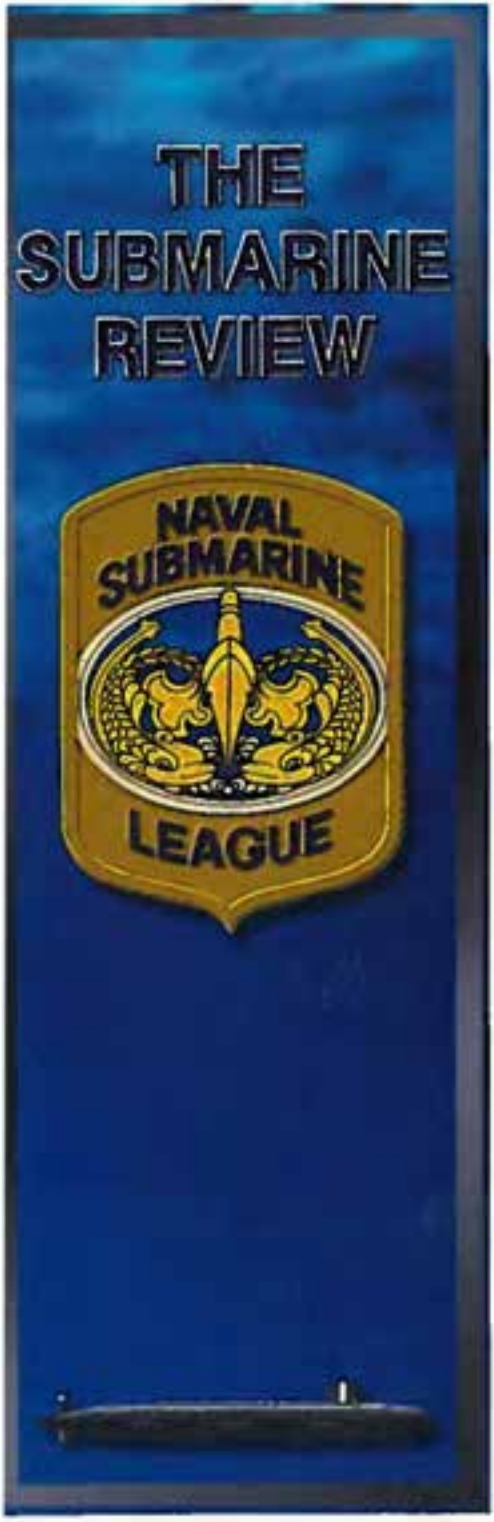

JANUARY 2002

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EDITOR'S COMMENTS

Two sets of remarks by active duty submarine leaders to rather diverse segments of the submarine community lead this issue of **THE SUBMARINE REVIEW**. Admiral Skip Bowman, the four-star director of the Navy's nuclear propulsion program and the senior American submariner, spoke to the Undersea Defence Technology conference in Hawaii in October. His message to that international gathering noted the recent recognition by world powers of the unique advantages of sea-borne stealth and the opportunities which submarines offer for leveraged extension of regional power. He also stressed, however, the vital nature of operational skills, high-level vigilance, shore-based support structure, and dedication to excellence at all levels that go into establishing, running and maintaining an effective Submarine Force. It is an impressive tour of the worth/cost considerations involved in world-class submarining and can be read with benefit at all levels of those involved in national security—for all powers: small, medium, large and super.

Vice Admiral John Grossenbacher, Commander of the Atlantic Fleet Submarine Force and leader of the operational U.S. Navy submariners, was in New London on the 11th of September and delivered a *submarine state of the union* address to the National Defense Industrial Association's ASW gathering, known to most of us as the *Clambake*. Naturally, his presentation was prepared in advance of the 11th , but it shows that readiness has to mean being prepared for the very unexpected as well as the predictable. The speech, therefore, wears very well as America, its Navy and its Submarine Force meet the challenges of a heightened and changed security environment.

Another Feature in this issue is a look forward by an R&D manager in the submarine section at Newport News Shipbuilding. With appropriate attention to the payload considerations of future submarines being emphasized over the past several years we are reminded that Hull, Mechanical and Electrical innovations and improvements are no less important, and can be critical to bringing to bear those very payloads we are striving for. The combat

aviation, and to a certain extent the surface, communities have seen the logic in the sacrifice of some performance in their basic platform (i.e.: the manned aircraft and ship) in order to afford a higher degree of performance in their secondary, uninhabited, delivery platforms. Perhaps the time is ripe for that discussion within the submarine community. Obviously, the maturity available with our secondary undersea delivery platforms versus the agility required in the basic submarine are the prime factors in the equation to be solved.

There are also two *history of materiel development* articles presented here. Both have to do with uniquely submarine sensors and both show the necessary development of technology as well as the evolution of technology into useful hardware. The submarine periscope has had a long history since John Holland delivered the first U.S. submarine without a workable periscope. Our boats have certainly come a long way since then and so have their periscopes. The level of optical sophistication presently at sea is most impressive. We all know that greater means of looking at the above-surface picture will soon be with us, however, the optical tube periscopes will be in operation for some time to come. This work (Part II will appear in the April 2002 issue) is an excellent summary and a good place to start considering where we should go next in visual observation.

The second materiel development history treats the introduction and evolution of the towed array. It is a much more compressed story than the one about periscopes and is more centered on one scientist and his associates.

There is also in this issue a descriptive piece about the Submarine Library and Museum Association and the Historic Ship NAUTILUS. This should be of interest to all for its tale of determination and persistence in bringing the *submarine story* to the public.

In addition to these, there are other Articles, Discussions, Reflections and a Book Review all on the subject of submarines. Enjoy.

Jim Hay

FROM THE PRESIDENT

First, Jan joins me in wishing you and your families a very Happy New Year. Second, as I start my second year as your President let me provide you brief *"state of the League"* report.

Your League is sound, making positive contributions to our Submarine Force on a number of issues important to National Defense. Individual and corporate membership is up and we are fiscally sound.

I had the opportunity to attend the Undersea Defense Technology (UDT) 2001 Conference in October where Admiral Skip Bowman delivered the remarks featured as the lead article in this issue. I also attended the TRIDENT conference at MIT where industry and military leadership discussed the future of the Trident force in general and SSGN in particular. These two events are even more important as the Department of Defense sets up the Office of Force Transformation. The director is VADM Art Cerbrowski, former President of the Naval War College. It is important that we all help make submarines a major factor in force transformation.

Articles in this issue on force transformation merit your consideration. Newport News Shipbuilding, a Corporate Benefactor, addresses issues that will affect what our force will do and how they can do it.

The NSL is restarting the educational grant program that was initiated by the Board in 1997. The program was suspended during the Centennial Celebration. Our hope is that we will be able to fund initiatives that will enhance our capabilities to promulgate our message on the importance of submarines to an even broader audience.

We continue to expand our support to our members with programs and activities in their local areas. The Atlantic Southeast Chapter hosted the presentation of the Frank A. Lister Award for Excellence as Chief of the Boat to MTCM Jeffery S. Hudson, USN in his homeport of Kings Bay. The presentation was made with his shipmates on USS WYOMING (SSBN 742 B) looking on. The presentation featured remarks by RADM Gerald L. Talbot Jr.,

COMSUBGROUP 10, TMCM Frank Lister and USSVI National Commander Jack Ensminger. The South Carolina Chapter supported a meeting in Millington, TN hosted by RADM George Voelker, Commander Naval Recruiting Command, to serve the large active duty and retired submarine community in that area.

The NSL Home Office is working with the leadership in the Northern California Chapter to elect a new President and set up meetings around the Bay area. Finally, our initiative to set up a Chicago area group was interrupted by the terrorist acts on September 11. We continue to work with area commands to improve how we meet the needs members in the five states surrounding Chicago.

Upcoming events include the Corporate Benefactors recognition on 4-5 February 2002, the Submarine Technology Symposium at Johns Hopkins University Applied Physics Laboratory on 14-16 May 2002 and our 20th Anniversary Celebration and Symposium at the Hilton Alexandria on 12-13 June 2002. Please put these dates on your calendars. Our programs for both of these events are firming up and promise to meet the high standard set in the past.

This issue of **THE SUBMARINE REVIEW** also addresses other issues facing our Submarine Force. For example, the information available from the operation of USS ALBACORE is reviewed. A Group Commander and a Commanding Officer address the issues of accountability and objective assessment of crew readiness and performance. Our senior Force Commander provides his assessment of the Force at the very hour that the September 11 attacks began. We must discuss these issues and educate our members, friends, and decision-makers on the relevance of the submarine. Your League will continue to support activities that illuminate the Submarine Force capability to contribute to National Security.

J. Guy Reynolds

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FEATURES

REMARKS AT UDT HAWAII 2001

by ADM F.L. "Skip" Bowman, USN
30 October 2001

It is a pleasure to join you today in paradise. Hawaii is a place of great tradition for the United States Submarine Force. In fact, just down the road in Pearl Harbor lies one of our submarine bases--a place we've called home for almost all of our 101 year history.

As the opening speaker, I want to set the stage for the discussions to follow over the next 3 days. Today, I'll be looking with you at the *worldwide state of the submarine* and making three points:

- First, we all feel pride as we celebrate the end of the first century of submarining and excitement as we look forward to the next 100 years. Both emotions are justified.
- Second, submarines are readily available on the world market today. An interested buyer can select a submarine with a wide range of capabilities. You need look no further than the UDT Exhibition Hall in the Tapa Room to see the products and services available from the world's leading undersea defense manufacturers, suppliers, consultants and research organizations.
- Third, in the midst of all this excitement over submarines and submarine technology, I question whether potential buyers have thought through the long-term stewardship responsibilities that are necessary for safe submarining? Have they properly conveyed to their country's leadership the continuous, high-resource commitment that must be made to become a responsible member of the world's submarine community?

So let me begin with the pride felt around the world as we open the door to the next century of undersea warfare.

Many can share in the pride that goes with 100 years of accomplishment. The first 100 years opened with submarines viewed as little more than stationary manned mines by many nations and naval leaders. By the end of the first 25 years visionaries were seeing the value in these unique platforms. Scientists and engineers made improvement after improvement. The second 25 years saw submarines become a major part of many navies and platforms to be reckoned with. The third 25 years saw the introduction of nuclear power, air independent propulsion and the marriage of missiles and submarines. The first 100 years closed with submarines recognized as major combatants by nations around the world.

As the theme of this Conference suggests, we meet symbolically to discuss the *next 100 years*. We close the book on what is, in effect, the global 100th anniversary of submarining.

Technology is moving at an incredible rate. I will not attempt to predict the future except to say that 100 years from now another group will look back and say that technology in the second 100 years advanced at a rate an order of magnitude greater than before.

More and more we recognize that submarines and other submersibles will have an increasing role in the maritime battlespace.

More and more navies and their parent governments are calling on submarines to play a major role in their defense establishment. People around the world are recognizing the contribution submarines can make when properly employed, and there is no shortage of suppliers.

In fact, there are no fewer than seven countries around the world today that are marketing submarines. This market has led to a worldwide total of almost 500 submarines operated by 40 nations.

The Pacific theater alone is home to over 300 submarines.

Why so many submarines? Simply put, submarines provide a nation instant credibility and what may appear, at first glance, to be a relatively inexpensive seat at a very important table.

The proliferation of submarines should come as no surprise. Submarines are in high demand around the world today because of their inherent characteristic: **stealth**.

Stealth allows a submarine to operate undetected, providing unmatched intelligence, surveillance, and reconnaissance capabilities. This same characteristic provides unobserved access to so called *denied access* waters—a capability not provided by any other platform.

Once on station submarines can provide ambiguous presence, seen or not seen, as the situation warrants.

In these second hundred years we will undoubtedly see a **further proliferation of submarines with even more advanced capabilities.**

This conclusion has been reached over and over again as the world closed out the first hundred years. From my perspective, no other warfighting platform has been studied more than the submarine.

In my country, the 1998 U.S. Defense Science Board study, *Submarines of the Future*, called the submarine the "crown jewel in our Nation's arsenal."

Many other countries seem to have arrived at similar conclusions and seem to be moving quickly to begin their submarine force or increase their numbers of submarines.

BUT I URGE CAUTION.

A review of our submarine history should help put this in perspective:

- In the last 100 years, there have been more than a hundred peacetime submarine accidents around the world that have resulted in the loss of life.
- These peacetime submarines accidents have taken a heavy toll. More than 2,000 men have given their lives beneath the sea.

Submarining is an inherently dangerous business. Submarines operate in an extremely harsh environment. Casualties that in most cases might be survivable aboard a surface combatant, pose more dire consequences for submarines. The consequences of fire, floodings and even a navigation error are more severe when they occur beneath the sea.

The tragic loss of KURSK is our most recent example, a vivid

demonstration of the explosive power of today's submarine-launched weapons, coupled with the unforgiving nature of undersea operations. The fate of the majority of the crew was decided in only a few seconds. Rescue of those not killed immediately proved a daunting and ultimately unsuccessful task.

Those of us who have operated submarines at sea recognize that we share a common culture. The responsible members of the community are forging ahead into the next century of submarining as a brotherhood sharing a common goal: to improve the safety of tomorrow's submarines and submarine operations. Many of the countries represented here today are working together to develop a better international submarine rescue program.

Operating submarines safely demands a serious, expensive, lifelong commitment. There are no simple, easy paths that guarantee success. That commitment increases with the number of boats being operated. Simply purchasing a new submarine on the open world market without this commitment is a formula for disaster.

Attempting to acquire a submarine capability without a total commitment to the submarine culture, without establishing the support infrastructure that safe submarining requires, will inevitably lead to tragic accidents in the second hundred years. No one should head down the path that will contribute to a repeat of the chilling statistics I cited earlier.

Admiral Hyman G. Rickover, the Father of the Nuclear Navy in my country, developed principles that speak to the commitment I'm discussing. His principles had to do with nuclear power stewardship, but I would argue that many are equally applicable to submarining in general. These principles have stood the test of time and are still very much a part of the success of today's United States Submarine Force.

So what were Rickover's principles of safe nuclear reactor plant operation that can be applied to safe submarine operations? I will discuss 8 of them:

First, select the best **people** available. Then **train** them to operate the equipment under the worst possible conditions—and **educate** them to know everything and do everything necessary, without question, to bring the submarine and her crew home

safely—before they step foot aboard their first boat.

Then number 2, establish high standards of **continuous training** and **qualification** for these handpicked operators. These training and qualification programs must be supported by well-defined standards and must be monitored by a dedicated cadre of experienced seasoned, professionals.

Number 3, demand the highest possible **quality** and **reliability** of submarine components and equipment. Implement exacting standards of design and manufacturing, with independent inspections and certifications. Oversee this quality at the point of manufacture.

Number 4, establish centralized control of the submarine systems and components—what we call **configuration control**. Do not allow quick fixes, easy work-arounds, installation of non-conforming components or material, or unauthorized changes to design.

Next, learn from experience—adopt an honest acceptance that mistakes will occur and set up a well-defined system for critique, feedback, and corrective action. In every case document and share the **lessons learned**.

Number 6, require **redundancy** in critical systems so that a single point failure does not jeopardize crew safety, survivability of the submarine or mission accomplishment.

Number 7, design a **layered defense** for safety—design systems to minimize the impact of casualties or accidents; where you can't eliminate the possibility of a casualty through system design, build in automatic protective features; and always rely on people to take appropriate action when accidents happen.

Number 8, **face the facts** of each problem or situation, do not let other factors such as costs or schedule lead to accepting questionable actions or to short-cuting established policies. Avoid the human tendency to accept simple easy *gimmicks* or management techniques as the solution to problems.

Simply put, my point is obvious: Submarine safety can't be bought.

It involves much more than buying a submarine on the open world market. This is **not** a so-called *turn key* operation. It is a complicated undertaking that demands a lifetime—in fact, several

lifetimes—of commitment: commitment not just to the bottom line, but to building an infrastructure to support the submarine through quality monitoring and enforcement; to creating a cadre of experts to oversee the design, development, and testing of the submarine and its components; and to train the team of experts who will serve in her and operate and maintain her at sea.

That commitment must involve all levels of Government decisionmakers. Without the unequivocal support of the Government, indeed the support of the entire nation, I daresay the existence of a safe Submarine Force is not possible.

Our world, now more than ever in the history of the Submarine Force, recognizes the capability that this platform provides—the crucial element of assured access—now and into the future.

However, although the submarine is an increasingly desirable platform for maritime nations of the world, the profession of submarining—remains an unforgiving business, one that requires dedication, tenacity, logistical resources, strong technical oversight, an unrelenting commitment to excellence, and the overarching support of our national governments.

During the first 100 years of submarining, nations of the world learned the crucial importance of developing, maintaining, and nurturing a submarine support infrastructure. This lesson—that safe submarining is more—much more than just submarine ownership—has been written in the blood of more than 2,000 submariners worldwide who sacrificed their lives over the last century.■

REMARKS AT THE NDIA CLAMBAKE

Submarine Base, New London
September 2001

by VADM John J. Grossenbacher, USN
Commander, Submarine Force
U.S. Atlantic Fleet

The United States Submarine Force is the best Submarine Force in the world. The synergistic, disciplined and innovative contributions of our people, scientists, engineers and industry leaders help us continue to be the best. While privileged to serve as Commander Submarine Force, U.S. Atlantic Fleet during the past fourteen months, I have stated my view of the challenges facing our Submarine Force in the new world order. Suffice it to say that in a world where instability is the now and foreseeable enemy, a world in which the consequences and undesirable manifestations of that instability will require the presence and use of military power, our submarines can and will make an even greater contribution than they have in the past and do today. Their stealth, endurance and agility allow them to deliver military capability anywhere in the world any time and by surprise. That stealth and surprise will be valued in the new world order. So, I believe our nuclear powered submarines are today poised to achieve their full potential for the first time in their history. They are a primary requirement for our future military strategy and a key foundation of America's military strength.

The following is a status report on our progress in meeting some of the challenges facing our Submarine Force, a submarine *state of the union address* of sorts that enumerates some of our past year's achievements and accomplishments as well as those areas where progress has been limited or not achieved.

First Successes

During the past year the Submarine Force has been substantially operationally successful throughout the world. One of our Pacific submarines conducted joint Prospective Commanding Officer (PCO) operations with the Australians and there are other important

Pacific operations that Commander Submarine Force, U.S. Pacific Fleet, Rear Admiral Padgett, USN will address. In the Atlantic, highlights included deployments and exercises supporting the Joint Forces Command, Southern Command, European Command and Central Command.

One of our 688's that is modified to carry the dry deck shelter and swimmer delivery vehicles had a superb deployment to the Mediterranean and demonstrated her unique capabilities in a host of NATO and bilateral exercises. She also off-loaded her dry deck shelter in Turkey and on-loaded the Deep Submergence Rescue Vehicle leading our participation in the very successful NATO submarine rescue exercise Sorbet Royal. Several of our attack submarines conducted the first open-ocean MK48 Advanced Capability (ADCAP) torpedo exercise in the Sixth Fleet area of responsibility. These torpedo firings took place in the Adriatic Sea, one of the many areas of the world where we need to know with certainty how our weapons will perform. In addition to testing the torpedoes, our submarines also evaluated engagement tactics versus a low speed, quiet target gained at very short range. The exercise was smoothly executed and will provide excellent data for use in tactical development and improving torpedo performance. An SSN conducted successful missions in the North Atlantic. Her operations supported Joint Forces Command and EUCOM and she was a key asset of CTF 84, the Atlantic ASW Commander. The ship also participated in a number of exercises with NATO and Northern European allies. We must maintain the capability and confidence to operate proficiently in all oceans of the world including the Arctic. This year we sent several of our SSNs under the ice and to the North Pole to conduct some very important testing including new under ice sonars and navigational equipment. We took some of our British shipmates with us to share experience and we learned a lot as we always do when we test ourselves in the tough Arctic environment. Another of our attack submarines completed a very successful deployment to South America interacting with the navies of eight South American countries and France. She participated in almost thirty multi-national exercises and gained invaluable diesel submarine experience with several foreign diesel submarines. U.S.

submarines conducted extensive operations in the Persian Gulf and Indian Ocean. Submarine contributions to battlespace preparation, TLAM contingency presence, support to the battle group, and Intelligence Surveillance and Reconnaissance were impressive. Our SSBNs earlier this year completed their 3500th patrol and continued to provide us with the foundation of national missile defense. And our SSBNs continue to fill an incredibly important role as substitutes for our inadequate number of SSNs during exercises, tests and development efforts.

The Department of Defense has directed the Navy to plan for the conversion of at least 2 OHIO class SSBNs to SSGNs - Tomahawk and Special Operating Force delivery platforms. Exactly how many, and when, and how we will pay for them remain open issues, but this is a huge decision for our Submarine Force and Navy. Not only does the country get the full benefit of its investment in these great ships, but we also get the opportunity to explore and demonstrate the impact of a submarine with a large payload on the way our Navy and Joint Forces fight. - Transformational is the right word to describe this enormous advance in undersea warfare.

We've had a very good year at Submarine School. We have substantially transformed traditional classrooms to electronic ones with all the resultant benefits of reduced time-to-train and measurable increases in training effectiveness. Sub School has also used technology to make the training resources resident in our schoolhouse available to submarines in port and at sea. Submarines can peruse and download most of sub school's training materials or ask for responsive training on-line, again, at sea as well as in port. There are currently over 1100 training products available in addition to e-mail and on-line chat and technical services to resolve questions and respond to unique training needs.

Technology has also allowed some of our officers to complete graduate courses underway, underwater. Through the combined effort of Old Dominion University and the Navy College Program for Afloat College Education, masters degrees can now be earned via CD-ROM based classes while at sea.

Progress

But it's too early to call them successes. First of all, people. Our submarine enlisted retention continues generally to exceed Navy averages. Our best retainer was USS WEST VIRGINIA (BLUE) with a 100 percent first term reenlistment rate for 2000. The only area where we do not lead the Navy is zone C, which represents those with 10-14 years of service. I think this is partly due to industry's recruiting of our well-trained and experienced Sailors. To help improve retention of this group we are talking to each of these Sailors one at a time; listening to their near and long term personal goals, and providing individual counseling to ensure they know the facts and make the right decision for themselves as well as the Submarine Force. We are also looking at larger reenlistment bonuses for zone B and C individuals, and we certainly support the Presidential budget proposal to improve mid-grade enlisted and officer pay. Officer retention is improving. Retaining enough young officers to 7 years in service is the key to ensuring we have sufficient department heads to keep department head tour lengths reasonable and giving us adequate selectivity for Commanding Officers and Executive Officers. The information I have seen is encouraging for those officer year groups approaching 7 years of service.

Recently we appear to be achieving success in our efforts to improve schedule performance in our depot level maintenance program. Less than a year ago, an Engineered Refueling Overhaul (ERO) took more than 27 months. Since then, two EROs are on track to be completed in the notional 24 months. Also, a Depot Modernization Period (DMP) last year took 14 months. A DMP in progress is projected to be completed in 12 months, one month ahead of the notional schedule. These improvements seem to indicate that NAVSEA's initiatives are improving schedule performance. Such improvements are critically important to our ability to keep SSNs at sea in the next decade when, at times, we will have almost 25 percent of the SSN force in depot maintenance availabilities. Each of the four public shipyards is scheduled to execute concurrent, sequential availabilities. The operational

impact of even one submarine falling behind will ripple through the Submarine Force reducing the already scarce scheduling flexibility and potentially delaying deployments. Shortfalls in funding depot maintenance in the past two years are now impacting our ability to start availabilities on time. This is very disruptive and has to be corrected or we will not give ourselves the opportunity to successfully meet the maintenance challenge ahead.

Over the past year, the Submarine Force conducted about two dozen diesel submarine exercises. SUBPAC's joint PCO ops with the Australians were an absolute home run because we not only got to operate against a capable diesel submarine but also put our PCOs on board to operate the Australian Collins Class. We are making arrangements to send an American student annually to the Dutch PCO Course, referred to as the PERISHER after its British origins since this will also enhance our diesel submarine experience. Steps have been taken to increase the number and intensity of exercises with Northern European, Southern European, and South American diesel submarines. We are not, however, sufficiently disciplined enough yet to systematically collect data, analyze it, and then effectively feed that knowledge back into tactics, techniques, procedures and technological development. This aspect of meeting the challenge of modern diesel and Air Independent Propulsion (AIP) diesel submarines requires different organization and coordination within the Submarine Force than during the Cold War and we are making those changes.

We are revising our guidance to provide greater flexibility in operating submarines with friends and allies. Further improvement in this area is an essential element of future battlespace preparation. Since the next undersea enemy we may fight could be a German-built submarine with French sensors and Swedish torpedoes owned and operated by a hostile nation, we must know the best diesel submarines and AIP diesel submarines very well. We also cannot surrender technological agility to the many different producers and consumers of diesel and AIP diesel technology as they can shop the international market place and have a smaller number of submarines to modernize and replace when obsolete.

In mine warfare, we have started requiring our submarines to use their high frequency sonar at the two east coast training and

evaluation minefields. We are learning a lot and building our foundation of mine warfare skills and experience. Meanwhile, mine stealth and lethality continue to advance. We need a realistic and more precise mine training range. Versatile exercise mines are smart training mines that can feedback information as to whether or not your submarine entered the mine's lethal envelope. Those mines along within an appropriately instrumented range are needed to support our long-term efforts in this area. Due to the age of the Mk67 Submarine Launched Mobile Mines (SLMM) and because we haven't conducted an exercise SLMM plant in several years, we are planning to conduct a mine planting exercise next summer. We'll see what the exercise tells us, but based on what I know today, I think we'll prove to ourselves again that we need to replace SLMM with the Mk48 based dual warhead mine to maintain a useful clandestine mining capability.

We are taking an active role in the development of Organic Mine Countermeasures and their concept of operations. Organic Mine Countermeasures are the family of sensors, sweeps and mine neutralization mechanisms that our Navy plans to incorporate into every carrier battlegroup. Submarine Development Squadron Five, is engaged in the testing of Long-term Mine Reconnaissance System (LMRS) vehicles and the refinement of the tactics, techniques, and procedures for employment of LMRS and other unmanned underwater devices. We have also reviewed our approach to mine warfare training. With the revised curriculum at Naval Submarine School, our officers receive formal indoctrination on the mine warfare mission during their pipeline training.

Progress has been made in the area of Anti-terrorism Force Protection. We need to take delivery of more patrol boats, more security personnel and waterside barriers to achieve the desired standards. Our standards are to have substantial landside and waterside barriers, the ability to rapidly sound an alarm and unambiguously warn someone who penetrates the barriers, and weapons of high enough caliber and rate of fire to stop them. Our submarines will have armed escorts when entering and exiting port.

