats were built by five shipyards, making it the largest class of submarines ever built by the U.S. Navy. As the lead boat in very large class of 1500 ton submarines, BALAO was bigger than life in many respects. BALAO introduced several new concepts to the Submarine Force when she was commissioned in 1943. The most important of these being the thicker pressure hull, using 7/8 inch high tensile steel plates rather than the 5/8 inch plate used in the earlier Gato class. During their lifetime the Balao class introduced new sophisticated electronic gear for detecting targets, a Torpedo Data Computer (TDC) for working out and setting torpedo firing angles, new Mark 18 electric torpedoes, and a Bathythermograph for detecting cold water layers, or thermoclines, under which she could slip to deflect enemy sonar pings and make the boat hard to detect. These technological advances gave the Balao class a level of reliability and battle survivability that had never been experienced by submarines of any nation to that time. And survive she did with an illustrious record. BALAO received nine battle stars for her World War II service.

After Pearl Harbor, we had only a handful of submarines that were able to respond. By 1943, however, the numbers of American submarines operating in the Pacific had increased by an order of magnitude. This offered a new strategy to submarine commanders—the ability to operate in groups—three to four boats at a time. These small packs multiplied the effectiveness of their patrols, increasing their options and reducing their vulnerability to counterattack.

For her first four patrols BALAO operated out of Brisbane, Australia. After that she homeported out of Pearl for the next six war patrols. During that time BALAO served with two small patrol groups during the war—Post's Panzers—consisting of SPOT, ICEFISH, and BALAO and led by Commander W.S. Post. And Barney's Boxers, with TENCH, SEA DEVIL, BALAO, and GROUPER and led by Commander W.B. Seiglaff.

This is one submarine doctrine that did not carry over from World War II. There is something about the personality of submariners that doesn't lend itself toward group operations.

Some of that is, of course, due to the fact that communication and coordination between submarines and other naval vessels while underway is not the easiest thing in the world to do. But that part is changing—I'll say some more about that in a moment.

It is also interesting to note that the last sea action of World War II was performed by BALAO. In the closing days of the Pacific war, BALAO sighted two Japanese patrol boats off the west coast of northern Honshu. BALAO made a surface run and attacked both boats with her deck gun, sinking one and damaging the other. Early the following morning the crew learned of Japan's surrender.

These new fleet submarines were *purpose built* for taking the fight to the enemy—designed with food, fuel, and weapons sufficient for long-range independent patrols. BALAO and her sisters enabled the Navy to shift its submarine doctrine from coastal defense to open ocean attacks on enemy warships and convoys critical to enemy logistical support. This doctrine of forward presence and strike warfare by the submarine remains with us today.

While it has been nearly 40 years since BALAO was stricken from the rolls, it is altogether fitting and proper, and a bit ironic, that we are gathered here today to rededicate this memorial. During the past 40 years and more, we have seen the mission of the U.S. Submarine Force come full circle. During the first half of the twentieth century, the mission of the submarine was one of strike, intelligence, reconnaissance, and covert operations. During World War II BALAO and her sister ships waged war against the Axis powers, amassing a record of devastation and sheer killing power that was unmatched by any other land or sea assault platform. American submarines like BALAO supported deployment and recovery of raiding parties and the insertion and removal of intelligence assets as a matter of course—the submarine was the perfect platform for this mission.

Then came the Cold War, and for the rest of the century the mission of the submarine fleet was primarily centered on anti-submarine warfare in the open ocean. The submarine was endowed with two assets that made it supremely capable in this mission—stealth, and endurance from nuclear power. But this mission, while vital to the nation's security, barely tapped the

potential of the submarine and largely ignored its earlier warfighting heritage.

Now the Cold War is over, and the missions of the U.S. submarine fleet have largely returned to their roots. Once again we submariners find ourselves sailing into shallow waters, occupied with strike warfare and land attack. The ASW mission remains, now vastly complicated by the littoral operating environment. Intelligence, surveillance and reconnaissance have once again become core missions of the submarine. And the support of special operations forces and strike warfare has now become such a high priority that we are transforming four of our giant Trident submarines into platforms dedicated to those missions.

Symbolism abounds here. Sixty years ago BALAO was built by the Bureau of Ships at the Portsmouth Naval Shipyard. Not long after BALAO was partly dismantled and eventually sunk in the '60s, so too was BUSHIPS. By 1966, BUSHIPS was no more, having been split up into two Naval Systems Commands, NAVSHIPS and NAVELEX. NAVSHIPS eventually merged with the Naval Ordnance Command, and the Naval Sea Systems Command (NAVSEA) was born in 1974.

While NAVSEA was busy building ships and submarines to fight the Cold War, what remained of BALAO sat here in the Washington Navy Yard. Time and weather took their toll—the sail was literally crumbling into scale before our eyes. As the Soviet Union dissolved, so was this memorial.

As the '90s drew on, we in the Submarine Force, as well as the rest of the nation's military, soon realized that we had to reinvent our boats, our missions, and ourselves. We had to transform ourselves from a blue water fleet to one more closely resembling the Submarine Force of 1945. We are even rediscovering the benefits of coordinated strike that Post's Panzers and Barney's Boxers explored during World War II. Critical advances in communications technology between submarines and other fleet assets as well as the Nation's command structure make the submarine a team player. Today we call this *Joint Operations* and the Navy is fully committed to this doctrine.

