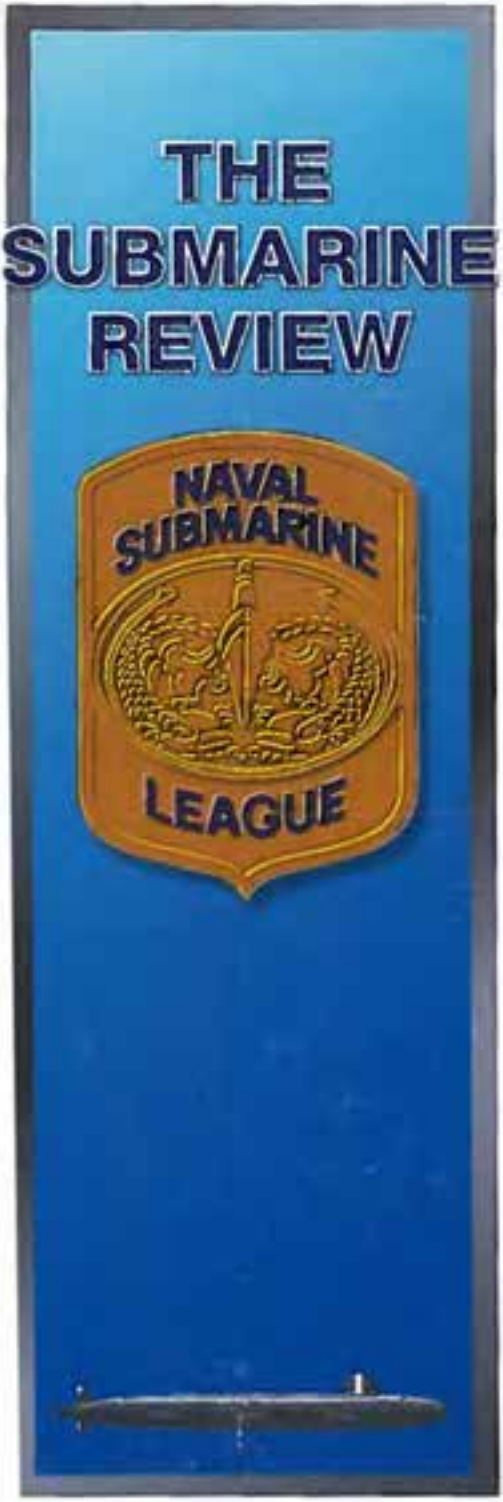

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EDITOR'S COMMENTS

This issue of **THE SUBMARINE REVIEW** continues the evolution of what we hope to be our new cover on the front of the January 2001 issue. We would appreciate any comments about the covers which appear on April, July and October issues of this Centennial Year as we decide on the final form. It seemed like a good idea to do all this colorful innovation during the time when so many other submarine-related events were taking place. Some may ask whether we are adding to the overall gaiety of the celebration or hoping to hide our changes within the excitement—but we think our heart is in the right place as we try to spice up the staid, sober and serious magazine just a little.

In addition to the normal sections on *Features, Articles, Reflections, Letters* and *Book Reviews* (normally there is a section on *Discussions* as well but we have a special case to present for that which we are holding for the next issue), there are two special interest sections in this issue.

The first special section relates to the recent tragedy of Russia's loss of the guided-missile submarine KURSK, which has prompted several germane comments about submarine disasters. We have articles both in the specific case and, more generally, in the possibly related area of internal weapon initiated submarine losses. The former comments, about the KURSK affair itself, are by a retired Russian officer experienced in submarines and in current defense industrial conditions within Russia. The Royal Navy's experience with hydrogen peroxide powered weapons are related by an old friend of the **REVIEW** who was intimately familiar with the tragic incident which resulted in loss of life and the sinking of an in-port submarine. Another account of a weapon/submarine disaster is related by the co-authorship of the retired Russian officer who was Exec of the Yankee submarine K-219, and a young American submariner also familiar with the incident in 1986 which we all watched unfold fairly near our own shores.

A second special section is presented as a *Point-Counter Point* set of views on the "women-in-submarines" issue which the Secretary of the Navy raised with the Naval Submarine League at

the Annual Symposium in June of 1999, and was strongly commented on by the Defense Advisory Committee on Women in the Services (DACOWITS) this past Spring. Three views are presented in the form of previously published articles. One, from the pages of the Naval Institute's PROCEEDINGS, is strongly in favor of the DACOWITS recommendation for assignment of women to submarines. The second article, from the Center for Military Readiness, is strongly against the proposal. The third commentary, also from PROCEEDINGS, is by a former Chief of Naval Operations with militarily cogent comments on the effects of such assignments.(It should be noted in the final of those three that titles of commentaries, as with all articles, are frequently determined by the Editor of the publication.)

Besides the two special sections, of course, there is much in these pages to inform and, in some cases, even delight the submarine community at large. *Letters* are here both to congratulate all of us and to ask questions about some instances which only a few will remember. A particularly well-put Memorial Day tribute is repeated (we apologize for the three month delay in delivery but it just would not fit into the July issue), and the saga of rescuing one of the Fleet boats for display reminds us of the tremendous effort exerted by dedicated volunteers all over country in presenting these memorial submarines to the public. The history of the Force is also addressed as a specific subject unto itself and begs comment from those with ideas as to how best to pass along those stories to the ones who come after us.

In his *From the President* letter to the membership immediately following these comments, VADM Dan Cooper specifically recommends both the *Feature* entitled Asking the Right Questions and the *Article* Preparing for War: Now or Later. In addition to those two, one should take particular note of the concepts put forth in his Address to the Annual Symposium by the Director of OPNAV's Submarine Warfare Division, also one of the *Features*. And we would be remiss if the tributes to two of the Submarine Force's outstanding officers were called out for special attention by all. As always, we can all learn much from men who have done great things in trying circumstances.

Jim Hay

FROM THE PRESIDENT

As usual **THE SUBMARINE REVIEW** has several thought-provoking articles, not the least of which is that of the tragedy of KURSK! I do not think any submariner will be surprised by the author's thoughts; however, it might be interesting to note that in the case of KURSK, as well as in the loss of Yankee K-219, the Soviet/Russian Navy and government originally stated a collision was responsible for the ultimate sinking of each. In neither case was that true.

Two additional articles which I strongly recommend to all are authored by Rear Admiral Jerry Holland and by Mr. Brian Ferren. In today's difficult period of resources, both diminution and allocation thereof, these two thoughtful discussions should cause us to better understand where we are and help to decide where and how we must get to where we want to go.

We have had an eminently successful year. As stated in Admiral Hank Chiles' and Dave Cooper's article, the League has been the primary catalyst in the successful celebration of the Submarine Centennial. I recently visited again the Smithsonian's Exhibit "Fast Attacks and Boomers" and although I have never liked the term *boomers*, the exhibit has been a tremendous success. We owe those primarily responsible in organizing it, as well as those who contributed time, components and money our gratitude. This is not just a biased statement—it has been reiterated in several publications and by all to whom I have talked after a visit.

Dan Cooper

FEATURES

I REMEMBER DICK LANING

by CAPT Charles S. Carlisle, USN(Ret.)

On June 15, 2000 I was privileged to attend, along with his family, classmates, and shipmates, an inurnment and memorial for my good friend and mentor, Captain Richard B. Laning at Arlington National Cemetery. The occasion brought back cogent memories of a truly remarkable officer.

It was my good fortune to serve as Dick's commissioning engineer officer and, later, executive officer on USS SEAWOLF (SSN 575) during the Navy's first experiences with submarine nuclear propulsion. To have served under his command and tutelage during that 1950s period of technical challenge and development was indeed unique.

SEAWOLF, the second nuclear submarine to be built, was powered by a developmental liquid metal cooled reactor. There were schedule delays during construction and activation caused by heat exchanger problems, which eventually prevented realization of the full potential of the design, and contributed to the decision not to continue that development in the Navy. However, the ship was completed and delivered to the Navy with that propulsion plant, and operated for two years without further problems.

During the extended pre-commissioning period Dick's unique leadership and vision came to the fore. As PCO, in addition to maintaining excellent working relations with the Bureau of Ships, the shipyard, and the sponsoring engineering laboratory, he used the extra time to organize, train and develop the wardroom and crew. There was continuing attention to the training, qualification and promotion of each man. He gave individual members and groups of the crew unique opportunities to gain professional training, insight and experience beyond their Navy ratings. He placed special emphasis on cross training, broadening of capability, and teamwork. And he built self confidence and morale.

SEAWOLF went to sea in 1957 with an exceptional crew, trained, self confident, and ready to meet whatever might be the challenges—and they did just that. At sea, Dick Laning combined his extensive WWII and prior post-war submarine development

experience with imagination and determination to achieve operational excellence. Under his unique leadership and vision the ship established a remarkable two year operating record, breaking new ground in the tactical use of this new type of submarine.

The operation of that ship under Dick Laning's command was a study in fine leadership. Control of the ship, and the conduct of its internal functions, went on quietly and efficiently. He very seldom took command, or gave direct orders. His role was largely that of coach, tutor and advisor, everywhere on the ship. Each officer and petty officer was given all of the responsibility he could handle, was challenged to meet it, and praised for doing so. Disciplinary problems were almost unknown. Good humor and comradeship were the order of the day.

I remember Dick Laning as a man of vision and ceaseless energy. Highly educated, and an avid reader, he was in continual pursuit of new ideas and technical innovation. He had little patience with doctrine and established procedures. He had vivid memories of his experience as a junior officer on the aircraft carrier HORNET in the early days of WWII in the Pacific, and as executive officer on the submarine SALMON during an engagement with the Japanese which nearly caused the loss of that ship. From those experiences he saw and valued technical competence, imaginative action, and innovative leadership.* And he was an inspirational leader. As a great submariner, he served his nation well!■

*Editor's Note: See the following for a bit more about Dick Laning, a teacher to us all.

- SALMON Survives Harrowing Ordeal, Capt. R.A. Bowling, Pg. 101, THE SUBMARINE REVIEW, July 1998.
- Dog Fighting Submarines, Capt. R.B. Laning, Page 107, THE SUBMARINE REVIEW, April 2000.

CAPTAIN JOSEPH F. ENRIGHT, USN(RET.)

Reprinted with permission from The New York Times, July 26, 2000.

Captain Joseph F. Enright, the skipper of the submarine ARCHERFISH, which sank the largest aircraft carrier of World War II, a Japanese ship whose existence had been unknown to the United States, died Thursday, July 20, at his home in Fairfax, Virginia. He was 89.

For directing the sinking of the carrier, SHINANO, Captain Enright, a Commander at the time, was awarded the Navy Cross, the service's second-highest award for valor.

Shortly before 9 on the evening of November 28, 1944, while ARCHERFISH was on surface patrol near the entrance to Tokyo Bay, its radar picked up a ship 12 miles away.

Commander Enright thought it was an oil tanker, but about an hour later he realized it was an aircraft carrier escorted by three destroyers.

The ship was SHINANO, envisioned as one of three super battleships, together with YAMATO and MUSASHI, but converted to an aircraft carrier after Japan lost four carriers at the Battle of Midway in June 1942.

It displaced 59,000 tons, according to post-war American estimates, making it the largest aircraft carrier that had ever been built, and it had extra armor to defend against torpedoes, the Japanese considered it to be virtually unsinkable.

Three hours before it was spotted by ARCHERFISH, SHINANO had departed in haste from Tokyo Bay on its maiden voyage.

Final checks on watertight doors had not been completed, and the crew was largely inexperienced, but Japanese naval commanders feared the carrier would be seen by American bombers, which had begun attacks on the Japanese mainland.

SHINANO was sailing west, to Kure, where it was to undergo finishing touches, take on fighter planes and bombers, and then enter the Inland Sea to defend the home islands.

SHINANO's lookout spotted ARCHERFISH at 10:45 PM. Over the next four hours, SHINANO's commander, Captain Toshio

Abe, fearing that he was being pursued by a pack of submarines, zigged and zagged in an effort to escape.

But at 3:17 the next morning, ARCHERFISH fired six torpedoes at SHINANO from a distance of 1,400 yards. Four torpedoes struck the carrier.

In his memoirs, "SHINANO! The Sinking of Japan's Secret Supership," (St. Martin's Press, 1987), Captain Enright described the moment:

> "I saw a huge fireball erupt near the stern of the target. Then we heard the noise of the first hit, carried to us through the water. 'Got 'em', I yelled. As I continued to peer into the periscope, I saw the second explosion rip the target's hull eight seconds later. 'Yahooooo!' I cried to myself."

ARCHERFISH, named for a freshwater fish in Australia and Asia and with a crew of 81, dived to 400 feet, eluded 14 depth charges from the destroyer escorts and escaped.

SHINANO had been designed to survive perhaps 20 torpedo hits but had been rendered vulnerable by inadequate and incomplete construction.

It sank at 10:55 the next morning with Captain Abe and hundreds of sailors still aboard. The destroyer escorts picked up 1.080 of the carrier's 2,515 sailors and civilian workers.