In order to help mitigate the impact of our SSN force structure-requirement mismatch, USS CITY OF CORPUS CHRISTI, USS

SAN FRANCISCO and a third submarine will be home ported in Guam. This increases submarine forward presence and reduces transit times. This will help, but is not a substitute for more submarines, and we are working toward a more efficient and fluid worldwide deployment scheme that has our SSNs doing multiple missions in multiple theaters each deployment.

With our submarines operating almost constantly in the very crowded shallow water of the littorals, we must invest and improve our submarine escape and rescue proficiency. Submarine Escape Immersion Equipment (SEIE), an all-weather escape and survival suit that replaces the Steinke Hood, is currently installed on 9 of our 688 Class Submarines and we hope to have it on all our submarines by 2005. Over the past 12 months approximately 900 personnel received SEIE training. We have made hatch modifications that provide hydraulic actuators to ensure ease of opening the escape hatches on 13 of our 688s. Completing the remaining submarines is a high priority. In order to improve submarine escape proficiency we must provide pressurized submarine escape training at Basic Enlisted Submarine School and Submarine Officer Basic Training. To support this, an escape training tank and diving tower is currently planned for 2005. We also need a pier side escape training tank or water filled cofferdam that we can place over our escape hatches in port and allow our crews to realistically test themselves in escape trunk and escape appliance operation.

Submarines and Special Operating Forces (SOF) are in my view inextricably linked. We are a perfect partnership. Progress in developing submarine SOF capability is taking a large leap forward with the advent of the Advanced SEAL Delivery System. We are moving forward to consummate the marriage of submarines and SOF, and deliver the full potential of their military capability.

We've made some progress in reducing the burden of administrative tasks that do not contribute to warfare proficiency or combat readiness, but we have a long way to go. SSBNs have adopted an electronic deck log, routine chemistry analysis and graphing is being automated, and tagout management is being computerized along with technical manuals. Our new combat systems facilitate a paperless fire control party which not only improves tactical performance but also makes data collection, event reconstruction

and analysis significantly less burdensome. Eliminating or automating all administrative functions that do not contribute to combat readiness remains our goal.

No Progress

There are several areas where progress is still a promise.

In the past three years Submarine Force structure has declined from 73 SSNs to today's 55 SSNs. At the same time submarine tasking has increased. Today, of the 28 SSNs in LANTFLT, 23 are operationally available. The impact of having fewer submarines than required to serve the needs of the theater CINCs results in the United States accepting increased risk abroad and has a corrosive affect on near term and future readiness both in the Submarine Force and fleet. During fiscal year '01, we satisfied 65 percent of fleet service requests, in fiscal year '03 we will satisfy 35 percent of them. In addition, tactical development exercises and research, test and evaluation exercises will be reduced by 50 percent. The corrosive effects are also causing our Submarine Force to experience higher deployed OPTEMPO, reduced time between deployments, and a fast paced Inter-deployment Training Cycle (IDTC). The IDTC schedule is a success oriented one. The impact of a single submarine fail-to-sail ripples through the force and is disruptive, making schedule stability and predictability a challenge. In the near and mid-term, refueling as many 688s as possible will help. The obvious long-term solution is to increase the Virginia class build rate to at least two submarines per year as soon as possible.

Sustained under-resourcing of our Submarine Force, a problem that is endemic throughout our Navy, has prevented us from making adequate capital investments for our future. As I've said, we need to build Virginia class submarines faster. We have developed a sound technology insertion plan to evolve the Virginia class submarines, but that plan is inadequately resourced. The Trident missile will have to have its life extended to match our Trident submarines' 42-year life, but this is not adequately funded. And the potential of electric drive and fielding of SSGNs need to

adequately funded. We are not adequately resourcing the modernization of our operational force with the result, among other things that the *R* in ARCI (Acoustic Rapid COTS Insertion) is not being realized. Chronic systemic under funding has resulted in compromises and cutbacks to some basic submarine programs that are the cost of doing business in operating the world's best Submarine Force. For example, today we attempt to shoot 6 exercise torpedoes per submarine every 12-15 months. Why this number? This number was arrived at based on resource limitations, not individual submarine or force wide proficiency. By contrast each Swedish submarine shoots 25 torpedoes a year. We are going to have to pay for these costs of doing business or we will not remain the highest quality Submarine Force in the world.

We need a disciplined technical approach to finding solutions to the many challenges we face. The focus must be on sound science, math and engineering, not marketing. At a conference celebrating the 50th anniversary of Submarine Development Squadron 12, Admiral DeMars, USN (Ret.) said "The rise of weapons system advocacy analysis in Washington to support the budget process, I believe, corrupted the analytical process in general. You have an approach which supports the answer rather than attempting to find the answer. The rise of contractor analytical support has created a demand for more analysts than the system can support and still maintain the required professional quality." The truth in the Admiral's statement is evident in our business daily and we need to change it.

Challenges have always faced our Submarine Force and I hope I've given you an appreciation for the status of some that face us today. By every measure, our people, our submariners, are as good, dedicated to service, enthusiastic and fun to serve with as American submariners have ever been. Working with them is the highest privilege and greatest honor of my job. They will be tested at some point in the future and our country will need them, and need them to be the very best.■

OVER THE HORIZON

A View of Submarine Developments

by Donald M. Hamadyk
R&D Manager, Submarine Programs
Northrop Grumman Newport News

"The future is ever a misted landscape, no man foreknows it, but at cyclical turns there is a change felt in the rhythm of events."
Robinson Jeffers, U.S. poet - Prescription of Painful Ends

"So the rule of military operations is not to count on opponents not coming, but to rely on having ways of dealing with them; not to count on opponents not attacking, but to rely on having what cannot be attacked".

Sun Tzu – The Art of War

Prologue

W. G. Cridlin, Jr.
Vice President and General Manager
Submarine Programs, Northrop Grumman Newport News

The submarine community is at a significant crossroads, underscored by the events of September 11, 2001 and ongoing developments. In a nation at war for an undefined period, multiple challenges lay ahead for submarine platforms, and due to the community's recent hard thinking and diligent articulation of future submarine roles, multiple opportunities for future submarine contributions will likely begin to emerge. As options for Ohio class SSGN conversions, Los Angeles class refuelings, electric drive and integrated power systems, USS JIMMY CARTER delivery, Virginia class future procurement, and major Virginia class variant concepts are weighed, decision makers and supporters alike will need both wisdom and resolve. No less is at stake than making possible the family of platforms and supporting technologies available to the joint force today, tomorrow, and in the *Navy After Next*. From delivering the first Virginia class submarines to

striving for the vision articulated in Submarines...The Road Ahead, and beyond, decisions made in the near term will impact our adaptability and breadth of options for many decades. As one viewpoint in navigating this critical crossroads, the following observations are offered from the perspective of a nuclear submarine provider, innovator, and technology integrator, Northrop Grumman Newport News.

The Landscape

Payloads: The Hot Topic. In the October 2001 **SUBMARINE REVIEW**, Rear Admiral Young succinctly outlined initiatives in place to foster technological innovation in support of the Submarine Joint Strategic Concepts. These initiatives support and are heavily influenced by the 1998 findings of the Defense Science Board Panel on the Submarine of the Future. It is clear that a renewed focus on payload capacity and flexibility, one of the salient recommendations of the panel, has indeed been invigorated. The successful transition of the Payloads and Sensors work from DARPA to Navy cognizance is a positive step in this direction. There is now a related, more near term movement to identify, characterize, and implement additional payloads for SSGN, again, a positive step in enhancing the submarine's relevance. Taking the cue from this approach, the concepts being developed for major Virginia class technology bundle variants such as a 2012-authorized payload modular, all-electric ship should be matched with a characterization of potential payloads. Without this characterization, it's difficult to imagine a compelling CONOPS for such a ship. The key word is *characterize,* not *design*. After all, given an uncertain future there is no way to specify exactly what will be needed to fulfill the Strategic Concepts, but the community ought to be setting the parameters as much as possible, and as early as possible. Thankfully, there appears to be good forward motion in starting to match promising payloads such as small, medium, and large missiles, UAVs, UUVs, and other devices to future submarines, and thereby progress in getting the payload and future requirements communities better linked to the platform and technology communities!

Inherent Submarine Attributes. So, the *payload message* has been received loudly and clearly. What about all the other findings of the DSB panel? Future submarines, like present submarines, will be total warfare systems, and as such, deserve total system consideration. All the flexible, modular payloads one could imagine may not be effective if the platform cannot deliver them in a timely, safe, and operationally effective manner. Other future desired attributes called out by the panel, such as increased littoral capability, improved low speed maneuvering, evasion capability, higher tactical speed, signature masking, and large aperture antennas, are all good examples of parts of the total system that may end up being as important as payload considerations. These capabilities should be familiar to most readers as linking strongly to the inherent attributes of the submarine platform, **Stealth, Agility/Mobility, Endurance, and Firepower**. To reiterate, recent focus on **Firepower** is an excellent trend. There should be a concurrent focus on the other attributes of the system.

So, what are the implications of an uncertain future and enemy for submarine platforms in the coming decades? What will the country need? The most prudent course would seem to be: maintain a focus on **Payloads/Firepower**, but keep our eye on the ball regarding the other fundamental enduring attributes of a submarine—**Stealth, Agility/Mobility, and Endurance** as well. A sacrifice in the pursuit of advances in any of these areas may ultimately result in a less relevant and less effective platform.

Let's address **Firepower** first, as this is really a *recently invigorated submarine attribute* that has received well-deserved significant attention of late. What is the progression for advancing submarine Firepower? The current thinking seems to be aligned chronologically as follows:

- Aggressively explore potential additional payloads and payload modularity concepts for SSGN.
- Use the Virginia class Advanced Sail to explore further employment of modular payloads, at a relatively modest cost increment.
- Keep investigating Virginia class technology bundles that include a large payload bay (significant improvement over

VIRGINIA payload capacity, with vastly more flexibility).

- Continue to strive for concepts that provide an Order of Magnitude payload capacity increase in the 2020+ time-frame.

This appears to be a logical and promising progression. There is still a clear need, as discussed earlier, to begin characterizing candidate payloads now for SSGN and beyond. This will require some help from the requirements community. Encapsulation of existing non-marinized payloads should continue to be aggressively pursued, to obviate the need for costly payload customization programs. Smaller, more affordable, and more agile future submarine payloads should be examined for cost/benefit tradeoffs, and the findings from this examination should be shared among payload providers, Submarine Force leadership, and shipbuilders.

A similar look at **Stealth** might reveal that there is a lack of consensus on the need for improved acoustic stealth, for instance. This is evidenced in the quest for secondary justification of moving to Submarine Electric Drive. The concomitant benefit of Electric Drive and Integrated Power Systems (i.e., supporting an all-electric submarine) seems to be desired. However, keeping the low RPM, improved acoustic stealth option viable in the coming decades, should it be deemed necessary, means pursuing Electric Drive in the near term for its primary benefit, **Stealth**, perhaps the single-most inherent submarine attribute. Non-acoustic aspects of stealth that particularly support littoral operations, and the DSB-identified future desired capability for signature masking, should not be ignored. The visually, hydrodynamically, and electromagnetically revealing littorals demand a platform that can remain covert.

If one examines the historical and projected advancement of **Agility/Mobility**, it's pretty clear that the trend in submarine design for a few decades has been away from maneuverability and speed. Why should we be concerned about these attributes? For the very reasons outlined in Rear Admiral Holland's discussions on littoral operations in April 2001. We need to keep the ability to provide a platform that thrives in a crowded, restricted environment. There are some positive signs. There appears to be some growing interest in improving slow, near surface maneuverability now. The point really is, let's not lose sight of a possible future

need for higher speeds and corresponding maneuverability at those speeds. There is no doubt that reliance on increased agility of offboards and ordnance in the future will be a key to this part of the puzzle, but the platform itself may at some point need a higher degree of overall mobility.

Nuclear power breaks the dependence of **Endurance** upon energy generation, so the weak links in potential greater endurance, if such a capability should be needed in the future, would appear to lie in **Habitability**. Environmental quality, increasing the sailor's Quality of Work, reachback to family and friends without sacrificing stealth, and all other aspects of improving the human existence while submerged are called into play. There has been some increasing interest in this area, but it's probably safe to say that the technologies which could provide solutions have barely been tapped.

Electric Drive is worthy of separate mention here, as it supports nearly all the submarine attributes, providing the foundation not only for acoustic stealth progress, but also for an All-Electric Submarine, which in turn paves a path to agility in platform movement (responsive changes in speed) and power management (responsive distribution of power among propulsion, payloads, and platform loads), and adaptability to evolving payload types and deployment techniques (directed energy weapons and electromagnetic launch of a wide variety of ordnance, sensors, and unmanned vehicles). Although many of these are still mere *ideas*, we need to strengthen the pursuit of al all-electric submarine. Clearly, a concomitant benefit of the Electric Drive/Integrated Power Systems/Electric Auxiliaries combination is **Affordability**. For example, as fewer systems employ hydraulics and other fluids running through metal piping systems, previously required maintenance of piping, valves, and other components due to corrosion will be avoided. The ability to produce a truly platform-modular submarine, the importance of which is discussed below, will also be enabled.

Technology Insertion

Today, Tomorrow, and Beyond. How well is the submarine community identifying, developing, and integrating technologies to advance the platform? There appears to be good overall progress, and Northrop Grumman Newport News has joined the community in embracing and helping shape the submarine vision with the following elements: Targeting of Payload and Sensor Insertion Opportunities, Pursuit of Flexible Interface Concepts, Electric Drive Development, Challenging of Hull, Mechanical and Electrical (HM&E) Paradigms, and integration of these elements into Virginia class Major Advances or Technology Bundles. In addition, we have noted with great encouragement the community's hoisting aboard of the Joint Strategic Concepts, and Admiral Bowman's now well-established tenets of Getting More Modular, Electric, Connected, Innovative, and Affordable. We continue to be optimistic regarding all these developments, and have actively contributed resources and innovative ideas to the shaping of this common vision during the past few years. Following are some views of how this is unfolding, from our perspective.

Today. The shipbuilders continue to operate effectively in a technology insertion environment of competition for ideas and collaboration on implementation. This environment remains mutually beneficial to the shipbuilders and the submarine program. Planning is in progress for technology bundling, but funding is still to be determined. It is clear that multiple submarine initiatives potentially competing for the necessary funding remain. It is important to note that Virginia class technology insertion, outside the C4I arena, is still not robustly funded, and therefore is proceeding at a relatively slow pace. From an industry perspective, this condition creates a challenging business case for releasing Independent Research & Development (IR&D) funds to generate further ideas. Improvement in funding levels will be required to make more dramatic progress on incremental technology insertion. In spite of this challenge, industry is investing resources and generating ideas that will help advance the Virginia class. A few representative technologies brought to the table by Northrop Grumman Newport News and our industry and government partners are:

- Blown Optical Fiber Technology to reduce installation cost and enable more flexible and adaptable shipboard information system architectures (leveraged from aircraft carrier technology).
- Towed Array Advanced Control System to avoid current fleet array problems and reduce array maintenance costs.
- Thermal Spray Coatings for increased component service life and decreased maintenance costs.
- Universal Launcher Concepts to provide a versatile means of accommodating a range of payloads.
- Multifunction Integrated Laser System to enhance wake detection, sound velocity profiling, and covert communication with off-board vehicles.
- Low Cost Fastenings for insulation materials, which replace volatile adhesives with commercial pressure sensitive adhesives.
- Fiber Optic Lighting to reduce weight and maintenance cost of traditional lighting systems.
- Composite Universal Modular Mast to significantly reduce weight and enable advanced sail modular payloads.
- Control Surface Louvers to enhance stern plane effectiveness.
- Micro-Vortex Generators which employ NASA's aerodynamics technology to improve maneuverability and control.
- Powder Coat technology for affordable construction.

Reflection: Today's Progress. Following are several observations on the current *state of the process* in submarine technology insertion:

- The SUBTECH process has recently revitalized a focus on the platform, after very appropriately aligning toward anticipated critical submarine capabilities (Joint Strategic Concepts). This is a positive step, and will enable renewed emphasis on key platform configurations and technologies which support the needed capabilities.
- Payload Modularity concepts are undergoing further development. To help predict, measure, and articulate the military value of payload modularity, a Submarine Force

level system engineering analysis was undertaken, and the results should prove invaluable in weighing the cost versus benefit of such concepts.

- Virginia class Technology Bundles to increase warfighting capability are being more precisely defined, and in support of these initiatives, POM issue papers are in progress.
- Funding for Submarine Payload/Sensor Demonstrations appears to be forthcoming. This is a positive step. However, in order to fully develop concepts for payload modularity now, necessary and viable payloads for the future need to be characterized now.
- Interest in possible acceleration of SSN23, SSGN, and Virginia class deliveries continues to germinate. While these are likely necessary and positive actions, we believe prudence should be exercised in not sacrificing the advancement and insertion of incremental and major technologies to the Virginia class.
- As Navy funding for Virginia class technology insertion continues to be constrained, the pace of insertion remains slow, and, as stated above, the corporate business case for IR&D investment in further new ideas becomes a greater challenge.
- Where technology may be commonly applied across submarine platforms, or even among surface and submarine platforms, cost sharing on technology insertion among program and fleet sources has the potential to initiate or accelerate motion. However, we have observed that this cost sharing can also delay action, as funding decisions can evolve into a *wait and see* approach as to which program office will provide funding first. This situation requires vigilance. Early signs of such hesitation should be acted upon.
- Due to funding constraints, maximum Total Ownership Cost (TOC) benefits will not be realized in the Virginia class in the most timely fashion. TOC reduction is generally not afforded significant priority or funding unless a front end acquisition cost saving is involved. This inherently limits realization of the potential life cycle savings over the

submarine platform's life.

Tomorrow. Northrop Grumman Newport News continues to explore other advanced technologies that could lead to more significant warfighting capability improvements to Virginia class in the future, in the areas of Payloads and Launchers, Embedded Sensors, Maneuvering and Drag Reduction Innovations, Flow Sensing, Hull, Mechanical, and Electrical (HM&E) Simplification, Advanced Materials, Electric Drive, and Automation. We are supporting the Virginia class and DD(X) Gold Team efforts for Electric Drive development, which positions us at the forefront of that technology. We also recognize that an ongoing priority for the Navy is personnel retention, and we are exploring technology that could improve the submariner's Quality of Work and reduce their workload, which could contribute to a higher retention rate. An example of this technology is Automated Information and Data Collection, which has the potential to reduce workload by electronically capturing and networking component maintenance information. In seeking improvement ideas, Northrop Grumman Newport News remains in a unique position to leverage nuclear aircraft carrier technology developments, and continues to do so wherever possible. Example technologies that hold promise for contributing to the above areas are advanced materials, composites, drag reduction, paint-on conformal antennas, and encapsulation of payloads to break dependence on marinization.

Beyond. There is now a window of opportunity for another facet of the submarine vision to be revitalized. Namely, a modest, but focused, conceptual look at the *next generation* submarine could be undertaken, in order to ensure the current critical mass of submarine design experts is tapped in a timely fashion, and most importantly to open the door for an even more agile, payload-rich future submarine platform option that could be responsive to a spectrum of unknown future threats. As evidenced in the dynamic world situation, emerging threats will not provide a grace period for development of new technologies, nor advance notification. Therefore, to maintain the ability to provide the country with a full spectrum of submarine options in the future, some level of conceptual activity is appropriate now.

Looking Ahead

Technology Refresh Cycles. As the Virginia class baseline hulls and later technology bundles begin to provide the fleet with increasingly capable, flexible, and affordable assets, the community should be looking beyond the current horizon to a next generation highly responsive, adaptable future submarine option. Perhaps the next significant challenge in being able to conceive of and produce this advanced platform will be the breaking of paradigms, namely in platform configuration, and in technology refresh cycles. New, agile, highly maneuverable hullforms, fabricated from advanced materials, employing novel propulsion and warfare systems, with a high degree of modularity, may be required to address future, as-yet-unknown threats. The key to actualizing useful technologies and putting them to work on a submarine platform is timeliness.

If one examines submarine technology evolution in major categories, it could be argued that approximate submarine technology refresh cycles today would be:

- Command, Control, Communications, Computers about 0-2 Years
- HM&E about 2-5 Years
- Payloads about 5-20 Years
- Propulsion about10-20 Years

Clearly, through careful planning and rapid, frequent insertion of Commercial-Off-The-Shelf (COTS) electronics, the Command, Control, Communications, and Computers category has experienced major improvements in aligning the technology cycle with the insertion cycle on submarines. This is highly evident in the Virginia class technology insertion plan.

However, two of the most critical areas of major submarine technology insertion, payloads and propulsion, are historically the most difficult, time-consuming, and costly to implement. New payloads typically have a lengthy design cycle, are dependent upon platform-payload interfaces for launching, and as a result, progress can suffer from the *chicken/egg syndrome*. Likewise, new platform-payload interfaces and launching systems do not typically receive much-needed attention until new payloads to populate them are developed or at least conceived. This creates a paralysis in the

advancement of submarine payload development and deployment. It is becoming clear that payload modularity may very well provide a mitigation path for this paralysis, by allowing payloads of different sizes, shapes, weights, and interface requirements to be accommodated on demand. *This approach could effectively decouple new payload development from new platform development, and allow or either to proceed as necessary at any time.* Key technology challenges to overcome to achieve payload modularity are the passing of power and data between the platform and the modules containing various payloads. In the propulsion arena, which we will broadly address as including propulsion plant, propulsor, and hydrodynamic development, advancements are extremely hullform-dependent and also carry the burden of long design cycles.

The above conditions highlight the need for strategies to facilitate technology refresh in these major areas. In the payload area, the development and exploitation of concepts for payload modularity, universal interfaces, and parallel payload/launcher design cycles are paramount to a successful strategy. In the propulsion and hydrodynamics areas, the future concept of platform modularity, increasing use of modeling and simulation where appropriate, and the continued use of scaled testing where required will provide the most successful path forward.

Strategy

Futures. To help reinforce why the community should even bother with *non-payload* thoughts for future submarines, one need imagine no further for examples than Captain Tangredi's recent discussions (April, July, and October 2001 issues of **THE SUBMARINE REVIEW**) on the conceivable range of military/political futures we may have in store. Here Captain Tangredi talks about asymmetric threats, weapons of mass destruction, and malicious use of technology in a manner that can be chilling at times, given recent events. These are not new ideas to most readers, but literally overnight have become starkly real. In the tricky business of attempting to align possible future submarine platforms with likely

futures, perhaps a useful analogy is the meteorologist's *hurricane chart*. There is a pretty narrow range of likely required submarine characteristics in the near term (for example, it's likely we will not need a faster, more agile, more acoustically stealthy submarine in the next few years), but over time the *cone* of possible required platform types spreads to include a broader range. We need to continually ask ourselves the question, "What will be the submarine's ongoing and future role in the war against terrorism, in other conflicts, and in new scenarios of peacetime, and how will this influence the platform's characteristics?"

In our view, the *business model* for looking at future submarine possibilities must include a facet that addresses the timeframe beyond 2020, at a modest level of investment. We can't stop innovating and advancing toward the next generation of submarines. Initiatives such as Submarine Payloads and Sensors, ONR's Swampworks, and other attempts to *push the envelope* are promising, and the SUBTECH process continues to provide the much-needed rigor for focusing current and near term R&D and S&T, but we owe it to ourselves to strive for a view *over* this horizon, and to ensure that whatever needs are found there can ultimately be satisfied.

Summary

The submarine community faces significant challenges, as well as significant opportunities, in the near term. Initiatives such as SSGN Conversion, USS JIMMY CARTER Modification, and Los Angeles class refuelings are critically important. Virginia class construction is proceeding well, and the increase in submarine production rate to achieve required force structure levels continues to be planned. Virginia class technology insertion is being executed steadily and efficiently, albeit at a slow pace due to funding constraints. There is now an opportunity to look further ahead and begin laying out options that may be needed for the future. As the Submarine Force starts down the path of metamorphosis in an environment of competing interests and constrained funding for technology insertion, the following considerations are offered to the community:

- Ensure the ongoing advancement of all submarine platform inherent attributes, **Stealth, Endurance, Agility**, and **Firepower** with the end goal being an effective, adaptable total system that survives and thrives over the *long haul*.
- Maintain focus on electric drive/integrated power system implementation to enable further stealth gains, and to provide the pathway to an all-electric submarine.
- Further develop payload modularity and platform modularity concepts to keep future warfighting options as open as possible.
- Define or characterize future desired payloads to the extent possible.
- Provide as much technology insertion funding as practical to further incentivize industry in generating more and better ideas.
- Begin exploring next generation submarine concepts and rethink paradigms of platform and process, in order to address high likelihood capability needs as well as to challenge and thereby preserve the dwindling submarine design industrial base.
- Support the development of advanced technologies that make all of the above possible.

As evidenced in our dynamic world situation, emerging threats will not provide a grace period for development of new technologies, nor notification of a need far in advance. Therefore, it will be prudent to continue introducing new incremental technologies to the Virginia class as appropriate, bundle major warfighting technologies into discrete packages for Virginia class major advances, and to begin exploring the ability to provide the country with an even more responsive, stealthy, payload-rich submarine option in the future.

The "translation effort between developing concepts and bending steel" mentioned by Captain Tangredi in October 2001 is now a fertile and critically important field. Northrop Grumman Newport News is proud to be an integral part of this effort to shape and achieve the submarine vision, and will continue to seek new and innovative ways to meet the Navy's submarine needs.■

THE TOLLING OF THE BELL CEREMONY
Modified for the September 11 War
by EMCM(SS) Steven F. Collier, USN(Ret.)

Editor's Note: Permission is granted for general reprinting/copying of this article. Appropriate modification of the actual ceremony may be done. Both the author and THE SUBMARINE REVIEW encourage others to use this method to commemorate America's sacrifice and determination.

As I spent the weeks trying to absorb the horror of the terrorist attacks this past September, I regretted that I was no longer serving on active duty, as I had previously for twenty years. There, I would at least have had the possibility of venting some anger and frustration through being a part of appropriately targeted tomahawk launches. However, having retired from the Submarine Force eight years ago, I desperately needed to find some sort of activity to again serve our nation—to do something to help—as I watched the country struggle under the pall of this momentous threat to freedom. I found one small way to help some by bringing an old submarine force tradition to my local neighborhood here in the heartland of southeastern Indiana.

The membership at my local American Legion Post 452 had determined to help the victims of September 11 by using their previously-scheduled upcoming dance evening as a fundraiser for the American Red Cross. With a suggestion from me, they also decided that it seemed appropriate to conduct some sort of patriotic ceremony during the dance in the interest of supporting and encouraging patriotism in our small country community.