Along with the Submarine Force, the entire military went through a huge restructuring process through the '90s. Consolida-

tion and realignment were the watchwords of the decade. That process was directly responsible for the Naval Sea Systems Command's return to the Washington Navy Yard as we began the twenty-first century.

And the result of that brings us here today. We are here to re-dedicate this memorial to the memory of the submarines and their crews that have sailed into harm's way. We in the Naval Sea Systems Command are proud to accept the duty, challenge and responsibility of restoring and maintaining this memorial. It speaks volumes to who we are, where we have come from, and where we are going.■

IN MEMORIAM

CAPT Edward L. *Ned* Beach, USN(Ret.)
RADM John S. Coy, Jr., USN(Ret.)
CAPT David G. Harscheid, USN(Ret.)
CAPT Paul Lee Humel, USN(Ret.)
Capt Paul C. Keenan, Jr., USN(Ret.)
CAPT Arland W. Kuester, USN(Ret.)
CAPT Charles B. Momsen, Jr., USN(Ret.)

THE EIGHTH WAR PATROL OF USS BALAO (SS 285)
Compiled from Original Diaries and War Patrol Reports
by CAPT Paul G. White, USN(Ret.)

USS BALAO, (SS 285) departed on patrol from Guam on 27 February in company with USS TENCH (SS 417), USS GUARDFISH (SS 217) and USS SEA DEVIL (SS 400), comprising Task Group 17.2.2 (*Barney's Bums*). Her eighth war patrol, under the command of Captain Bob Worthington, covered the 34 days from 27 February through 1 April 1945.

On 28 February a message was received reporting that a B-29 had ditched in an area near to the Task Group track. The following day the Task Group was ordered to search for two lifeboats from the ditched aircraft which had been spotted by air. On 2 March, since other U.S. ships and aircraft in the search area had already recovered seven crewmen, the group was ordered to discontinue the search and resume transit. However, at 0730 on the next morning the group was ordered to reverse course and resume the search. This order was countermanded at 1030 and the transit resumed after a considerable expenditure of time and fuel.

The group arrived at the assigned patrol area at 0000 on 7 March at which time BALAO had expended 29,000 gallons of fuel in transit alone. In addition to the lifeboat search, communications among the group proved to be particularly frustrating during this transit. Several radio bands were employed with indifferent success, as well as flashing light and radar. The surface search radar, the SJ, was employed as follows: BALAO would observe an interference spoke at a particular bearing, train the antenna to that bearing and key the radar transmitter in Morse code. Recognitions signals were exchanged to identify the two submarines. This was probably the most reliable of the communication methods employed but the radar operators were not always up to speed on CW procedures or the proper use of recognition signals and the SJ radar failed with great regularity.

On 9 March BALAO was patrolling in her assigned area off the southwestern tip of Kyushu. At 0910 masts and smoke were sighted through the periscope and she commenced a submerged approach on a tanker guarded by two escorts. This attack was

greatly hampered by the target's proximity to the shore and poor visibility. Four torpedoes were fired but without success. Two possible dud hits were heard at approximately the correct time. A moderately accurate depth charging was the only reward for this engagement. By 1225 the escorts and AO had cleared the area so BALAO headed back to try again. This chase proved unsuccessful as well and was abandoned that evening.

A contact report was received from USS JALLAO (SS 368) on a target group of four ships and two escorts and BALAO took up the chase. Subsequent communication from Jallao on the next morning (10 March) reported that USS KETE (SS 369), twenty miles ahead, had taken up the attack. At 0403 BALAO witnessed a tremendous fireball about 14 miles ahead indicating that Kete had found her target. BALAO attempted to close the action on the surface but the dawn arrived before she could get in an attack position. A second ship was observed to be blown sky-high at 0538. BALAO arrived submerged in the area of the previous action at 1326 but nothing remained but bits of wreckage. KETE was lost on 20 March due to enemy action.

The CO included a diary entry on 13 March indicating that the boat had tracked by radar, a particularly aggressive enemy rain squall, which had been pursued at 19 knots.

On 18 March BALAO conducted a surface gunnery attack on a small Japanese whaling vessel with 5-inch, 20mm and 40m cannon. The first round of 5-inch detonated prematurely; exploding just after the round had cleared the deck, resulting in numerous shrapnel holes topside. The second round was a misfire. While the bore was being cleared, fire was maintained with the 20mm and 40mm guns. Eight 5-inch rounds were required to sink this ship. Four survivors were recovered, one of whom died shortly after being brought on board. One of the three remaining survivors was the captain of the whaler who spoke a little English; another was a 19 year old boy. The three POWs were kept in separate spaces, the captain in the after torpedo room, the 19 year old in the mess decks and the third (known as *Sour-Puss*) in the forward torpedo room.

Later that day a message was received giving the position of a Japanese convoy. BALAO surfaced at 1100 and proceeded to intercept. Smoke was sighted on the horizon at 1400. By 1538 the

convoy could be identified as four large ships in the main body with two escorts. This identification was subsequently modified as being four large ships and four escorts. During the evening hours BALAO ran on the surface to achieve a firing position while avoiding the escorts. At 0020 on the 19th BALAO crossed to the shallow-water side of the convoy since she would not be expected inshore.