Neither of SHINANO's sister ships survived the war. The battleship MUSASHI was sunk in October 1944 and the batttleship YAMATO was sunk in April 1945.

Joseph Francis Enright was born on September 18, 1910, in Minot, North Dakota and graduated from the United States Naval Academy in 1933.

Only a few months before the sinking of SHINANO, Commander Enright seemed destined for an undistinguished naval career.

He had served three years aboard the battleship MARYLAND, and then entered the submarine service.

In the fall of 1943, while skipper of the submarine DACE, he received an intelligence report giving the position, course, and speed of a Japanese aircraft carrier, SHOKAKU.

But he had been unable to maneuver his submarine to make an

attack, and had allowed the carrier to pass unscathed.

Upon returning to Midway, he was so chagrined that he asked to be relieved of his command.

The Navy transferred him to administrative duties, and it was not until September 1944, when he was given command of ARCHERFISH, that he received a chance at redemption.

He retired from the Navy in 1963 and then worked for the Northrop Corporation, helping to design navigational equipment.

He is survived by a sister, two grandchildren and five great-grandchildren.

In August 1945, Commander Enright visited Dock No. 6 at the Yokosuka Naval Shipyard in Tokyo Bay, where SHINANO had been built.

On September 2, 1945, Commander Enright and his crew were present for the final chapter of World War II. ARCHERFISH was among 12 American submarines accorded the honor of standing by in Tokyo Bay as Japan surrendered aboard the battleship MISSOURI.■

IN MEMORIAM

CAPT Joseph F. Enright, USN(Ret.)
Mr. Sven Rahmberg
HMC(SS) Ralph T. Riley, USN(Ret.)

ASKING THE RIGHT QUESTIONS

by Bran Ferren
President, R&D and Creative Technology
Walt Disney Imagineering

A presentation given at the Submarine Development Group TWO and Submarine Development Squadron TWELVE 50th Anniversary Symposium, May 21, 1999.

I am truly delighted to be here. I have had great pleasure and have built great admiration since I have worked with a number of people, Admiral DeMars and others in this audience, over the past year or two. You have my admiration and respect, and please treat any of my comments today as coming from that perspective!

I am going to talk to you based upon my vast-at-sea experience of two days on ALEXANDRIA. I think this qualifies me to speak in your behalf and to talk about your future! If I had to find the one thing that was most impressive to me about my trip out on ALEXANDRIA, it was the superb quality and teamwork of the crew. I think the real asset you have on every single level is the quality of your people. That's what got you here, it's what's going to get you into the future, and I found that to be truly refreshing and remarkable because I don't see that in a lot of other places that I'm asked to visit. You should be very proud.

I'm not going to talk to you today about information superiority, about INFOSEC, about information management, and all of that stuff because it's really boring and lots of other people can talk to you about that. We are in the middle of a frenzy these days where people are providing really wonderful answers to the wrong sets of questions, so part of what I'm going to talk about is the process of asking the right questions, and I'll let you worry about getting the answers.

You can't or shouldn't talk about information technology without the top of your list being people, because all this other *junk* we have in computers and technologies—this computer thing—is going to blow over relatively rapidly, and we will be left with

something which is actually useful, intelligent, and helpful. You should not mistake the fact that any of the technology we currently have in computer technology is that—it's primitive, it's bad, it gets in the way of things rather than helping things, and the sooner we recognize it as being that, the better. At the same time we have nothing better, so part of our challenge is to learn how to manage through this rather embarrassing period in the evolution of computer technology until we get to some level of wisdom which, because the rate of change is accelerating so rapidly, will be sooner than anyone would imagine from looking at history to this point. It's not just changes *happening*, but the rate of change is *accelerating* in a way that we have never seen before in any area related to technology, with the possible exception of the first critical technology, which was language, which enabled us to cease being a herd animal and build a civilization.

The first half of this talk is going to be about people and leadership because I think *that* ultimately is the secret to success in information technology. The second half is going to be about my observations of what I've seen in the submarine fleet. And the third half will be about what I see as being the biggest challenges facing you! Interestingly enough, I just finished an intelligence community talk about a week ago, and I find the parallels between the challenges and opportunities facing the submarine fleet and the intelligence community to be quite remarkable. The notion of transitioning out of the Cold War way to thinking, of grappling with technology, of grappling with an aging population when the future is youth, is a very common set of challenges and issues.

Why focus on people rather than technology? It's very simple. We understand *exactly* where the technology is going. We have all sorts of really great rules of thumb, like Moore's Law, which reinterpreting what Gordon Moore said, is that at constant dollars the power of computation doubles every 18 months. People said the power of computation was going to run out 20 or 30 years ago; it didn't. People are now saying it will run out because of feature size and whole bunch of other things; it won't. Just assume for the next 20 years you're going to have that increase in performance, and you'll be largely accurate. What you can't predict is social phenomena, cultural phenomena, and the sorts of things that we go

to war for. Therefore, that's the interesting area to focus on because it's the unpredictable domain.

Part of our challenge when we look to the future is to understand that our vision of the future on one level evolves, but at the same time comes back to things we know and understand. Why? Because fundamentally although our technology is changing very, very rapidly, we as humans are not. The same basic motivations of love, fear, passion—all the things that have motivated us for hundreds of thousands of years—still motivate us. Which is why, at the turn of the century, the vision of the utopian American society was a little house in the country with a green lawn and a white picket fence—it evolved through the Jetsons, it evolved through the General Electric house of the future, it evolved through a whole bunch of things. Right now it has evolved to, at the turn of the next century, and in fact, the millennium, the vision of a little house in the country with the lawn and white picket fence and an Internet terminal. We come back—we come back because we are motivated by the same basic human needs and desires. Incidentally, those desires are why we go to war.

I feel a bond with many of you in this room because you are the leaders who are going to make the sorts of changes necessary to keep this country and the way of life represented by the free world constant so that it is meaningful, so that it retains passion—and passion is the most valuable asset you have in this room—and so that it guides us into the future. Leadership and where leadership comes from is something I have studied a bit, and I find it fascinating and confusing.

There was a great study commissioned by another armed force that shall remain nameless—the Army—that looked for who makes the best leaders. What they wanted to find, using the traditional technique of scenario planning where you plot important axes against each other, was who makes the best leaders. The challenge was determining which axes are the most important determiners of leadership. The first axis they picked—and needless to say it has to be something that applies across an organization—was *smart to dumb*. In every organization—in this room— one of you is the dumbest person, and one of you is the smartest. The other axis was

lazy to energetic, because the same thing applies. After a relatively minor extensive study, it was determined that if you're looking for the global leaders of tomorrow, you don't start with *lazy and dumb*. At the same time it was kind of interesting because *dumb and energetic* turned out to be much worse when you reviewed the data; I will let you reach your own conclusions! It started to be counter-intuitive for me because it turns out *smart and energetic* isn't so hot either. These people are a *big* pain the neck; they get out, terrorize everybody, are really annoying, nothing is ever good enough for them, and you can't wait for them to get out of an organization. Turns out *smart and lazy* won because ultimately they make the best leaders. They delegate well, they certainly don't want to do all the work themselves, so they're happy to find people who do it for them. There's an old saying, "A's hire A's, but B's hire C's", and you see this in organizations. When you have the best and smartest people and the laziest leaders, they build phenomenally powerful organizations.

Now so what, why did this matter? Well, it gave me the impetus to start thinking about the kinds of people that build organizations and make decisions. There are, in fact, two kinds of people in the world—there are people who believe there are two kinds of people in the world and there are people who do not. However, of the two types of people who are most relevant to a lot of what we do and a lot of what you do, the first type I would call a *requirement person*. Requirements people believe that you put together a team, a requirements team—you study the problem, you go talk to the customer, you listen to the customer, you look at past history, you look at the competition, you do research and development, you test it, you do focus groups, you do a whole bunch of things designed to get you a thing called a *requirements document*. Once this is bought off on, you toss it over the transom to a bunch of people you've never met or seen before; they go act upon it, they build it, it gets tossed over to another bunch of people whose job it is to take it and use it. Sometimes these are contractors, sometimes government users—it varies. You then wait, and you get to see if it was any good, if it was great, everybody basks in the reflective glory of a process well done. Incidentally, you can tell if you're a requirements person in a requirements organization because

requirements people tend to build requirements organizations. People make the vast mistake of building their organization based upon consensus—people that agree with them—rather than diversity—people who will challenge them—but that's a common to human behavior. But if you have viewgraph projectors in your conference rooms, you're a requirement organization—simple as that, and you know who you are! Now if the outcome is a great success, everybody's happy. If it isn't, you begin to search for the guilty party. The first thing you do is compare the end product with the requirements document. If they agree, you kill the requirements team because they clearly didn't take their job seriously or were not competent enough to the task. If they don't agree, you kill the contractor because clearly they were irresponsible, spending your taxpayers' money irresponsibly, and bad human beings.

Incidentally there's a *big* thing these days about bringing creativity into requirements driven organizations. Understand that in many requirements organizations, this is not only undesirable but inappropriate. For example, if you manufacture penicillin for a living, do you want every employee on the production line leaving a mark on the molecular structure of the drug? The answer is probably not; to acknowledge their creativity isn't necessarily helpful and is often destructive as a good first step.

The second type of person I would call a *big idea* person. Big idea people are different. They would never dream of talking to the customer because all you get from talking to customers is minor incremental events, as they are bound and trapped by what they know. Instead, you get people who are a lot smarter who just figure it out and say trust us they're going to love it when they get it". Big idea people don't believe in the high watermarks of the requirements process or freezing the requirements early. They think it's a crime against nature to freeze a requirement because it precludes the ability of continuous improvement—the notion that you constantly iterate, make things better as yo go, including even after they ship. Big idea people don't believe in metrics because their notion is that what they do is largely qualitative, and by definition you can't apply metrics to a qualitative process.

Interestingly enough, the most effective organizations—and I would argue a necessity for organizations that will survive in the future—are those that can combine big idea thinking and requirements thinking. We're one of them, and incidentally Imagineering is 48 years old, so fairly comparable with this organization. We build theme parks that cost billions of dollars. They're built out of bricks, mortars, bits, bytes, and electrons, and if you don't put them in the right place in the right sequence, you go over budget and you don't open on time. At the same time if you finish under budget and ahead of schedule and it's boring, our business model collapses because we make all our money in the last ten percent which is typical in theme and entertainment businesses.

Now what's your problem? So you just get some big idea people and requirements people; you put them together. Here's the problem—they hate each other. They despise the ground the other walks on. Requirements people think big idea people are irresponsible, out of control, undisciplined, incapable of being team players, dress funny, etc., etc. I won't elaborate much on what big idea people think about requirements people, other than to say they believe it drains the life force out of the room to merely have one present. Big idea people treat this idea that requirements people talk about —*out of the box* thinking—with great amusement because it never occurred to them there was a box. It's only requirements people who believe there is a box that you have to think out of.

Why is this relevant? Because, again, our success and your success depend upon combining big idea thinking and requirements thinking. The success of the United States of America depended upon it, and there was a big idea called the Bill of Rights. How is it that a set of instructions for how to run a nation that's 200 years old is working as well or better today than when it was instituted? How many of your processes and procedures or specifications or protocols work well two years later, five years later, when they are delivered? It's because it's a different philosophy; it's underpinning the very fundamental set of why human beings should react to each other in a civil way to proceed with an orderly society. It gives you the flexibility for dissent, it gives you the ability to change your mind and refine things, it has provisions for all of that.

The idea of the nuclear Navy and the nuclear submarine fleet

was a big idea. It was not obvious, it was not straightforward, it was not just a matter of engineering—it was a big idea. The reason we did as well as we did in Iraq and are now having as few lives lost in what we're doing in Kosovo was because of an Army general's idea called *Own the Night*. Very simply stated, he wants to be able to fight as well at night as he does in the daytime. That's a big idea, and with it all of the people who work on radar, electro-optics, and everything else can develop the series of requirements necessary to be successful.

Part of the challenge here is that big ideas are always expressed as one sentence. It might be a compound run-on sentence, but it's one sentence, and that sentence is one of the essential components of leadership. The first challenge is identifying the vision; the second one is articulating it and motivating people to do things they never believed they could do before. What I would argue you need is a vision for information technology and the next 50 years of the nuclear Navy and the nuclear submarine fleet. Part of the challenge is it's hard to do this type of thinking, and it's almost impossible to do it inside organizations that require consensus because individuals are trapped by their own experience.

When I was on ALEXANDRIA, which was a great experience, I was struck that there are two different types of people who designed ALEXANDRIA. One type was propulsion people, and the other type was everyone else. Propulsion won, because when you look at the back of the boat and compare it to the front of the boat, the back of the boat is a beautifully designed, conceptualized, and implemented system. Clearly systems engineering ruled: it was beautifully integrated; things were not covered up to make them pretty but they were designed to be accessible; things were intuitive to one skilled in the art as to what they did and how they did it, and so forth. You go to the front of the boat—the command control area—and it looks like a weekend at Radio Shack and a meg welder. Basically, the philosophy seemed to be that electronic technology and information technology make a nice decorative contribution, but shouldn't otherwise interfere with the operation of the boat.