I remembered from my service in the Submarine Force having been present at several events that included the *Tolling of the Bell* ceremony for lost submarines and shipmates. The mood I remembered from those ceremonies seemed a perfect fit for the present situation.

I searched the web for examples of words that could be modified for this ceremony. While looking for examples of wording through web pages of Submarine Force history, I was surprised to find examples of that tradition being used even beyond the Navy. One

example I read about discussed the use of a Tolling of the Bell ceremony in Texas during a *Remember the Alamo* birthday.

The best example of wording I located on the web was from the transcript of a speech given in 1996 by Captain Bill Weisensee. I began with his words, and modified and updated them to try to capture the current situation and needs in our country today. The text was broadened to include a memorial of civilians as well as military lost in the terrorist attacks, and the call to remembrance expanded to include the civilian arm of our homeland defense forces as well as all branches of the military now engaged in this new war. I presented the idea and words of the ceremony to the Post membership, and they all loved the idea, though few had even heard of such a thing before.

Before the dance, an appropriate bell was borrowed from a nearby farm, and arrangements were made for a neighboring Post to provide their funeral detail Color Guard to assist us. The Legion members were in their uniforms. We conducted our Tolling of the Bell ceremony using the script below after the band's first break. A local trio sang the National Anthem (at the point shown in the script.) The ceremony was very well received by all members and guests at the dance. Most present had never seen or heard of anything like this. Many of those present expressed strong feelings of having been moved by the ceremony.

The script is presented here for use by any familiar with the tradition. Such a ceremony could be conducted in any number of public forums- civic organizations, public meetings, corporate gatherings, etc. Its value is in helping sustain patriotism and national pride, as well as the reaffirming of commitments by the attendees evoked through the words in the ceremony. From comments I heard from neighbors and friends who were present, I believe the words can render salve to some Americans who are privately hurting, provide hope to others, and strengthen resolve in the value of our liberty.

THE CEREMONY

The Color Guard is called to post the colors, going to PARADE REST.
(OPTIONAL: If available, a spotlight is shined on the U.S. Flag and other lights dimmed.)
The bell remains silent until directed further on, the reader begins reading:

"Ask not for whom the bell tolls; it tolls for thee." So wrote the 16th century poet, John Donne, in his sonnet: "No Man is an Island."

Throughout the history of our country, the village church has called the faithful to worship by ringing a bell that could be heard throughout the countryside. At other times this same bell rang out to herald important community announcements or to alert the people to some danger or calamity.

Our tolling of the bell ceremony will begin shortly. In an age of satellite navigation and instantaneous communications, where villages have grown to become huge cities, this ceremony may seem little more than an historical curiosity. But it is much more to those of us that have sailed on and beneath the seas, or marched on foreign lands, or flown in enemy skies in defense of freedom.

It remains an expression of grief and remembrance—calling out to comrades and loved ones who gave their lives in defense of freedom. For long years our entire planet was engaged in a fierce struggle between those who loved liberty and those who were devoted to tyranny. For most of that period the situation was dire and the outcome uncertain. Our entire nation, civilian and military, embarked on a supreme effort to turn the tide and we found willing allies among the freedom-loving people on earth.

We now find ourselves faced again with the challenge.....

(As the reader pauses, the bell now begins tolling slowly, solemnly, about once every several seconds until the end of the reading. The beginning of bell tolling is the cue for the color guard to come to ATTENTION. After about the first three introductory tolls of the

bell, the reader continues reading...)

This bell tolls a tribute to those business men and women, janitors, children, moms and dads, executives and secretaries, military officers and enlisted, policemen and firemen, and all of the thousands of citizens of this great nation who were lost on September 11.

The bell tolls our sorrow for those lost in Pennsylvania, Washington and New York; but it also tolls our determination to remember and reaffirm the following three things:

- First, that **freedom is not free** and citizens that are not willing or able to personally pay its price can only be *made* free—and *kept* free—by the exertions of those willing to serve in our armed forces, public offices, and law enforcement and intelligence agencies. One of the best examples I know of God's special providence for America is the way he continues to raise up, in each generation, patriots willing to risk all to guarantee the blessing of liberty to their countrymen. **This bell tolls a tribute to those currently on the front line of defending our freedom** in the new war.
- Secondly, the American veterans who purchased our peace in the past, and the soldiers, sailors, and airmen, agents and public servants who go forth again today to again pay the price, **must never be forgotten.** A nation that cares for those who have borne the heaviest burdens of citizenship in battle will never lack for a new generation to dare greatly in the cause of freedom. **The bell calls a new generation to serve in defense of freedom,** whether that be in the armed forces or government organizations engaged in the battle.
- And finally, the bell tolls to remind us that, in the words of Thomas Jefferson, **"the price of Liberty is eternal vigilance."** On the day that the first man disobeyed his creator, the world became a very dangerous place, never more so than today. One day God "will make all wars cease." But until he does, the bell calls us to take watch and remain alert.

After three more final tolls, the bell falls silent.

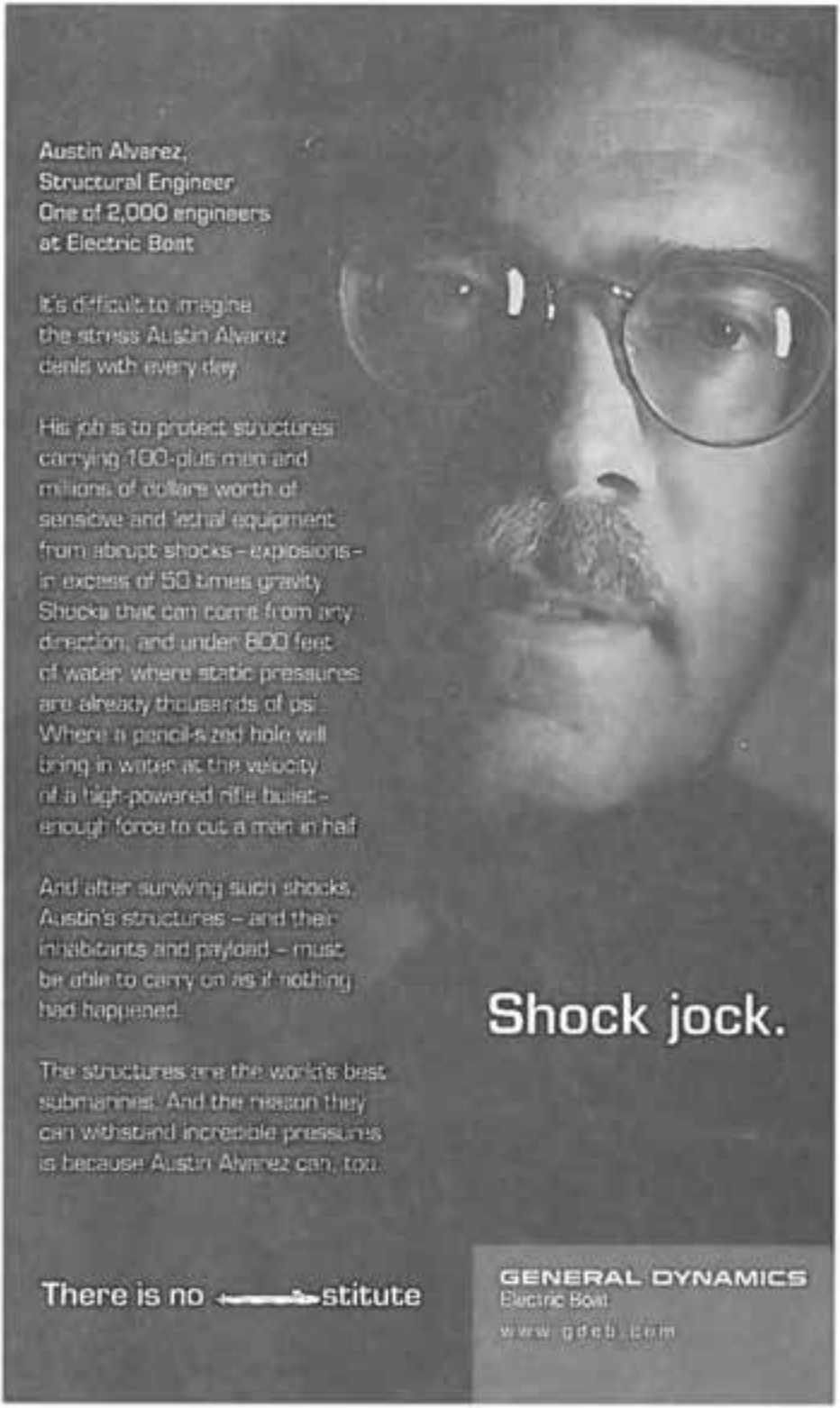
(OPTIONAL: The silencing of the bell is the cue for the Color Guard to come to PRESENT ARMS, followed by a song leader leading in the singing of the National Anthem, or alternatively, a soloist singing it. Upon completion, the Color Guard returns to ATTENTION.)

The ceremony is ended as the Color Guard retires the colors.■

(The author will send the words electronically to any who so desires. Send requests to stevecollier@mail.com.)

IN MEMORIAM

Floyd R. Corteville
Dr. Franz Hoskins
CAPT Walter J. Kraus, USN(Ret.)
LT John H. Mullin, USN(Ret.)
CAPT Glen Sieve, USN(Ret.)
TMC(SS) John N. Thornton, Jr., USN(Ret.)


Austin Alvarez,
Structural Engineer
One of 2,000 engineers
at Electric Boat

It's difficult to imagine
the stress Austin Alvarez
deals with every day.

His job is to protect structures
carrying 100-plus men and
millions of dollars worth of
sensitive and lethal equipment
from abrupt shocks – explosions –
in excess of 50 times gravity.
Shocks that can come from any
direction, and under 800 feet
of water, where static pressures
are already thousands of psi.
Where a pencil-sized hole will
bring in water at the velocity
of a high-powered rifle bullet –
enough force to cut a man in half.

And after surviving such shocks,
Austin's structures – and their
inhabitants and payload – must
be able to carry on as if nothing
had happened.

The structures are the world's best
submarines. And the reason they
can withstand incredible pressures
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DE-ESCALATION: A MISSION FOR RUSSIA'S SUBMARINE FORCE?

by Nader Elhefnawy

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In June 1999, Russia staged an exercise which posited a NATO attack on Kaliningrad. Russian forces proved incapable of defending the enclave with conventional arms, and a faltering Russian defense was rescued by counterattacks with nuclear-tipped air-launched cruise missiles against targets in Poland and the United States.[1] The Russians coined a new term for the type of operation undertaken by the strategic bombers involved in that exercise, *de-escalation*.

De-escalation involves the use of a limited nuclear attack to demonstrate Russia's seriousness about a certain type of action on the part of an enemy (defined as large-scale aggression against Russia or its allies), and to raise the cost of attack for the aggressor. The idea underlying it is not to break its ability to fight by destroying its military capability, but to make the other side blink, and terminate its assault, thus *de-escalating* the crisis.

As risky as such a course of action is, the widespread belief is that such threats are more credible than the saber-rattling which accompanied earlier Russian protests over NATO expansion, NATO's military intervention in the Balkans and American policy towards Iraq. For instance, might the United States be so quick to launch air strikes against Iraq if an implicit threat of limited nuclear attack hung over its aircraft carriers, or airfields? Might Saudi Arabia or Bahrain permit the launching of air strikes from its territory under such circumstances?

While one may hope that such questions will remain solely the stuff of technothrillers, the Russian military has since repeated the exercise. Perhaps in connection with those exercises, Russia has

also repeatedly tested Western air defenses, beginning with several incidents in which Russian bombers approached Icelandic, Norwegian and Alaskan airspace. To date, Russian deescalation exercises have focused on the launch of stand-off missiles from bombers, but bombers are not the only weapons platform for Russia's nonstrategic nuclear weapons. Russia still possesses land- and sea-based weapons, and while these are in storage, the informal 1991 agreement that keeps Russia from deploying these (as opposed to air-launched weapons) is non-binding. Consequently, should Russian policymakers continue to believe that deploying tactical nuclear weapons will offset a perceived threat from the West, Russian submarines may share the deescalation mission with Russia's air force.

Russia's Post-Cold War Submarine Force: An Overview

Russia's navy has traditionally been a submarine navy, like the navy of the other great twentieth century land power which challenged the principal sea power of its day, Germany. While the Soviet Union built up superpower-sized blue-water surface and naval air capabilities during the Cold War, the Russian navy usually had more submarines than surface ships, and today considers its nuclear-powered, missile-firing attack submarines its first line naval force. Consequently, while Russia has been relatively quick to abandon its aircraft carrier construction program, it has continued to invest heavily in its submarine program, pressing ahead with the development of its fourth-generation submarines.

Nonetheless, Russia's naval power has shrunk greatly in the past ten years, surface and submarine units being slashed by about eighty percent. Much of it was outdated equipment that would have had to be sloughed off as a necessary part of creating the kind of leaner, meaner fleet that would allow it to remain significant as a naval power, but advanced ships and submarines are also being lost to a lack of maintenance. The result is that the Russian submarine force had shrunk from 323 submarines in 1991 to 73 in 2000, and has been projected to come down to 53 in 2010. Despite the high-profile, large-scale exercises the navy has routinely staged since the mid-1990s, and the priority that the submarine force has been

accorded generally, aging equipment, shortages of manpower and funds, and the inadequacy of the existing basing and supporting facilities cast further doubts on the combat-readiness of those units that remain operational.

The missions that the Russian Navy has been assigned are to protect the country's coastline and exclusive economic zone; to protect Russian access to the sea, and Russian shipping; and to resolve conflicts on the sea in Russia's favor. In order for the Russian Navy to fulfill these missions, it would require twice as many units as it now has, even assuming that they are equal in training and technological sophistication to western boats, which is not the case.[2] Instead, the Russian Navy is spread so thin that it is even outmatched in the Baltic Sea by Sweden, and in the Black Sea by the Turkish Navy.

Nor is this fact likely to change any time soon, since to paraphrase naval analyst Joshua Handler, Russia simply will not be able to build and operate a superpower-caliber navy on a Third World country's economic base. In practical terms, the Russian submarine fleet may be preserved as an institutional, industrial and technological core around which the country may rebuild its fleet in better times, as a coastal defense force, as a component in its strategic nuclear deterrent, and perhaps in the belief that an outnumbered, rusting navy is better than no navy at all. Nevertheless, a militarily effective Russian navy would be even better, and Russia's naval planners have looked to tactical nuclear weapons as a way of improving Russia's seaborne military capability.

The Return of Tactical Nuclear Weapons to Sea

For several years the Russian Navy has requested permission to deploy tactical nuclear weapons aboard its surface ships and submarines again, and may have already received it. The nuclear weapons that are supposed to have been moved into Kaliningrad in January 2001 were specifically being moved to a naval storage depot. Norwegian television reported in April 2001 that the KURSK had been carrying tactical nuclear missiles. While the Russian government denied this report as well, Russian defense

analyst Pavel Felgengauer claims that this would almost certainly have been the case, as the submarine had been headed to the Mediterranean for exercises.

Moreover, Russian naval bombers have staged tests of the air defenses around American carriers in much the same way that the Air Force's strategic bombers approached Icelandic airspace in June 1999. In October and November 1999, a pair of Sukhoi-34s *buzzed* American aircraft carriers in the Sea of Japan. While explicit references have not been made to them in such a context in the available literature, this suggests that the Russian Navy is also grappling with the issue of de-escalation operations.

It also suggests that warships may be targets for de-escalation operations, and evaluated from a military and political standpoint, they may in fact be more attractive than targets on land. A ship may be more vulnerable from a military standpoint than a target on land, and an attack on it would be easier to deny. If plausible deniability is seen as a virtue in a de-escalation operation, and it may be since the purpose is to send a signal without provoking retaliation, then sinking a ship would be preferable to an attack on a national homeland. Sinking a ship would be *cost-effective*, a way of maximizing the effect of a small nuclear explosion. Additionally, because de-escalation does not require that the weapons involved be directed at targets in the particular region where the crisis is being played out, Russia may attack the American targets closest to hand, and these could be naval vessels.

This being the rationale, a submarine would be superior to a bomber in conducting such an attack, and not only because Russia no longer has enough bombers to overwhelm modern warships with massed missile attacks. A submarine not only carries a heavier weapons load than a bomber, but is also capable of sneaking closer to its target than any existing Russian bomber in order to launch its weapons, whether nuclear-armed torpedoes or missiles. (In fact, the maritime environment may be one where de-escalation missions can be conducted even with conventional weapons, as by sinking a warship with conventionally-armed missiles and torpedoes.) That combination of superior stealth and payload would also make Russian submarines superior to aircraft at executing de-escalation missions with nuclear-tipped cruise missiles against land targets.

All told, Russia still had thirty-eight nuclear-powered submarines in 2000, all of which were capable of firing cruise missiles. Because of Russia's lengthy littoral, giving it coasts along the Arctic, Baltic and Black Seas, and the Pacific Ocean, most of the areas where it operates are well within the range of its twenty-two diesel-powered submarines as well. This gives Russia a total force of some sixty nuclear attack and diesel submarines, and even assuming the fleet's projected deterioration, two-thirds of it will remain in 2010.

Consequently, while Russia's submarine force may not be adequate to challenge even regional competitors like Turkey, it is strong enough in numbers for the sort of mission described here. De-escalation operations are also less demanding from the point of view of training than sustained submarine combat against an enemy's surface or submarine forces. Just as the Russian air force may only be able to effectively defend Russia against large-scale aggression through de-escalation, the assignment of the de-escalation mission to Russia's submarine force may, unfortunately, be the only way in which that branch of its military can defend the country's maritime interests.

What is truly surprising and disconcerting about this is not that these ideas are new, but that they are old. Weapons of mass destruction like nuclear weapons are asymmetrical weapons, most commonly used by the weak to offset the greater power of the strong, which is how Russia views its security situation. De-escalation appears to be a revival of the Russian doctrine of *selectively employing* nuclear weapons during the Cold War.

Rather than representing innovation, de-escalation represents a reversion to habits of thought and action that were supposed to have ended in 1991, after which, to quote George Kennan, open war between Russia and the West was supposed to have become improbable and unforeseeable. The reality is that Western relations with Russia have been far more bumpy than most Americans realize, and even if such a conflict is unforeseeable, the danger of an accident or miscalculation is considerable.

Relations between NATO and Russia have admittedly improved in recent months, but the fundamental problem of Russia's anxiety

about the West, the reason Russia perceives a need to deploy its tactical nuclear weapons, remains. Consequently, improving American relations with Russia (to ensure that war does remain improbable and unforeseeable) and more generally countering the proliferation of tactical as well as strategic nuclear weapons, must remain priorities for the United States even after the end of the war on terror. ■

ENDNOTES

1. Nikolai Sokov, Russian Strategic Modernization (Lanham, Maryland: Rowman & Littlefield Publishers, Inc., 2000) 171.
2. Valery Aleksin, "Russia Needs a Strong Navy" Proceedings Dec. 1997.

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.

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THE ORIGIN OF THE TOWED ARRAY
An Interview with Marvin Lasky

by Robert P. Largess

The question which more than any other plagues the sleep of the historian is "Have I really got it right?" Since I first began to research the history of ALBACORE, I have been continually chastened to realize how wrong my assumptions have been. ALBACORE is still best known for her perfectly streamlined *teardrop* hull and second submerged speed—reportedly 36 knots.

The hull came from the groundbreaking Series 58 model tests run at the David Taylor Model Basin (DTMB) in 1949. It was revolutionary to apply them to a submarine, yet the principles of streamlining were well understood. Only slowly did I come to appreciate that the real mystery which required the building of ALBACORE was the problem of controlling a submarine at the unprecedented speeds streamlining plus nuclear power would allow. Still, it is only since publishing several articles and a book on AGSS 569 that I have understood (I hope) a third and perhaps most significant reason for building the pure streamlined submarine: its acoustic properties and implications for sonar.

The nuclear submarine was one of the most crucial factors in winning the Cold War. The invulnerability of our Ballistic Missile Submarines ended the possibility of a disarming pre-emptive strike against our nuclear deterrent, and thus, more than anything else laid to rest the chance of a nuclear holocaust. Our attack submarines became the *capital ships* of the Navy, ensuring our control of the sea and the use of it by our carrier forces and shipping. The chief threat to both was the much more numerous Soviet nuclear submarine fleet. They often frightened us with their very high performance, speed, maneuverability, structural strength, diving depth; but the fact which gave our submarines their essential and decisive margin of superiority was their stealth, born of silence, and their own tremendously effective sonar listening powers. This was achieved by a highly secret, very long term program of undersea acoustics research, giving us the power to detect and track their submarines at extreme ranges—an achievement unguessed by

the Soviets until it was revealed by the Walker spy ring in the 1970s.

The U.S. Navy's superiority in the field of underwater acoustics goes back to its active partnership with the American scientific community, forged in World War II. Some of the most basic research breakthroughs were made then; afterwards, it was continued at DTMB, the National Academy of Science's Committee on Undersea Warfare (CUW), ALBACORE. But as Rodney Carlisle, author of Where the Fleet Begins, a history of DTMB, puts it: "Unlike other areas, the field of underwater sound was of interest only to the Navy, and specialists could not count on broad-based industrial support or shared investment from other branches of the military or civilian government departments ... the Navy had, in effect, created a Navy-controlled and highly classified interdisciplinary area of scientific research and development" (Carlisle, 280). Underwater sound became the Navy's own *secret science* pursued by a community of specialists working at various naval research facilities, publishing their findings in a group of classified journals.

The contribution of these men was vital to winning the Cold War. Their story deserves to be told; but it was hardly guessed until 1992. Now, telling it is hampered by the fact that it was classified for decades, and much is still secret. Tracking down the details of work done fifty years ago is not an easy matter. Many of the participants are deceased, and those who remain are very elderly. The chance to record their experiences is running out; this article is at least, a stab, in that direction.

An Interview with Marvin Lasky

When I first began researching ALBACORE, I spoke to Captain Frank Andrews, submarine project officer at DTMB, Commander of Submarine Development Group 2 (SUBDEV-GRU2), in command of the search for THRESHER, later Professor of Engineering at Catholic U. He told me "You should talk to Marvin Lasky." Unfortunately, I didn't, until just before the publication of my book on ALBACORE years later.

Who is Marvin Lasky? In Science and the Navy: the History of

the Office of Naval Research, Harvey Sapolsky writes: " ONR ... promoted the concepts of towed arrays for submarine detection. The latter work, which has added greatly to antisubmarine warfare capabilities, was championed nearly single-handedly by Marvin Lasky, an ONR scientist who received the Defense Department's Distinguished Civilian Service Award for his efforts." In fact, Lasky received this award, the highest military decoration given to civilians, twice, as well as the Navy Distinguished Civilian Service Award (Sapolsky, 85).

So—"who was that masked man"? This article attempts to give the outline of the story, mostly in his own words. All direct quotes not otherwise attributed are his. One point that cannot be emphasized enough is his constant reference to his colleagues and their work, much of which I have regretfully left out. "It was a team effort in which we all marched together ... we lived together as a family, on and off submarines."

Mines, Torpedoes, World War II and Project General

Marvin Lasky was born in Brooklyn, New York, graduated from Brooklyn College with degrees in Pharmacology and Physics, then went to Columbia. When World War II broke out he sought to enlist, but on his first attempt was turned down because of asthma. But "like all Brooklyn College graduates" he had taken the Civil Service exam: "it was still the Depression and jobs were scarce." He was hired by the Navy to work at the old Torpedo Station at Alexandria, Virginia, "then commanded by a chief warrant officer and producing an updated World War I design torpedo, the Mark 14 3A, using World War I technology, the identical gate valve, alcohol-air system, while the Germans had gone over to electric propulsion and were working on the acoustic torpedo."

Meanwhile, "seeking to become more qualified as a scientist", Lasky went to Catholic U. at night. "Catholic U. had put together a special course for the Navy on hydrodynamics and the behavior of submerged bodies such as torpedoes."

His second attempt to enlist was successful, he was trained as a

radar technician, and found himself at the end of the war sweeping American-laid mines in Sasebo harbor. He saw Nagasaki and "had visions of America so affected. We felt we didn't want to be on the losing side. Coupled with the fact that I was Jewish—I lost family in Poland to the Germans, family in Siberia to the Russians—that gave a powerful motivation to my later work."

After his discharge, he was hired by DTMB, based on his experience with mines and torpedoes, to work under V.L. Crisler on "Project General". This was a torpedo counter-measure, a towed paravane trailing a cable with acoustic sensors and explosive charges located along it. If a torpedo crossed the cable, its noise would detonate the nearest charge. It was tested at DTMB's establishment on Lake Pend Oreille in Idaho. "It was a ticklish operation; we didn't want the sensors exploded by wave noise. We never really got the problems solved—but the technology that spun off educated and trained a lot of Model Basin people in problems that were eventually very useful to ALBACORE", including towed sonar.

DTMB had developed an underwater TV camera to observe flow patterns and cavitation around various experimental sonar domes and fairings tested aboard ALBACORE. From this camera was developed the video system used by the NAUTILUS to observe the underside of the ice pack on its transit to the North Pole. When it was discovered later that the wake from the ALBACORE's sail, hitting her prop and control surfaces, was a major source of noise, Lasky suggested removing her sail, and using a vidicon towed with the Project General technology to replace her periscope.

Blimp Towed Sonar, Surface Ship Silencing

Meanwhile: "V.L. Crisler was concerned to indoctrinate me into ways of adapting my knowledge into the problems he saw facing the Navy. To keep me interested he gave me the job of flying on blimps from Lakehurst in 1947-48 and towing sonar from them."

An active sonar in a fish-shaped body, it was called ATERE (Airship Towed Echo-Ranging Equipment). "It didn't work very well. Because the tow cable formed an antenna 1000 feet long, we

picked up all the radio traffic on the East Coast. But we solved the problem of making a large winch and cable system efficient, small and portable. The first towed sonar on ALBACORE was an adaptation of this winch and cable system. Nothing is lost."

ATERE ultimately led to the highly effective helicopter "dipping" active sonars used for many years. Towed sonar aboard the blimps held out the prospect of a vehicle combining the sonobuoys, MAD, radar, and other sensors of the patrol plane with the active sonar of the helicopter. How successful it was is an interesting question. Reportedly its *fish* could be towed at 60 knots, but could not operate at any such speed because of flow noise. A ZPG - 2 used it to track NAUTILUS in 1955, but she learned she could easily escape by going to a speed above that at which it could operate, and breaking the contact—just as she did with surface ship sonars.