The main body was organized as two columns with larger ships leading each column. Firing position was attained at 0252 and four torpedoes were fired at the leading ship in the near column and two at the leading ship in the far column. BALAO then swung around and fired four shots from the stern tubes at the trailing ship in the near column. Due to the intensity of the action there was a slight breakdown in procedures and no times of fire were recorded. Four hits were heard, the leading ship in the near column was seen to be in flames and the trailing ship in the near column was observed to blow up. Hits on other targets could not be verified but it was believed possible that one or more hits had been attained on one of the escorts. BALAO submerged to reload and then surfaced to return outside the 20 fathom curve before first light. There were no effective counterattacks, probably because the Japanese had expected that any attack would come from the deep-water side.

Later that afternoon, while on submerged patrol, BALAO sighted two sets of masts. On closing these potential targets they proved to be Japanese trawlers. BALAO surfaced at 1743, immediately sighting two more trawlers. All four trawlers were taken under gunfire and sunk. A life raft was thrown over the side to aid survivors and one young prisoner was taken aboard. He subsequently proved to be an 18 year old Chinese lad named Too Wing. This was too much for the crew who immediately nicknamed him *Biplane*.

The third torpedo attack took place on 21 March against a convoy of two merchant ships and four escorts. The convoy was tracked by BALAO on the surface throughout the early morning hours but each time BALAO attempted to get to a suitable firing position an escort would close in and force her to withdraw. Captain Worthington surmised that he had been detected and tracked at least part of the time by enemy radar. At 0545 he

decided that, with the approach of dawn, "it was now or never" and commenced closing with the main body. As soon as this decision was made the starboard escort commenced to head for BALAO. The CO rang up full speed and commenced to cross ahead of the convoy in order to shoot from the far side, possibly taking them by surprise.

At 0615 BALAO arrived in a firing position only 1000 yards off the convoy track, maneuvering for a stern shot. Minutes later one of the escorts came out of the fog, 1400 yards astern, and turned toward BALAO. Changing setup rapidly BALAO fired four stern tubes at the destroyer. At almost the same time, the destroyer opened fire on BALAO with her forward gun. BALAO immediately increased speed and opened out under cover of a smokescreen that, as Captain Worthington said, blended nicely with the fog. Four explosions were heard but it could not be determined which, if any, were from torpedo hits on either the escort or the main body following astern, and which were the impacts from the escort's gunfire.

BALAO opened out to 5000 yards from the main body but at least one of the escorts was tracking BALAO by radar, eventually closing to within visual gunfire range. At 0712 the escort recommenced firing. BALAO dove after releasing a radar decoy. When submerged, a bubble target and an NAC noisemaker were also released. By 0759 it appeared that the escort had been evaded since the pinging had stopped and screw noises could no longer be heard. However, the respite was to be short-lived. Twenty minutes later the escort was again heard, commencing to close. Sound conditions were excellent and there were only forty fathoms of water in which to evade. By 0915 BALAO was under heavy depth-charge attack. Twenty-one explosions were heard in close succession.

Captain Worthington stated in his patrol diary that, "They were close but not blockbusters." The explosions were above and astern and the boat got an immediate ten degree up-bubble from the blasts. Immediately after the attack, pinging resumed, apparently right on top of BALAO but no attack followed. By 1020 sound contact on the escort was lost. The tenacious escort however had not yet broken off the fight. At 1105 strong pinging was again heard,

apparently in preparation for another attack, which surprisingly failed to materialize. In a few minutes the escort could be heard drawing off in the direction of the convoy. Since there was the possibility of a *sleeper* lying in wait, BALAO delayed coming to periscope depth until 1240. On conducting a visual and radar sweep, no contacts were observed.

At 0938 on 26 March BALAO battle-surfaced to attack a small Japanese freighter by gunfire, submerging again at 0956 after destroying the target. This left BALAO low on fuel and with only four rounds of 5-inch ammunition and four forward torpedoes remaining. She was subsequently directed to return to Guam for refit, arriving on 1 April.

After the war, a group was convened to accurately establish the actual tonnage sunk in the Far Eastern Theater, based on Japanese records. This was the Joint Army Navy Assessment Group. The findings of this group were that only one of the ships, claimed by BALAO on her 19 March torpedo attack, was credited This was the Hakozaki Maru a 10,400-ton transport. It is probable that the second ship, reported as hit and burning by BALAO, managed to run herself aground before she sank. In accordance with JANAG rules, this was not credited as an enemy sinking.[1]

Vice Admiral C. A. Lockwood, USN, COMSUBPAC, in his forwarding letter to the patrol report called it "a splendid, aggressive patrol resulting in the sinking of two large ships by torpedo fire and five trawlers and one small ship by gunfire. The excellent marksmanship of the gun crew is of special note."

Captain Worthington was awarded the Navy Cross for this patrol. His citation reads:

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[1]CDR John Alden reports that on 19 March 1945 Worthington attacked a convoy and believed he sank two transports, for which he was given wartime credit. The convoy was MOTA-43, of which HAKOZAKI MARU was sunk and TATSUHARU MARU was hit but reached Shanghai. This was picked up in an Ultra intercept but made known only to a select few people. On 26 March BALAO sank SHINTO MARU #1 and was credited with it. JANAC was given information from Ultra so knew that only the two ships were sunk, hence the difference in credits.