Now at some time in the past this may have been a sensible

perspective and in fact, I would argue, as recently as 20 years ago. And you know, seawater and high performance electronics—it's not a good thing to start with. The idea of these narrow-band interfaces like CRTs and other things—all of it seems perfectly sensible. What happened as this technology was introduced is we got a progressively better series of nice boxes that all independently work reasonably well, don't talk to each other, aren't integrated, and most importantly, aren't integrated into the sensibility of the people in the leadership position. They are a decoration for the command and control system.

Now if you're thinking that you're at an advanced stage of digital technology, you're not better off than any of the rest of us are—that's primitive junk! It's important to remember that because we are at a very primitive stage in the evolution of digital technology. I would argue what is known about acoustics relative to the submarine fleet is barely known. You think it has gone as far as it can go—I would argue that why do you think the head of IBM, Watson, when he was asked what the potential market for computers was, answered "five or six" when they introduced the first mainframe computer. That's where you are in understanding undersea acoustics. If you believe that you have a sophisticated knowledge of it, if you believe the mission is training people to understand decibels, acoustics, and propagation phenomena, you're wrong. Machines should understand that, not people. People should have the information presented to them in such a way that they can naturally assimilate it.

There is a terribly dangerous fiction that the big danger for the war fighter—and it's not just submariners but everyone else—is information overload. These poor people—their brains are going to crumble if they get another little bit of information and you've just got to filter it, simplify it, make it more basic. Nonsense! If you digitized this room at the resolution that a human being can perceive it and move around in it, this would be somewhere between 100 terabytes, 10 pedibytes, somewhere in that range of information. Any of you have trouble downloading a 100 terabyte data base when you came in here this morning? Did you have trouble understanding the use of the seat? Was there any ambiguity about which way to face? When someone talked to you, did you

have to understand and recognize all the people in the room to be able to parse who it was and what they were saying to you? No, because this information is presented to you in a way that millions of years of genetic and biological history has attuned you to be able to deal with.

The challenge in information technology in submarines is to get the information presented for the war fighters in such a way that it is natural to the way they process information, so that if a target is over there and it's acoustic, it sounds like it's coming from over there rather than some ambiguous place. We have taken the ability for human beings to grasp abstraction, which was one of our great gifts, and used it as a weapon against our own effectiveness. The fact that we can grasp abstraction means we can read and write because there's no logical extension of language that gives you reading and writing. It's a pure abstraction, and we parse things in multiple layers (some other talk I can talk to you about that) because it's a complete abstraction yet we've learned it. I would also argue incidentally that it's a fad and in 250 years we won't be reading and writing; it will have been replaced by something better because it is an abstraction and therefore it's vulnerable.

What's natural is the way we process language. What's natural is the ability to do sensor fusion. We talk about automatic target recognition—it's all nonsense. The only system that's ever been able to do that is a human being. Why? Because there is a big difference between information and knowledge, and while there is an explosion of information going on at the moment, there's no such explosion of knowledge. The amount of good guys, bad guys, countries, square miles on the planet is all largely the same. So if you're thinking about it as this huge increase of needles in haystacks, you're wrong. In the needle and haystack analogy, we are dealing with finding a constant number of needles and having exponential growth of hay. A scientist would say the signal-to-noise ratio is deteriorating. One of the critical things to understand in information systems is that your challenge is not processing that. It's also not filtering, because filtering is a flawed concept. Until we can do context based filtering, the stuff that you care about in this world is not the stuff you knew about in advance. Every

technique we use in the submarine these days to reduce the amount of information, because of this false belief that we need to give a person less information, is based upon only passing through what we understand. But nothing in life that's interesting is something that you understood before. The novel stuff and the stuff you need to know as a war fighter is that which you've never seen before. Our information systems won't pass that at the moment; they filter it out because they don't know the difference between it and noise. At the moment, there's only one system that will do context based analysis information—a human being.

Now, why is this relevant? Because when I was on the submarine, I had *no clue* as to where I was. None of the information systems made any sense for me to get at that. If I'd had a window, it would have helped. I could have looked out and said at least I was under water. I didn't know; there isn't a light that goes on that says "you're under water". The fact is you have no sense of where you are. You can talk all you want about battlespace and information display and so on, but at the same time we make it so abstract, you don't know where you are. Certain people have the ability to think in three-dimensional space; they can work through these abstractions, but they are a very isolated group. The promise of information technology, not at the primitive state we have now but later when we do ultra wideband interfaces to human beings, is to relieve this, to give us a sense of where we are and what's going on in a way that millions of years of genetics help us to appreciate.

ALEXANDRIA did a maneuver where it surfaces quickly (emergency blow, which in our industry has a whole different connotation). They explained to me that we were going to surface as quickly as you possibly can—hold on and so on and so forth—deafening noise, everything's happening, everybody's looking at each other. Twenty percent of the people in the crew had never been out at sea, and this was pretty impressive. You're leaning back, and you're image is that this thing is rocketing skyward. We break the surface and then lay over—very impressive. Well, you know, think about it folks. The boat is 600 feet long, and we were 600 feet down. All the boat did was lay on its side, poke its nose out, and fall over. But you have no sense of that; you think all hell is breaking loose. You know, the boat is

longer than the depth we were down, for goodness sake. Do you think if you submerged under the water five and a half feet and then blew your way to the top, anyone would be impressed? I mean, let's get real here!

At the moment all of the thinking that I see going on submarines is analog thinking. Not surprising—the ocean is analog, people are analog—they think analog. And as long as you think that the digital stuff is designed to complement the analog rather than fundamentally be the intellectual space—the decision space—that you're working in, it's going to remain like that. I don't want to criticize what I saw on the boat because I see it as enormous promise. I think we can start to understand, however, that the most valuable technology we have on our submarines at the moment is the human beings, and understand that the problem with the way we're dealing with information technology is we have a whole variety of sensors—some smart, some dumb. These sensors give us an enormous bandwidth of information, so the front end signal processors take this bandwidth and reduce it down. Smart people sitting at some Navy lab then figure out what signatures are, Doppler components, and all sorts of other things, and they reduce it down. After that other people say, "Well, you know, we have operational protocols, we have to divide it up"—they do a bunch of things. These get further reduced down to successively smaller paths of information until there's a sonar display, there's a position display, and so on. Then this interfaces to a human being, the only ultra live-band multiple data path knowledge extraction parsing system ever developed.

Now as engineers, or as leaders, where do you think the problem is in the information flow here? This is not *subtle*. This is a crime, and what you're talking about doing now is making it *smaller* because of information overload. It makes no sense at all. The strategy needs to be to get wideband interfaces into the human being, put people in collaborative information spaces. Right now I could say, Quick! Let's find out what fire protection is in this room." By observation, we can instantly put together a relatively good first guess at what the total fire control management system for this room is. We can talk to each other collaboratively. I can

say, "Gee, look over there. Am I missing a firebox? Is there one around the corner?" Instantly someone can tell me, and we can very quickly synthesize out of all this information terabytes of data. We don't have to sort through a pedibyte of data and do data analysis and reduction. We just all look at the room; we talk to each other. You log it, you appoint someone to keep an eye on it, and you move on.

This isn't hard. It's only hard if you turn it into a bunch of technical mumbo jumbo about bit rates and bandwidth—all of that other stuff. It's just nonsense. You know that any time someone says the future of sonar is ultra narrow band, you know that the future is probably ultra wide band. You're doing stuff in the narrow band space just because it's easier to think of algorithmically, but obviously it's going to be more robust to be active low energy ultra wide band and basically let sea state and background noise be your active sources. This has been known forever, but it's too hard to think about because we don't understand how to process incoherent nonlinear information. The human brain does, and if you present this in a way that the human brain can naturally accept, you have a shot at it.

This culture of awareness and information overload, standardized interfaces—don't get me started on standardized interfaces—we're now saying we need common operating environments, we need all this other stuff. It's all nonsense. High performance people doing high performance jobs need custom interfaces, not COTS standardized interfacing. Put all the COTS in the middle ware, but the interface to anyone doing a high performance job needs to be custom. Why? Because in the entire history of our planet, that has always been what works. Do you think it's intuitive to fly an F-16? Is it intuitive to play a piano? Is it intuitive to drive one of those racing cars? Is it intuitive to do any of the high performance tasks that a human being has every done? No—yet we think the same information technology that my secretary has at the office is good enough for your war fighters to be able to win the war. I don't buy it. If it is the case, it is the only time in the history of human high performance tasks that it has been the case. Getting over believing this stuff is really, really important. Customizing the interface to the task and the sensibilities of the

people is critical.

Let's think about what the submarine fleet is going to be like 50 to 100 years from now. I think it's fair to do that, pretty easy to predict. Two hundred knot speeds will be commonplace, routine, straightforward. The notion of constellations as orbital constellations that exist up above in our overhead world will exist in the sea. They will start out as being large physical objects, then become micro, then become nanotechnology, but all of the problems with communication command and control—reconfigurability, networking, and so forth—will be solved by undersea constellations. It's a given.

Active sonar will be the rule, not passive. Active sonar has a low probability of intercept and so on, but generally speaking sonar thought of in isolation is always doomed. Sonar thought of as part of a fusion environment with other undersea phenomena, most of which we don't understand—that's entirely sensible. The mistake people make is thinking computers work the way people do. They don't. Computers slow down when you give them more information; we solve problems faster with more information. If we tried to understand this room's fire control management system by plugging our ears, looking through a soda straw, and not being able to touch or see anyone around, that exercise would be much, much harder to do. At the same time, that's what you're doing to everyone in the information space on a submarine at the moment. You're making people look at the world through a soda straw. It's just not sensible.

Even though one great strength of submariners has been their autonomous independence, spirit, and passion—and this independence has kept them strong—it's time to take that independence and wire it up to the rest. It doesn't mean giving up your independence, it doesn't mean giving up your spirit, but it means you're participating in the larger information space. If you are not included, you will not be able to make the same depth of contribution that you can otherwise.

Reconfigurable technical and physical architectures will happen 50 to 100 years from now, where basically ships' hulls technical systems will simply reconfigure themselves on a MEMS (micro

electro-mechanical system) and then nanotechnology level to suit the task ahead—change their hydrodynamics, change their acoustic propagation, change a whole bunch of things—their electronic properties, their optical properties before it. Probably the Navy will be privatized, but that's the subject of another talk.

What are the big challenges ahead? I think the first one is vision—you need to recapture a single sentence vision of why you're doing all of this. I would argue that the vision is going to be in information technology, that ultimately the same fundamental technical impetus that nuclear propulsion provided the submarine fleet for the last 50 years—when it arrived and how it arrived—will be the same sort of engine that drives you in the future. Information technology is where you can make nonlinear advances over other people playing in the same field. The ability to believe that, the ability to get people to deal with that, I think, is essential to taking that vision and bringing it to reality. Vision is an essential component of leadership. You cannot lead without vision, and I would argue that the subtleties of vision are still there, but the final vision, the point that takes all of these activities and lets them converge to a point of meaning and synthesis, that is missing. You have to recapture it and rediscover it, because without it, you won't deal with the other elements.

What are the other elements? A big one is talent. If you are not capable of attracting, hiring, and retaining the best people in the world, you're doomed. At the moment, the best people in the world in information technology are not going into the Navy, and they are not going into the submarine fleet. They're going into Silicon Valley start-ups; they're going into Microsoft they're going into Disney; they're going into a whole bunch of other companies who have a vision that the kids are buying into. The fact that there are no kids in this room should give you a loud and clear message that there's something wrong, and we need to pay attention to it. Without talent, it will not work. If you believe that information technology and mastery of it can be as important as nuclear propulsion was for the future of the submarine fleet, that's a problem you have to address as if it were your most critical emergency. You should think of it as being the top priority.

Second one—it's a big problem—it's called trust. In this

country, the American people do not trust their government and by extension, they do not trust the Navy. The Navy doesn't even trust the submarine fleet, depending upon who you ask. If you cannot restore that sense of trust, you will not get the vote of confidence of the dollars in funding necessary to carry out your mission. The ability to maintain that balance of passion, autonomy, and independence, but at the same time restore trust, is critically important. You can't do it without the talent, but once you have the talent, that's job one.

Connectivity—this idea of how do you maintain independence but become connected to the larger information space—is critically important. I don't think there's anything that's more important. It will require change. However, we don't like change. And if there is a sobering sense of doom and gloom lurking in the back of your mind, it is because you have some real issues. I don't think you have really big issues; I think you have the same issues all of us face. But what I think you have to do is recapture the vision so that you have a source of passion that can move you forward into the future. Understand by definition you are genetically inherited of a gene that resists change—if you feel something changing you will reject it. That's what you do as individuals that's what your organization does because it's staffed by humans. Understand that type of discomfort is a good discomfort, and you'll always want to have it. This type of discomfort that comes from lack of vision—that you can fix. The other one you're born with—learn to like it.