Next, Crisler brought Lasky into the massive lengthy effort at DTMB to study surface-ship noise and silencing. Propeller cavitation emerged as the number one problem, and here "a towed hydrophone, streamlined to reduce self-noise, would be towed alongside a destroyer" while staff observed the props through ports and compared the visual onset of cavitation with noise (Carlisle, 278). The same approach was followed on ALBACORE, with tripod-mounted TV cameras replacing the visual ports.

At this point, acoustics, ship noise, and silencing became Lasky's main work—ALBACORE was authorized in 1950, and "because of my experience with blimps, Crisler nominated me to become part of the ALBACORE team."

SUBDEVGRU2 and the SSK

During the next two years while ALBACORE was building, this team was trained and readied. They were assigned to SUBDEV-GRU2 under the guidance of Frank Andrews. "He was the man who indoctrinated us into submarines. A commander at the Model Basin, he had a Ph.D. He had access to the leading scientists and Navy brass. We had an Admiral,they called him *Fearless Freddie* Warder, for his exploits against the Japanese in World War II. He

was a power in the submarine Navy. Frank introduced John Craven, myself, and Alex Tachminge on one of our liaison visits and got his backing for our testing program with ALBACORE."

SUBDEVGRU2 had the twin purpose of exploring the role of the submarine in anti-submarine warfare, and familiarizing civilian scientists from many institutions with the realities of submarine warfare. Later it was to include ALBACORE, TULLIBEE, THRESHER, but at the beginning it was equipped with SSKs, the specially built K-1 to 3 and fleet boats modified as submarine killer submarines. The civilian group from DTMB who joined SUBDEVGRU2 at this time later made outstanding contributions to submarine technology. "The crew that went to sea on ALBACORE had to be trained and readied, had to develop technologies, so ALBACORE would be something we were educated for, so we wouldn't waste time learning on the spot. Richard Dzikowski, Alex Tachminge, a guy named Hawkins did maneuvering and control, John Craven did the boundary layer, I did the acoustics."

The uniquely fruitful partnership that had developed between the Navy and the American scientific community in the field of undersea warfare began in World War II. The connection was initiated by the civilian scientists themselves (as it was with the atomic bomb). As Lasky describes it, it was Vannevar Bush and Harvard President James B. Conant in 1940 who sought a meeting with Roosevelt and obtained his personal authorization for their project to mobilize American science for military research. And at Harvard, F.V. *Ted* Hunt established an undersea research program; he personally coined the term "sonar". "He educated and trained almost all the acousticians in undersea warfare. His Ph.D.s were everywhere."

This scientific effort was directed first against the Germans in the Battle of the Atlantic, then to supporting the U.S. submarine war against Japan. But at the close of the war, we were rocked by the discovery of the German Type XXI streamlined U-Boat, with high submerged speed and endurance. It was simply beyond the capacity of any countermeasures we had. And it was quickly apparent that the Soviets were determined to build a massive fleet of Type XXI clones, threatening a new, unwinnable Battle of the Atlantic.

However, another piece of captured technology offered some hope of a solution, the GHG, a German sonar, a passive multiple hydrophone array. Ordinary wartime U-Boats had a listening range of ten miles at low speed, and the Type XXI could listen out to 4km at 15 knots. This was far beyond the ranges and speeds at which our active sonar could operate. And the Navy was astounded at the capability of the huge set aboard the war-prize heavy cruiser PRINZ EUGEN, using 240 hydrophones. She had tracked HOOD over the horizon in her famous battle with the BISMARCK, and had used it to avoid many British submarine torpedoes (all but one) throughout the war. She duplicated this feat for the US Navy in 1946, detecting and avoiding numerous torpedoes on an exercise. (Hackmann, 292-5).

This increased sonar range suggested the idea of the SSKs, numerous, mass-produced,inexpensive submarines, with no need for high speed or deep diving, quiet and with powerful sonars, to bar the Greenland - Iceland - UK Gap to Soviet Type XXI snorkellers. The purpose-built and conversion SSKs were given the huge 20 ft., BQR-4 passive sonar, a conformal array based on the GHG (FLYING FISH actually tested the original huge set from PRINZ EUGEN). They detected submarines at 38 miles or more with their all-passive sonar suites, and demonstrated that the submerged submarine was plainly the ideal sonar platform, with sonar performance exceeding that of any surface ship (Friedman, 84). On the other hand, though the SSKs were the quietest boats in the Navy "unfortunately silencing was little understood". (Friedman, 78). In 1950, tests showed that with sonars placed as originally planned around her sail, machinery noise would have halved detection range on GRAMPUS. (Friedman, 78).

From SOFAR to SOSUS

However, the fundamental breakthrough that was to go far to solve the Soviet submarine threat had already been made. During World War II Maurice Ewing and his colleagues at Woods Hole Oceanographic Labs discovered the existence of deep sound channels in the ocean, capable of transmitting low frequency sound

thousands of miles. This led to the establishment of three SOFAR (Sound Fixing and Ranging) stations for locating airmen downed at sea. The airman would drop a small explosive charge set to explode in the deep sound channel. Anywhere in the Atlantic, this signal would be detected and its position triangulated. Lasky says these stations are still in operation today, and revealed the position where SCORPION was lost in 1968, by the sound of her hull imploding.

After the war, leading scientists in wartime research formed the National Academy of Science's Committee on Undersea Warfare (CUW), to continue their successful partnership with the Navy. Ewing and F.V. Hunt served on the CUW's Panel on Low Frequency Sonar, which made, in 1950, the recommendation that led to SOSUS (Sound Surveillance System)—a network of fixed seabed arrays, 1000 feet across, mounting 40 hydrophones. They covered the North Atlantic at first, then much of the world's oceans. By the end of the 1950s they were capable of detecting and tracking virtually every Soviet submarine at sea.

Lasky says "SOSUS was based on a system of sound spectrum analysis called Lofar. Every ship has an orchestration of sound. It comes first of all from the propellers—that's very low frequency — then you have prop cavitation, then machinery noise, some continuous, some intermittent, then flow noise over the hull, through the piping. Diesel engine sounds were the loudest and transmitted over the longest range—so SOSUS was originally set on the diesel submarine snorkelling."

For many years the Soviets totally failed to suspect we were tracking their subs; and this yielded a bonus in their failure to bother silencing them. We experimented with mounting diesel engines on sound-isolating mountings—they never did. (Lasky sustained permanent hearing loss aboard SCOTSMAN, the British sub that carried the first sound-mounted engines). The Soviets made great efforts to exceed our subs in performance and weapons, ignoring silencing until they learned of the existence of SOSUS from the Walker spy ring in the 1970s when they made desperate efforts to catch up.

Acoustics and ALBACORE

"The initial mission of ALBACORE was to go to high speed without cavitation, through her good hydrodynamic flow characteristics. The CUW knew they knew nothing about flow noise at high speeds—the only subs we had which had ever been there were the British hydrogen peroxide boats, EXPLORER and EXCALIBUR."

It was the towed passive array which gave the individual submarine the power of detection, localization, and classification possessed by SOSUS. Yet, the towed array actually originated as a tool to study ALBACORE's self-noise. Indeed, it is little appreciated that a main purpose of ALBACORE from the very beginning was acoustic study. The best hydrodynamic, low-drag shape was also the best acoustic, low-noise shape.

For example, NAUTILUS astounded the Navy in 1955 with her speed and the tactical superiority over ASW it gave her. But this was in spite of her appalling, unexpected noise at high speed; she could not use her own sonar above 8 knots. Poor hydrodynamic design caused vibration intense enough to cause structural damage; flow past flood openings created resonances in her ballast tanks. In the spring of 1956, Lasky presented a synopsis of her noise problems at a conference at BuShips: props, gear whine, reactor auxiliary pumps, *whistles* from hull openings and sail, creaks and groans from her hull as she changed depth. (Weir,185) Lasky says this analysis was the work of Alex Tachminge.

However, vast progress was made very quickly. Gary Weir writes: "From the operating community's vantage point,radiated noise and the capability of GEORGE WASHINGTON's active and passive sonar took priority after the missile system". In 1960 John Craven, chief scientist for the Polaris project, had sought to eliminate all possible sources of noise before completion. (Weir,263)

Gary Weir writes "As part of a team of physicists working on the acoustical problems of ALBACORE at DTMB, Marvin Lasky explored sources of noise common to all submarines and a few that were more characteristic of AGSS 569. All of these vessels displayed five major problems: noise over the passive sensors,

transmission of vibration through the ship's structure, machinery noise, water flow around the hull, and the noise of the propellers. Of these, water flow around the hull was the most important and least understood because no submerged submarine had ever achieved very high submerged speeds" (Weir, 140).

Yet the teardrop hull helped in other areas; it produced the optimal flow of water into the propeller, reducing prop cavitation. And individual sources of noise were identified, studied, and eliminated in detail. "Specialized test runs included the study of vibration and sound emitted by nearly every conceivable part of the boat, including ballast tanks and superstructure vents. Researchers traced flow noise around the anchor and anchor chain, hatches and escape trunks, towing padeyes, stern light and cleats, handrails, whip antenna, stern planes and dorsal rudder, periscope housing, and sonar domes" (Carlisle, 249).

Thus, 569 lost her bow planes "so damned noisy I had them taken off." DTMB insisted on a dummy sonar dome, for the study of its hydrodynamic characteristics. "There was no sonar dome or acoustics in the original plan that came out of the CUW." And no sonar either; 569 was given an old, ineffective JP at the insistence of her skipper, Ken Gummerson, to avoid collisions while surfacing. This was replaced by a JT, which performed poorly until placed under the fiberglass DTMB dome, where it exhibited remarkable high speed performance. TV cameras and stroboscopes were used to observe cavitation and flow around the dome. Her second skipper, Jon Boyes, remarked, "We could hear through our own white noise at 30 knots with the JT, and were able to track Guppies at great distances because ALBACORE's streamlining made her so quiet."

Lasky recalls the Germans had problems with flow noise when they mounted the GHG on the high speed Type XXI and went to a World War I technique of enclosing the sonar in a water-filled dome. The next step was to move the sonar to the bow; Lasky attributes the idea of making the bow itself into a sonar dome to Howell Russell, senior projects manager in the DTMB acoustics lab.

Howell Russell says: "Our object was to create a quiet sonar platform as far from sources of noise as possible. We cut 6 feet of

the steel bow off, took a mold of this, and the shipyard used this to create an identical bow of fiberglass, woven cloth and resin. We installed an early model sonar in the free flooding area behind it. All the new boats have it, but it was a first for ALBACORE."

In 1960, the early sonar was replaced with a powerful combination of BQS-4, the first major postwar active sonar, and BQR-2B, the American version of the GHG, the passive array used in the SSKs. In 1962, a first breadboard version of DIMUS (Digital Multi-beam Steering) was added to the BQR-2B, using an omnidirectional spherical array of 24 hydrophones, digital processing, and electronic rather than noisy slow mechanical beam steering. Frank Andrews says: "DIMUS was a method of processing sound coming into the array, a narrow beam distinct from all-around noise. It's like 24 searchlights on all at once, simultaneously looking in all directions, unlike a single beam that's mechanically steered." Thus, the spherical array was capable of tracking a contact in three dimensions; DIMUS made it both omnidirectional and capable of picking up very weak signals through the background noise.

ALBACORE ran tests with this sonar April to December 1962 under the direction of the San Diego Marine Physical Laboratory, where DIMUS had been invented by Dr. Victor C. Anderson in 1951. DIMUS contributed to the effectiveness of the huge spherical bow arrays which were an essential part of the design of all U.S. attack subs from TULLIBEE on, to the point where LOS ANGELES was intended to operate hers in a completely passive mode.

Writing the History of Sonar

"At this time [after 569's completion] I became acquainted with Aubrey Pryce, an Englishman who was working to compile a summary of acoustic data, done by so many different people in so many different countries. He encouraged me to develop the history of the effort going back to World War I and beyond, so we wouldn't repeat problems that had already been solved."

This was the origin of his series of articles, mostly in the

Journal of Underwater Acoustics, tracing the history of sonar from its beginnings to 1970. In his research, he recovered many forgotten but useful concepts—including the passive towed hydrophone array.

He found that in 1917 the Navy had assembled a group of specialists under Dr. Harvey Hayes of Swarthmore College at the New London Naval Experimental Station "to derive as quickly as possible the best available technology to defeat the U-Boat." With the Submarine Signal Co., they produced the "Eel", using 48 hull-mounted and towed hydrophones, tested aboard the destroyer JOUETT. The system was binaural, indicating both range and direction. Two arrays with 12 hydrophones each were towed 300-500 ft. behind the ship, 100 feet deep and 12 feet apart. A 12-channel electrical compensator provided electrical delay-line steering. On April 1918 JOUETT tracked submarine G-2 doing 7 knots in Long Island Sound.

"This system not only detected and located the direction of submerged targets but also by means of cross-fixing from the known geometry of towed and hull-mounted equipment could measure the range ... Note that at time 11:44, with own ship proceeding at *20 knots*, the target was held at about 1200 yds. range" (Lasky, "Review of Undersea Acoustics: To 1950", 6).

When Dr. Hayes met with his British opposite numbers in 1919, they urged the development of their active, echo-ranging gear, ASDIC which the US Navy chose to pursue.

Genesis of the Modern Towed Array

The passive linear array towed by the modern nuclear submarine had its origin in the technology Lasky devised to measure the ALBACORE's self-noise. Acoustic research on the ALBACORE was a double-sided effort. The more she was quieted, the greater her listening powers. And the more sensitive, sophisticated, and quiet her measuring equipment grew, the greater its potential for anti-submarine use.

During his year at SUBDEVGRU2 before ALBACORE, Lasky worked on the problem of making electrical connections through a submarine's hull to removable equipment outside, based on his

experience with mines. "I developed a removable torpedo-loading hatch with 6 waterproof, pressure proof electrical connections. This enabled us to transfer our instrumentation from one boat to another; we could on- or off-load a submarine in 3-4 hours."

The next step was to use the ATERE equipment to stream a simple hydrophone from ALBACORE's sail to measure near-field noise, "first at 15, then 30, then 45 feet. We were careful not to get it tangled in the screw." Howell Russell tells the story of hearing gunshots and shouts on the headphones the first time he tried it. "Bang! Bang! Aaaaaa! They were listening to a John Wayne movie in the crew's quarters."

Lasky says: "The big problem was to get a sensitive hydrophone that could be towed at depth—our early ones leaked. But it was quickly apparent that this would allow picking up very long range signals. Sound transmission in the ocean is very complex, but the low-frequency sounds of submarines persisted and were identifiable through the ambient noise produced by ship traffic, biology, the 60-cycle hum.

"We towed sonar to measure ALBACORE's self-noise. Her first priority was to go to high speed without cavitation. When this was accomplished I got to work on the towed linear array. In 1956 I left DTMB to join Aubrey Pryce at ONR, where we achieved our towed array accomplishments.

"Aubrey convinced me that towing the array and doing it quietly was useless unless we quieted the platform—you didn't want to just listen to your own noise. We were then just as noisy as the Soviets. To quiet the platform we needed a systems approach; we were listening in the very area we were noisiest."

But according to Norman Friedman, ONR and DTMB did a special study of flow noise in 1959-61, towing a 50 foot, 11 hydrophone array on a 3-mile cable, achieving "by far, the lowest self-noise to date over the full range of Lofar to medium frequencies (100 Hz to 1090 Hz) at speeds up to 10 knots" (Friedman, 67).

Lasky says "with the SSKs the problem was to achieve detection ranges of 10-20 miles whereas in order to intercept a Soviet nuclear sub trailing one of our carriers, you needed ranges of 100 miles and more. To get them, you needed a quiet sub, listening at optimum

depths. This was the impetus of the towed array."

In February, 1962, ALBACORE tested "Towflex" made by the Chesapeake Instrument Co., which later became the towed array division of Gould. It was probably the first submarine-towed hydrophone array.

"Towflex was the first. It was a Chesapeake Instrument name. They made it for me and they didn't do a very good job. The hydrophones were carried on a coaxial cable, and the flexing of the cable caused noise. We went back to a World War I technique, enclosing the hydrophones in a water-filled space. First we used a flooded fire hose, then we used Kevlar, a Dupont fabric that was abrasion resistant and acoustically transparent. The one that actually worked was refined by Hughes Aircraft and the Underwater Sound Labs. Hughes very largely made the first version that worked a guy named Mike Basin was responsible.

"We had determined that the units had to be neutrally buoyant, and before we did any electronic signal processing with them, we towed them for stability. We did the initial telemetry, and Underwater Sound Laboratory took it over after that, made it smaller, transistorized the electronics. A guy by the name of Harold Nash did that.

"I've been very fortunate in having very capable guys working with me. Al Sykes, Aubrey, George Boyer—they were wonderful scientists—we had all worked at DTMB in different capacities, but eventually joined ONR to carry on the mission of improving our undersea warfare capabilities."

Thus in 1962, we can see ALBACORE, with her powerful bow sonar with DIMUS and first towed array, as an embryonic prototype of the Los Angeles class: a killer of enemy nuclear submarines, fast, maneuverable, deep-diving, very quiet, with tremendous passive listening powers. This was the formula which gave us superiority over the advanced Soviet nuclear sub fleet in the 1980s, the last decade of the Cold War, and made possible the Navy's offensive "Maritime Strategy". Analogous to the fighter airplane's role of gaining command of the air, the nuclear submarine became the primary weapon for gaining control of the sea, necessary to allow us the use of its surface by our "power projection" forces, carrier and amphibious groups.

ALBACORE underwent a major reconstruction from December 1962 to March 1965, before resuming towed array testing. In the meantime, a towed array for operational use was being planned. Friedman writes that the National Security Industrial Association (NSIA), a group of major defense contractors, had done a study of ASW in 1964. They were tremendously impressed by SOSUS —they envisioned a submarine towing a complete 1000 ft. SOSUS array at the end of a 10,000 foot cable. In 1965 they proposed that the next submarine sonar include a bow spherical array and a towed array, using the BQQ-3 Lofar spectrum analyzer.

But to use Lofar effectively, it was necessary to have detailed profiles of Soviet submarine sound spectra—necessarily recorded by US submarines lurking in Soviet operating areas. But, unless at a dead stop, flow noise over hull arrays would mask the low end of the Lofar spectrum. "The ONR experiment with towed arrays offered a solution. Isolated from much of a submarine's self-noise and suffering little flow noise, the towed array could be used while the submarine moved" (Friedman, 67).

The first array actually in service, authorized in 1965, may have been the Tuba-II (BQH-4) "The 258 foot, 3 inch diameter array, towed on a 2,600 foot cable, carried three subarrays of 50 hydrophones each. The entire system was effective between 10Hz and 20kHz" (Friedman, 67).

Ballistic missile submarines used the smaller, simpler BQR-15, permitting them to look aft, behind their prop noise. Numerous arrays followed, retractable, clip-on, longer, thinner, lower frequency. SURTASS was a mobile supplement to SOSUS, towed by auxiliaries. Spruance and Perry class escorts, as well as Los Angeles SSNs, could operate completely passively, listening out to great distances, no longer advertising their presence by active *pinging*. Array length permitted the easy determination of range by triangulation.

Atlantic Underwater Test and Evaluation Center (AUTEC)

Lasky received the DoD Distinguished Civilian Service Awards for towed sonar in 1972. However, he had earlier received this

award for another achievement as Director of Acoustic Programs at ONR, the creation of AUTEC. During his early years there, major advances were made in silencing. During her Phase II 1956-60, for example, a careful effort was made to attack all sources of noise on ALBACORE. Her piping and auxiliary machinery was given resilient mountings to prevent vibrations from being transmitted through her hull; plastic coatings to prevent water noise were tested inside her tanks and free-flooding superstructure. These efforts led to the *raft-mounted* geared turbines used in THRESHER and most later nuclear boats.

As silencing and passive sonar improved dramatically, they came to represent a crucial part of the U.S. margin of superiority. We needed a careful analysis of our own submarine sound signatures to reduce them to the absolute minimum and extrapolate the ranges at which they could be detected. In particular, we needed to check our submarines upon completion and after modification and overhaul to make certain there was no unsuspected source of noise, a construction or design flaw, a faulty piece of machinery, even a loose piece of gear, to ruin a submarine's stealth and announce her presence. ONR and BuShips sought to create an instrumented test range to serve this purpose.

"It required the coordination of parts of the system that often don't talk to each other. Vince Prestipino at BuShips got the authorization for it, I did the acoustic work, and we shared the award for it. ONR wouldn't normally have any control over scheduling submarines. Code 525 over at BuShips was the submarine code, Code 371 was the ship silencing code. Through Frank Andrews introducing us to the people in submarines and Vince Prestipino knowing everybody in silencing, we were able to join them both together. It was a team effort; it didn't come full-blown from the brow of Jove."

AUTEC was a joint US-British project. The site chosen was Tongue-of-the-Ocean near Andros Island in the Bahamas. It is a gigantic undersea canyon, 15 by 100 miles, as much as 6,000 feet deep, with immensely steep drop-offs forming its walls and only one access channel. Isolated from shipping, it possesses the necessary depth, space, ideal weather and low ambient noise. John Bentley writes that it was not complete until 1969, but it was

in use much earlier (Bentley, 92). ALBACORE apparently visited it for the first time in 1959.

AUTEC possesses three ranges: for weapons testing, calibration of sonar, and the third, the Acoustics Range, is for measuring, recording, and analyzing the sound signature of our submarines. In addition, DTMB created MONOB I (Mobile Noise Measurement Barge) from an ancient water barge and moored her near Eleuthera Island, where she was used to measure the sound signature of ships and submarines using variable-depth hydrophones. Manned by DTMB personnel, Lasky says V.L. Crisler was her originator.

The Fly-Around Body

As valuable as AUTEC was, it meant that every submarine had to expend considerable transit time to travel to one very expensive instrumented sound range in one specific place, to undergo periodic sound checks on a rigid schedule. Would it be possible to develop a simple, relatively inexpensive piece of portable technology that a submarine could use to check its self-noise any place, any time without any serious interruption of its operations? The answer was the Fly-Around Body (FAB), conceived by Lasky out of his long experience with towing. The FAB, described in interviews with Lasky, Howell Russell, and a January 2000 **SUBMARINE REVIEW** article by Jack Hunter, was a wing-shaped hydrofoil tethered body, "flown by remote control from inside ALBACORE, using hydrodynamic lift to "rise" against the pull of its faired tether cable, like a kite. The FAB proper towed a neutrally buoyant hydrophone array behind it. "Flown" from ALBACORE's nose, it could be positioned anywhere 360 degrees around her hull, at any distance to at least 100 feet out.

Jack Hunter writes: "The concept was to take near field noise measurements while turning on and off various pieces of equipment. Once the first set of readings was taken the array would be moved further away from the hull by increasing the scope of the tow cable and a second set of readings would be taken. The collected data would be processed to determine the boat's radiated noise signature."

Lasky says: "After the towed array was proven, we concentrated on the sound field around ALBACORE. With the FAB we could measure in yards what we had previously measured in miles. There were three elements to it: one was the towed array, one was the positioning system used to place it around ALBACORE, and the third was the analytic method for taking the near-field data we obtained on the cylinder of sound around ALBACORE, and translating this based on theory into far-field, into what the enemy hears. It was a huge research effort based on a very complex mathematical exercise, which Mike Junger pioneered. With our support he published a book called Sound Structures and Their Interaction. He was one of the early doctoral graduates of Ted Hunt.

"I did the array, and the controllable wing paravane was designed by Dr. Folger Whicker—this is patented at DTMB. The tow cable carried the remote control signal as well as the acoustic signals received from the array: they varied considerably around the submarine.

"The idea of the whole system was to eliminate the need of every submarine to go to Tongue-of-the-Ocean, not only on completion but after every upkeep and overhaul. It was very expensive. John Craven sponsored the FAB with me at ONR."

Jack Hunter describes how the FAB was stowed on a cradle aft of the sail. ALBACORE's dorsal rudder was turned into a crane by the addition of a boom and winch and used to raise and lower the FAB into the water. It was necessary to put divers into the water to connect and disconnect the hoist cable, thus limiting operations to sea state two or less. He wonders if this mighn't be part of the reason the FAB was not pursued, although he notes the process of attaching the *clip-on* towed arrays was similar, using divers.

Lasky says: "The problem at the time was controlling the paravane; it really needed an autopilot. At that time the necessary computing capacity was an extremely expensive proposition. Meanwhile AUTEC was a going program, already funded and successful. But if the Cold War had stayed hot we might have gone ahead with it. But FAB technology is incorporated in the towed cameras Robert Ballard used to find TITANIC."

In regard to FAB's effectiveness and problems, Jack Hunter writes: "ALBACORE deployed twice to Ft. Lauderdale with FAB. The first set of trials ended prematurely when a casualty to the control system caused the FAB to crash into the sub and crush the fiberglass body."

(About this incident Howell Russell recalls: "Once we racked up the FAB, clobbered it against the hull. Well we called the FAB 'the Yellow Bird' so some wiseguy hung a plucked rubber chicken from the sail with the sign 'Sighted Bird, Shot Same.'")

Jack Hunter continues: "On the second test the system worked well. The noise data obtained were then verified on multiple runs at AUTEC."

ALBACORE tested the FAB at Ft. Lauderdale in 1967. She also conducted FAB Phase I trials at Tongue-of-the-Ocean, and FAB Phase II trials off Portsmouth in 1968, according to her ship's history. In 1970, ALBACORE began modification for Project SURPASS, her trials with viscous polymer liquid to smooth her boundary layer. But Project SURPASS was never completed, due to the final failure of her troublesome GM 16-338 *pancake* diesels, and that was the end of the availability of a full-scale submarine for such imaginative tests.

Lessons and Questions

This article only scratches the surface of the story of the Navy's *secret science*, and of Marvin Lasky and his colleagues, Frank Andrews, Aubrey Pryce, Richard Dzikowski, Ted Hunt, Vince Prestipino, Mike Junger, Howell Russell, and many, many others. Writing it would be a major labor, but very instructive. One particularly impressive aspect of the acoustics program is the ease with which these men moved back and forth between the most abstract and complex principles of Physics and practical, ingenious engineering. Another is the rapport that existed between the scientists and the Navy.

"Our Model Basin civilian crew had the best cooperation not only from the officers but also from the enlisted men, especially in the forward room, where we installed the bulk of our gear. They

not only *hot-bunked* elsewhere but also cheerfully gave up their bunks to the Model Basin research personnel and helped us install our instruments in the superstructure and around the propellers ... ALBACORE was a miracle brought to fulfillment by the goodwill, superb team effort of many dedicated individuals. We were blessed by the good fortune to be friends and close companions, that we were not killed by the same misfortune that overtook our friends and sometime shipmates on thresher."