"The President of the United States takes pleasure in presenting the NAVY CROSS to

COMMANDER ROBERT KEMBLE
RITTENHOUSE WORTHINGTON
UNITED STATES NAVY

for services as set forth in the following

CITATION:

"For extraordinary heroism as Commanding Officer of the U.S.S. BALAO during the Eighth War Patrol of that vessel in the enemy Japanese-controlled East China and Yellow Sea Areas from February 27, 1945 to April 8, 1945. Maneuvering his vessel in shallow waters, Commander (then Lieutenant Commander) Worthington launched seven aggressive torpedo and gun attacks against enemy shipping, sinking three ships and five trawlers totaling 20,238 tons. Although subjected to unusually heavy hostile countermeasures, he carried out skillful evasive tactics and brought his vessel safe to port. His leadership and courageous devotion to duty were in keeping with the highest traditions of the United States Naval Service."

For the President,
/s/ James Forrestal
Secretary of the Navy"

SEA STORIES

A SHIP AND A SHIP'S COOK 1941-2002

by RADM M.H. Rindskopf, USN(Ret.)

Scene I—1941

USS DRUM (SS 228) was launched at Portsmouth, New Hampshire on 12 May 1941 with Mrs. Thomas Holcomb, the wife of the Marine Commandant, as sponsor. She was commissioned on 1 November 1941 under the command of Robert H. Rice and ordered to Pearl Harbor on completion in January 1942.

Gerard J. DeRosa was launched on 10 August 1925 at Bayonne, New Jersey, sponsored by his parents, August and Josephine DeRosa. He attended Bayonne High School but left in February 1943 during his senior year, forged his father's signature, and followed his brothers into the service, Paul into the Navy and Milton into the Army.

Scene II—1942-1945

DRUM was the first new construction submarine (and possibly the first new ship of any type) to arrive at Pearl Harbor after the start of hostilities. On 15 March 1942 she proceeded through black oil and ships utterly destroyed to the Submarine Base where she loaded torpedoes and other supplies, and departed on her first war patrol on 17 April 1942. While DRUM was never awarded a Unit Citation, she completed 13 war patrols with a commendable record of 15 ships sunk for 80,000 tons and another 15 damaged, putting her eighth on the list of tonnage and 20th for ships sunk.

Highlights of her career included:

- On her first night in her assigned area south of Nagoya, Japan on 2 May 1942, she sank MIZUHO, a Japanese seaplane tender (and the largest ship sunk to that date) with one torpedo in a night surface attack. Shortly thereafter, having submerged, she fired three torpedoes at a stopped escort, only to have the torpedoes run deep under the target

and fail to explode. She was harassed for the next 22 hours by numerous depth charge attacks. Her first patrol netted three ships sunk and three damaged.

- On her fourth patrol, under the command of Lieutenant Commander Bernard F. McMahon, she encountered a Japanese carrier in mid ocean, ferrying a load of aircraft to Truk Atoll. Because half her tubes were loaded with mines for planting in the Bungo Suido, she was able only to damage the carrier and send her back to the Empire for repairs.
- On her eight war patrol out of Brisbane, Australia, under the command of Commander Delbert F. Williamson, she sank a submarine tender of 11,500 tons. In the ensuring counter-attacks by a group of escorts, DRUM received a crack in the after bulkhead of her conning tower. She was ordered to Pearl Harbor for repairs which resulted in the near collapse of the conning tower during a deep test dive, necessitating her transit to Mare Island Navy Shipyard, California for a new conning tower with a 400 foot depth capability.
- On her 11th war patrol, under the command of Lieutenant Commander Maurice H. Rindskopf, she provided intelligence on Japanese activity in the vicinity of Leyte Gulf in the Philippines prior to General Douglas MacArthur's famous "I have returned" landing after which she was ordered to patrol in Luzon Strait. In five days she expended all 24 torpedoes, sinking three ships and damaging another three.

DRUM was at Midway Island in transit to her 14th patrol when the Japanese capitulated. She was ordered to her building yard in Portsmouth, New Hampshire and decommissioned on 16 February 1946.

Jerry DeRosa received his boot training at Great Lakes, Illinois. Upon graduation as a Seaman 2nd Class, he was ordered to Brisbane, Australia to join USS FULTON (AS 11) Relief Crew. There he met Chief Machinist Mate Ned Zelkowski who also hailed from Bayonne, New Jersey and knew Jerry's parents. Jerry expressed a desire to join a submarine, was tutored by the Chief, promoted to Seaman 1st Class, and was assigned to DRUM prior to

her seventh war patrol in August 1943. As a member of the Commissary Division, Jerry's feisty and affable personality made him a crew favorite, and earned him an additional nickname of *Guinea*. His cooking skills earned him promotion to Ships Cook 3rd Class by the 11th patrol. On 7 November 1943, he cooked his last meal of meat loaf with gravy, mixed vegetables (because the labels had washed off the cans), and freeze-dried potatoes, with jello for dessert for the 13 officers, four Chief Petty Officers, and 67 crew as DRUM returned to Majuro Atoll in the Marshall for refit. He was detached on 23 November 1944 along with the Commander Officer, Lieutenant Commander Mike Rindskopf, who had served on board for exactly three years, made all 11 patrols and over 1000 dives.