I thought there was an excellent point made earlier, and it was on my list as well-complexity. I have a slightly different take on complexity because I believe that starting 15 to 20 years ago, all the technical systems you are using became more complicated than any human being can understand. Yet, the methodology that you're using is still based upon complete understanding—whether it's complete understanding of an enemy, or of a reactor, or a computer system. Nobody understands how computer systems work now. There's no one at Intel who knows how an Intel chip works. They understand the general concept, but it was CAD systems running simulations by the other CAD systems that built that chip. Do you

think anyone looking at the chip could say, "That transistor doesn't belong there?" No, they have no clue. Just as nobody understands what all the millions and millions of code in an operating system do. Realize you're never going to be able to understand how things work so that you can validate them against a known model, and therefore you need a different set of rules and a different set of tools.

There is one additional thing that I would like to talk about because I think it's a bigger issue than any of the issues I've discussed, and it's fundamental to your success. It's a problem that's bigger than war, and bigger than crime, and bigger than drugs, and bigger than AIDS, and bigger than overpopulation and overcrowding—it's called education. The idea that we of the free and intelligent world, and in particular this country, have allowed the state of education to reach the state of decline that it has in the U.S. is a real crime. The fact that the most sophisticated technology in any inner city school in this country is the metal detector that frisks kids for weapons when they go into the building ought to be fundamentally unacceptable.

The Internet is probably, I would argue, the most important technological contribution to humankind since language. Why? Because it's the most important storytelling technology that's ever been introduced. Every time a storytelling technology, whether it's language, reading, writing, moveable type, newspapers, telephone, telegraph—you go down the list—every time one of these has been introduced, it has changed the direction and the course of society, and it has become largely permanent. The Internet will be the most effective storytelling medium ever, which means 1) it's going to be the most important for us as a entertainment medium, and 2) it's going to be the most important leadership medium, because leadership is about storytelling. You have never met a great leader who is not a great storyteller—doesn't matter if it's a political leader, military leader, or teacher you remember from school. And that's the final point—teacher—because teaching is about storytelling.

Now storytelling in the command and control situation is how you will get a three-dimensional, four-dimensional picture of what is going on and what is happening. At the same time, that same

technology will turn inward to our schools—an electronic book that fits in the palm of your hand, powered by solar energy connected to the Internet by a satellite and costing less than a textbook, capable of speaking in any language because it does autonomous translation and transliteration—this is the greatest gift to information space management, to education, that the world has ever seen. I'm not talking about replacing teachers with computers, because if you think that happens, you don't know what teachers do or you don't know what computers do, or both. I'm talking about providing *power steering*. It's power steering so that the message of one great teacher can reach many. It's power steering for you so that your great leaders and people with unique insight can reach many in real time and continuous manner.

Our kids are our future—the future of the submarine fleet, the future of the nation, the future of the world. If you don't start believing as individual citizens of your respective countries that education is your top priority, you're going to have a community of dummies. That's not what you're going to need to capture your vision. If you retain your independence, if you can retain your passion—realizing that you've barely scratched the surface on what is possible in submarine warfare defense, you've barely scratched the surface of what is possible in information technology, and realizing the role and contribution that you can play not just to maintaining an intelligent and educated Navy and submarine fleet, but an intelligent and educated planet—we will have the future to look to.■

ADDRESS TO THE ANNUAL NSL SYMPOSIUM

by RADM Malcolm I. Fages, USN
N87

Thank you Admiral Cooper for the opportunity to speak again this year at the Symposium. I consider myself especially fortunate to be here serving as N87 during the Centennial year of our Submarine Force. Not only do we celebrate the momentous achievements of our first century, but the Centennial also gives us the opportunity during our celebration to reflect on what the future holds.

Loosely stated, the future of the Submarine Force will be the focus of my remarks here today. Over 100 years, the submarine evolved from an experimental pipe dream, dismissed by critics of the day, into the capital ships of our great Navy. The submarine enjoys a pride of place in our Navy that even its most ardent boosters could not have foreseen in the early days. With our current investments, we can only continue to improve that capability into this new century. But in my view, our great success cannot blind us to change. We must not let parochial concerns, born of our very success, snuff out the flame of innovation that is the foundation of the Submarine Force's remarkable achievements.

As in my remarks last year, some of the ideas for this presentation come from a book. Last year I discussed the implications of George and Meredith Friedman's *The Future of War*. This year I will discuss some thoughts I had after reading *The Innovator's Dilemma*, by Clayton Christensen, who is a professor at the Harvard Business School. Though both books merit your attention in their own right, my purpose is not to offer my review of their contents, but to discuss the underlying implications that they have for what we do in the Submarine Force as we enter our second century of existence. Both works approach the same problems from different points of view, so let me offer brief summaries to set the context, which I think you'll find instructive to us in the Submarine Force.

Though I'm sure that you remember every word I said last year verbatim, I do feel compelled to recap what I said last year for the benefit of those who were not here, or who might have been getting

a cup of coffee while I was speaking.

Distilled to its essence, the argument in the *Future of War* is that all weapons systems have a life cycle. In the earliest phase of life, the weapon system has a nearly pure offensive capability. But over time, and as countermeasures to the weapon develop, more and more resources must be dedicated to protecting the weapon system. The pattern continues until the weapon reaches what the Friedmans call "senility", which is the point where the platform becomes so costly—usually without a commensurate increase in offensive capability—that it impedes the development of warfighting capabilities in other areas.

One example in the *Future of War* is the armored tank. Now, before I continue, let me caveat my remarks by saying that what follows is not my endorsement of what the Friedmans say about tanks. I don't hold myself out as a tank expert, and the takeaway from this is not the banner headline "Submarine Admiral says Tanks are Dumb!" My purpose instead, is to show the Friedmans' analytical framework applied to a contemporary example, so that we might better understand how it applies to us in the Submarine Force.

In its initial iteration, the tank provided revolutionary military capability. It allowed penetration of defensive lines while at the same time shielding the tank's crew from artillery fire. The tank sounded the final death knell for the armed cavalry, which was surely the senile weapons system of its day. Though born with pure offensive capability, the tank became encumbered over time with defensive implements, as technologies developed to combat the tank's offensive capability. As necessity demanded the increase of defense, the size and breadth of the logistics train required to support tanks grew apace. In the current state of evolution, we now have M-1 tanks that weigh over 60 tons each. These behemoths are so large that those charged with employing them fretted about being able to use them given the substandard roads and bridges in the Balkans.

More alarming is that the tank, once regarded as the *ne plus ultra* of offensive firepower on the ground, cannot adequately defend itself against the current generation of Brilliant Anti-Tank,

or BAT, munitions. BATs, utilizing acoustic, infrared or radar sensors can be deployed is sufficient number so as to overwhelm any of the tank's defenses on their way to scoring hits on the tank's vulnerable topside.

The end result is that we have a weapons system that has grown far more expensive, complicated and consumptive of logistical resources, without much improvement at all in its offensive capability—the classic senile weapons system. Again, my purpose here is not to pick on any particular service branch or warfare area in the Navy—none of us are immune to self-interest. I point out that it was Navy traditionalists who, in response to the growth of steam propulsion, once mandated that every warship be equipped with masts and sails. I do want, however, to illustrate the point that we all must guard against the reactionary conservatism that argues that a better-protected version of the implements that won the last war will be effective in winning the next.

I'd like to turn now to an outline of what I consider to be the major points from Clayton Christensen's *The Innovator's Dilemma* which, as I said in my introduction, provides us a good deal of thought material when considered in the context of *The Future of War*.

The basic premise of *The Innovator's Dilemma* might succinctly be stated as follows: *That logical competent management decisions that aim to serve an organization's best customers may also lead to the reasons why that organization ultimately fails.* More chilling perhaps is the contention that traditional management approaches, like better planning, working harder, adopting a longer-term perspective and better customer focus all tend to make the problem even worse. Now at first blush these concepts appear to be counterintuitive. To help elucidate them, I'll use some of the examples from the book to illustrate, but first I'd like to define a distinction that is crucial to understanding the author's point.

The distinction to consider is the difference between *sustaining* and *disruptive* technologies. I'll use Christensen's examples from the computer industry to illustrate the differences between *sustaining* and *disruptive* technologies. A *sustaining* technology is one that improves the performance of established products along the dimensions of performance historically valued by mainstream

customers. As an example, a technological advance that increased the speed or storage capability of a mainframe computer is an example of a sustaining technology. On the contrary, a disruptive technology is one that—on first appearance—results in worse product performance, and does not appeal to mainstream customers, but may hold promise, initially for a different target customer base. A good example of a disruptive technology is the desktop computer. For instance, a user of large database mainframes in the 1980's would have surely scoffed at the idea of using Commodore 64-based disk drives or processors in their applications.

In the beginning, circa 1980, IBM held a dominant position in the hard disk and mainframe computer industry. The state-of-the-art in hard disks was the 14-inch drive used in IBM's various mainframe computer configurations. Hardly resting on their success, IBM invested heavily in making the 14-inch disks run faster and to increase the memory density of the disks. These improvements are examples of *sustaining* technologies.

At the same time, a few small companies started offering 8-inch drives which had lower unit costs, but had much **lower** total memory, and were **more** expensive on a cost per megabyte basis. Due to their limitations, there was nothing in the nature of 8-inch drives to recommend them to IBM's best mainframe customers, who told Big Blue that they wanted higher capacity and lower cost per megabyte. So IBM, being an enterprise run by rational, intelligent people, ignored the 8-inch drive and focused their efforts on making better 14-inch drives.

Eight-inch drives were initially adopted in the nascent minicomputer market, where the smaller drive's virtues—small size and lower unit cost—enabled production of small and relatively low-cost computers, which were new products in a niche market that had not existed before.

Over time, the capabilities of 8-inch drives improved as their makers looked to better serve their customers and eventually 8-inch drives possessed capabilities that made them suitable for use in mainframe computers. This development essentially wiped out all the product lines of the makers of 14-inch drives, and caused several companies that relied exclusively on supplying assemblies

or parts for 14-inch drives to fail.

So how did this state of affairs come to be? As long as the slope of technological improvement in a disruptive technology exceeds the slope in the customer's demand, there will come a point when the customer's need can be met sufficiently by the disruptive technology, which was formerly inadequate.

Of special importance, note that this does not presume that the backer of sustaining technologies is standing still. Quite the contrary. Fourteen-inch drive makers listened to their customers, and spent vast sums on improving the capacity and lowering the cost per megabyte of their drives. But since *actual* demand—as distinguished from what the customers *said* their demand was—did not increase apace, the 14-inch drive makers ended up in a state of technological oversupply. Although the larger drives were far more capable and more efficient than the smaller ones, they were driven from the market due to the 8-inch drive's lower unit cost and performance level that was sufficient to meet consumer demand.

In the hard drive industry, this cycle repeated itself as newer smaller drives appeared and new computing device markets developed among the early adopters of the new technologies. Thus, we have evolved from mainframe to mini- to desktop- to micro- to laptop-, and now to handheld computing, all in a matter of 20 years or so. And, as Mr. Christensen recounts, the opposition of sustaining vs. disruptive technology played itself out in each instance.

It is worth pointing out that this *sustaining* vs. *disruptive* dichotomy is not restricted to the computer industry or other fast-moving elements of the so called *new* economy, where the normal rules might somehow be thought to be different. In its day, Sears was *the* dominant retailer in the United States. It ranked at the top of any list of the most admired American corporations. Its retail stores were strategically located throughout the country, and the Sears catalogue was nearly as ubiquitous as the telephone book in American homes.

Of course, that is not the situation today. On both the retail and catalog fronts, Sears missed the *disruptive* appearance of discount retailers, now best exemplified by WalMart and the *disruptive* appearance of focused catalogs like L.L. Bean and Land's End.

And just as in the case of the 14-inch hard disk makers, it was the failure of market leaders to effectively assess the impact of *downmarket* trends that led to their ultimately being overcome. Market leaders succumbed to developments that they once dismissed, in favor of making better versions of their high margin products for their best customers.

Before I turn to the challenges that I believe that the ideas in these books provide to us in the Submarine Force, let me connect an idea in the *Future of War* to one in the *Innovator's Dilemma*. I submit that a weapons system becomes "senile" from a *Future of Warfare* perspective at exactly the point where the curve of the disruptive technology crosses the curve of customer demand. Though the dominant sustaining technology has also improved—the same for weapons systems as it is for 14-inch hard disks--customer demand can be met by *disruptive* means, rendering the prior dominant mode superfluous and therefore "senile".

Having laid this foundation, perhaps you're asking, "Admiral, so what the hell does this all mean for us in the Submarine Force?" Let me frankly say that I hardly presume to have all the answers. But here are some thoughts.