This *band of brothers* spirit is no illusion; it is echoed by practically everyone the writer has spoken to connected with ALBACORE: CO's, crew, DTMB and CUW scientists. It says a great deal about the U.S. Navy as an institution that it could foster, trust, and apply such a complex and sophisticated scientific effort. The acoustics program could fruitfully be compared with such efforts as that of Rickover and the creation of nuclear power, or that of BuShips to produce an effective *fleet boat* before World War II under Cochrane and McKee, or perhaps the effort to make carrier aviation work in the 1920s and 1930s. And, of course, the Manhattan Project that produced the atomic bomb.

Gary Weir quotes Marvin Lasky: "Let me tell you why the civilians were able to control ALBACORE. Because of the spillover of scientific effort from World War II and the respect of the naval officers in charge for civilian expertise in solving naval problems. This has since evaporated" (Weir, 142). If this is true, then it is all the more important to understand this time and its achievements, so we can, perhaps, recapture its brilliance and ingenuity when these are needed again. As Marvin Lasky says, "Nothing is lost."■

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LOOKING AROUND:
A SHORT HISTORY OF SUBMARINE PERISCOPES
Part 1

by John Merrill

Mr. Merrill retired from a long and distinguished career at the New London Division of the Naval Undersea Warfare Center. He currently writes historical works involving that lab and it accomplishments.

Preface

After John P. Holland delivered his practical 53 foot submarine to the U.S. Navy in April 1900, there was an immediate stronger international interest in submarines. By 1914 there were 400 submarines in 16 navies. The first United States periscope patent was granted in 1902, and periscope changes and improvements have been almost continuous since then.

Early submarine success in World War I brought important evidence of the submarine's capability. Still, acceptability of the submarine as a significant part of a navy remained in doubt in some circles. Beginning in the 1920s, the United States Navy assumed a broader and aggressive role in submarine design and construction. This led to submarines better matched to naval needs. Preparation for countering the improving submarine was lacking by all sides in the decades between the World Wars.

Operationally the submarine as an asset to the navy improved significantly during this period and prior to World War II. The fleet boat design with a *guerre de course* mission was in place. Part of the improvement included the development of a useful periscope capable of helping to protect the submarine and an essential tool for locating its targets.

The submarine accomplished much during World War II; with the nuclear submarine in the decades following World War II, submarine utilization broadened to include submarines designed for attack, deterrence, and intelligence. Multipurpose periscopes beyond optics tailored for the missions provided challenges at that time and now for periscope designers and engineers. During the

entire 20th Century, the periscope changed, but was always a key to meeting the mission needs of the submarine.

Introduction

The concept of seeing around corners with two mirrors, each mounted at the ends of a tube, predated by years the somewhat still primitive but more sophisticated optical submarine periscopes that became a routine part of all submarines by World War I.

Today, it is difficult to imagine a submarine without two periscopes. However, John Holland's successful HOLLAND VI, the first practical submarine delivered to the United States Navy in April 1900 lacked a periscope. Even though elementary periscopes were extant when the 53 foot HOLLAND VI was under construction, Holland was not inclined to include a periscope in the design.

Holland's preferred way of sighting was to porpoise the submarine and note the location of the target through 3-inch by 3/4-inch plate-glass viewing ports located around the top of the turret with its 24 inch diameter hatch.[1] His technique of broaching, sighting the target, and then submerging like a porpoise, in lieu of a periscope for visibility and target sighting did not enhance the submarine's stealth. Several years later, improvements using prisms, lenses and other enhancements brought an improved periscope capability far beyond techniques that had been used such as the *camera Lucida*[2]. While improvements have been made, the basic principle (the reflection of objects through mirrors or prisms arranged in a tube) prevailed in the 20th century. Periscopes were a necessary addition. Without a periscope, even at shallow depths the submarine was running blind underwater.

The evolution of how to build a practical submarine took many years. The advent of the more practical HOLLAND VI in 1900 and the ensuing spurt in submarine construction established the need for submarine operators to know what surrounded them up on the surface but at the same time not to be seen. The optical solution was the only one available. Bringing the optical tube into the pressure hull raised overall submarine design questions as well as optical engineering issues in adapting to the submarine and its

environment. The periscope tube penetration of the pressure hull and the attendant potential for water leakage provided persistent engineering demands. During the entire 20th Century, periscope-engineering goals were always present.

Origins

By the beginning of the 19th century, scientists and inventors were using mirrors and prisms to maneuver images for viewing. Yet only towards the end of the century did a submarine application for these techniques come into prominence. The 1880s saw Holland diligently moving his designs towards his ultimate submarine. In 1881, 1883, and 1885, three submarine launchings represented Holland's efforts without periscopes. At the same time, other submarine inventors and builders such as Claude Goubet in France, Thorsten Nordenfeldt in Sweden, and Stefan Drzewiecki in St. Petersburg, Russia were similarly investigating, building and selling submarines with periscope capability.

The March 16, 1916 issue of the *Scientific American* cast light on the origin of the periscope.

"Who invented the Periscope?

To the editor of the Scientific American:

It is stated by some writers that the periscope, the eye of the submarine, was invented by the French. The first device of this kind to be used in naval warfare was invented by Thomas Doughty in 1864. He was at that time Acting Chief Engineer in the U. S. Navy. During Banks's Red River expedition Doughty was on the turreted monitor OSAGE. The gunboats were annoyed by bushwhackers and Confederate cavalry picking off their men. Doughty rigged up a sheet iron tube extending from a few feet above the deck to the engine room below, with opening near the top and bottom, and by arrangement of mirrors he could see on shore. When attacked, he would signal the gunners to turn loose, and the enemy soon learned to give OSAGE a wide berth. He little

realized that his invention would be utilized in the world's greatest war...He distinguished himself in the Red River expedition and subsequently was at Mobile. He was one of the old-time, resourceful engineers of the Mississippi River and after the war he resumed his profession. He died in St. Louis in 1896.

W. R. Hodges
St. Louis, Mo"

A contrary view to U.S. Navy engineer Doughty's 1864 Civil War periscope appeared in the Professional Notes of the Naval Institute *Proceedings* in 1914. "The development of the Submarine Boat Periscope—As an historical fact it has been set forth that a submarine boat sight tube was invented in France by Marie Davy" in 1854. Prisms as a substitute for mirrors in a periscope were reported as early as 1872.

In 1877, during the Russo-Turkish War, Drzewiecki made trials with a submarine using a propeller and equipped with periscope towers. This Polish inventor and scientist is credited with being the first to use an optical tube, the forerunner of the modern periscope. The French 118-foot submarine MORSE included a periscope in 1899.

1900-World War I

Submarine construction flourished and in the United States, the Electric Boat Company laid down the keels for five Holland VI type submarines in the fall of 1900 and two more in 1901. In Great Britain between 1902 and 1905, Vickers Sons and Maxim constructed thirteen Holland-type submarines under Electric Boat Company patent leasing. As the first British submarine (A1), was being built, secrecy was part of the scene. British Navy personnel assigned to the submarine were designated as "for special service."[3] The actual construction was clandestine and took place undercover in a "yacht shed". The word submarine was avoided because of secrecy. Stealth as a unique attribute of submarines may have been the reason, but submarines and the word secret often go together.

Captain Reginald Bacon RN, the first Inspecting Captain of

Submarines and head of the embryonic British Submarine Service, saw the need for a periscope. Because of Captain Bacon's interest, Sir Howard Grubb, a well-known Irish scientist, authority on optics, and telescope manufacturer, was asked to design a periscope. Grubb's first United States periscope patent in 1901 was followed with a second United States patent in 1903 with a modification to include the use of relay optics for a wide field of view.[4]

Initially the British A1[5] and A3 were fitted with short periscopes. Later, Captain Bacon as a passenger on board a periscope-equipped submarine took over command during an exercise and in the excitement of a pursuit encountered a **low bridge** with the **periscope** up. Only the periscope was damaged. Five of the first seven A1 British submarines were eventually equipped with the Grubb-designed periscope.

In February 1902, the Royal Navy cabled Isaac Rice (President of Electric Boat) "Course can be accurately kept by Sir Howard Grubb's periscope." It has been noted that Frank Cable of Electric Boat, in England at the time, brought back the idea of a periscope to the United States.[6] The United States submarine SS5 (MOCCASIN) commissioned in 1903 was periscope equipped. Five of the seven initial Electric Boat submarines were equipped with periscopes. For more than fifty years, the periscope was the submarine's only visual aid. In the late 1950s, a low light television was installed for under ice operations aboard the nuclear-powered submarine USS SKATE (SSN 578).

The Professional Notes section of the Naval Institute *Proceedings* for June 1902, disclosed "Recent reports that a new periscope permits a submarine to survey the surface from a depth of 50 feet, while formerly to a depth of 20 feet. The new periscope is telescopic." The rapid increase in the numbers of submarines may be noted in a further comment in the *Proceedings* stating that the French government ordered the construction of 13 additional submarines.

FULTON, an experimental submarine launched June 12, 1902 by the Electric Boat Company, was eventually sold to Russia. It was intimated that its periscope was useless with the submarine at 20 feet.[7] In the early days, British periscopes were stored on deck

in a horizontal position. To operate the periscope, the submarine had to be on the surface; the periscope raised and secured by stays to hold it in position before diving. In the lowered position, the periscope head was sleeved in canvas. Retractable periscope masts appeared later.

Simon Lake, a Connecticut submarine inventor and builder from the Bridgeport area, constructed his first sophisticated submarine, PROTECTOR, in 1902. The 65 foot 130-ton submarine included a Lake periscope patented in 1903 called the *omniscope*. With its series of lenses and prisms, it allowed the entire horizon to be viewed plus an estimate of the range to a target. Lake was the first to use a rotating periscope on a submarine. An improvement on his periscope was patented the same year and called Combined Ventilating and Observing Tube. (The ventilation concept could be considered a precursor to the German schnorkel[8] developed in the1940s.)

The U. S. Navy tested Lake's periscope in 1902-03; comparing it with Grubb's British designs; and it became U.S. Navy's favored design.[9] Lake offered PROTECTOR to the United States Navy. The Navy hesitated: Russia, then at war with Japan, purchased PROTECTOR from Lake and ordered five more submarines from him. Later, during World War I, Lake built submarines for foreign nations as well as for the United States Navy.

ADDER, the second A class submarine built by Electric Boat Company and commissioned in 1903, conducted a submerged periscope trial. The periscope was rigged through the forward port ventilator. This allowed the submarine to run for three hours at a depth of 11 feet with the conning tower 7-1/2 feet below the surface of the water.

The advantage of two periscopes soon became apparent: one with larger optics designed for broad area search, with smaller optics in the second periscope optimized for attack. For example, one of the Japanese Holland-type submarines launched in 1905 was equipped with a second periscope. In the 1906, the United States Navy contracted for three submarines, each equipped with two periscopes.

Water leakage and vibration were two long-term periscope-

engineering problems. The leakage caused image fogging and improved periscope joints and desiccation techniques provided mitigation. Vibration degraded the performance of the optics. These deficiencies were addressed and relieved as periscopes evolved.

An abundance of names for underwater viewing instruments confronted users through the years. Names for these early periscopes included Hydroscopes, Omniscopes, Storoscopes, Cleptoscopios, Altiscopes, and Eleptoscopes. The names optic tube and periscope persisted. From 1901-1907, as many as thirteen United States patents were awarded for submarine periscopes and their improvement. Two periscope inventors patented 360° or panoramic presentation to the user. Early periscopes, even with targets presented upside down when astern and standing on their ends abeam, still allowed users to judge relative bearings.

By the first decade of the 20th Century, submarines were increased in length and diameter. The tonnage expanded from HOLLAND's 63 tons to 160 tons with a larger crew; 2 officers and 9 men instead of HOLLAND VI's crew of 7. The length increased from 53 to 105 feet. The length made room for a conning tower six feet above the deck, providing an improved position for navigating on the surface. The conning tower also afforded a much better housing for the periscope, now recognized as a vital part of the submarine. In some submarines having the eyepiece of the periscope located in the conning tower instead of the control room, an additional ten feet of periscope height and thus greater observation range was achieved.

It should not be inferred that periscope development or the melding of the periscope with the submarine platform was anywhere near a *fait accompli* at this time. Finding solutions to engineering problems proved difficult as a result of the periscope's operating in a troublesome salt water environment that included mechanical stresses from movement through the water, changes in temperature, and impact on the periscope and its optical system by water wave action. Water leakage at the seal between the pressure hull and the periscope tube was a constant problem. The wake or feather made by the periscope tube at the water's surface could give away the submarine's presence. In 1910, under the aegis of the

Anti-submarine Warfare Committee recognizing this weakness sponsored experimental machine gun firings at periscopes as a way to counter enemy submarines.[10] Long-term engineering addressed minimizing the periscope's wake and visibility (optical and later radar).

The long periscope tubes moving through the water vibrated and degraded the images, requiring a reduction in the speed of the submarine. This challenged submarine periscope system designers. Periscope vibration also originated from the submarine itself. It should be noted that during World War II, German U-boats were sometimes limited to speeds of less than five knots when attacking an enemy because of the effect of vibration on optical sighting.[11] For this reason, many attacks were conducted on the surface. The mechanical requirements presented by simply the raising, lowering and positioning of the periscope were enormous and required years for refinement.

Another significant aspect in this evolution relates to the submarine adapting to the operational needs of the periscope. Maintaining the periscope at a nearly constant position with respect to the height of the periscope head above the surface of the water was a formidable task for the evolving submarine. Addressing these requirements became an ongoing quest for both the Navy and those involved in the engineering and manufacture of periscopes and the design of the submarines. Some of the solutions were immediate while others awaited continuing technological advances in the years ahead.

While sighting with the periscope, particularly at low speeds, it was essential to keep the periscope at a fixed height above the water's surface. Holding the submarine steady within one or two feet made for difficult handling. Torpedoes also prompted submarine handling improvements. The potential for broaching and veering as the torpedo exited the submarine emphasized the need for improved handling. Later, this need for improved handling was addressed when bow planes were added to ease depth keeping and broaching. The United States E-Class submarine launched in 1912 included horizontal bow rudders or bow planes to enhance depth keeping.

Early pre-World War I periscopes typically were fixed height and mounted in a fixed-ahead position. This required the submarine to porpoise to bring the periscope head above the surface. The fixed-ahead required the submarine to change course to look in another direction. Periscopes, which could partially extend and contract into the hull, were an improvement.

Beginning with USS SEAL commissioned in 1912, Simon Lake constructed 28 submarines for the Navy during the period 1910 to 1923. Simon Lake was the only competitor of John Holland and is credited with design aspects of the modern submarine including escape trunk, conning tower, diving planes, control room, and **rotating and retractable periscope.**

By 1912, simple periscopes and the gyroscopic compass simplified submarine navigation. About this time, retractable cable-controlled periscopes were being introduced in some submarines such as the D-Class. Optics needed improvement and lenses required frequent desiccation to prevent fogging. The new submarines were designed to keep up with the fleet, and the periscope had to be long enough to see from 30 feet below the surface.[12]

World War I Begins

As mentioned above, at the start of World War I in August 1914, there were 400 submarines in 16 of the world's navies. Innovations and improvements abounded and effective submarine use as an offensive weapon was slowly beginning to be recognized. By 1914, submarine speed was about 14 knots on the surface and 9 knots submerged. The submarine's stealth, improving agility, and better Whitehead, Bliss-Leavitt, and other torpedoes plus the periscope contributed to greater acceptance of the submarine as an implement of war. Total acceptance of the submarine was gradual for other reasons. The submarine, not in the capital ship class, was considered as the weapon of the weaker nation; its full potential was not universally grasped.

Acoustic sensing at this time was in a primitive stage of development during World War I; this proved to be a two-edged sword. The submerged submarine's presence was not as likely to

be determined by the searching enemy. Antisubmarine warfare, including weapons such as depth charges to destroy enemy submarines, was in a rudimentary stage. On the other hand, without an acoustic sensing capability, the submarine submerged was deaf and blind when operating below periscope depth. The propellers of nearby surface ships could sometimes be heard in the submarine.

The submarine was handicapped at periscope depth; the distance to the horizon for sighting targets was minimal because of the periscope closeness to the surface of the water. Even surfaced with a raised periscope, the submarine's range of vision in clear weather was less than the range of vision of an enemy target or submarine hunting surface ship much higher above the surface. A 1915 book on submarines noted that a periscope 20 feet above the water could observe a battleship at 10,000 yards and 2,200 yards at 1 foot. Submarine-hunting aircraft with their ability quickly to search wide areas of ocean were soon recognized as an additional liability for submarines on both sides.

Longer periscopes allow the submarine to observe at a greater depth but introduced other problems. In addition to increased water pressure, a longer optical tube is more prone to vibration from water action. Increased length causes image dimming due to the greater optical length. The September 2, 1914 issue of the *Scientific American* reported treating lenses with magnesium fluoride to reduce dimming. Increasing submarine diameter accommodated longer periscopes, increasing height of the upper periscope lens above sea level. This lengthened the distance to the horizon, although not significantly.

Antisubmarine hunting aircraft benefitted greatly due to their height of observation and the distance to the horizon. During World War I, an aircraft at 5000 feet could sweep an area of about 300 miles. This improved; and in World War II, aircraft were responsible for more than half of the 800 U-boat sinkings. The aircraft is assisted further by the wake created by the periscope head as it moves through the surface of the water. Wake reduction was eventually achieved by narrowing the upper portion of the periscope tube to have a pencil-like shape. Periscope heads with

dimensions a few inches or less were achieved in some instances. U-boats by 1918 were generally able to look for aircraft in the area before surfacing. In the latter part of World War I, convoys accompanied by aircraft were virtually immune from U-boats.

Dr. Frederick Kollmorgen

Born in Germany in 1871, following university studies, Dr. Kollmorgen directed his career to optical instrumentation and lens development. Before coming to the United States in 1905 to work at the Keufel and Esser Company in New Jersey, he held positions as an optical advisor with telescope manufacturers in Austria and England. In 1909, he made application for his first submarine periscope patent which was granted October 11, 1911. These basic optical elements and mechanical structural designs pioneered by Kollmorgen continued in use throughout the 20th century.

In 1916, when World War I stopped imports of foreign lenses and optical instruments, Kollmorgen headed a small group of scientists and technicians that formed the Kollmorgen Optical Corporation in Brooklyn, New York. Their purpose was to design and build periscopes for the expanding submarine service of the United States Navy. For the remainder of the 20th 20th century, the Kollmorgen name has been associated with numerous state-of-the-art U.S. Navy submarine periscopes and those of other navies.

A recollection by George Carroll Dyer (Vice Admiral, USN, retired) is of interest. In 1919, Dyer was the Commanding Officer of a Holland designed D-class submarine.[13] The Electric Boat Company (EBCO) constructed the three D-class submarines in 1909-1910. D-class improvements cited by EBCO included having two periscopes. Dyer recalls operating with a fixed position periscope:

> "The D-3 had a fixed periscope, which meant that you had to be on an absolute level in order to really make a decent approach on a target. Because if it got the least bit angled down by the stern, which the D-3 was very apt to do, you couldn't see anything except the sky. Because the periscope

was fixed. It was the last class of submarines that had the fixed periscope. All the rest had eyepieces that could be elevated or depressed. If the submarine got a little angled down, you turned the glass up."[14]

Scientific American Supplement No. 2055, May 25, 1915 in "Various Forms of the Periscope" reported on the principles and development of a valuable instrument used in war. The section on submarine periscopes provides a summary of the state of the art at that time.

The general characteristics point out that modern periscopes (1915) have a length of from 16 to 24 feet, and a diameter of 6 to 9 inches, field of view of about 65 degrees and a magnification of 1.25 to 1.5. The optical system can be rotated to face in any required direction and the eyepiece remains fixed.

The article included components of the periscopes built by Sir Howard Grubb, the primary provider for the British Navy:

1. A reversed telescope, giving a reduction of about 0.25
2. A telescope giving a magnification of about 2.0
3. An erecting prism which can be rotated so that the image given by the system is correctly oriented
4. A telescope giving a magnification of 3.0

The two telescopes (1 and 2) were face to face, first reducing the image and then enlarging it. The last telescope (4) included a fixed eyepiece and prism, so arranged that the observer looks horizontally at the object. At the focus of the eyepiece are placed a scale and pointer to show the bearing of the object sighted and a ruling to allow the distance to be estimated when the size of the object is known.

Periscope advances included photography. In 1915 between May and December, a British E class submarine (Holland design), using a periscope equipped with a camera in the Sea of Marmora, penetrated Constantinople harbor and took photographs.

Periscope Status 1917

A 1917 book by Marley F. Hay, *"Secrets of the Submarine"*,

summarizes the periscope and some its characteristics at that time. The author credits French submarines with having periscopes 50 years previously (1867). He generalizes that all submarines have two periscopes and some three. Vertical observation of aircraft is the primary use of the third. With diameters of six inches most scopes can be set at 18 or 20 feet above the superstructure deck with the top of the scope 3 or 4 feet above the surface of the water in a moderate sea. The top five or six feet are tapered down to two or three inches in diameter and painted in mottled colors to obscure the periscope. In some instances, a dummy seagull is mounted on top to provide further camouflage. Periscope viewing arranged in the conning tower and in the control room is typical. Other periscope features include horizon scan with a field of vision of 40° - 60°, a rotating upper prism to provide images in correct positions, and magnifications of the order of 1-4.

Gyroscope Compass

Elmer Sperry's gyroscope compass (patented in 1908) was installed on the submarines E-1 and E-2 commissioned in early 1912. Prior to this invention, only non- ferrous magnetic material could be used for periscope construction. Further, when submerged the magnetic compass did not function well in the steel hull as the magnetic compass was surrounded by electromagnetic fields produced by the electric propulsion motors. The compass was mounted outside the hull and viewed with mirrors or a telescope from the conning tower. In general use of magnetic materials in the vicinity of the compass was minimized where feasible.

Kollmorgen Begins

During the World War I period, Bausch & Lomb, Keuffel and Esser, General Ordnance and the newly founded Kollmorgen Optical Company comprised the sources of U. S. Navy submarine periscopes. The improving submarine platform required periscopes having proper magnification, field of vision, vertical and horizontal movement and other attributes that would optimize the ability of the operator to assess his environment.

Addressing these requirements under a 1916 contract with the Chief of the Department of Construction and Repair, Kollmorgen delivered his two original periscopes (one forward and one aft), to the K-1 (SS-32). The submarine, commissioned in 1914, was 154 feet long, displaced 521 tons, and was one of the twenty U.S. submarines to reach the war zone and report for duty in the Irish Sea and near the Azores. The Navy paid Kollmorgen $1,385 and $1,685 for the periscopes.[15]

Periscope Disguise

In November 1917, the War Department received a recommendation from a lawyer in Oakland, California, with a suggestion to make the periscope above the water less conspicuous: Disguise the periscope with a decoy of a bird with a glass breast and wings movable by springs. Additional decoys of birds native to the geographical area could provide and make the periscope-mounted decoy a less likely target.

Periscope Assessment

That periscopes were yet to be perfected can be seen in an accounting of periscope problems faced by the fleet of 27 R-Class boats constructed during World War I. Problems included poor focus, lack of eye cushions on the ocular or eyepieces, low power, air bubbles and moisture leaks into the inner tube, lens scratches, leaks, missing screws, and hydro-dynamically induced vibration at normal submerged speeds.[16]

War Reparations: U-boats

At the end of WWI, six German U-boats were made available to the US Navy at Harwich, England, as part of war reparations. They were brought back to the United States. The Navy's operational forces carefully examined the U-boats' capabilities. As a result, the following years were sometimes referred to as the *German Years*. These German submarines influenced the designs

of new United States submarines into the 1930s. The Chief of Naval Operations (CNO) created a list of private contractors and subcontractors who were allowed to examine the technological advances presented by the U-boats. Kollmorgen, by 1920 an important periscope builder, was included in this CNO list of companies allowed to go aboard and examine the German advances in submarine design and construction.

Between the Wars

In the 1920s, the aforementioned Navy examination of German submarines strongly confirmed the potential for improvement in United States submarine design and construction. Additionally with the experience of building more then 70 submarines during the World War I period, the Navy perceived a need to control the contractors. To achieve this, the Navy began an expanded and more direct role concerning submarines and their procurement. The goal of improving the quality of the United States submarine diesel engines, radio communication capability, periscopes, armament, habitability, and other factors led the Navy to take this step. The contractor, not the Navy, drove submarine technology at this time. Acting in the new role of coordinator and catalyst for the first time, Kollmorgen, Sperry Gyroscope Company, Electric Boat Company, and others were supported by the Navy to advance submarine technology.

For the following fifteen years, an ongoing debate regarding the mission of the submarine continued, hampering a consensus regarding the Navy's submarine needs. The mission choices debated included coastal defense, battle-fleet support, fleet independent operations using stealth to advantage, independent offensive operation, and unrestricted warfare policy. This indecisiveness defining the submarine's role led to a variety of submarine designs. The mid-1930s fleet submarine configuration prevailed for the duration of World War II and accommodated the role of unrestricted warfare. This fleet boat design emulated the successful U-boats and warfare of Germany's World War II *course de guerre*. German submarine designs such as the U-135, one of the World War I reparation submarines, provided a reliable prototype for

submarine design.

These years saw the Navy more actively and broadly participating in the design and engineering of submarines. Moving away from dependence on commercial submarine builders, the Portsmouth Navy Yard became an important center for submarine engineering development and construction.[17] Between the years 1914-1971, 134 submarines were constructed at Portsmouth. It has been stated that in the pre-nuclear era, more submarines were built at Portsmouth than any other yard. By the mid-1930s, Mare Island Naval Shipyard in California was added to the Navy's active submarine building program.

In related technical fields, radio communications, underwater sound, and periscopes (Kollmorgen) were given Navy support and encouragement. Advances in these technical areas took place during this period at government, industrial and university locations.[18] With Navy assistance, Kollmorgen's financial and management practices were improved and their periscopes were widely installed.

German U-boat periscopes were found to be superior to those found on British or American submarines. For example, the periscope heads tapered to less than inch in diameter and provided a reduced and more difficult target at sea level. It was clear that American optics needed upgrading. Improvements followed, but the quality of the 1918 German U-boat periscope still exceeded that of United States periscopes. Quality United States periscopes were available by the late 1930s.

Barr and Stroud Ltd. of Glasgow, Scotland, periscope builders, discussed in their 1922 pamphlet "The Submarine Periscope", the technical aspects of their state-of-the-art periscopes which consisted of cruising or lookout (surveying the horizon), attack (conning to the target), and night scopes. The article pointed out the light loss in a periscope amounting to as much as 31percent due to the optics.[19] Sky search capability, desiccating apparatus, pressure capability (of the order of 100 pounds per square inch), a range and inclination finder, and velocity of a target were cited as features of importance for submarine periscopes.