Jerry reported to HOWARD W. GILMORE (AS 16), and with her made a circuit of the Southwest Pacific including Brisbane, Australia, and Humboldt Bay, New Guinea, before arriving at Subic Bay, PI in March 1945 to resume a heavy schedule of submarine upkeeps. Jerry DeRosa volunteered for further patrols by seeking ships' cooks willing to swap billets. He was rebuffed by the cook in LAGARTO (SS 371). However, the BULLHEAD (SS 332) cook was prepared to trade billets until the Division Personnel Officer decreed that Jerry would be returned to the States for further assignment because he had served in the war zone for two years. LAGARTO was lost in May 1945 and BULLHEAD in August.

Jerry enjoyed 30 days leave, spent time in the galley at the Brooklyn Navy Yard, and was discharged from the Navy at the Sampson, New York Naval Training Center in March 1946.

Scene III—1947-1969

DRUM was transferred to the District of Columbia Naval Reserve program as a training ship on 18 March 1947 and was moored at the Washington Navy Yard until 15 June 1969. A reunion of nine officers, led by the second and fourth Commanding Officers, Rear Admirals Berny McMahon and Mike Rindskopf, was held on board in 1963. DRUM was destined for scrapping until the USS ALABAMA Memorial Commission requested that the

Navy tow her to Mobile where she would join USS ALABAMA (BB 60) as a tourist attraction.

Jerry DeRosa, as a young man of 22, joined his father in a grocery store in Bayonne, after which he gained employment at the Sherry-Netherlands Hotel in New York City as a cook's helper. Although he received promotions, he decided to resume his military career. Since he was unable to return to submarines, he enlisted in the U.S. Army as a corporal and was ordered to Ft. Dix, New Jersey for a refresher course prior to assignment to Jump School and the 82nd Airborne Division in Ft. Benning, Georgia. After marrying his first wife, Ruth, in 1951, he was assigned to the 187 RCT in Korea as a Mess Sgt. 1st Class. When the Division returned to Japan in 1952, he adopted a son from the Bepo Orphanage, and then another when the Division was stationed in Germany in 1956. Sadly, after Jerry's return to the United States, his wife died in 1958. Her parents cared for the children as he completed the remainder of his 20 years' service in Korea and Italy. He retired from the Army in May 1966 as a Staff Sgt. E6. In retirement, he worked for the State of New Jersey in a school for the mentally retarded as a Food Service Instructor, and taught cooking to prisoners in a minimum security prison.

Scene IV—1970-2002

DRUM opened for business at Battleship Park on 4 July 1969 with Mrs. Jolene Edwards, wife of then Congressman Jack Edwards, as the sponsor. Approximately 10 million visitors have toured the ship which has been maintained by the Staff of the Battleship Commission and volunteers from Submarine Veterans, Incorporated. In July 2001 DRUM moved from her 31 year berth alongside the quay wall, astern of USS ALABAMA (BB 60), to a cofferdam ashore where she now rests on concrete saddles, some 15 feet above sea level, and is once again open for visitors.

The DRUM crew, under the successive leadership of Lieutenant Commander James D. Watson (formerly a Quartermaster), Lieutenant Commander Robert E. White (formerly a Motor Machinists Mate), and Bill Lister (formerly a Chief Radioman), has enjoyed a reunion at the ship every year since 1971. The 1989

reunion drew a high of 29 along with wives, children, grandchildren, and great grandchildren. At each reunion, a memorial service is held for departed shipmates and wives. As a ship's bell tolls, a rose from the magnificent Commission garden alongside the ship is dropped into Mobile Bay.

Jerry DeRosa, who married his second wife, Doris, in 1982 is now living in retirement in New Smyrna, Florida. Together they have manned the hospitality room for many reunions, including that in 2002. In addition, he made good his 2001 vow, and cooked the banquet dinner for some 50 guests, consisting of Chicken Kiev, roast pork with gravy, broccoli, and fresh mashed potatoes, with a celebratory layer cake decorated with an American flag for dessert. The banquet speakers, including Ms. Rosamond Rice, the daughter of DRUM's first Commanding Officer, poignantly brought back memories of DRUM's illustrious career—13 war patrols from April 1942 until April 1945.

A ship and a ship's cook 1941-2002!■

REUNIONS

USS BUMPER (SS 333) ASSOCIATION Sept. 2-5, 2003, Reno, Nevada. Contact: Edward W. Stone, 308 Merritt Avenue, Syracuse, NY 13207-2713; (315) 469-3825.

USS RICHARD B. RUSSELL (SSN 687)/ USS TAUTOG (SS 199/SSN 639)
Sept. 3-5, 2003, Reno, Nevada. Contact: John Chaffey (307) 645-3245; e-mail: tautog@nemontel.net

USS SCAMP (SSN 588) Sept. 1-5, Reno, NV. Contact: Lou Minor, 3260 Hector Road, Newcastle, CA 95658, (916) 663-3921; e-mail: www.uss-scamp.com.

REMEMBERING *DOC*

by RADM Paul J. Ryan, USN
Commander
Mine Warfare Command

Almost all submariners fondly remember *Doc*. They came in all shapes and sizes, ranging in seniority from HM2 to HM Master Chief. They constantly dispensed aspirin, inventoried their medical supplies, and worried about crewmembers with abdominal pains. They were great listeners and a wonderful resource for a CO, XO, or Chief of the Boat to gauge the health, well-being and morale of the crew. Although I can't remember all their names, I can clearly picture all the independent duty corpsmen I've served with on submarines and they were all great guys.