One might consider that the Submarine Force's first hundred years were the beginning and maturation of the ultimate *disruptive* technology. In the beginning, it was regarded with disdain by conventional naval thinkers—the leadership of the dominant *sustaining* technological apparatus—for which the ultimate embodiments of American naval power were the gleaming battleships and armored cruisers of the Great White Fleet. As the disruptive community, we may have had a particular freedom to innovate that was foreclosed to the already well-established and institutionally conservative surface navy of the early 20th century.

When initially introduced into the inventory of the world's navies, the submarine was generally considered to be useful for coastal defense and little else. But the impact of German submarines in World War I showed that submarines could confound even the mighty Royal Navy. The submarine platform proved its mettle as a singularly powerful offensive weapon. In World War II, as almost all of you know and in which some of you participated, the

American Submarine Force—relegated before the war to picket and screen duty—strangled Japanese maritime capability in the Pacific.

The advent of nuclear propulsion, which only fringe elements might have considered viable in 1940, fomented a revolution in submarine capabilities. The Submarine Force, unconstrained by the dogma of defining what was possible only in terms of what already existed, developed what is today a defining characteristics of the American submarine—the ability to get anywhere in the world quickly and to stay there for as long as necessary. In 1950, there were probably very few people who might possibly have predicted that in the year 2000 that every American submarine would be an extremely quiet, fast, deep-diving nuclear-powered vessel. Worthy of note in this context is the coupling of two formerly *disruptive* technologies—nuclear propulsion and missiles—that have provided the Submarine Force with some of our best capabilities. Nuclear propulsion and missiles enabled us to develop the invulnerable leg of our strategic triad, and the D-5 missiles on Trident submarines today are perhaps the ultimate expression of American power. Nuclear propulsion and missiles also have combined to give us the no-notice land attack capability that we employ with Tomahawk missiles.

So here we stand today, after a century of excellence. As I said in the beginning, with no pretense of modesty, submarines are now capital ships in the greatest navy in the world. No longer the employer of the *disruptive* weapons system technology, we have become unquestioned market leaders, and are working to *sustain* the edge that our tradition of innovation has bequeathed to us who are now its custodians. But as the market leaders, we cannot even for a moment stand still and assume that because we are dominant now that we will be so forever.

We cannot let our success reduce our capacity and flexibility to innovate. This is the cultural challenge laid down for us in the *Innovator's Dilemma*. It is in the nature of large and successful organizations to develop what Mr. Christensen calls "Rules of Organizational Behavior" to regulate their activities. These 'rules' limit the flexibility of organizations to innovate in the truest sense of the word. Innovation is perhaps an overused word, but when I say "true sense," I mean innovation as having the will to take

chances on potentially revolutionary advances in our capabilities. We must not carelessly use the word innovation to describe the methods by which we will develop incremental improvements in capabilities that we always provide. If that were ever to become the case, then it would be a matter of time before true innovators would provide the means to supplant our capabilities at lower cost.

Just where will we be in 2050? As the events of just the hundred years of ongoing military submarine development show, it is a loser's game to try and predict with any accuracy what the Submarine Force of the future will look like. The wisest seers in any era never look so foolish as through the lens of history. Perhaps future submarines will be smaller. Perhaps they will use alternate propulsion technologies. Perhaps they will strike ashore from the other side of the earth by reflecting high-energy lasers off of satellites. Perhaps we will be able to use off-board sensors to plot minefields and to trigger the firing of anti-ship or land attack weapons, which covertly lay dormant in pre-staged launch pods. We may not even need submarines—or surface ships, or airplanes—at all in support of our national defense.

Especially now that we are in a dominant position, we need to honestly assess how our roles might be better done by other means in order to improve our capabilities and maintain our value to the American people.

Are submarines *senile* weapons? Are there *disruptive* technologies that can do what we can at lower cost? We do have unquestioned dominance below the sea, and can deliver credible firepower, as well as unique intelligence for our customers—the Fleet CINC's, the NCA and ultimately the American people. But we must never be fooled that our current exalted position will be maintained by merely making incremental improvements to the capabilities that we already have. Our past and current success is the legacy left to us by the risk-takers and innovators of the past. Our future depends on our ability to overcome the inertia of success and continue to truly innovate. Continued dominance means that we must therefore be ever more vigilant to the *disruptive* technologies that may render us obsolete. As Secretary Danzig admonished us here last year, we cannot become like Narcissus and lose

ourselves in the admiring gaze of our own reflection. If anything, we must increase our sensitivity to the *downmarket* trends. Consider the ASW challenge.

Owen Cote has written a most thoughtful piece entitled the *Third Battle: Innovation in the U.S. Navy's Cold War Struggle with Soviet Submarines*. At the conclusion of this work he further poses questions about what he characterizes as the Fourth Battle, submarines and ASW after the cold war. There are insights here for the types of disruptive challenges we are likely to face in the ASW arena.

Though we regularly make the case that ASW is a Navy team sport, if these disruptive challenges enjoy success, the impact will fall hardest on the Submarine Force.

Owen argues, and I agree with him, that we face these challenges. First, the marriage of the air independent, non-nuclear submarine with over the horizon, fire and forget, anti-ship cruise missiles and high endurance, wake-homing torpedoes. Traditional ASW approaches, employing radar flooding and speed are not likely to be successful against this threat.

Cote argues that the second challenge will occur when we are fighting for less than "all out stakes." In such conflicts we will likely have a very low tolerance for shipping losses. Cote compares ASW against a quiet target to the SCUD hunting of Desert Storm, i.e., protracted, asset intensive, high false alarm rate, high weapons expenditures, and low success rates. The difference though is that SCUDs were terror weapons without much military utility. Submarines pose both a military threat and political risk. The impact on the flow of forces and supplies into a theater will be dramatic until the ASW threat is eliminated.

The third disruptive challenge comes from the fact that the Navy's traditional focus on Blue Water sea control has shifted to power projection and land control in the littorals. The multi-mission pull on all platforms as a result of this doctrinal shift further impacts the multi-dimensional approach necessary for ASW to be successful in the new security environment.

Let me reiterate, if these disruptive challenges are successful, the critics will be asking why we are building $2B submarines, not why the ASW mission was removed from S-3 aircraft. We must

keep our eyes on this one.

Well let me return to the *Innovators Dilemma* and Christensen's suggestion for how to deal with it; as you will see we are moving in the right direction.

At the heart of the *Innovator's Dilemma* is that rational organizations are charged by their stockholders to maximize profit based on what current customer demand is. In the case of the Submarine Force, that means we take our resource allocations and put them to work as best we can to achieve desired force levels and to make our individual platforms as effective as they can be. From a management perspective, it is not rational to allocate otherwise productive resources to investigate things that have nothing to do with the core business. But this seemingly counterintuitive prospect is exactly what the *Innovator's Dilemma* would require of dominant enterprises that seek to maintain leadership and expand markets. In his book, Mr. Christensen tells us that a method to resolve the apparent conflict between future vision and the present-day bottom line is to empower small cells within the organization. These semi-autonomous groups—set loose from the constraints of the bottom line—are free investigate the *disruptive* technologies, and to seek out how to incorporate those new markets into the larger organization, or find ways to counter them.

Consider this scenario: the vast majority of our peacetime force structure requirements are based on the justification that we need hulls to do ISR. But what if off-board vehicles and sensors could make it possible to lay down networks of undersea sensors that could process data and transmit it to remote stations. What if we could deploy remotely controlled small mobile sensors that could move around on land and were configured with chemical, acoustic, visual or vibration sensors. The pace of technological development suggests that these sorts of things may well be possible. Perhaps their combination of capability and price will make them more efficient and effective than a submarine for a large fraction of our ISR tasks. Will we find ourselves in a position where we are oversupplying the market for stealth, because we invested too heavily in improving the *sustaining* technologies of our core product, at the exclusion of investigating *disruptive* trends that seem

in the current view to be inadequate to the customer demand?

Again, I can't tell you what the future looks like, but I do think that we are making significant strides in the Submarine Force to address the future in non-conventional ways. Consider, for example, the work being done by DARPA, in the payloads and sensors study. We've put money behind empowering visions that are currently not part of the FYDP, and may never be. But we're giving some bright minds the opportunity to reshape the vision of the Submarine Force of the future. I look forward to the results of their work.

Another sign that we are not being complacent is through the Future Studies Group. By design, the FSG takes savvy observers and tasks them to consider alternate future visions of what the world might look like in the future. I think that their considerations of the need to improve our ability to use off-board sensors, improve connectivity and payload are right on the mark.

More important, perhaps, is the FSG's focus on modularity and on human factors. Modularity, in my view, is essential to our long-term viability. It will allow future leaders to take the inherent advantages of the submarine platform and equip it with payloads and capabilities that may currently not even have been imagined. This can be considered to be somewhat analogous to the computer examples I discussed earlier. The computer as a concept has not changed—it has inherent advantages to do certain types of tasks. What has changed, resulting from the spur of *disruptive* technologies is that the computer is being used in new ways that were not imagined in earlier times. So it can be too for the modular submarine. The concept of the submarine will be the same, but open architecture will permit *disruptive* technological developments to refresh the submarine's capability in novel ways.

Our work with DARPA, the FSG and through efforts like the SSBN security program, which is chartered to evaluate unconventional threats, are all signs that we have not become complacent, but I believe that we can do more. We need to be prepared for a world where swarms of small craft deploying undersea weapons will challenge our access to the littoral. As well, we need to be ready for smart, inexpensive mines that can similarly challenge us. And most importantly, we need to improve our payload capability.

Those of you who attended the Submarine Technology Symposium may recall Admiral Natter's reproach to us that we need to use our stealth to do more than just tell the battlegroup "Incoming!" Mr. Ron O'Rourke, the CBO analyst and friend of the submarine community also echoed those sentiments. Ron said—and I agree—that we need to develop compelling capability that is easily understood by legislators and the American people who are asked to approve the sums we ask to buy submarines. Though our lifecycle costs are competitive with other platforms, the natural political tendency is to focus on the near-term dollars. Our acquisition costs are high, and we need to develop better payload capability and need to do a better job of educating legislators and lay people about what those capabilities are.

Let me switch gears again and provide you with a few specific examples of how our investments in new capabilities may enable revolutionary advances in the future. In the UUV field, the Long-Term Mine Reconnaissance System will come on line in 2003, followed by the Mission-Reconfigurable UUV in 2008. I see these developments enabling dramatic advances in key military capabilities.

Think about, for example, mine identification and clearance. Much of what we in the Submarine Force can provide is predicated on our assured access to littoral regions. One defensive strategy that a potential adversary might use to deny that access would be to deploy large numbers of inexpensive mines. Currently, mine identification and clearance is a challenging and time-consuming process. Sensors are dragged through the water by either a ship or helicopter to identify the mine. Once identified, a second vessel must relocate the mine and use divers or marine mammals to place explosive charges on the mine to disable it. To execute this in a benign environment is challenging enough, but success seems to become exceptionally doubtful in the face of a determined adversary. It is eminently logical that any entity that would mine areas to deny submarines would also utilize anti-ship or anti-air weapons (which are available on the market now) to defeat our attempts at mine clearance.

None of us are too fond of the idea of putting a submarine,

along with a crew of 125, in harm's way as a mine sensor, regardless of how good ARCI, Phase IV, will be.

LMRS will give us autonomous, remote mine sensing capability, a vast improvement over what we have now. But consider the possibilities that may become available with MRUUV. We may be able to deploy UUVs that carry small bomblets in the payload bay, enabling a UUV that is configured to both detect and neutralize mines by itself. This capability would be present in a *fire and forget* vehicle that is not dependent on any datalink to a controlling vessel. If it comes to fruition, it will provide greater capability, lower cost and far less risk to people and valuable assets, which to my mind all indicate the hallmarks of a *disruptive* technology considered in a military sense.

Beyond mine warfare—a current capability that UUVs will do better—consider some of the ways that UUVs may provide capabilities that don't even exist today. For example, the MR-UUV's payload volume could be used to deploy data collection assets, like periscopes, antennas or acoustic sensors that can be deployed up rivers and in waters too shallow for submarines to operate in. The MRUUV might also be used to service an ADS (Advanced Deployable (Sonar) System) field, downloading data and uploading search parameters. ADS fields could trigger dormant UUVs to deploy and put acoustic tags on transiting threat submarines. A tethered UUV deployed form a submarine could be plugged into an ADS field to allow real-time processing of littoral water data with the submarine at a safer stand-off range. UUVs might further be able to relay launch orders to pre-staged weapons pods to initiate land attack strikes. The possibilities that will be enabled by having an open payload volume in a covert autonomous vehicle will only be limited by our imaginations. We need to continue to be sensitive to the *disruptive* technological developments that can be utilized on UUVs, even if they don't all pan out and even if they eventually may reduce the demand for things that we do today with a submarine.

For UUVs to realize their full potential, we need disruptive breakthroughs in energy modules. LMRS will have an on-station time of 40 to 60 hours. Incremental improvements in battery technology are being made, but the realities of the periodic table

mean that there is a limit to how much energy we can put in a battery on a UUV that fits in a 21 inch tube. But in that limitation lies opportunity for *disruptive* approaches, perhaps to develop submerged UUV service stations that can recharge UUVs, or to alternate propulsion technologies like advanced fuel cells that can provide the endurance necessary to gain maximum advantage.