The March 1927 issue of the Naval Institute *Proceedings* cited a Japanese periscope development. Trials aboard the Japanese

submarine B-16 included satisfactory testing of a periscope enlarging six diameters, which made it possible to see correctly as high up as 1,000 meters.

Bureau of Construction and Repair (BCR)

Charged with ship construction, including periscopes, Bureau personnel responsible for periscopes were sometimes perceived as reticent in regard to change. A 1983 book on submarines commented on the BCR"...and they fought change every step of the way... That change came at all was through the pushing tactics of the young submarine commanders—who had to live with the product."[20]

In the post World War I period, the BCR moved toward the standardization of type and design of periscopes. The goal was to improve periscope replacement and parts supply. Previous to 1927, contracts for submarines covered the entire boat, installation and equipment. As a result, there were 70 different periscopes, all similar with the same essential features. This precluded interchangeability and made replacement and parts supply difficult. As a step toward resolving this difficulty, a Manual of Instructions for Submarine Periscopes was issued. The manual included detailed drawings and specifications from four manufacturers.

U.S. Navy Periscope Builders 1927[21]

Company	Periscopes in the Fleet
Bausch & Lomb Optical Co. New York, NY	80
Kevin, Bottomly & Baird Glasgow, Scotland	10
Keuffel & Esser Co. New York, NY	50
Kollmorgen Optical Co. Brooklyn, NY	136

United States submarines increased in length and beam beginning in the mid-1920s to 1930s.

Class	Length	Beam	Year
Barracuda	341 feet	27 feet 7 inches	1924
Argonaut	381 feet	33 feet 10 inches	1928
Narwhal	371 feet	33 feet 3 inches	1930
Dolphin	319 feet	27 feet 11 inches	1932
Cachalot	271 feet	24 feet 9 inches	1933

Periscope Length[22]

1916	10-20 feet
1945	30 feet
1960	30-40 feet
1990	46 feet

Typically 40 or 50 feet longer with greater beam than earlier submarines, the new dimensions made it possible to have longer periscopes. The longer periscope tubes required greater rigidity to prevent excessive vibration causing poor images and possible damage to the optics. At that time, existing tubes were constructed of brass, naval bronze, or composites, and low speed was required to reduce vibration. German periscope tubes constructed of steel were found to be more rigid, less susceptible to vibration problems and had experienced little corrosive action due to seawater. Steel became the material of choice for periscope tubes by many of the world's navies. Periscope bending due to movement through the water was countered by using two tubes: an outer one to resist pressure and an inner to contain the telescopic components.

Periscope Stadimeter

A stadimeter is a device for determining the range to an object of known height. Measuring the angle between the horizon and top of the object (usually the masthead) whose height is generally known provides a basis for the range calculation. The range is independent of the angle of that target to the submarine. By mid-1928, the Navy was evaluating stadimeters. One was a United States Naval Gun Factory type Mark V stadimeter with a range of 8000 yards. The other, made in Jena, Germany by the Carl Zeiss Company, had a range of 11,000 yards and was of particular interest. Models were placed aboard the three V-Class submarines for evaluation. The 1930s saw periscopes equipped with stadimeters. In addition to its use in fire control, the stadimeter became useful in both piloting and navigation via the periscope.

Three Periscopes

The mine-laying 381 foot USS ARGONAUT (SS 166), commissioned in 1928 at Portsmouth, was the largest submarine built by the United States until after World War II. It was equipped with three periscopes. Two were raised and lowered by cable hoists, the eyepiece of one in the conning tower and one in the control room. To reduce vibration, the upper periscope was equipped with a streamlined retractable section (fairing). The other scope in the conning tower was raised and lowered hydraulically. Later, it was determined that this periscope was not needed and it was removed.

Through the years, two persistent periscope problems confronted engineers. Previously mentioned, one was vibration of the scope tube as it passed through the water. The other was related to the exposed periscope head and the wake or plume of the above-water portion of the periscope as a target. The former was addressed by providing a fairing to streamline the part of the tube exposed to the water. A fairing may reduce vibration at speeds of 6-7 knots or higher. Decreasing the target size was addressed by tapering the upper section of the tube and minimizing the size of the head to reduce the observed wake of the above-water portion of the

periscope. Camouflaging the exposed section was also implemented.■

ENDNOTES

1. Holland's *Fenian Ram*, launched in 1881, also had viewing ports.
2. An 19th century prismatic device that projects an image of an object on a plane surface for tracing.
3. Richard Compton-Hall, *Submarine Boats: The Beginnings of Underwater Warfare*, Arco Publishing, NY, 1984 (p. 1-3).
4. "Notes on Submarine Periscopes," William J. Rowan, Navigation, Spring 1967, Vol. 14, No. 2., p. 8.
5. The periscope on the submarine A1 was non-rotatable. When the A1 was lost in 1904 with all hands due to a collision with SS BERWICK CASTLE, the non-rotatable periscope may have been the cause.
6. Compton-Hall, *op.cit.*, 1984.
7. Jeffrey L. Rodengen, *The Legend of Electric Boat*, 1994, p. 49.
8. Rowan, *op.cit.*, 1967. P. 7.
9. Both Simon Lake and Sir Howard Grubb were developing periscopes in 1902 and the Navy attributes the invention to both men. However, it was during World War I that Grubb, while responding to the demand for periscopes, brought the design closer to perfection.
10. Brayton Harris, *The Navy Times Book of Submarines*, Berkley Books, 1997, p. 158.
11. Michael Gannon, *Operation Drumbeat*, Harper & Rowe Publishers, New York, 1990, p. 42.
12. Alden, John D., *The Fleet Submarines in the U.S. Navy*, Naval Institute Press, 1979, p. 4.
13. The British version of the D class approved in 1906 were the first to be diesel driven and fitted with a gun.
14. U.S. Naval Institute, Oral History Collections.
15. *The Submarine Periscope 1916-1991*, Kollmorgen Corporation, Northampton, MA, (no date), p. 6.

16. Periscope comments from *Building American Submarines, 1914-1940*, Gary E. Weir, Naval Historical Center, Department of the Navy, Washington DC, 1991, p. 77.
17. Richard E. Winslow II, *Portsmouth Built: Submarines of the Portsmouth Naval Shipyard*, Portsmouth Marine Society Publication Six, published by Peter E. Randall Publisher, 1985.
18. Gary E. Weir, "Silent Defense 1900-1940", Undersea Warfare/Summer 1999, p. 14.
19. The light loss in a single polished lens can be about 4 percent. Some coatings may reduce the loss to -1/2 percent to -1/4 percent. Without coatings only 5 percent of the available light would reach the eyepiece.
20. Edwin P. Hoyt, *Submarines at War: History of the American Silent Service*, Stein and Day, NY, 1983, p. 68.
21. These periscopes were raised and lowered using cable hoists and motors. In mid-1944, SPIKEFISH (SS 404) was the first to be fitted with hydraulic periscope hoists.
22. Operating in shallow water with a long periscope can be a challenge.

REUNIONS

USS BECUNA (SS 319) New London, CT September 22-24, 2002. Contact: Dick Geiler, 28 Billings Lake Rd., North Stonington, CT 06359. Phone: (860) 889-2846; e-mail mrgitch@aol.com

USS BUMPER (SS 333) Association August 28-31, 2002,Buffalo, NY. Contact: Edward W. Stone, Secretary, 308 Merritt Ave., Syracuse, NY 13207-2713. Phone: (315) 469-3825; e-mail ews_w2eer@juno.com.

USS U.S. GRANT (SSBN 631) New London, CT September 13-15, 2002. Contact: Michael Arterburn, 210 Marywood Avenue, Claremont, CA 91711. Phone: (800) 350-5445; fax (909) 621-0966; e-mail SubManSSBN631@aol.com.

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RECOLLECTIONS OF A MAVERICK

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

Dr. George Sviatov, naval architect with Ph.D.s in designing of ships and defense history, is an independent analyst in Bethesda, Maryland.

Ten minutes before 9 AM on January 15, 1965 a Captain 3rd Rank of the Soviet Navy came up to the Moscow Kremlin's permits bureau. He had an appointment with the First Deputy of the Soviet Prime Minister Dmitry Fedorovitch Ustinov. "Have you a gun with you?", he was asked at the permit bureau. "No", he answered.

Exactly at 9 AM that officer approached the office of the First Deputy of the Prime Minister. It was not a big office. In its entrance room there were two secretaries—a man and a woman. "Dmitry Fedorovitch is waiting for you", says the man. "Come in."

The officer was me, Georgy Ivanovitch Sviatov, then a senior research fellow of the Central Institute of Military-Technological Information of the Soviet Armed Forces General Staff in Moscow, came in to the study. Dmitry Fedorovitch was sitting at his desk. He stood up, shook my hand and sat down at the adjacent table, and invited me to sit down face to face with him.

First, he asked, "What do you think about our new Project 667A ballistic missile nuclear submarine?" I said that recently I had visited the Severodvinsk shipyard, had seen the leading ship in the Assembly shop, and by my assessment she is the best product of the Soviet design and shipbuilding community.

Then he told me, "Well, what do you like to report to me?"

I understood that I should deliver my message to him in a time span not more than 15 minutes. In these minutes I had to present the most important information which was the result of my five years of independent *maverick* research on a comparative analyses of Soviet and American nuclear submarine development, and some recommendations for the native shipbuilding.

My response was, "Dmitry Fedorovitch, for 10 years I worked as a naval architect, a Navy supervisor at the Severodvinsk shipyard and as a research fellow at the Leningrad's Central Navy Research Institute, building and preliminary designing of Soviet nuclear submarines. I was the first junior Navy supervisor on the first Soviet Project 627A nuclear attack submarine and on the first Soviet Project 611V diesel ballistic missile submarine, built and tested Soviet Project 658 nuclear ballistic missile submarine, Project 627A nuclear attack subs, and Projects 659 and 675 long range cruise missile nuclear submarines, and participated in preliminary designing of Project 671 next generation nuclear attack submarine, super new Project 661 nuclear extremely fast attack titanium submarine with new Amethyst short range cruise missiles, and Project 667A ballistic missile nuclear submarine with 16 new missiles. And in 1960-61 in the Central Navy Military Shipbuilding Research Institute I had accomplished an intelligence research. I collected relevant classified and open information and redesigned the best American attack and ballistic missile nuclear submarines: SKIPJACK and THRESHER, GEORGE WASHINGTON, and ETHAN ALLEN classes. So, I am a person who knows better than anybody else about the Soviet and American nuclear submarines combined. As a result, in 1962 I delivered my above mentioned report (117 printed pages) and lectured at the Scientific-Technological Committee of the Main Navy Staff.

In the attachment to that report I presented preliminary blueprints on my visions of the future SSN and SSBN Soviet nuclear submarines on the base of Skipjack-Thresher, Projects 671 and 661 nuclear attack submarines, and of George Washington-Ethan Allen, Project 667A nuclear ballistic missile submarines.

My major new naval architectural ideas were for a drastic reduction of categories and classes of Soviet nuclear submarines, using only steel as hull material, use of improved existing water-water nuclear reactors with 17,500 hp, and use of the Thresher type scheme of sonar and torpedo tubes arrangement. In addition, I recommended a two reactors-two turbines-two propellers power plant with elimination of reserve electric motors. My plan used a longitudinal bulkhead in two power plant compartments and 20 percent buoyancy reserve for providing surface and underwater

dynamic unsinkability of a submarine with almost any one compartment flooded .

My attack sub had to have a length of some 80 meters, a maximum pressure hull diameter of 9 meters, a speed of 36 knots, and a test depth of 500 meters. Six bow and two stern 533-mm torpedo tubes with 32 torpedoes and missiles as armament, and her surface displacement has to be some 3000 tons. My SSBN sub had to have the same principle naval architectural characteristics with a speed of some 30 knots, a surface displacement of some 6000 tons, a length of some 120 meters, and 16 strategic ballistic nuclear missiles in a 40 meters long cylindrical compartment."

In conclusion I stressed the economic issues of cost-effectiveness of the Soviet program of nuclear submarines building.

I told Ustinov, "Dmitry Fedorovitch, Americans are building approximately 100 nuclear attack and 50 nuclear ballistic missiles submarines. Let us assume that an attack submarine cost is some $50 million and a ballistic missile submarine $100 million. That is $10 billion. Let us add $5 billion for their basing infrastructure. In sum $15 billion. They are building only two categories: attack and ballistic missiles subs and only two classes: THRESHER and ETHAN ALLEN, with only one architectural scheme and one type nuclear power plant of 15,000 hp. That is the highest possible degree of standardization and unification.

We are building four categories: torpedo attack (Projects 627A and 671), torpedo and short range missile attack (Projects 661 and 670), ballistic missile strategic submarines (Projects 658 and 667A), and long range cruise antiland and antiship missiles (Projects 659 and 675) nuclear submarines. Plus we continue building much less effective diesel ballistic missile (Project 629) and torpedo (Project 641) subs. *(Editor's Note: The Project number to NATO designation correlation is as follows: 627A-November; 671-Victor I; 661-Papa; 670A-Charlie I; 658-Hotel; 667A-Yankee; 659-Echo I; 675-Echo II; 629-Golf; 641-Foxtrot.)*

Our serial Project 627A sub costs some 12 million rubles. A comparable American serial Skipjack class sub costs some $60 million—five times cheaper in comparison of dollars and rubles (the difference is in levels of salaries).

So, if we would have the American level of standardization and unification, we should need for our similar program some 3 billion rubles. If we continue our current policy of nuclear submarines building, we should have spent at least twice more money—some 6 billion rubles."

On that point I had finished my report.

Ustinov listened to me attentively. Then he said: Well, we are trying to choose the best projects. Are you suggesting we copy the American nuclear submarine building program?"

"No", I answered. "Only their attitude to standardization and unification and some of their best naval architectural decisions, especially ALBACORE type hull form for an attack submarine and THRESHER's scheme of sonar and torpedo tubes arrangement. I am against reduction of buoyancy reserve from 30 to 15 percent, one reactor power plant, one propeller and reduction of surface unsinkability degree. I am for transfer placement of two reactors and for a longitudinal bulkhead in two engineering compartments. My nuclear attack sub must have six compartments (1-bow sonar equipment, storage battery and living; 2-bow torpedoes and living; 3-control room and living; 4-reactors, turbogenerators and auxiliary mechanisms; 5-turbines and reduction gears; 6-stern torpedoes, rudders and planes equipment) and 14 ring like ballast tanks with kingstones (12 in area of the 6 compartments and two in bow and stern). So, my sub will have guaranteed surface unsinkability with any one flooded compartment and underwater dynamic unsinkability with flooding in the first, second, six and a half of fourth and fifth compartments. That would be a revolutionary jump in submarine naval architecture. In essence such a submarine will have a possibility to sail underwater with one flooded compartment in battle conditions. By the way, Americans made such a jump in the TRITON class nuclear submarine, but their naval architects implemented a correct but too simplistic approach copying naval architecture of surface ships."

"Well", said Dmitry Fedorovitch, "go to the Chairman of the Council of Minister's Military-Industrial Commission Titov and tell him that I ordered you to organize your report for the Shipbuilding Minister Boris Evstafievich Butoma".

I went immediately to Mr. Titov. He asked me how I had

reached Ustinov. He also said that recently Commander in Chief of the Soviet Navy Fleet Admiral Gorshkov approved the 12 year Soviet Navy's shipbuilding program. Then he asked me where I was working. I told him that my superiors were at the Scientific-Technological Committee of the General Staff. He recommended me to report first to the naval experts of that body. I agreed and did so to Rear Admiral Zenkin. But that body and that person were absolutely insignificant in decision making.

It was a victory. I felt that Ustinov's impression of me was positive. I had to push up, using Ustinov as a step.

But it meant that in a case of my successful report to the Shipbuilding Minister, I could probably get a responsible job related to submarines in his ministry. It meant also that I would have to struggle with four design bureaus and a number of civilian and naval chief designers who would fiercely resist reductions of their projects' number. Or I could go to a design bureau in Leningrad to become a designer of my project of a nuclear submarine.

At that time, however, I was an analyst of United States' naval policy in Moscow and had planned my career as a scientist and scholar. I was getting additional money by writing my articles and books about U.S. nuclear submarines (I could not write anything about Soviet submarines).

So I did not demand to present my report to Butoma (to the unexpected pleasure of the shipbuilding bureaucracy). I stopped my maverick's activity, and continued working in my Moscow military research institute. Two years later I became Captain 2nd Rank and defended my first Ph.D. in submarine naval architecture at the Shipbuilding Faculty of the Naval Engineering Academy in Leningrad. It was probably better for me but not for my country. As people say: a winner gets nothing. In principle I am not sorry for such a decision. My nature was much more multifaceted than naval architecture and later I become a head of the military-technological section at the Institute of U.S. and Canada, and Captain 1st Rank. For the first time in my life I visited the USA in 1976 and later I became a Senior Fellow of the Institute of World History of the Soviet Academy of Sciences, and defended my

second Ph.D. in history of United States defense policy since WWII. My English was becoming better and better. I published a book about nuclear submarines and a book about the history of American defense policy. But could it be I lost an opportunity to be a Shipbuilding Minister of the USSR?■

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NAVINT NEWS

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From NAVINT issue 15 September 2001.

Six Nuclear Submarines on Seabed

On 9 August Vice Admiral Mikhail Motsak, in charge of the operations to raise the wreck of KURSK, said that six nuclear submarines are at the bottom of the sea, two American and four Soviet.

According to Motsak, the KURSK tragedy is probably the first event in the history of the [Soviet/Russian] Navy which was made public on the day of the disaster. "Nothing of the kind was possible earlier as nuclear submarine disasters were not made known to the general public", he said. He recalled that details of the accident with S-80 diesel-electric missile-armed submarine (Project 644 or Whiskey Twin Cylinder), the first sunken Soviet submarine to be raised, became known "only many years after it sank...Some details of the tragedy with the S-80 submarine are painfully reminiscent of the KURSK tragedy," said Motsak.

The accident occurred on 27 January 1961, when S-80 was on a combat training mission in the same area of the Barents Sea where KURSK sank many years later. The entire crew of 68 men died in the disaster. Only seven years later, on 23 June 1968, the rescue ship ALTAI found S-80 lying on the rocky seabed at a depth of 196m. As a result of Operation Glubina (Depth), S-80 was raised on 24 July 1969.

According to Vice Admiral Motsak, the S-80 disaster made it possible for the Commander-in-Chief of the Soviet Navy "to secure the allocation of money for the development of...naval rescue resources." The money went to finance the construction of the KARPATY salvage ship, capable of lifting sunken submarines.

Solution to Russian Navy's Submarine Reactor Problems Gets Closer

A U.S. delegation led by Senator Richard Lugar visited the Zvezdochka shipyard and the Severnoye Machine-Building Enterprise in Russia's White Sea Severodvinsk on 26 August to discuss joint programmes for scrapping the Russian Navy's decommissioned nuclear-powered submarines. A Svezdochka spokesman, Alexander Bobretsov, told Itar-Tass that the programmes would be discussed after the U.S. budget for the new fiscal year has been passed.

American delegations have visited Severodvinsk regularly since 1992, when the U.S. and Russia adopted an inter-governmental programme of mutual threat-reduction, part of which includes the scrapping of decommissioned submarines. The U.S. Government has provided Russia with free industrial equipment and with funding for the programmes. An enterprise for recycling liquid radioactive waste from submarines has been set up at Zvezdochka with American assistance, and a base for storing spent nuclear fuel is being built.

Several nuclear powered submarines, formerly serving with the Northern Fleet are being cut up in Severodvinsk at the moment, but there are another 100 awaiting disposal.

News in Brief

Ten children of the Russian submariners who died in the KURSK tragedy have been given a ten day holiday in Scotland by the efforts of the Royal Navy submariners' wives. This is separate from the US $10,000 raised by the British submarine community and presented to the Submarine Association. That donation, matched by $100,000 raised in Russia, was used to provide better accommodation for the dependents.

From NAVINT issue 15 October 2001.

Denmark's New SSK Commissioned

On 17 August the Royal Danish Navy (RDN) held a ceremony to celebrate the renaming of the former Royal Swedish Navy submarine NswMS NÅCKEN HDMS KRONBORG at Aalborg. The renaming was conducted by the Commander-in-Chief of the Danish Armed Forces, Air Force Gen. Christian Hvidt. After the ceremony the submarine was formally handed over to the RDN.

The Commander-in-Chief said, "KRONBORG is Denmark's most modern submarine. She will help sustain the high level of technical competence for which the Danish Submarine Service is well known, until the pan-Nordic *Viking* project is realised,". Gen. Hvidt further emphasised the uniqueness of the Danish Submarine Service, which has been an important part of Denmark's armed forces for more than 90 years. "The last time the Danes bought submarines, it was Norway that provided the technical support and know-how," noted RAdm P.B. Sörensen, from the Danish Defence Materiel Administration. "Today, it is Sweden. Without the support of Swedish politicians, the Swedish Defence Materiel Administration (FMV), the Swedish Navy and Kockums, this upgrade of Danish naval capability would not have been possible. The signing of the contract on 13 February this year was the signal to start a hectic refit and upgrade programme, conducted by Kockums in Karlskrona, as well as a full crew-training programme. We wish to express our thanks for all the effort and commitment, which has made the project such a success".

RAdm Bertil Björkman, of FMV recalled that NÅCKEN had always been a "happy ship", and wished her continued success. Kronborg is a famous castle once inhabited by Shakespear's Hamlet.

US Edging Towards SSKs for Taiwan

The Bush Administration may be moving closer to its goal of providing eight diesel-electric hunter-killer submarines (SSKs) to

the Republic of China Navy (RoCN) in Taiwan. According to *Military Procurement International*, citing a report in the *Far Eastern Economic Review*, the US Navy is putting pressure on General Dynamics' Electric Boat division to buy a 40 percent stake in the Australian Government-owned Australian Submarine Corporation (ASC).

ASC built the six advanced 3000t Collins class SSKs at its yard in Adelaide, South Australia, whereas no US yard has built an SSK for many years. Senior Royal Australian Navy (RAN) officers are quoted as saying that Electric Boat could extract enough knowledge from the Collins design to enable the Groton, CT yard to develop a hybrid design.

The subject of building SSKs for Taiwan has hitherto been taboo in Australian Government circles, on account of Australia's large Chinese market for mainly agricultural produce. In the aftermath of the New York and Washington bombings, the US Government may call on its loyal Australian ally to concede the point, even at the cost of some face-saving subterfuge such as a pretence that Taiwan would be buying an all-American design.

Thailand Looks Again at Submarines

After more than half a century without submarines, the Royal Thai Navy (RTN) is bidding to acquire some urgently. Second-hand they might be, but Thailand must have them, said Navy chief Admiral Prasert Boonsong this week. The RTN originally wanted to lease three new German submarines, but given the current weak economy it has decided to settle for two second-hand ones. Thailand has looked at second-hand submarines from Italy, the Netherlands and Germany and would expect to pay a few billion baht for a leasing arrangement, according to the *South China Morning Post* last month.

In the event the RTN announced that it plans to acquire at least two second-hand Gal class IKL Types 540 diesel-electric submarines from Israel, whose navy was considering scuttling the three 25 year old boats or selling them for scrap, as it was having a hard time finding a buyer for them. Israel retired the last of the Gal class last summer after the third German-built and -financed

Dolphin class submarine arrived. The Navy has neither the budget, nor the manpower or the support infrastructure to operate both types of submarines, according to the *Jerusalem Post* on 6 September.

Politics rather than finance has bedevilled the RTN's previous plans to acquire submarines on several occasions. In part this is caused by an RTN tradition of allowing relatively junior officers to put forward major projects. These proposals then reach the media, resulting in worldwide speculation and a queue of hopeful naval salesmen; then the officer promoting the project is overruled, and the salesmen fly back to their parent companies to report that the RTN never intended to buy anything.

News in Brief

- The Canadian Department of National Defence (DND) is to issue Requests for Proposals (RFPs) during the next six months for a naval combat system operator trainer and a submarine command team trainer, both to support the New Victoria class submarines.
- The Italian Ministry of Defence intends to buy a number of lead-acetate accumulator batteries for the modernisation of the four Nazario Sauro class submarines, almost certainly Type PY900 from Compagnia General Accumulatori (CGA). The order is likely to be signed in September next year.

From NAVINT issue 1 November 2001.

News in Brief

- The Royal Australian Navy (RAN) diesel-electric submarine RANKIN will be launched at the Australian Submarine Corporation (ASC) shipyard in Adelaide, SA on 10 November. She is the last of six Collins class to be built for the RAN by ASC. She will probably be handed over in the middle of next year.
- Following to the failure of the former Soviet Government to

anticipate the changes that would be brought about by the end of the Cold War, over 100 nuclear powered submarines, all destined for ultimate scrapping, have piled-up at the Northern Fleet base.

Updates

- The Indian Navy's plans to build six Project 75 *Scorpène* type diesel-electric submarines (SSKs) at Mazagon Dock Ltd., (MDL) in Mumbai may run into trouble. MDL is reported to be in no condition to undertake construction of complex modern SSKs. The yard has been idle for nine years, and would need an investment of at least $50 million to bring it back into operation. This is a conundrum for prime contractor Thales and principal sub-contractor Connoisseurs of Indian submarine programmes will recall a serious disagreement over MDL's contract to build IKL Type 1500 SSKs at MDL in the 1980s, resulting in termination of the order at four units instead of six.
- On Tuesday 18 September a Russian nuclear powered strategic submarines (SSBN) successfully test-fired a ballistic missile from under water, off Russia's Pacific Coast, according to an official Navy announcement. The missile was launched by the SSBN PODOLSK of the Pacific Fleet from the Sea of Okhotsk, and hit the designated target at the Navy's Chizha range on the Barents Sea coast of northern Russia. Navy spokesman Captain Igor Dygalo said in a statement that the successful launch confirmed the "efficiency of the combat control system and reliability of the Navy's strategic nuclear forces."

  It is not known to which class PODOLSK belongs, but a reasonable guess if the Project 667 series (Delta group), a previously numbered Project 667B Murena (Delta I), Project 667BDR Kalmar (Delta III), or Project 667BDRM Delfin (Delta IV) SSBN.

From NAVINT issue 1 December 2001.

Sweden's New S-SRV Submarine Rescue System

The Royal Swedish Navy (RSwN) is one of the few navies possessing a submarine rescue system, based on the URF vehicle. This system is, however, nearing obsolescence and the URF's effective life will end around 2007-2008.