Everybody who has qualified in submarines knows that the wardroom table is designated as the operating table for emergency surgery at sea, and that there are operating lights and other surgical equipment stored in various nooks and crannies in the forward end of the ship. During my XO tour I remember having a conversation with my CO about how we'd handle an emergency surgery onboard. I was surprised when he told me that he'd sit in his stateroom and I'd sit in the wardroom with the appropriate medical manual, reading the operating procedure to the Corpsman and ensuring exact procedural compliance!

If you've been around submarines long enough you've probably heard folklore about a Corpsman performing an emergency appendectomy at sea. It's caused many a Corpsman, CO and XO to sweat about a crewmember with abdominal pain and I remember medevacs on several submarines I've served on for crewmen with probable cases of appendicitis. I recently had the opportunity to talk to the Sub Vets chapter in Corpus Christi, Texas, and had the pleasure of meeting Mr. Wheeler Lipes, the legendary Corpsman who actually performed an appendectomy at sea on USS SEADRAGON during World War II. The Sub Vets chapter is so proud of Mr. Lipes that they have a print of an article about his experience that they show to all visitors. Here's a quick summary:

"On September 11, 1942, USS SEADRAGON was on a war patrol in the China Sea. Nineteen year old Darrel Rector was having stomach pains and went to see his Corpsman, 22-year-old

Pharmacist Mate First Class Wheeler Lipes. Lipes diagnosed acute appendicitis and went to brief the CO. When the CO asked Lipes if he could fix it, Lipes replied that he could, but he wasn't authorized to operate. The CO then put a written authorization in Rector's medical record, and Lipes proceeded. He gathered some shipmates to help, set Rector on the wardroom table, covered his face with torpedo grease to save him from ether burns, used a tea strainer to administer ether, and spoons as retractors when cutting through Rector's abdomen. Rector's appendix was swollen to about nine inches and was infected and gangrenous. Lipes removed it in surgery that lasted 1-1/2 hours and stitched up his shipmate with black silk thread. (A routine appendectomy by an experienced doctor takes less than 45 minutes.) Rector regained consciousness about 30 minutes after surgery, asked for something to eat, and returned to the watch bill 13 days later."

Lipes retired from the Navy as a Lieutenant Commander in 1962 and had a successful second career in medical administration. He still bursts with pride at his legendary status in the submarine community but thinks the real hero was Rector for letting Lipes operate on him!

So for those of us on active duty, take good care of your Corpsman, you never know when he may have to operate on you! For those in the retired ranks, cherish the memories of those Corpsmen who took such great care of you and be thankful that we were able to conduct all those medevacs.■

THE EARLY DAYS

by CAPT David G. Smith, USN(Ret.)

Our fourth nuclear submarine, USS SWORDFISH (SSN 579), was built at Portsmouth Naval Shipyard in Portsmouth, New Hampshire (now Maine). I was in the fourth nuclear class in New London (Jun-Dec 1956), followed by prototype training in Idaho (Jan-May 1957). I reported to the SWORDFISH pre-commissioning crew in the summer of 1957. During sea trials (1958) we were operating submerged off the New Hampshire coast when quite a few members of the crew reported headaches along with other physical discomforts. The atmospheric monitor in the control room was checked and the meter for carbon monoxide (CO) was found to be pegged high. The ship was ventilated and the atmosphere was returned to normal. None of the crew had any lasting adverse effects. The cause of the problem was investigated with most disturbing results—the shipyard had provided us with containers of charcoal, rather than hopcalite. We had loaded the charcoal into the CO burners and proceeded to see. When the CO burners (with emphasis on the burn) were started, the temperature of the charcoal was raised to the ignition point and a large amount of CO began to be introduced into the ship's atmosphere. So much for quality control in the early days of submarine atmosphere control. Thereafter, every new supply of hopcalite received a *torch test* before it was loaded into the CO burners.

SWORDFISH departed the building yard on March 19, 1959, and joined Squadron Ten at State Pier in New London, Connecticut. After a period of shakedown training, the ship departed for the North Atlantic and its first involvement in submarine special operations. Returning from this operation, while running submerged at high speed of North Cape, the ship struck an uncharted pinnacle, our next unusual experience. We damaged our pit sword and the skipper wanted to retain it for inspection purposes. I was selected to go over the side to tie a line onto the damaged sword so that when it was ejected we could bring it aboard. Needless to say, the water was quite cold, but we successfully replaced the damaged sword with a new one and restored the system to operation, submerged and continued our transit back to New London.

Completing the special operation and refitting in New London, the ship started its transit from the Atlantic to the Pacific Ocean. After a brief port call in Cape Canaveral, in July, and then Naval Station Balboa, during passage through the Panama Canal, the ship arrived in Pearl Harbor, home port for the next many years. *Gunboat diplomacy* was still a part of the political scene in Washington, and so SWORDFISH was tasked to head to the Western Pacific in order to demonstrate the significance of submarine nuclear power to President Garcia of the Philippines and President Chiang (Kai-Shek). SWORDFISH was the first nuclear submarine to enter WestPac waters.