Another investment that may provide the foundation for incorporation of new *disruptive* capabilities is in covert communications. We are placing antennas now on submarines that have EHF MDR capability. EHF allows covert communications through narrow beams and frequency-hopping algorithms. MDR capability will allow data rates in the range of 128-512 Kbps. Contrast this with our current low-data rate EHF capability of 2.4 Kbps. Think about how fast your internet home page would load on a 2400 baud modem compared to a DSL connection. Now imagine the possibilities for passing tactical data between elements of a battlegroup or from a shooter to a weapon by using a covert, high data rate. High data rate covert communications will not only enable extraordinary advancements in warfighting capability. We might even be on the threshold of having loved ones back home be able to send video familygrams to our deployed sailors.

And what about SSGN? Combining long-range precision weapons, in high numbers, with a submarine platform provides the stealth that makes defense easy, with a weapon against which defense is extremely difficult. What we are talking about is a resurrection of our post WWII experience, where radical innovation made the submarine a key player in a new mission area, assuring continued relevance in a different security environment. This truly represents a disruptive technology, and by the way, would reduce some of the multi-mission pull I discussed earlier, that impacts the Navy's ASW capabilities.

Well, I've been talking for awhile now, and it's probably about time for me to stop. Let me summarize some of my talk:

- The Submarine Force emerged as a superior example of a *disruptive* technology. Over the course of the last 100 years, the submarine has emerged and currently occupies a privi-

leged position as a capital ship in our navy. In business terms, we are now a dominant market player and are geared toward improving our capability through investments in *sustaining* technologies.

- We must be especially vigilant—now that we've achieved such a significant mainstream position—to balancing our investments in *sustaining* technologies and having the foresight to put resources behind potentially *disruptive* technologies that appear to have little short term relevance, but which may revolutionize submarine capability in the long run. It is a certainty that promising new technologies will emerge, the challenge we face is a *cultural* one. We must be sensitive to the cultural conservatism that is a by-product of our success. We cannot be timid in our commitment to try new things, even if all those new things turn out not to do what we thought they would. We must remain the truly innovative community that we have been for our first 100 years.
- Our efforts, through our DARPA payloads and sensors work, through the Future Studies Group and the SSBN Security Program are excellent first steps to focus our attention on an uncertain future. However, I think that we need to do more.

It may rightfully be said that no warfighting platform changed the nature of warfare more completely than the submarine did during its first century. That said, we need to keep our minds open to how things that we currently do might be better done by other means in the future. The corollary to that thought is that we need to develop compelling new capabilities for the submarine that don't exist today, but that will take the submarine concept and continue it as a vital contributor to our nation's defense for the next century and beyond. Thank you very much for the opportunity to speak today.■

SUBMARINE CENTENNIAL UPDATE

by ADM Hank Chiles, USN(Ret.)
and CAPT Dave Cooper, USN(Ret.)

We are having a fantastically successful, near-continuous celebration of the 100th anniversary of the birth of the U.S. Navy Submarine Force.

A check of the list of Submarine Centennial Events on the Centennial web page at www.navy.mil shows that we have successfully completed 74 of the total of 90 events listed. The events have been of all sizes and types and locations throughout the United States. There were at least nine different Birthday Balls in April that were attended by literally thousands of active duty and retired submariners and their friends. Submarines and submariners have visited numerous namesake cities and states with participation in parades, speeches, and memorial services. New memorials honoring our submarine heroes have been dedicated at Bangor, Seal Beach, and Pearl Harbor, just to name a few. Our five submarine postage stamps have been very well received and there have been numerous first day cancellation events around the country.

Probably the most impressive event, at least in regards to the total number of visitors, was the opening of the exhibition at the Smithsonian Museum of American History. The exhibition is titled *Fast Attacks and Boomers—Submarines in the Cold War*. To quote a conversation reported in the *Washington Post*, "An exchange between a boy and his father who went through the exhibition on a recent afternoon probably sums up the reaction of many visitors.'Ick,' the boy said, looking at the cramped triple-tier bunks. 'I'm glad I don't have to live in a boat like this.' 'Me too,' said the father. 'But I'm awful glad these guys are willing to do it.'" the Resident's Associates seminar series in late April was sold out.

Thanks to the many generous contributions in response to our fund raising pleas, the Centennial Committee has been able to provide almost $130,000 in financial support to the active duty Submarine Force for many of their Centennial events and activities. This has allowed them to defray some of the cost to the junior personnel to attend events and to include features in the events that

they could not have done otherwise. The Committee has also provided 500 copies of a Centennial tri-fold handout to each of 33 different submarine museums. These folders contain material to educate the public on the history and value of our Submarine Force.

The Centennial has been well publicized in national and local papers and television. By the end of the year, we will have had articles in *Popular Science, Popular Mechanics, National Geographic, Parade, Readers Digest, U.S. News and World Report*, and others. Even though it was fiction, the screening of the movie U-571 by Universal Studios gave us an opportunity to get some unplanned publicity and highlight the extraordinary professionalism and heroism of World War II submariners. The release of the movie in VHS and DVD later in the year will include a Navy public service announcement and an interesting contest to make the public even more aware of submarines. Universal Studios kindly provided charitable showings to benefit Dolphin Scholarship, the midshipmen at USNA, and our Centennial program.

We suspect that you have received more fund raising letters for the Centennial than you wanted to see, and to those of you who have generously contributed, we offer you our sincerest thanks. We have received, or have pledged, almost $3.5 million that nearly meets our planned expenses. Over 97 percent of the contributions have come from our generous corporate donors. A listing of these donors appears on the next page and you are encouraged to thank representatives from those corporations when you see them. A special thanks is appropriate to Lockheed Martin Corporation as the primary underwriter of our Centennial celebration.

The submarine stamps have been very popular. Of the 65 million 33 cent stamps printed, only 18 million were held by the central distribution point in June. About half of the 1.5 million sets of five stamps have been purchased.

There are still keystone events before the end of the year that you are encouraged to attend if you are in the area. A submarine memorial statue will be dedicated at the U.S. Naval Academy in front of Dahlgren Hall at 1400, Sunday, 22 October. A memorial service is planned at the Naval Academy Chapel on 7 December 2000. Please try to attend these events and other listed on the web page as we approach the end of our Centennial year.■

SUBMARINE CENTENNIAL CELEBRATION

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THE SUBMARINE REVIEW

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

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

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

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

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

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LOSS OF A SUBMARINE

DEATH OF KURSK

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

Our time, as well as other times of the 20th century, is full of disasters which are connected with unprecedented technological developments and boundless human ambitions and intolerance. The July 25 French Concord disaster in Paris with 113 dead, the August 8 Moscow's Pushkin Square bomb's blast with 11 dead and 96 injured, the Russian KURSK SSGN is on the bottom of the Barents Sea after blasts in her torpedo room on the 12th of August, with 118 dead. And 143 killed as the Gulf Air jetliner crashed in the Persian Gulf near Bahrain on August 23, 2000.

KURSK was on the bottom in the area with depth a little bit more than 300 feet with at least her two forward compartments flooded and the majority of her 118 crew members dead, while some of them may have been alive in the stern compartments. The Russian defense, defense-industrial complex, and navy authorities, after a number of controversial and simply false statements, had accepted it as a disaster and asked for a foreign assistance. Ultimately the Commander in Chief of the Russian Navy Admiral Kuroedov headed the rescue operation in the Barents Sea, and President Putin interrupted his vacation in Sochy and returned in Moscow to control the situation. When the rescue operation had been finished without any survivors, the Russian President met relatives of the victims for consolation and help, and the national mourning took place.

In connection with all that, it would be desirable to get answers for some relevant questions:

- What kind of a nuclear submarine was KURSK, why was she so big, heavily armed, deep diving, and fast?
- What was she doing in that naval exercise in the Barents Sea?
- What had happened with the submarine on 12th of August?
- What had been done to save a survived part of her crew?
- What kind of influence will the disaster have on the Russian

defense policy?

Project 949A (Oscar-2) cruise missile—torpedo nuclear submarine KURSK (K-141) of the Krasnodar (K-148)-class had been built at the huge Russian Severodvinsk shipyard on the White Sea in 1993-1994 and commissioned in 1995. In 1997 and 1999 two more such class submarines the TOMSK (K-526) and BELGOROD (K-139) were built at the same shipyard and commissioned. In all, from 1986, 12 of this class SSGNs had been built in Severodvinsk. In the last decade Russia built only this class and Project 971 (Acula) of the K-284-class attack nuclear submarines (from 1985 to 1999 15 such submarines had been built in Komsomolsk and Severodvinsk, and commissioned).

Existence in the Russian Navy of modern individual SSGN class submarines is the result of the cruise missile designers' domination (first of all, the Chief Designer, Academician V.N.Tchelomei, in which Bureau worked Sergey Khrushchev, son of Nikita Khrushchev) in submarine designing and building, and the wish of the Navy's leadership to get long range supersonic, larger caliber submarine cruise missiles as soon as possible for creation of a serious missile threat to American aircraft carrier groups.

That long way of development commenced in the beginning of 1960s with PAPA (project 661) K-162 SSGN, a titanium nuclear submarine with surface displacement of about 5,200 tons, 10-1,600 mm caliber subsonic Ametist cruise missiles with range some 60 kilometers, 4-533 mm bow torpedo tubes and 8 reserved torpedoes, and 44.7 knots world record maximum speed. The ultimate result had become Project 949A (Oscar-2) class SSGN nuclear submarines, which have a submerged displacement of 18,300 tons, crew - 108 officers and enlisted men, 24 Granit supersonic cruise missiles in side stationary containers with diameters about 1.8 meters, inclined on 40 degrees to horizontal plane, with range more then 550 kilometers, 2-650 mm and 4-533 mm torpedo tubes with 18 reserved torpedoes and torpedo size missiles, turbines' power 100,000 h.p., and speed up to 33 knots, with a test depth of 600 m. The designer of Oscar was the St. Petersburg's Rubin Design Bureau (the head and general designer of which is Igor Spassky, the Project 949A first chief designer was P.P.Pustintsev, the second is I.L.Baranov, the chief naval supervisor is Captain 1st rank

V.N.Ivanov).

Following last year's summer exercises, KURSK ventured into the Mediterranean and simulated an attack on a U.S. carrier battle group, the first time in at least four years that a Russian submarine had been so bold.

This year's exercises, which began August 10, set a milestone for the number of surface ships and submarines that went to sea together and the variety of ordnance they fired. Up to 30 ships participated in the exercise.

In addition to KURSK, the maneuvers included a ballistic missile nuclear submarine, an aircraft carrier, a Kirov-class cruiser, the world's largest warship of its kind, several guided missile cruisers and destroyers. In that largest Russian naval exercise in recent years were fired cruise missiles, torpedoes and a long range ballistic missile. KURSK fired cruise missiles and torpedoes. Two Tu-22M Ukrainian supersonic strategic bombers with long range cruise missiles also participated in the exercise.

For Captain 1st rank Gennady Lyatchin and nearly a score of others in the control room of KURSK, Saturday, August 12, had to be a day of pride and triumph. His underwater aircraft carrier had successfully completed a torpedo-firing run and was preparing for another one. Lyatchin, 45, one of the Russia's most experienced submarine commanding officers, radioed the task-force commander for permission to fire. The permission had been granted. But instead of the sounds of torpedoes being blown from torpedo tubes, sonar operators aboard the two U.S. submarines, working with the American surveillance ship LOYAL, on patrol about 186 miles west-northwest of KURSK, heard two explosions, one short and sharp, and after 2 minutes and 15 seconds, the second enormous thundering boom. A Norwegian seismic institute also recorded the explosions and said the second carried the force of two tons of TNT, registering 3.5 on the Richter scale.

Evidence later obtained from underwater cameras shows that the blast in the torpedo compartment with reserved torpedoes and torpedo size cruise missiles tore open the entire double-hulled forward section of the 505 feet ship, an area the size of a school gymnasium on the right side of the submarine. Seawater would

have slammed into the torpedo compartment, instantly killing the men on duty in that area. In the control room just aft of the shattered torpedo compartment, Lyatchin, the five Northern Fleet staff officers and a score of officers and petty officers manning the ship's controls would have had no time to react after the second blast before the combined power of the blast and seawater tore through, destroying the gleaming arrays of switches, computers and video screens that constitute the *brain* of a huge submarine. All would have been killed outright or quickly drowned. From there, the water likely cascaded through passageways into communication spaces and living quarters just after the control room. At that point, the floodwaters were probably thwarted by the thick watertight forward bulkhead of the fifth, number one reactor compartment with a VM-5 pressurized water reactor.