Earlier this year Kockums presented a new concept for a submarine rescue vehicle, the S-SRV. It has two pressure tight compartments: the Rescue Compartment and the Pilots and Machinery Compartment. The rescue compartment can be pressurised to permit a hyperbaric transfer of the submarine's crew. The three-man crew includes two pilots and a rescue attendant.

The RswN requirement calls for a rescue vehicle capable of rescuing the entirer crew of one of its submarines, so the S-SRV has a capacity for 35 rescuees. Injured crew members may require up to five rescues, and stretchers are provided.

The manoeuvring system, combined with the rotating mating skirt, enables the S-SRV to mate with the submarine at angles up to 60 degrees. After a submarine accident it is very likely that the crew will be exposed to rising pressure inside the hull. Transfer Under Pressure (TUP) capability is therefore important. Today's technology is more advanced than anything available 30 years ago. The use of a software database has changed the design process radically. Information on all components, dimensions, volumes, weights and centre of gravity is fed into the database continuously. Increased diving depth dictates better materials and precise calculations. To limit the weight of the S-SRV the arrangement of the pressure hull has been made less complex than in the URF. High tensile steel, combined with advanced methods of calculation and testing, made it possible to fine tune the design.

The S-SRV's navigation aids include advanced sonars and underwater cameras. Highly accurate compact optical gyrocompasses with low power consumption are also available. Navigation data from the cameras is presented to the pilots on compact displays. In addition to standard underwater telephones and

transponders, the use of an acoustic data link is under consideration, to improve communication with the mother ship.

The aim of the design and its logistic support is to be airportable, by large aircraft, such as the C-17 Globemaster, the A-400M, the C-5 Galaxy, and An-124 Antonov *Condor* transports. Improvements to the handling system should include better recover, i.e., a safer way of connecting the tow- and lifting-cables in the open sea.

Rolls-Royce Wins Nuclear Support Contract

Rolls-Royce has been awarded a £100 million contract from the UK Ministry of Defence to support the Royal Navy's (RN) force of nuclear attack and strategic submarines (SSNs and SSBNs). The company will provide a total power plant support package for the next three years, and future programmes for the period 2004-2011 are potentially worth another £300m.

The contract covers design improvements, inspection, refurbishment, condition-monitoring, and a continuous safety review for the pressurised water reactor powerplant. Rolls-Royce will also continue to conduct research into the development of future powerplant options for the Future Attack Submarine (FASM). The company designs, supplies and supports all the reactor systems and equipment for the RN's SWIFTSURE, TRAFALGAR, VANGUARD and the new Astute class submarines—a total of 19 boats.■

DISCUSSIONS

LEADERSHIP BALANCE

by RADM C.H. (Chip) Griffiths, Jr., USN
Commander, Submarine Group NINE

The Navy and the Submarine Force are facing an indefinite future state of both violence and something less than violent war. Given this environment, we would benefit from a better, more mature discussion of the bridge between encouraging aggressive, innovative leaders who are not adverse to experimenting and allowing mistakes, on the one hand, and fostering a standard approach of deliberately judging the potential costs and consequences of endeavors where failure can result in lives at risk. There is a lot at stake in getting this formula right. If we become too conservative, we will become relatively stale and impotent, and drive away good Sailors who want to be part of an exciting, winning team. If we get too aggressive, we can end up with more disasters at sea, ultimately undermining the public's confidence in our institution. This is a core issue for us.

It is also an issue that will remain elusive to clearly capture and define. The many communities in the Navy will each have their own corporate view. More importantly, the very nature of the Navy is to distribute the interpretation and execution of leadership policy to ship/squadron commanding officers, of which there are hundreds. But we can collectively focus on the issue in a continuing way to keep continual awareness and constructive thinking at work.

The USS GREENEVILLE tragedy has caused me to think more on the natural tension between inspiring and innovative leadership, on the one hand, and mature risk versus gain assessment by our sea going leaders. One way the Submarine Force can get traction here is to use the seminar method to challenge our leadership on scenarios that cause them to have to really think about risk versus gain. But first a word of caution. When I was a commanding officer I was frustrated when the Squadron/Group would hold CO meetings that I would label as *mechanical* in subject, such as a

reiteration of recent message guidance on what has gone wrong lately, etc. When I grew up and became a squadron commander I would collaborate with the other local unit commander to hold CO training that was battle/deployment tactics focused, and encouraged participation in a learning environment aimed at creating new value. The stimulation factor was there or we didn't schedule the meeting to happen. Hopefully I will continue in this way as a group commander.

So with the need to keep the training stimulating and participatory in mind, here are some candidate examples:

- Surfaced submarine operations in challenging environments
- Force projection
- Tactical innovations during workups for patrol or deployment
- Tactical innovations during deployment or patrol
- Search and rescue by submarines
- Inspiring the crew
- Inspirational engagement with the public

We are commencing to work our way through this list at Submarine Group NINE. Hopefully it will serve a useful focusing purpose in achieving a balance in our leadership challenges.■

SUBMARINE UNIFORM INSIGNIA

The Naval Submarine League is building a display of current submarine uniform insignia from all countries that have submarines. This display will be exhibited at our annual symposiums and housed at League headquarters. According to Pete Prichard, in his book, Submarine Badges and Insignia of the World, (Schiffer Publishing Ltd., Atglen, PA) over fifty countries have had submarines since their invention. Anyone having current foreign submarine uniform insignia they would be willing to donate is asked to contact League headquarters at (703) 256-0891 or 1-877-280-SUBS.

THE SUBMARINE BATTLE EFFICIENCY AWARD: FROM SUBJECTIVE COMPETITION TO OBJECTIVE COLLABORATION

by CDR Mark L. Gorenflo, USN

Each January, the Submarine Force Commanders announce the previous year's winners of the Battle Efficiency E. These ships and crews represent the best of the Submarine Force, with one submarine crew from each squadron chosen for their accomplishments during the previous year. There is no doubt that the crews selected deserve to be recognized. However, it's harder to answer the following questions:

1. Why were the other submarine crews in each squadron not selected?
2. What can these crews do to improve their performance and receive recognition for their *Battle Efficiency*?

I will argue that the current system, which limits the award of the Battle Efficiency E award to one submarine crew per squadron, fails to recognize deserving crews and sets up perverse incentives which do nothing to advance the professional excellence of and quality of service in the Submarine Force.

How are our current Battle Efficiency award winners selected? Does it depend on examination results? Does it depend on subjective assessments by the squadron staffs? Is there an attempt to *share the wealth* in awards through the squadron? Does winning one year preclude winning the next? If you're in shipyard (as so many of our submarines will be in the next few years) are you automatically excluded? Are there other criteria employed? The fact is that at no time in my career have I ever known the answers to these questions. Commodores are pretty much left to their own devices in selecting their Battle E nominees. While this is, on the face of it, a logical prerogative of command, it has the following undesirable side effects:

- Criteria for selection (if they actually exist) differ from

squadron to squadron

- Criteria can change within the same squadron with a new commodore (on my first ship, we had 3 commodores over 3 years—a not uncommon event in the Submarine Force)

While thinking through how to best position the ship for a Battle E nod, wardrooms in which I have served have tried to read the Commodore's mind. Does he depend largely on the advice of his staff? Then let's make sure we schmooze the squadron chiefs and staff officers with five pound 2Ks and burgers on the pier. Does he depend largely on examination results? Then we better get that Above Average or better on the ORSE—which is just about the only external inspection remaining which provides adjectival grades.

Furthermore, the winner take all Battle E system engenders tremendous competition between Commanding Officers and, hence, their crews. CO meetings with Commodores could become cockpits of contention, where the principal agenda item was always overcoming the adversary (the submarine across the pier, not the Soviets) rather than figuring out ways to do things better. Good ideas were not shared, bad experiences were hidden or downplayed—all to stay sweet in the eyes of the Commodore and remain viable for the Battle E.

Clearly this system, while identifying one excellent crew per squadron, did little to advance the Battle Efficiency of the Submarine Force as a whole:

- Ship training time and energy were skewed to do well on inspections, which today principally means the ORSE. Every incentive exists to train crews to ace ORSE driven scenarios. Choreographing the ship's crew becomes a principal concern of the Engineer, COB and XO. Testing and interviewing on the latest ORSE hot topics drives short range training plans. If this translates into *battle efficiency*, the transfer function is obscure and to many junior officers, for whom the ORSE workup and ORSE are an unrelieved misery, as indecipherable as Fermat's Last Theorem or General Relativity.
- The lack of standard, objective criteria across the Submarine

Force raises questions about the fairness of the award process and, more importantly (since no award process will seem fair to everyone), deprives the Type Commanders of a useful tool to focus the efforts of their crews on force wide issues and problems requiring correction or improvement.

- The winner take all mentality inhibits teamwork and cooperation *among* submarine crews. Good ideas are hoarded. Lessons learned the hard way are submerged in obscurity—until an untoward event brings a crew and its shortcomings, staggering and blinking, into the glare of the ex post facto million candle power spotlight.

In the place of the current subjective, winner take all system, I would propose an objective system where every crew who meets the standards would get a Battle Efficiency Award. While there are many ways to set the bar, here's my proposal for criteria suitable for the award:

1. **Average or better on major inspections.** In truth, everyone in the Submarine Force leadership is happy with an average on the ORSE. Senior members of the NPEB congratulate Commanding Officers whose ships receive an Average on a *successful* ORSE. The difference between and Average and an Above Average is often a single drill or set of evolutions. This will put inspections in perspective.
2. **For those ships who deploy during the year, a certification from the *customer*** (the Battle Group Commander for CVBG SSNs, the Type Commander N2s and N3s for ISR SSNs, STRATCOM for SSBNs) of their *battle efficiency*. Each customer can establish a set of criteria for success that they expect from their submerged assets and then challenge the submarines concerned to meet those criteria. This focuses a submarine's training time and energy on their mission, rather than inspection choreography.
3. **For Submarine Force wide issues, the Type Commanders could establish additional objective criteria for their crews to meet.** In the current retention critical environment,

benchmarks in reenlistments and attrition would be excellent criteria. As other issues come up, other objective criteria can be established. We measure just about everything a ship does, we should be able to employ these metrics to good purpose.

4. **For those submarines in an overhaul or DMP (a larger proportion of our Force in the near future), Average or better on their PORSE and a successful Crew Certification** could be substituted for the first two criteria, which are only really suitable for operating submarines.

This system captures all the goodness of competition (by setting objective, relevant and appropriately challenging targets of excellence) while avoiding its pitfalls. Everyone will know why they won a Battle E (if they did) or what they need to improve on in future (if they did not). The award will focus more on ***mission*** rather than ***inspections***, and will recognize that the mission of our brethren rockbound in shipyard is to get out of there as quickly and with as much proficiency as they can muster. Successful ships will be more willing to share their successes with their fellow submariners in a new, non-zero-sum game version of the Battle E competition. Conversely, frank assessment of errors will be more frequent and their lessons learned more readily available for all to benefit from.

Will more submarines get a Battle E? Almost surely. And they will deserve it. Let's change now from a system of ***subjective competition*** to a system of ***objective collaboration***.■

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THE SUBMARINE COMMUNITY

DOLPHIN SCHOLARSHIP FOUNDATION THEN AND NOW

by Kathy Grossenbacher
DSF President

The year 2001 marks the 40th anniversary of the Dolphin Scholarship Foundation. To commemorate the 40th anniversary, I will be writing articles for the next several issues as a way to keep the history alive, to share some interesting facts, discuss the future goals, describe the selection process, highlight the *typical* scholar and explain now very important your help is in ensuring that this wonderful foundation continues to grow for many more years.

In 1961 when Vice Admiral Grenfell was the first Commander, Submarine Force Atlantic Fleet (COMSUBLANT), his wife, Martha, along with a small group of other submarine officers' wives, started what is now DSF. That one $350 scholarship to an officer's son in 1961 has grown to 131 scholarships of $3,000 each to both officer and enlisted children and stepchildren of qualifying applicants.

I became the 16th President of DSF in July 2000. As set forth in th bylaws of the foundation, the wife of the current COMSUBLANT is always the President. Since July 2000, I have had the opportunity to meet with submarine flag and major commanders' wives and their husbands at various conferences. I have also met with small groups of junior officers' wives, ombudsmen, COB's wives, as well as with the Chiefs of the Atlantic Submarine Force. One of my goals has been to have one or two key staff personnel from the DSF office travel with me to different locations within the Submarine Force so we can inform as many people as possible about the foundation, how it has grown from two small rooms above the kitchen in the admiral's home to a professionally run office with a staff of five paid employees and myself.

What I have realized since July 2000, is how little most people, including senior officers and chiefs, know about DSF, the history,

the goals, how much money we raise and spend in our pursuit of educating submarine college bound children and stepchildren and how much mor we need to raise in order to reach our projected goals. DSF is a unique scholarship with a long history to be proud of. It is **not** funded or supported by the Navy or the Submarine Force. DSF is a private foundation that is the very **best** within the military communities today because submarine wives and family members, as well as private donors and kind individuals have contributed year after year. With your continued support, DSF's commitment to our scholars will remain strong. We have a challenging goal of 200 scholars by 2009. We also have a goal of finding corporations and foundations to contribute to our foundation so we can reach the goal of educating 200 scholars by 2009. I hope you all will be my eyes and ears. The staff and I are looking for good ideas and welcome your suggestions.

In the coming months, I will explain where the name came from, talk about expanding the DSF name, explain our goal of finding corporation and foundations to contribute money to the foundation, describe the tireless efforts of the past presidents, our Board of Directors and the staff, introduce you to the fabulous, priceless scholars and explain the selection process we use to select them. I am asking you all to be a part of the future growth and thank you for what you do to help our **Dolphin Scholarship Foundation.**■

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SUBMARINE FORCE LIBRARY AND MUSEUM HISTORIC SHIP NAUTILUS

by CAPT Arne C. Johnson, USN(Ret.), President and CAPT Michael G. Riegel, USN(Ret.), Executive Director Submarine Force Library and Museum Association

The Early Years

The Submarine Force Library and Museum originated at the Electric Boat Company in Groton, Connecticut in the early 1950s. Recognizing the lack of a readily available compilation of information relating to submarine history, the shipbuilder Electric Boat created the Submarine Library. Electric Boat acquired numerous books, letters, artifacts, manuscripts and other submarine paraphernalia for internal use. In 1955 the library was made available to the general public.

During the next decade the Submarine Library grew in size and stature. In 1964, Electric Boat could no longer support it and donated the Library to the U.S. Navy, whereupon it became the Submarine Force Library and Museum. The contents were then transferred to the New London Submarine Base and two classrooms in the Submarine School's Gilmore Hall were made available for display of the artifacts and library use. Commander I. J. Viney, the Academic Director of Submarine School, was given the additional duty as Head, Submarine Library and Museum. In early 1968 with Lieutenant Commander E. E. Williams serving, the title was changed to Director, Submarine Force Library and Museum and the position given department head status on the Submarine Base. Also in 1968, a five man Board of Advisors was created to provide the commanding officer with broad viewpoint counsel on the museum. The initial membership of the Board was Lieutenant Commander Williams, Chairman, Admiral J. Fife; Commander H. S. Crosby; Commander R. L. Miller; and QMCS (SS) J. Silvia. In 1969, the Library and Museum moved into more spacious quarters in Building 83 adjacent to Gilmore Hall.

In 1970, the Board of Advisors discussed the necessity for establishing a Museum Association to act as a depository for

donated monies to support the Submarine Force Library and Museum. In November 1972, the Certificate of Incorporation of the Submarine Force Library and Museum Association Inc. (the Association) was signed by Admiral James Fife Jr., USN(Ret.); Vice Admiral Vernon L. Lowrance, USN(Ret.); and Robert B. Chappel. The Association is a tax exempt, non-profit organization, incorporated in the State of Connecticut. By June 1973, the Association was up and running with a set of bylaws signed by Admiral James Fife Jr., President; Rear Admiral David H. Bell, USN(Ret.), Vice President; Captain John K. Nunnelly, USN, Secretary (and CO of the Submarine School); and Captain John B. Hess, USN(Ret.), Treasurer. The principal purposes of the Association are to:

- Assist the Submarine Force Library and Museum in all its objectives and foster and perpetuate it as a medium that promotes historical knowledge of submarines.
- Stimulate among present and past submariners and the general public awareness, recognition, and pride in the role of the submarine in naval operations past, present, and future.
- Promote historical knowledge of submarines through the collection, preservation and dissemination of such knowledge.
- Assist the maintenance, development and expansion of the Submarine Force Library and Museum.
- Receive, hold, and administer gifts of any type or nature for the furtherance of the foregoing purposes.

With the Commanding Officer of the Submarine School (and subsequently the Commanding Officer, Submarine Base) always filling the Secretary position, the Association officers then provided the leadership and directed the Museum and Library Staff. Rear Admiral Bell took over the presidency in 1974 and for the next twelve years the activity was frequently referred to as *Dave Bell's Museum*. The Museum Director's position was filled by a series of very competent chief petty officers.

Returning NAUTILUS

The world's first nuclear submarine, USS NAUTILUS, was decommissioned in 1979, and it was decided to preserve her as a museum piece. By 1979, various groups were vying to have her homeported in different locations. There was strong representation to berth NAUTILUS at the U.S. Naval Academy in Annapolis, Maryland. The Navy finally decided to berth NAUTILUS at the Washington Navy Yard. Many in the Groton, Connecticut area, including the Association, wanted to bring NAUTILUS back to where she was built and close to the Submarine Force Library and Museum. Prominent in this effort was Association life member Frank Scheetz whose vigorous lobbying brought the issue to the forefront. Lieutenant Commander C. *Robbie* Robertson, a member of the Association Executive Board, was a close friend of Ex-Governor John Dempsey and persuaded him to actively promote bringing NAUTILUS home to Connecticut. The then current governor, Ella T. Grasso, was a protégé of John Dempsey and also a supporter. The NSL **REVIEW** editor, Jim Hay, was Commanding Officer of the Submarine Base at the time and had the pleasure of showing Governor Grasso where NAUTILUS would be berthed. Governor Grasso expended a *silver bullet* on President Jimmy Carter. Thus in May of 1980, the White House approved berthing Nautilus in Groton, overturning the Navy recommendation of berthing the ship at the Washington Navy Yard.

The White House stipulated that the federal government financial outlay for the project be capped at $2.8 million. Additional funds for the project would have to be raised by the state. Subsequently, the U.S. Government only authorized $1.93 million, the State of Connecticut put up $1.0 million, and the balance had to be raised from private contributions. The Connecticut Nautilus Committee (CNC) with Ex-Governor John Dempsey, Chairman, and Jack Shannahan, Executive Director, was formed to raise funds from the private sector. Fortunately, two members of the Association executive board, Rear Admiral Bell and Vice Admiral Lowrance served on the CNC executive committee. They convinced the board that the support facility for NAUTILUS should be expanded to include a new Submarine Force Library and

Museum, which required about $5 million above and beyond the $2.9 million federal/state cap. The project went forward with the state loaning the CNC the money while the drive for private funds continued. The CNC raised about half of what was needed and the state legislature eventually forgave the remaining loan.

In 1986, construction was completed and the Submarine Force Library and Museum relocated to the new site, just outside the Submarine Base main gate. The Commanding Officer designated the Officer in Charge of NAUTILUS the Museum Director and the day to day direction of the museum shifted from the Association back to the Navy. To execute his responsibilities more effectively, the Officer in Charge and key assistants took over the limited administrative office space, displacing the museum and Association staff to the library. This situation coupled with the fact that 95 percent of the museum collection was in storage initiated the future requirement for more space.

The Association continued its supportive and advisory role. In order to raise more monies, it opened a small gift shop in what was designated as the Museum cloakroom. Under the supervision of Association Administrator, June Johnson, profits from the gift shop over the next decade enabled the Association to provide over half a million dollars of museum support and to significantly increase its financial reserves. With this financial support the Museum was able to access and display significant items of submarine history including a full sized replica of Bushnell's TURTLE, the sail of USS GEORGE WASHINGTON, the mini-sub USS X-1 and the original propellers from USS NAUTILUS.

Relocation Results

Co-locating the museum with NAUTILUS proved to be a huge success. The Museum became one of the most popular tourist attractions in the state with a visitation of about 280,000 per year.

The new museum is located on approximately 5 acres of federally owned land. It includes the Museum building, the Historic Ship NAUTILUS (SSN 571), a number of outdoor displays including midget submarines, a picnic area, and a 150 vehicle parking lot. A more complete description of the museum is provided later in this article.

Expansion

After a decade of operating at the new museum site, the Association Executive Board reviewed various alternatives to aid the museum and library in meeting current and future requirements. Most significantly, a lack of adequate space permitted display of only about 5 percent of the museum collection. In addition, the library was overcrowded with administrative staff, and museum artifacts were deteriorating in storage in a dilapidated building on the base.

In 1997, the Board agreed to raise several million dollars and proceed with the museum expansion project. Executive Board member Dave Hinkle who was ably assisted by the all time great fundraiser, Vice Admiral Joe Williams, Jr., chaired the Capital Campaign steering committee. The committee met biweekly and brought on a full time Campaign Director, John Demlein who skillfully administered the day to day campaign effort. Dave Hinkle persuaded Governor Rowland to provide up to $2 million of matching state funds if the Association could raise that much from private sources. The campaign raised about $1.6 million of new money, and the Association dipped into its reserves to make up the difference for the $4 million project.

Association Vice President Ray Woolrich chaired the construction committee. The Committee met weekly for about three years, planning, supervising, and shepherding the project to completion. The goals of the expansion project were to:

- Provide more artifact display space.
- Tell the submarine Cold War story.
- Create a first class research library.
- Provide climate control storage for perishable artifacts.
- Provide a real gift shop.
- Provide classrooms for educational events.

These goals were achieved. Another goal will be pursued when funding permits and that is to create a submarine experience in the museum theater for all visitors. The theater is built but the experience has not yet been developed.

Dave Boyd, the Association Executive Director, skillfully negotiated and executed the agreements between the Association, the state, and the U. S. Navy, none of whom talked the same language or operated on the same frequency.

The Museum Today

The Submarine Force Library and Museum is the Navy's official submarine museum. The museum's primary exhibit item is the Historic Ship NAUTILUS. The museum library serves as the repository for the records and history of the U.S. Submarine Force from its beginning to the present day. New books, photographs, and documents are being added daily. The museum is open every day most of the year. The library is open to researchers on weekdays. Both the library and museum are closed on Tuesdays during the winter months. With the expansion project complete, the museum has 9200 square feet of exhibit space, an 800 square foot gift shop, a 71-seat theater, a classroom, climate controlled storage, and a new research library.

Outdoor Exhibits

Upon arrival to the site, the first objects visitors are likely to notice are the sail from the Navy's first ballistic missile submarine, USS GEORGE WASHINGTON (SSBN 598), and a Polaris missile mounted just aft of the sail. Next is the anchor from a Sturgeon (SSN 637) class fast attack submarine.

There are several midget submarines, in order from the museum entrance moving toward the river:

- Italian MAIALE, a WWII vintage swimmer delivery vehicle.
- A U.S. Navy Seal team swimmer delivery vehicle.
- USS X-1: Midget Experimental Submarine, originally designed to use hydrogen peroxide as an oxygen supply for the internal combustion engines, this submarine served in a research capacity in rigorous and extensive tests to assist the Navy to evaluate the ability to defend harbors against very small submarines.

- Japanese *Type A*: larger ships carried these short-range two man submarines to the areas of operation. They were generally unsuccessful.

Just prior to entering the museum, visitors will notice the two rings that represent the diameters of the U.S. Navy's first submarine, USS HOLLAND, and the Navy's largest submarine in operation today, USS OHIO.

Just to the left of the rings is a 5 inch/25 caliber World War II deck gun plus the hatch cover and upper portion of a Poseidon Missile tube. Finally, immediately to the left of the entry doors is a Harpoon anti-ship missile.

Indoor Exhibits

Suspended in the entrance foyer is a replica of Jules Vernes' NAUTILUS as depicted in the 1954 Walt Disney movie *20,000 Leagues Under the Sea*. The model was built by Dave Bishop, an early museum staff member. A mural, taken from an illustration in the first edition of the book published in Paris in 1870, graces the entrance wall.

Revolutionary War Through World War II

To the right of the main entrance the museum is principally devoted to the early history of the submarine from the Revolutionary War through WWII, although some post WWII exhibits are located in this section.

The left side of the main corridor contains three exhibit rooms. The first is a composite control room/attack center from Sturgeon class attack submarines and an early fleet ballistic missile submarine. The second is a recreated WW II submarine attack center with periscopes through which one may view NAUTILUS or the Thames River, and a short tape that describes a torpedo attack by a WW II submarine. The third room recreates a WW II submarine control room and includes a short tape that describes a submarine dive sequence.

The model wall on the right of the main hall, contains scale

models of the major types and classes of submarines from USS HOLLAND (SS 1) to the present Los Angeles, Ohio and Seawolf class submarines. All models are built to the same scale, giving the visitor a real sense of the change in size and shape as the submarine has evolved.

The main exhibit floor is to the right of the model wall. It contains a variety of exhibits, including two mini-theaters, illuminated panels, large-scale display, and exhibit cases. Each mini-theater seats approximately ten people and shows a continuous program. Exhibit cases trace the world development of 18th and 19th century submarine inventors from Robert Fulton to Sweden's 1886 NORDENFELT. An exhibit case titled "The U.S. Submarine 1900-1939" includes photos of John Holland's earliest submarines, the sinking of USS SQUALUS, and the development of the fleet boat. Another case calls attention to the contributions of such pioneer developers as John Holland and Simon Lake, including pictures of submarines under construction and the shipyards in which they were built.

Illuminated panels depict submarine operations in the Pacific during WW II and measures used by ships to deter submarine attack. Another panel explains the role of the fleet ballistic missile submarine in providing strategic deterrence and national defense from the 1960s to the present.

Several large scale displays are provided; a full size replica of David Bushnell's Revolutionary War TURTLE, a complete McCann rescue chamber, submarine messenger buoy, a 20 mm deck gun, several torpedoes, a Subroc missile, and Polaris A-3 ballistic missile. Additionally several WW II submarine battle flags are on display.

The dominant displays of the second floor are a 50-foot cutaway model of the WW II submarine GATO and a display of fifty-seven large photographs of submariners from 1900 to the present. The exhibit floor also includes the NAUTILUS room, which offers a splendid view of the Submarine Force Museum and the Thames River.

The Cold War and Beyond

The section to the left of the main entrance, added during the

museum expansion from 1998 to 2000, is principally devoted to submarining in the Cold War and beyond. On the right side of the corridor the visitor will find "The City beneath the Sea" a lighted cutaway model of a Los Angeles class attack submarine built by Commander Richard Alexander, USN(Ret). Various kiosks and displays tell the story of the submarine in the Cold War from strategic deterrence to antisubmarine warfare.