SWORDFISH arrived off the port of Keelung on the northern tip of Taiwan (Formosa) in the early morning of March 8, 1960. The Commanding Officer, Commander Shannon D. Cramer, had organized the wardroom officers to ensure a smooth handling of the day's visitors. I was assigned the tasks of surface OOD and tour officer when submerged; Carlisle Albert Herman (Carl) Trost, as Auxiliary Division Officer and Diving Officer, was assigned as submerged OOD; and the other officers, not on watch, were assigned as tour officers. We entered the harbor and moored alongside a wharf. On the wharf was a warehouse, the roof of which was lined with soldiers armed with machine guns and rifles. Similarly armed soldiers were placed a considerable distance up and down the wharf, presenting an impressive display of security. With appropriate pomp and circumstance we boarded Vice Admiral C.D. Griffin, the new Commander Seventh Fleet, and Generalissimo Chiang, along with the official party. The crew manned the rail, side-boys were in place and all were piped aboard. This was a special occasion as it was only the second time a head of State had embarked in a nuclear submarine—the first being when President Eisenhower rode SEAWOLF out of Newport.

Once the official party was aboard and below, I got the ship underway and proceeded to the diving position. Upon arriving, I turned the deck over to Carl Trost , secured the bridge and went below to assume my tour duties. Carl submerged the ship and I proceeded to tour General Peng Meng-Chi, Chinese Army, Chief of General Staff (the top military leader); Vice Admiral K.K. Liu, Chinese Navy, Naval advisor to the President, and Mr. Joseph

Yagan, Deputy Chief of Mission, American Embassy, Taipei. The CO conducted the tour for Vice Admiral Griffin and President Chiang. After a 45 minute tour through the ship, during which I explained how we operated and the functions of all the equipment, we returned to the Attack Center where the President, and subsequently Vice Admiral Liu, took the bow planes as SWORDFISH performed its *angles and dangles*.

During the tour period other wardroom officers had been touring Major General S.K. Hu, Chinese Army, the President's interpreter (and incidently a graduate of the University of Michigan), Vice Admiral Smoot, USN, Head of Taiwan Defense Forces, Major General C.C. Doan, USA, Chief of MAAG Taiwan, and several other ranking officers.

Upon completing all the touring and indoctrination, the senior visitors were escorted to the Wardroom and the ship prepared to surface and return to port. Carl Trost took the ship to periscope depth and ordered the diving officer to "surface without air." The surfacing alarm was sounded and the ship angled to the surface. The lower bridge hatch was opened, I proceeded to the upper hatch, opened it and proceeded to the bridge with a lookout. The lookout and I put our binoculars to our eyes and proceeded to scan the horizon for contacts. It was then that a serious chain of events began to unfold as a result of a valve mis-positioning on surfacing.

While scanning the horizon with my 7 x 50 binoculars, I suddenly noted that the horizon was elevating in my field of vision. I took the binoculars from my eyes and realized that the ship was submerging—the bow and forward deck were already completely under water. Immediately I dropped down to the upper hatch to attempt to close it, arriving there slightly behind the surface of the ocean. Fortunately the hero of the day, QM-1 S.J. (Stanley) Schmel had been on watch at the chart-table at the rear of the attack center. He had sensed the abnormal down angle of the ship and ran forward to the bridge trunk. He slammed shut the lower hatch just as about 15 gallons of water came through the hatch. Fortunately most of the water was contained by the grating and drain sump, and very little made its way forward toward the wardroom—where Shannon Cramer was entertaining the distinguished guests.

When Carl Trost had ordered "surface without air," a crucial

error had been made. Rather than directing the discharge of the Low Pressure Blower to the ballast tanks, the valve was opened for overboard venting via the sail exhaust pipe. As a result, no air entered the ballast tanks and the ship assumed a surface configuration with only neutral buoyancy. As luck would have it, the slightest imbalance would send the ship back down to a submerged condition.

Fortunately the coordinated actions of all the watchstanders saved the day. Stanley Schmel had shut the lower hatch in time to keep all but a small amount of water out of the ship, I had shut the upper hatch in time to keep the bridge trunk from filling completely (but barely), and Carl and his diving party had reversed the angle on the ship with the planes, getting the ship back to the surface before the water reached my head and that of the lookout (but both of us were standing high in the sail). The discharge of the low pressure blower was shifted to the ballast tanks, positive buoyancy was achieved, the ship was placed in a surfaced condition, the bridge trunk was drained (eventually) and I relieved Carl as OOD and proceeded to conn the ship back toward Keelung harbor and make the landing.

Throughout this excitement Shannon Cramer and the distinguished visitors in the wardroom had been unaware of any abnormality. The discussions of submarine nuclear power had continued and as we approached Keelung Generalissimo Chiang Kai-Shek was invited to go to the bridge. He and Major General Hu came to the bridge for a brief time and enjoyed the view of a serene ocean—unaware that we had almost given them more of an indoctrination in submarine operations than they would have wanted.

In less than a year, SWORDFISH had steamed over 50,000 miles, of which over 90 percent was submerged. The crew had conducted the first of its many special operations and experienced several of its many unusual events. The book of Lessons Learned was filling rapidly, as was the record of significant accomplishments. Returning from our WestPac deployment and looking forward to some inport time, we received a message advising our schedule had changed drastically. We were advised that we would be in Pearl Harbor for only four days before deploying to the

southern Pacific on a special operation relating to the return of a Russian space flight. Shortly after returning from WestPac special operations, and again looking forward to inport time, USS SARGO suffered her oxygen explosion and SWORDFISH was tasked to take her assignment to WestPac. Lieutenant Dave Johnson kept tract of the at-sea time and as my memory serves me, SWORDFISH was underway almost 300 days of that year. So went the early days of attack nuclear submarine operations.■

THE SUBMARINE REVIEW

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

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The League prepares **REVIEW** copy for publication using Word Perfect. If possible to do so, accompaning a submission with a 3.5" diskette is of significant assistance in that process. 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. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League.** The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League..