The men whose duties placed them in the reactors control room and the turbine and machinery spaces behind the reactors would have probably survived, but the flash flooding in the forward part of KURSK would have caused the bow to drop, pitching the 24,000-ton boat into a dive. In seconds, the sub would have pounded into the seabed some 350 feet beneath the storm-driven surface of the Barents Sea.

Automatic systems would have *scrammed* the reactors, pushing control rods into the cores and shutting them down. KURSK, its shattered bow shoved into a furrow of sand, and heeling to port some 20 degrees, lay silent, without power or heat or light or hope, its 118 souls dead or doomed.

The majority of the crew was in the part of the boat that was hit by the catastrophe that developed at lightning speed. It was all over in the space of several minutes. The tapping out of SOS signals in Morse code indicated that some crew's members survived for a time in the stern sections of the boat. But Admiral Vyatcheslav Popov, commander of the Northern Fleet, admitted on Friday August 18 evening, that no tapping had been heard from the sub since August 14, two days after the accident.

The Northern Fleet's Accident-Rescue Service began the rescue operation almost immediately using its special vessel MICHAIL RUDNITSKY with her rescue crafts. On August 18 a rescue capsule reached the rear escape hatch on the submarine for the first

time, but could not latch on the hatch and returned to the surface. Later, on Monday, August 21, the Norwegian divers managed to open both covers of the stern escape hatch and had discovered that the 9th and all other compartments of the sub were flooded, and all possible survivors were dead.

It is interesting to note that the most important information about the cause of the disaster and the reasons for it had been published in the main military daily newspaper *Krasnaya Zvesda"* (Red Star). Its article published Thursday, August 17, suggested that the blame for the KURSK accident could be put on a cheaper torpedo design. It was removed from the newspaper's server on Friday. The printed version of the newspaper contained no reference to the article.

The article said that KURSK was refitted at the Sevmash shipyard in Severodvinsk in 1998 to carry a new type of torpedo. Representatives of the Russian Navy were against these torpedoes but the industry managed to lobby the upgrade through. The new torpedoes were difficult to store and dangerous to handle. The reason the Navy was forced to accept them was that the production of the new torpedoes was cheaper.

The main type of the previous torpedoes, used on Project's 949A submarines, were with silver-zink batteries. They were safe and are launched in standard way by a pneumatic-hydraulic system.

The propulsion of the new torpedoes used liquid fuel. The torpedoes were launched with a help of a trigger that produces gas, shooting the torpedo out. The use of liquid fuel for propulsion of new missiles in the Russian Navy was abandoned in 1980s and replaced with solid fuel. One of the reasons was the fact the liquid fuel was too explosive. Additional proof of that version was the fact that on KURSK were two torpedo specialists from Dagestan's *Dagdiesel* plant, one officer and one civilian, which helped in the test of new torpedoes in time of the exercise.

The Friday, August 18, edition of the *Red Star* contains a version of the accident, widely promoted by the head of the defense industries, Deputy Prime Minister, Ilya Klebanov, that the submarine collided with an "unidentified object". This was a shameless lie of a major culprit, which promoted the dangerous torpedoes, not

by means of his evil will but because of incompetence. The guilt is also on Admiral Kuroedov, who did not support his fleet specialists, who objected to taking these new dangerous torpedoes.

President Putin took personal responsibility for the disaster. He met personally with victims' relatives and provided to them significant financial help. It gives him credit. He likes to revive the power of his armed forces, and that is also right. Literally on the eve of the catastrophe he made a correct major decision to shift priorities in the development of his armed forces from the strategic nuclear missiles to the conventional general purposes forces. To that it could be added that he needs now more efficient tactical land and air forces to deter and wage local wars of a Chechen's and Middle Asia's models. As to the naval general purpose forces, he needs to strengthen the Pacific and Black Sea fleets and the Amur and Caspian flotillas' surface ships and amphibious forces. And, as usual, the devil is with the details. Nobody says that Russia does not need nuclear general purpose submarines. But if to choose between the Project 949A SSGNs and Project 971 SSNs, the latter are cheaper, more safe and more efficient subs. To consider the American aircraft carriers as a major military threat for Russia (for which task Oscars had been created) in long range planning is unreasonable and, simply saying, stupid policy. History proved that Russia was mainly a continental power, and its major victories had been achieved first of all in land battles. And again nobody is saying that Russia doesn't need a navy. It needs it and it has it. But increasing of its power now is not a very urgent task. In this case modesty is the best policy.■

AN EARLIER WEAPON CASUALTY

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

A torpedo battery can be dangerous, as some of us well know; but High Test Peroxide (HTP), as a fuel, is very nasty stuff indeed if mishandled.

Granted, HTP packs a powerful punch at fairly low cost; but as Dick Boyle, Officer-in-Charge of the U.S.Navy's experimental midget submarine X-1 (briefly in service 1956-57) said "high concentration unstabilized hydrogen peroxide has no place in a fighting ship". The Royal Navy discovered this, the hard way, on 16 June 1955 when the 950 ton submarine SIDON went to the bottom of Portland Harbor alongside her depot ship MAIDSTONE.

SIDON had embarked torpedoes of a new type fueled by HTP: they were fitted with blowing heads (not warheads) for test firings at sea later in the day. The submarine was due to sail at 0830; and the captain, Lieutenant Commander Hugh Verry, was already on the bridge with First Lieutenant Ed Puxley and Engineer Officer Roy Hawkins.

At 0825 officers at breakfast in MAIDSTONE's wardroom on the upper deck heard a dull thud followed by the shrill sound of alarm bells. Surgeon Lieutenant Charles Rhodes, finishing two years National Service, went to the ship's side to see smoke belching from SIDON's conning tower: other hatches were shut, as normal when preparing for sea. Another eye-witness saw not just smoke but "a sheet of flame" shooting up "through the conning tower, followed by more flames and smoke; then bits of equipment and furniture, hats and coats, clouds of paper were blown into the air". Engine Room Artificer Peter Leech and Petty Officer William (*Happy*) Day were checking the diving panel in the control room some 100 feet, and separated by two bulkheads with open doors, from the source of the explosion which occurred in the fore-ends when one of the HTP fish was manually loaded into its tube. Immediately before this operation the valve on the torpedo's storage tank had been opened to admit fuel to the engine. It seems that the volatile HTP met dirt or a foreign substance when passing through the connecting pipe: this acted, violently, as a catalyst. Men in the

torpedo loading space, including the torpedo officer and an engineer officer from the depot ship, were blown to pieces.

Leech, relatively distant in the control room, said there was a loud thud and a burst of orange flame followed by thick yellowish-green smoke. He was tossed ten feet through the door of the tiny radio shack at the after end of the compartment. Although dazed, he heard somebody shouting "everybody out of the boat" and climbed up the conning tower ladder to walk across gangplanks to the safety of MAIDSTONE. His colleague Day heard a "dull sort of bang" before the blast lifted him off his feet: the next thing he remembered was coming to in hospital.

Day was probably assisted by Surgeon Lieutenant Rhodes who had removed his spectacles, found and donned breathing apparatus, and raced down to SIDON where Steward Dereck Jones, on duty in MAIDSTONE's wardroom, saw him "go down the hatch in a cloud of smoke" and, a minute later, "come up half-carrying an injured seaman." Then Rhodes went down again. Four times he brought up a man from the smoke; but by the time he was attempting another rescue, a little later, the submarine's bow section was low in the water—flooded through the damaged torpedo tube. The gallant young Surgeon Lieutenant was last glimpsed gasping and struggling with his breathing apparatus at the foot of the conning tower ladder just before SIDON sank.

Meanwhile, SIDON's Captain, Jimmy and Engineer had sped down from the bridge. Hawkins started the low-pressure blower to suck out smoke, but this did little to clear the atmosphere. He then donned breathing apparatus and joined Verry, Puxley and Rhodes who were fighting a way forward, through piles of debris in the passageway, to see if they could "get some of the boys out". But they found the fore-ends bulkhead door was almost wholly blocked; and soon afterwards, realising that the boat was sinking, Verry ordered "abandon ship".

The 767 ton mooring vessel MOORDALE, berthed not far away, immediately came to assist when her master saw that SIDON was in trouble. The crew succeeded, with commendable speed, in securing a wire around the submarine's stern; but they could not prevent SIDON slipping beneath the surface, bows first, at 0845. It all happened very quickly.

Frogmen from MAIDSTONE were equally swift to react, but there was no reply to their taps on the bottomed submarine's hull. By early afternoon it had to be accepted that three officers and ten ratings, trapped in the boat, were dead.

The Royal Navy thereafter declined to use hazardous HTP in weaponry. The short-lived British boats with HTP Walter-type propulsion plants—EXPLORER and EXCALIBUR completed in 1956 and '58—were nicknamed *the two exploders*; and Soviet sailors called their contemporary HTP Quebec-class boats *cigarette lighters*.

Although it is not known, at the time of writing, exactly what initiated the fatal explosions in KURSK on 12 August 2000, it may be that the Russian Navy has failed to heed the lessons learned forty-five years ago in SIDON.■

LOSS OF A YANKEE SSBN

by CAPT 1st Rank Igor Kurdin, Russian Navy (Ret.)
and LT Wayne Grasdock, USN

Editor's Note: Captain 1st Rank Igor Kurdin, Russian Navy Retired, served as the Executive Officer on K-219, from 1983 to 1986. He also has served as the Commanding Officer of Yankee and Delta class submarines. He lives in Russia. Lieutenant Wayne Grasdock, U.S. Navy, is Navigator on USS PHILADELPHIA (SSN 690). Captain 1st Rank Igor Kozyr, Russian Navy Retired, and Lieutenant Commander Igor Fyodorov, Russian Navy Retired, assisted with portions of this article, as a liaison officer for the Saint Petersburg Submariners Club. Captain Kozyr lives in Russia, Lieutenant Commander Fyodorov lives in Florida. Professor Georgine DiVirgilio, U.S. Naval Academy, translated portions of this article.

During the Cold War years, the United States military trained primarily to fight and win major theater wars. The United States pursued a strategy of containing the Soviet Union and the seven *satellite* nations in Eastern Europe who signed the Treaty of Friendship and Mutual Assistance in Warsaw on May 15, 1955. Led by men like First Secretary Josef Stalin, First Secretary Nikita Khrushchev, and Admiral S.G. Gorshkov, the Warsaw Pact pursued the development of a modern and innovative fleet. By 1986, the Soviets had amassed a Navy that Secretary of the Navy John F. Lehman described as follows:

> "What is particularly disturbing about the 'fleet that Gorshkov built' is that improvements in its individual unit capabilities have taken place across a broad area. Submarines are faster, quieter, and have better sensors and self-protection. Surface ships carry new generations of missiles and radars. Aircraft have greater endurance and payloads. And the people who operate this Soviet concept of a balanced fleet are ever better trained and confident."[1]

This modern and innovative fleet, however, did not come without a great deal of cost. The Cold War was the most demand-

ing national security challenge the Soviet Union faced since World War II. It dominated strategy, force planning, and defense budgets for nearly half a century. Although personnel costs, both mental and physical, are difficult to assess, this article portrays anecdotal evidence of one costly Cold War incident.

Captain Second Rank Igor A. Britanov, Russian Navy, was the Commanding Officer of RPK-SN K-219, a 667A Project boat (Yankee I class ballistic missile submarine), which encountered distress in the Atlantic Ocean. The incident onboard K-219, an explosion and subsequent fire in missile tube number six, occurred approximately 600 miles east of Bermuda in October of 1986. The Soviet Union claimed that the incident was due to a collision with a U.S. submarine. Captain Britanov says, "There was no collision."[2]

Although the book Hostile Waters is based on a true story of K-219, this article is the most accurate technical representation of what took place—it leaves out the *Hollywood*. Although this article is an accurate description of events, it does not fully portray the significant damage that was inflicted on the submarine, nor the heroic efforts of the crew to save it. Despite these efforts, only one sailor, who died in the reactor compartment, received an award. Word of this award and the happenings of this incident are not spoken of in Russia. Captain Britanov states that in the eyes of his government, there are no heroes from K-219. When asked the number of times he is called to be a guest lecturer at Russian functions, he simply states, "None—I do not tell the story the way my government wants me to tell it. I did not collide with an American sub."

As the reader progresses through this article, attention is directed to two issues: One: Readiness. The limitations of Soviet military finances, and the continual, demanding requirements of increasingly frequent submarine patrols and deployments during the Cold War, literally stretched their submarine force to the breaking point. As K-219 highlights, the Soviets had an inadequate force for the missions they attempted to accomplish. America's Submarine Force and families are counting on senior civilian and military leadership to carefully assess the extent of our participation in

peacetime engagement activities and smaller-scale contingency operations. In 1777, Thomas Paine said, "Those who expect to reap the blessings of freedom must undergo the fatigue of supporting it."[3] How much fatigue is enough? How much risk is too much? Our Submarine Force must have the right number of people matched with an adequate number of submarines.