A missile tube section and missile tube locking ring from USS JAMES K. POLK (SSBN 645) are displayed near the entrance to the museum's 71 seat theater. Exhibit cases depict the role submarines played in strategic deterrence as the most survivable leg of the strategic triad. A display case honors Vice Admiral Levering Smith and Vice Admiral William Rayburn, two pioneers of the fleet ballistic missile submarine Navy.

A large technology display rounds out the new museum section. This display depicts how submarines can now be used for a variety of missions from cruise missile launches, insertion of commando teams, intelligence gathering, and surveillance of enemy coastlines.

The Historic Ship NAUTILUS

NAUTILUS is significant in submarine history for several reasons:

- It is the world's first true submarine. Nuclear propulsion ended a submarine's dependence on diesel engines and electric batteries.
- It is the first ship to go to the North Pole, achieving this goal in August 1958.

NAUTILUS is moored to the pier at the museum. Visitors take a self-guided tour of the ship and may use an audio wand that provides a description of major areas along the tour route. The tour route includes the torpedo room, wardroom/officers' berthing area, attack center, crew's mess, crew's quarters, chief petty officer quarters, scullery and crew's galley. Improvements are planned to the tour by adding foreign language capability to the audio presentation.

Future

With the end of the Cold War, the Museum now has the opportunity, as well as the obligation, to showcase the extraordinary contributions of the Submarine Force during that volatile era of history. More importantly, advances in interactive multimedia education and in museum tradecraft have left the Museum's mostly static exhibits clearly outdated in their appeal to today's visitors. If the Museum is to remain a strong participant in America's agenda of informed science learning, it must expand its educational experience and excite students and visitors of all ages and backgrounds about the application of technology to submarine construction and undersea operations.

The Museum staff envisions great things for educational improvements at the Museum, including many challenging and educational interactive elements. The following are examples:

1. An interactive buoyancy tank to enable a visitor to bring water in and force water out of a model submarine and change other factors that alter the submarine's buoyancy.
2. A sonar room to illustrate how submarines detect, locate, and track other vessels and biological species.
3. What do whales sound like below the surface of the water? A school of shrimp? Another submarine? Icebergs?
4. Just how does a submarine navigate around the world for months at a time?
5. How does the ship make fresh water and oxygen?

Introducing these and similar elements is very much in keeping with the current educational goal of our country, to reestablish world leadership in science and math.

The need for creating a multiversional educational environment is also in keeping with this goal. In today's educational environment students and Museum visitors alike have come to expect more. They need to be challenged. Interactive exhibits supplement book learning and personal experience.

What better way to learn math and science than by enjoying first-hand the submarine experience? And one can begin to appreciate just how far-reaching applications of submarine

technology really are: nuclear power; precision inertial, space-based and bottom contour navigation; atmosphere control; ballistic and cruise missile technology; sound quieting; smart weapons; underwater communications; and much more.

The library is probably the foremost submarine research library in the world and contains priceless documents such as the early inventors' blueprints and World War II war patrol reports. These documents need to be preserved in modern media so they will be available for future research; therefore, the use of the library needs to be more aggressively promoted.

One of our goals is to make the community more aware of the treasure right here in their back yard. We plan to host various events for civic groups such as the Chamber of Commerce to enlighten more of our neighbors.

The Museum can add much to the weekend of a submarine veteran's reunion. The museum staff has been most cooperative in support of social events at the museum, although the current heightened security has limited their flexibility somewhat. We encourage those planning a submarine reunion to consider the New London area. We can provide more fond memories and nostalgia than other venues.

Summary

The Submarine Force Library and Museum stands as a unique, nationally recognized institution. Today, as in the past, the Museum serves to educate young and old alike on the technology of submarine operations, on the contributions of the U. S. Submarine Service to the preservation of world peace and democracy, and on the significant contributions and skill of the men and women who made it all happen. In the future we hope to do it even better. We hope and believe that you and your friends will find a visit to the museum a truly rewarding experience.■

REFLECTIONS

USS DRUM (SSN 667) COMMISSIONING SPEECH

by RADM M.H. Rindskopf, USN(Ret.)
Mare Island, CA
15 April 1972

I am long since the last member of the commissioning crew of DRUM on active duty. It is fortunate for me that this traditional ceremony is taking place before 1 July because I too shall then join the ranks of *Retired Drummers*.

It is most appropriate to make this occasion a bringing together of the past and the future, the old and the new.

Frequently submariners have had the honor of speaking at submarine commissionings. Now and then, a former commanding officer of the namesake submarine has had the pleasure of opening a new chapter in the long line of U.S. submarines. Perhaps never before has there been a speaker who was so much a part of a predecessor as I was of DRUM 1. I intend to take advantage of this circumstance to tell a few tales about DRUM never told before.

One such story appears in a new little booklet published by the Submarine Wives called *Dolphin Tales*. I commend that volume to all submariners, wives and friends for it clearly demonstrates why the submarine family is different and special.

DRUM I was the first new construction submarine to arrive at Pearl Harbor after the attack on 7 December 1941. She was of course the result of a submarine design which was initially approved in 1937. She was an *accident*, but a most fortuitous one! Fleet Submarine was the general nomenclature applied to these boats because they had been conceived to support the fleet. They were to be scouts which could precede the battle force ranging ahead far and wide with maximum surface speed just about the same as the battleships, but with the capability to submerge for relatively short periods—at slow speeds. They had excellent sea keeping qualities even if all the watchstanders on the bridge spent a good part of their four hours wet from neck to shins. They had

tremendous endurance...and this characteristic was perhaps the most significant.

When World War II broke out, the United States Navy found itself with an enemy in the far Western Pacific and almost no forces capable of doing battle with him except these fleet submarines. By sheer good fortune, the requirements of the battle line scout were identical to the demands of a distant submarine campaign against an enemy whose very existence depended upon sea going supply of an island homeland; and, who, because of faulty planning, failed to develop an anti-submarine warfare capability up to the task of protecting that lifeline from DRUM I and the other fleet submarines.

It had been pre-war doctrine that all submarines on war patrol wherever located operated submerged by day, surfaced by night, and were expected to attack in daylight using the periscope to obtain needed data.

The war quickly shot holes in these procedures and soon all submarines were spending considerable time on the surface in daylight—and more significantly firing torpedoes at night even without one of the miracles of war—radar!

Thus it was that DRUM's first attack, south of Tokyo Bay, was at night against a large Japanese seaplane tender. Captain Bob Rice provided needed data by intuition from the bridge and our small torpedo salvo sank the target. The Japanese were not happy with this turn of events and clearly demonstrated this with the initial depth charging of DRUM—some 18 hours sporadically from midnight to dark. By that time DRUM's endurance submerged was approaching exhaustion and surfacing in the face of whatever the Japanese would have in the area was becoming our only course of action.

In one of those incidents which leave an indelible mark, Captain Rice talked to the officers in small groups telling us of his decision (not that it wasn't obvious to all of us) and expressing hopes that we would somehow survive our ordeal. But he was more poignant in his words about the ship. He regretted, he said, that this fine ship, a tribute to the Portsmouth, New Hampshire Shipyard, would meet her end before she would pay for herself in destruction to the enemy.

The surfacing did take place as planned—but no Japanese were in sight. DRUM survived to pay for herself!

But her career wasn't entirely grim and jammed with drama.

In early 1943 DRUM was assigned to the Southwest Pacific Submarine Command, operating out of Brisbane, Australia. Commodore Jimmy Fife, a famous no-nonsense submariner, was in command. The opportunity which DRUM's arrival in the area offered was more than he could pass up. His first message started Fife to DRUM. All subsequent messages were so headed and many contained martial words and phrases. Our response was in kind, "DRUM to Fife", and later Admiral Bull Halsey, in overall command at sea in the area, joined the party.

Perhaps it is fact that DRUM is the only musical instrument that is also a fish!

There were many other depth chargings for DRUM. We had one quartermaster who took delight in keeping an accurate count with one of those little devices normally used to count attendance. I can't recall his final tally, but I can still recall the closest charges we ever received—north of New Guinea—following a successful attack against a Japanese convoy, while DRUM was under Bill Williamson. A small, tenacious and accurate patrol boat laid several strings of big charges right on top of us. He put a crack in the steel plating of our conning tower causing a small stream to squirt in. A call for technical assistance quickly brought the repair man with his wrench on the theory that if "if it leaked, tighten it". But, instead, the incident ended our career in the Southwest Pacific and we returned to Pearl Harbor for repairs.

On the subsequent sea trials I was calmly watching our descent to our test depth (not much by today's standards) when I noted the sides of the repaired conning tower bending inward. That was deep enough! And away we went to Mare Island for a new conning tower—and reunions with our families.

By that time, early 1944, submarines were being built with heavier steel and our new conning tower had a test depth some 100 feet greater than the rest of the ship. Mare Island did an excellent but all too quick job of replacement and we were off again. The rest of my time on board was spent in trying to do submerged

loops so the strongest part of the submarine would be on the bottom! We never made it.

Although DRUM never won any unit citations, she was a proud ship that bore a proud name.

Even before the end of the war, the Germans showed that submarine design could be considerably improved. The snorkel and a submerged speed approximately double the DRUM's gave the submarine far greater capability but it was not until 17 January 1955 that evolution became revolution in submarine warfare. That was the day NAUTILUS was "Underway on nuclear power".

Since then, there has been steady progress in every phase of submarine design. The hull is now highly steamlined, the reactor core life has been tripled, extending the interval between major overhauls, the speed has been markedly increased, the ship is quieter and more difficult to detect by a wide margin, the sensors are capable of far longer ranges and provide data of great accuracy to a very sophisticated weapons control system and torpedo armament.

DRUM II is no accident! But she will need all the capability built into her to best her competition.

I need not tell this audience that the United States has a world challenge unmatched in history. The Soviet Union has demonstrated that it has a clearly defined strategic posture in which it seeks parity with the United States.

The government has set priorities within the Soviet Union which place the attainment of an adequate military strength above consumer products and the well being of the people.

They have built highly mobile and effective ground forces with integrated armor and close air support. It is especially designed for the heartland position which the USSR enjoys with respect to Europe and Asia.

The continuing strengthening of the Soviet strategic forces has received much media coverage. The combination of ICBMs with massive nuclear warheads in very hard underground silos and the large fleet of Yankee class ballistic missile submarines identical in appearance to our early Polaris ships apparently nearly meet the goals of the Soviet planners.

In this connection, remarks by two senior DoD officials are

pertinent. At DRUM's launching just short of two years ago, ASD(PA) Daniel Henkin said, "We cannot be unmindful of the fact that within the next two years the Soviets are expected to have between 400 and 500 operational launchers on Polaris-type submarines. And we cannot ignore the fact that at present construction rates of six to eight submarines a year, the Soviet Navy by 1974-75 could match or exceed the 41 U.S. Navy Polaris/Poseidon submarines".

But in his testimony before Congress in January 1972, Secretary of Defense Laird stated, "The Y-class ballistic missile submarine force of the Soviet Union could be as large as our Polaris/Poseidon force by the end of 1973, rather than 1974 as I predicted last year."

The Soviet Navy is their showpiece of progress. From a fleet built around a large force of conventional submarines tasked with defense of the homeland, their Navy has exploded into a worldwide organization operating in all the important ocean areas. They have put to sea not a few, but many, new classes of sophisticated surface ships armed with highly effective surface-to-surface anti-ship missiles.

Their submarine force is slowly decreasing in size. But more than making up for that is the rapid introduction of second and third generation nuclear powered ships, including the Yankees I mentioned before in the strategic role, and attack types of very high speed, armed with anti-ship missiles. These new submarines challenge us and threaten to decrease the wide margin of qualitative superiority which we enjoyed in the earlier days of nuclear power.

This challenge is now—today, tomorrow, and next month.

What is the United States doing about it? We are streamlining and modernizing our armed forces, tailoring them to deter war, and to work with our allies around the world as they build their own forces to the point where they are capable of defending their own lands. We are planning for an all volunteer force, reduced in size as it is improved in quality.

Our strategic forces will be a combination of land and sea based missiles of high accuracy supplemented by safeguard anti-ballistic missile systems deployed on a selected basis.

Our general purpose forces will be an integrated combination of highly effective aircraft armed with potent tactical missiles, an army supported by mobile armor, battlefield missiles and close support aircraft, and a Marine Corps capable of rapid movement to distant trouble spots followed by entry into action using helicopters of modern design.

Our Navy will be shorn of all fat. It will provide the seagoing element of our strategic forces—Polaris/Poseidon today with ULMs to follow. It will be capable of projecting power overseas, if need be, in concept with the Marines. It will contain many new classes of ships designed for the unique tasks the Navy faces, including sea control ships with air power, hydrofoils, surface effects ships, multi-year buy destroyers, patrol frigates, agile and numerous, and highly effective attack submarines of great versatility.

All these new forces, coupled with modernized older units together provide the counter to the Soviet challenge.

DRUM is a part of those new forces, and she knows it! She knows that her systems must be capable of performing to specifications and then some. She knows that she must provide the wherewithal for her commanding officer and ship's company to execute complex, vital missions in support of her country.

And Captain Jim Willis knows this too. His career spans more than 15 years during which he has gained a broad appreciation of Navy missions and tasks. He viewed the problems from the surface in a destroyer; saw complex air operations from his engineering job in our nuclear powered attack carrier; and developed the skills of a well rounded submariner as a result of tours in both attack and Polaris submarines.

This background and keen sense of responsibility have been key factors in Captain Willis' leadership as DRUM progressed from a series of unconnected pieces to the point where she was ready for sea trials. DRUM's crew has now met the rigid standards which Vice Admiral Rickover has enforced in nuclear power matters since before the days of NAUTILUS. His insistence on nothing short of perfection in nuclear design, construction and training makes it certain that DRUM will never be towed home from sea as was one of the Soviet's nuclear submarines in a recent drama in the

rough North Atlantic.

She is fully groomed for the challenge which her forthcoming tactical training will bring—training which will prepare her for vital missions in the deep ocean.

DRUM is the outstanding platform I've described because thousands of people have had a part in producing her. The skill and dedication of the men and women of Mare Island Naval Shipyard—from designers to welders to the fire watches—have made it all come to reality and one of them also is a link between the past and the future.

Rex Pettigrew of Shop 38 was a motor machinist mate in the old DRUM with me. He is here today as he was when Mrs. Rindskopf and I rode the ship down the ways on her launching. To him, to Captain Barnes and to all hands in Mare Island, I say, "Well done."

To Captain Willis, his officers and his men go my admiration and best wishes as they take DRUM to sea as a ship of the United States Navy.

But there is a pang of jealousy in my words. I wish I were young enough to have a part in making history!

Addendum

A SUBMARINE IN A BATHTUB?

My wartime home for three years, USS DRUM (SS 228), spent some 20 years as the Reserve submarine in Washington, DC. Since 1969 she has been moored at the Alabama Memorial Park in Mobile, alongside the namesake battleship USS ALABAMA, as an effective visitor attraction. DRUM has suffered the ravages of saltwater and damage from a hurricane. On 1 August 2001 she got underway for the final time, moving a few hundred feet into a specially prepared dry basin just off the waterfront. There her badly deteriorated stern section will be repaired, ensuring her years of service as a memorial to all who sailed in submarines in World War II.■

A WALLY BISHOP STORY

by CAPT James H. Patton, Jr., USN(Ret.).

As many already know, Wally Bishop was the Chief of the Boat in USS SCORPION (SSN589) when it sank in May of 1968. The name is also familiar to the residents of Bishop Hall, an enlisted living facility on Submarine Base, Pearl Harbor. What follows is a Wally Bishop story that is perhaps not quite as well known.

In the Fall of 1961, SCORPION was on the blocks in a Newport News Dry Dock. She was having her main shaft replaced, since another of the 588 class had twisted hers off (fortunately outboard of the shaft seal) during a surfaced Back Emergency bell. While in dock, some other work had been done involving the watertight integrity of the Torpedo Room, and a 15psi air test of the compartment was in progress. TM1(SS) Wally Bishop was the individual on watch in the Torpedo Room during the test.

Lieutenant Jerry Holland was the Duty Officer, and Ensign Patton, aboard only a month or two, his Duty Officer Under Instruction.

Following the successful air test of the Torpedo Room, the bleeding down of pressure was started. At about 5 psi, there was an explosion in the room, and sound-powered phone communications were lost with Petty Officer Bishop. Looking into the room through the watertight door's deadlight was like looking into a jar of Grey Poupon mustard. Here is where Jerry and my recollections of the events of 40 years ago diverge. I seem to remember that Jerry swung the ventilation system bulkhead flapper open to depressurize the Torpedo room, and that the flapper's O-ring headed for the Engine Room. Jerry recollects that he managed to get his back into the watertight door itself and crack it open. Neither bulkhead flappers, nor even more so watertight doors, are easy to operate with any differential pressure across them, and Jerry Holland isn't one who comes to mind as a big and powerful man. In any case, however, adrenaline served its purpose one way or another, the Torpedo Room was depressurized, and we entered to find Torpedoman Bishop.

He was unconscious, was removed and quickly revived, was dazed but apparently unhurt and was sent to the shipyard's hospital for observation. When the smoke was literally cleared, it became apparent what had happened. The pyrotechnic locker had exploded, blowing its door off, and Petty Officer Bishop had flooded it, extinguishing an intense fire before more of the many other signals, flares and smokes ignited. It remains very credible that he had saved the ship, and that Jerry Holland had, by whatever means, saved him.

The mechanics of the explosion proved to be simple. There were then devices called *deep SEIS* (believe it stood for something like Submarine Emergency Indication Signals). After a safeing wire was removed from these SEIS, they would arm on increasing pressure—as seen when a signal ejector was flooded and equalized, and subsequently ignited on decreasing pressure—about 5 psi—some 10 feet from the surface as it floated up. One of the Yellow smokes had had a defective safeing wire, allowing it to arm as the Torpedo Room was pressurized, and it went off as designed as air pressure was being bled down.

The final bit of the story is that TM1(SS) Bishop was subsequently made SCORPION's Chief of the Boat as a First Class Petty Officer with the unanimous consent of the Goat Locker which, in those early top-heavy days, probably had as many as twenty Chief Petty Officers attached. As far as I know, he continued in that position through the tragedy of May 1968. I think others who knew him would agree with my intuition that if SCORPION had been savable that day, Wally Bishop would have saved it again.■

NAVAL SUBMARINE LEAGUE
HONOR ROLL

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LETTERS

BOB STYER'S SEA STORIES

by CAPT Robert E. Thomas, USN(Ret.)

I just finished reading my July 2001 issue of **THE SUBMARINE REVIEW** and found Captain Bob Styer's *One Submariner's Sea Stories* very interesting. It brought to mind my experience with the start up of the nuclear power training in New London, that involved Bob Styer and other familiar names.

When I was a student in Submarine School in the first half of 1950, I was a bachelor and enjoyed shore leave more than I did studying. In those days, the school posted your class standing for every examination in each of the various subjects. On one set of engineering exams, I stood #55 (out of a class of 60). Realizing my stay in New London might be very short, I did start studying. Near the end of the term I somehow managed to stand #1 on one tactics exam.

Almost five years passed and I received a set of orders to report to Submarine School for duty as an instructor. Along with the orders came a letter from the school asking what department I thought my *talents* could best be utilized in. Remembering the above related experiences, I stated I should be in the Tactics Department. When I reported, guess where they assigned me; Engineering!

I had only been teaching a couple of months when the school O-in-C, Captain Cy Austin, told me to accompany him to a briefing at SubLant headquarters. Being a lowly Lieutenant, I took a seat in the back of the conference room. Admiral Rickover was the main attraction of the day. I am not sure, but he may have been a Captain at that time. He told the assembled group that all officer students going through the school must have at least six hours of indoctrination in nuclear power. Some of the World War II skippers, notably Slade Cutter and Pinky Baer, had some rather strong comments about where all of these officers would be assigned, since NAUTILUS was just starting to operate. Rickover prevailed and it was determined that since the nuclear power plant turned the propellor, that subject would be assigned to the Engineering Department of the school. I now found out why I had been taken to the meeting. To ensure some continuity, it was determined that the instructor who had the most time remaining on his tour of duty as instructor would be the nuclear power instruc-

tor. Since I was the last officer to report for duty in the Engineering Department, that mantle of responsibility fell on ME!

In March of 1955, Captain Austin and I flew to Idaho and spent a few days being briefed by Bob Styer and Bob Crispin. I remember that our orders specified that Cy Austin and I wear civilian clothes to Idaho, instead of our uniforms. Upon my return to New London, I went to NAUTILUS and gathered up some old movies, and overhead projector slides from Les Kelly and Nick Nicholson. I now had about two or three hours of material present. My problem was that I was allotted six hours to present the material. The individual class sections in those days was ten officer students. I managed to fill the six hours with some instruction, liberal and lengthy coffee breaks, and a slightly early dismissal from class in the afternoon session. I thought I was managing to get through the material in a somewhat satisfactory fashion, when I was asked some questions from a Lieutenant (jg) Carl Trost that I could not answer. After teaching the subject for about two classes, Bob Styer and Bob Crispin came to New London and took over my duties in a very outstanding manner. Some of my old students may remember those days.

Captain Thomas was commissioned at NROTC University of Notre Dame in 1945 and served in surface ships for four and a half years before starting a submarine career that lasted for 19 years. He finished his career in the amphibious Navy and retired in 1970.

MORE ON GREENEVILLE AFFAIR

Reference is made to "A Minority View on GREENEVILLE by Captain Byron in the October 2001 **SUBMARINE REVIEW**. It is considered the scope of the enquiry proposed by Captain Byron is far more extensive than required or appropriate.

From time to time in all walks of life new procedures are introduced and become standard practices without recognition as to some of the risks involved. Perhaps this occurred with the submarine emergency surfacing procedure.

It is accepted that in a real emergency there may be attendant risks associated with the submarine emergency surfacing procedure.

However, when practising or demonstrating the submarine emergency surfacing procedures the possibility of encountering such risks must be reduced to a minimum. There are so many vagaries involved: the visibility for the last all-round look; the submerged time and speed prior to initiating the emergency surfacing procedure; the inability to ensure sound detection due to the capricious nature of underwater sound detections; etc.

Therefore, to minimize such risks it would seem prudent to only practise or demonstrate the submarine emergency surfacing procedures when airborne surveillance is available to monitor the area and, if surface contacts enter the area, is able to initiate a signal signifying "STAY DEEP AND CANCEL THE PRACTICE OR DEMONSTRATION SUBMARINE EMERGENCY SURFACING".

If such a policy directive exists, it was obviously ignored. If such a policy directive does not exist, one has to wonder why.

Respectfully,

E.G. Gigg
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SYMPOSIA INFORMATION

The Submarine Technology Symposium will be held at Johns Hopkins Applied Physics Laboratory May 14-16, 2002. Register online: www.jhuapl.edu/sts.

The annual NSL Symposium will be held June 12-13, 2002. Registration packets will be mailed to NSL members in April.

BOOK REVIEW

DEATH ON THE HELL SHIPS:
PRISONERS AT SEA IN THE PACIFIC WAR
by Gregory F. Michno
Naval Institute Press, Annapolis 2001
ISBN 1-55750-482-2

USS PAMPANITO: KILLER ANGEL
by Gregory F. Michno
University of Oklahoma Press, Norman, OK 1999
ISBN 0-8061-3205-1
Reviewed by CDR John D. Alden, USN(Ret.)

These two books by the son of a submarine veteran contain much of interest to readers of **THE SUBMARINE REVIEW**. By virtue of extensive research in archival records, accounts of former POW s, and interviews with survivors, Michno has compiled an appalling history of Japan's mistreatment of prisoners of war on the notorious *hell ships* that transported thousands of them throughout the Pacific. Of some 126,000 captives who sailed on these ships (all that can be verified from incomplete records), over 21,000 died. Of these deaths, about 93 percent were caused by *friendly fire*, i.e., U.S. and Allied submarine and air attacks.

The author was drawn into this area of study because his father, Frank B. Michno, served as a Motor Machinist's Mate on PAMPANITO (SS 383) during the war. What started as a memoir of his father's career expanded into a history of the submarine and its crew, and ultimately into the broader subject of the Japanese POW transports. To Michno, what most distinguished PAMPANITO from other wartime boats was the fact that it "rescued more men at sea than any other American submarine." These men were prisoners of war who had been incarcerated on RAKUYO MARU, one of the victims of an attack on convoy HI-72 by a wolf pack consisting of PAMPANITO, GROWLER (SS 215), and SEALION (SS 315), during which hundreds of less fortunate POW s met their deaths.

Michno notes that a few U.S. intelligence personnel often were aware from decrypted Japanese messages exactly which ships in the convoys were carrying POWs but for security reasons were

forbidden to pass such information to the submarines on patrol. Even if skippers had been made aware that their own countrymen were in jeopardy, the author acknowledges that it would have been impossible for them to single out these ships and avoid torpedoing them without letting entire convoys escape untouched.

Although survivors almost unanimously described the *hell ships* as ancient rust-buckets or worse, the prisoner transports actually seem to have been typical examples of the Japanese wartime merchant fleet. In fact, the crowded holds filled with makeshift tiers of wooden shelves were probably the same accommodations normally provided for Japanese soldiers and refugees, who often occupied other compartments on the same ships as the POWs. However, the already weakened and sick prisoners were clearly the victims of terrible neglect, denied access to fresh air or sanitary facilities, provided with wretched food and insufficient or polluted water, and too often subjected to sadistic abuse from their captors. Under the circumstances, it was remarkable that any prisoners at all were able to survive the sinkings long enough to be rescued by our submarines.■

In May 2002 a coffee table book entitled ***United States Submarines*** *will be available in bookstores. The book covers the first 100 years of the Submarine Force. It contains over 730 magnificent photographs and twenty-three captivating articles; most are written by veteran submariners such as John Alden, Ned Beach, Bill Crowe, and Joe Williams to name a few. One will enjoy just flipping through and looking at the photographs. Perusing the captions will convey a higher level of understanding. Reading the text of an article will be quite educational and insightful. Those of us who have seen the preliminary work believe it will be a knockout.*

The book will sell for $75. The Submarine Force Library and Museum Association is planning to offer an early release copy of the book for a charitable donation of $100 or more. In addition to the book and a substantial tax deduction, the donor will receive a one-year membership in the Association. Among other benefits, Association members receive a 10 percent discount on Museum store purchases. Donation orders will be taken once the book is printed, probably in March of 2002. You will be kept informed.