Comments on articles and brief discussion items are welcomed to make **THE SUBMARINE REVIEW** a dynamic reflection of the League's interest in submarines.

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

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THE BRAVEST MAN
The Story of Richard O'Kane & U.S. Submariners in the Pacific War

by William Tuohy
Sutton Publishing, Ltd., 2001
ISBN 0 7509 2767 4

Reviewed by CAPT C. Michael Garverick, USN(Ret.)

This review started with a query from the Public Affairs Officer of USS FIFE (DD-991) asking for some information regarding the ship's namesake in preparation for its decommissioning. The Internet quickly turned up many *hits* that were both informative about Admiral Fife's World War II experience and interesting enough to cause me to dig deeper into his role in the operation and management of the submarines under his command.

Three items were of immediate interest. The relief of a significant number of commanding officers (CO) after one or two patrols; the influence of Rear Admiral Fife in reforming the organization of the approach party; and the delay in correcting torpedo problems in the first 18 months of the war were puzzling. I turned to the League's resident WWII scholar, Rear Admiral Mike Rindskopf, for some additional resources. He had just met William Tuohy and suggested that I read his book. Mr. Tuohy had just sent a copy of the book to Jim Hay for a possible review, so I was in business.

Richard H. O'Kane became a principal focus in identifying some of the root causes for the relief of his CO in WAHOO after her second patrol and the establishment of the Morton-O'Kane approach team with O'Kane as executive officer (XO) on the periscope and Dudley W. *Mush* Morton, the new CO, as the conning officer. Morton also accepted the faulty and unreliable torpedo problem as one to be managed, and focused on hitting the target with each shot rather than using a spread.

Mr. Tuohy implies that Dick O'Kane was instrumental in getting Lieutenant Commander Marvin G. Kennedy relieved and enlisted Rear Admiral Fife in the process. Additional resources confirm this assertion and make it clear that O'Kane was not going to serve another patrol on WAHOO with Kennedy as CO. Fife set

up the relief by placing Morton on board as the *Makee-Learn* on WAHOO's second patrol, and then relieved Kennedy for the third patrol.

The Bravest Man continues on to describe in some detail the problems in submarine leadership at the start of WWII and reports that about 30 percent of 135 skippers were relieved by February 1943. The discussion of the "skipper problem" is enlightening and is an important lesson to be learned for our current level of conflict.

Fife had proposed that the CO place the XO on the periscope during submerged approaches so that the CO could stand back and place the ship in the best firing position based on all of the intelligence and information available. This organization was unique in submarine operations but several other COs were trying it. Morton told O'Kane that he would make the approaches and that he would conn the ship into the best firing position. That way, Morton said, he would not be scared.

This assignment gave O'Kane all the confidence he needed to become the expert he was to become in command of TANG. The third patrol of WAHOO was one for the record books with a destroyer and four merchant ships sunk. Morton stated that O'Kane was "the bravest man I know" in preparing awards for his crew.

The freeing up of the CO to watch the overall operation of the ship was finally achieved in the Submarine Force with the improved sonar systems and submerged approach. It took almost 20 years for the surface forces to learn that the CO needed to be in the Combat Information Center instead of on the bridge, getting all of his information through a telephone talker and radio speakers.

Tuohy integrates other submarine history in this 422 page book, making it an interesting narrative along with first person narratives of O'Kane's exploits as CO of TANG and XO WAHOO. The arrival of Rear Admiral Lockwood in Pearl Harbor started the long-term solution to the torpedo problem. Tuohy discusses the disparate command structure and finger pointing by reviewing seniors and the shore establishment at the source of the problem with no meaningful results other than submarine losses. Lockwood initiated his own investigations that ultimately identified the exploder and depth control problems but it was not until September 1943 that the improved torpedoes showed up in the fleet. The

narrative report highlights many of the individuals and operations that made the torpedo scandal what it was—a monument to poor program management and end-to-end testing before sending the weapon to sea.

The continued success of O'Kane as CO TANG is a compelling story of what a CO can do with his ship and the desire to succeed. Earlier reports of O'Kane's rash and foolhardy actions that caused concern with his wardroom and crew settled down as he racked up more ships than any other submarine. Tuohy also writes a compelling account of the circular running torpedo and the sinking of TANG that won First Prize in the 2002 Naval Submarine League Literary Awards. O'Kane's ultimate capture and return to a hero's welcome and Congressional Medal of Honor completes an informative book.

Current submarine commanders should review the lessons learned in this book as we prepare our forces for continuing the war against terrorism. Innovative leaders such as Jimmy Fife need to test new ways of operating ships and aggressive COs such as Morton and O'Kane need to challenge the status quo and find ways to meet their current needs with available resources. Finally, the development of the SSGN gives the acquisition community a great challenge to ensure that we do not deliver an untested weapon system to the fleet.■