The second issue to note is Safety. In the U.S. Submarine Force, at times, there may seem to be *micromanagment* or a perceived lack of trust by seniors—five or more people may check one person's work (i.e., SubSafe and nuclear work packages). Nothing can be further from the truth. Keeping the ship and men safe is priority one. Perhaps the incident on K-219 would not have occurred if one more person checked the last maintenance performed on missile tube number six.

The Homeland Said, "You Must"

According to plan, on 4 September 1986, RPK-SN K-219 set out to sea on operational duty. The Commander of the submarine, Captain 2nd Rank Igor Anatolyevich Britanov, was an experienced submariner who had earned the right to independently command an RPK-SN Project 667 AU in 1981. The cruise was his third as a commander and his thirteenth as an officer. This time, however, he was not commanding his usual vessel. On board K-219 watch was kept by the first crew of K-241, which included 31 officers, 38 mitchmen *(Ed. Note: Warrant Officer)*, 49 seamen, and was brought up to full strength with first class specialists. This time, cruise training had never been so chaotic.

The Cold War was ongoing and the Soviet Navy (as well as the Strategic Rocket Forces) bore the brunt of the two superpowers' nuclear missile standoff. The Soviet Union's response to the American deployment of Pershing IRBMs and cruise missiles on the front line in Europe was to build up the forces of the VMF of the USSR, and to extend RPK-SN patrolling up to the immediate shore of the United States. This made the flight time of missiles aimed at targets on American territory equal to that of American missiles aimed at targets on Soviet territory.

The number of military patrols for RPK-SNs rose to 2-3 times

per year. Technical resources reached the limit of their capabilities, and the repair base was far from adequate for the fleet's new tasks. The situation was even more difficult for Soviet submarines: 2-3 military cruises per year, unused leave, muddled training—all this became the norm. Under the pressure of these conditions, senior commanders had to close their eyes to the fact that non-proficient crews were going out to sea on *alien* boats. Discussion of crew proficiency and cohesiveness was not allowed.

An analysis of the K-219 personnel roster reveals that in the course of cruise training, 11 of the 31 staff officers had been replaced, including the chief executive officer, the executive officer, the missile (BCh-2) officer, the torpedo (BCh-3) officer, and the chief of the radio-engineering service (RTS). A similar situation existed among the warrant officers. Sixteen of the 38 mitchmen had been replaced, including both of the BCh-2 petty officers. This analysis is not to criticize Rear Admiral N.N. Malov, who was Chief of Staff for the 19th RPK-SN division, responsible for crew assignments. At that time, on orders from above, he brought five strategic underwater missile carriers into operational duty.

Why did the Captain agree to go out to sea unprepared, on a boat that was alien to him, and with a crew that included personnel unknown to him? Because if Britanov had refused, he would have been replaced by someone else. Let us turn to the events of 3 October 1986.

Explosion in Missile Tube No. 6

After 30 days at sea, K-219 maneuvered into its designated area of the Sargasso Sea in the North Atlantic. At 0456, on 3 October, the submarine rose to periscope depth for routine communications. Five minutes later it began a descent to 85 meters. The technical situation on board was as follows: the GEhU(electric plant) was operating in *one-echelon* mode, and the capacity of the starboard reactor was at 30 percent; the port reactor had been suppressed/damped by all the absorbers, and the steam production plant (PPU) and the turbine were ready for operation; the starboard

turbine operated the screw, and the port shaft line was ready to operate the propulsion motor.

At 0514, the BCh-2 officer and the *hold machinist/engineer* in compartment IV discovered water dripping from under the plug of missile tube No. 6. During precompression of the plug, the drips turned into a stream. The BCh-2 officer reported water in missile tube No. 6 (the third tube from the bow on the port side), and at 0525, the Captain ordered an ascent to a safe depth (46 meters). The pump was started in an attempt to dry out missile tube No. 6. At 0532, brown steam clouds of oxidant began to come out from under the plug of missile tube No. 6. The BCh-2 officer declared an accident alert in the compartment and reported the situation to the GKP (main control station). Personnel assigned to other compartments left compartment IV. Nine people remained in compartment IV. The Captain declared an accident alert. It took the crew no more than one minute to carry out initial damage control measures, which included hermetically sealing off the compartments. Five minutes later, at 0538, an explosion occurred in missile tube No. 6.

Black smoke appeared in compartment IV, followed by water with rocket fuel components flowing into the compartment from the destroyed pipes in the upper part of the missile tube. The Captain quickly gave the order for an emergency ascent to the surface. Inspection of the compartments revealed the following damage: a high level of gas in compartment IV; about 4.5 tons of water in the bilge of the compartment; and temporary loss of control of the status of the missiles in the other tubes. Other systems on board also suffered damage. The submarine's Kashtan loudspeaker communications system was knocked out, as well as the Kashtan systems for the missile BCh in compartments IV and V. The R-651 radio transmitter was practically knocked out. Indicators and lights in the compartments were smashed. In the superstructure, the high-pressure airline was damaged. The GEhU control panel indicated the following: on the port side, the direct current 220 volt network power supply was inoperative; the automatic valves supply feed water to all the steam generators on the port side opened; and the independent *tertiary-circuit* valves opened. The Kama *electro-energy* system console indicated that the insulation resistance of the

electrical systems on both the port and starboard sides was zero. By command of the GKP, lines of defense were established in compartment II (control station) and missile compartment V, and a backpressure of air was created in these compartments.

At 0610, personnel in missile compartment V and auxiliary machinery compartment VI were transferred to turbine compartment VIII. Seven minutes later a report came from missile compartment IV: it was impossible to remain in the compartment because of the large amount of gas and the high temperature. The Captain ordered that compartment V prepare to receive personnel from missile compartment IV. At 0635, personnel were withdrawn from compartment IV, but three crewmembers stayed behind, including the BCh-2 officer. The electrical (BCh-5) officer ordered that the port GEhU begin operating.

After the withdrawal of personnel from compartment IV, at 0645, a damage control party, consisting of two people, was sent to compartment IV to appraise the situation and help the three crewmembers in the compartment. Because of the great amount of smoke, the party could not locate the BCh-2 officer or conduct a detailed examination of missile tube No. 6. The bodies of seamen I.K. Kharchenko and N.L. Smaglyuk were removed from the compartment. The survey team members did not make any kind of attempt to switch the *electro-consumers*, nor did they discover the source of the smoke.

At 0725, ventilation of compartments IV, V, and VI, into the atmosphere, began. At daybreak the senior executive officer examined missile tube No. 6 from the top of the fairwater. The tube cover was gone, the rocket head was not visible, and the cover shaft was opened to the side. The outer hull structure around the tube was damaged. The shield-fairings to the covers of tubes 1, 3, 4, 5, and 7 were torn away and hanging overboard. The missile deck around tube No. 6 was deformed, trickling brown smoke.

At 0851, two members of the damage control party were sent to compartment IV for a second time. The level of gas in the compartment was lowered and visibility was improved. Water stopped flowing from the upper part of tube No. 6. The party found the lifeless body of the BCh-2 officer, Captain 3rd Rank A.V.

Petrachkov.

The pumping system in tube No. 6 was primed with outboard water and the hold of compartment IV was dried through the main bilge. When the pump for tube No. 6 was started, water and thick brown smoke began to come out of the damaged pipes in the upper part of the tube. The GKP ordered the pump stopped. The body of the BCh-2 officer, gas analysis equipment, and ISZ equipment were removed from compartment IV.

At 0925, the port GEhU began operating. The starboard and port PPUs were in operation with starboard capacity at 30 percent, and port capacity at 50 percent.

The Captain made the decision to discharge the oxidant by emergency means and to pump the tube. To accomplish this, he briefed an additional four groups from BCh-2 and BCh-5, and sent them to compartment IV. All attempts to pump the tube produced more steam clouds of oxidant and water. The last group started the emergency oxidant discharge pump. Water under the pumping head began to inundate the compartment's electrical equipment, including the switchboards. This caused short circuits in the switchboards, which started a fire. The fire consumed the electrical equipment and the pumps stopped. The GKP ordered the last damage control party to leave compartment IV.

At 1754, the GKP decided to introduce Freon from the fire smothering station (LOKh) in compartment III, into compartment IV. The Freon supply pipe was not dense and some of the Freon began to enter compartment III. The supply of fire suppressant to compartment IV was stopped. At about 1800, the gas composition of the air in compartment III worsened; the amount of nitrogen oxides exceeded the maximum permissible dose by 10 to 40 times. By order of the Captain, personnel entered the ISZ. Some personnel crossed into compartment II. Personnel were forced to abandon the communications post and the coded communications post. As a result, radio communications were broken. A routine dispatch about the situation on the submarine was not transmitted, and a radio telegram from the Commander of the Soviet Fleet with recommendations for damage control was not received.

At 1840, in order to inspect compartment V, the bulkhead door connecting compartment IV and compartment V was opened. In

compartment V there was a great deal of smoke, which was mistaken for a fire. This was reported to the GKP, who ordered that Freon be introduced into compartment V from the LOKh station in compartment VI.

At 1930, due to the loss of the 50 hertz, 380 volt power supply in the network on the starboard side, the starboard reactor's emergency *shielding* was activated. The reactor *compensating lattices* did not go down to the lower rear switches.

Twenty minutes later, personnel in reactor compartment VII reported to the GKP that there was smoke in the lower region of compartment VI. The compartment was abandoned. The bulkhead flapper valves between compartments V and VI did not close, and personnel crossed into compartment VIII. About this time, the pressure in the marine hydraulics system fell to zero. In order to secure the nuclear safety of the starboard reactor, BCh-5 specialists (senior Lieutenant N.N. Belikov and Seaman S.A. Preminin) were sent into reactor compartment VII, three separate times, in an attempt to lower the reactor compensating lattices manually. After Belikov lost consciousness, Preminin continued to work in compartment VII. At the same time, by command of the GKP, compartments VIII, XI (turbine), and X (end) were ventilated into the atmosphere, and the pressure in these compartments fell to atmospheric pressure. However, because the pressure in compartment VII remained elevated in relation to that in compartment VIII, personnel in VIII could not open the bulkhead door connecting VII and VIII when they were done ventilating. The vacuum system in the lower region of VIII was turned on to try to equalize the pressure but was stopped when brown smoke began coming out of the piping. The GKP ordered Preminin to try to open compartment VII's ventilation system flapper valve in order to lower the pressure in VII, but Preminin no longer was able to do this. Nor could the damage control team from the other side of the compartment. Further questioning from the GKP elicited no response from Preminin.

At 2130 the MMF (International Naval Fleet) vessels FYODOR BREDIKHIN, KRASNOGVARDEYSK and BAKARITSA set out for the area where the accident had occurred.

By 2300, according to personnel reports, the gas composition in the compartments had worsened. The ISZs had used up their resource and the temperature of the bulkhead between compartments III and IV had risen. Based on reports received, the Captain supposed that there were fires in compartments IV, V, and VI; that VII was pressurized, and that there could be fires in compartments VII, IX, and X. Given that the resource of the ISZ had been exhausted and that the (assumed) fires in compartments IV and V could cause missiles to explode, the Captain decided to take the port reactor off line and to prepare to evacuate personnel to the MMF vessels.

Emergency protection of the port reactor was abandoned and the plant was switched to cooling mode. Evacuation of personnel began and was completed by 0100 on 4 October. After evacuation of the bow and conning tower, the stern hatches were closed and battened down. The Captain and six officers remained in command on the bridge.

At 0146 the TsKP (central command post) of the VMF received a report from the Captain of K-219 through KP (command post) of the MMF: "Fire in all the compartments, no motion. Six men on the submarine. Large fires in the holds of compartments IV and V. The Captain awaits the order to abandon ship."

At 2245 a damage control party commanded by the Chief Executive Officer embarked on the submarine and surveyed compartments I, II, and III. These compartments were dry, the pressure was normal, and emergency lighting was on. In addition, the accumulator battery had been partially discharged. The pressure in the high pressure air system had fallen to ½ the normal pressure, and the pressure was absent in the hydraulics system. The boat's pressure hull above compartments IV and VII was warm, possibly due to residual thermal *separations* in the reactor. The pressure and hull temperature in the area of the other compartments was the same as that of the outside air. The bulkhead between compartments III and IV was cold up to the upper edge, and warm higher up.

In the bow compartments, the damage control party corrected the trim by blowing the main ballast tanks (TsGB) in the bow, and began preparing the submarine for towing. The party did not

examine the stern compartments because the stern hatch had been flooded. With the onset of darkness the party suspended its work and left the submarine.

Sinking of the Submarine

At dawn on 5 October the damage control party continued to prepare the submarine for towing. At 1815 the motor vessel KRASNOGVARDEYSK began towing. The submarine's draught and bow trim slowly continued to increase. On 6 October at 0620 the towing cable snapped, and the bow and stern entry hatches were submerged. The damage control party was not able to descend to compartment III because the lower conning tower hatch was jammed. The submarine continued to lose buoyancy. When it was submerged up to the level of the superstructure deck, the damage control party left. At 1100 the submarine was submerged up to the level of the fairwater. The GK (commander in chief) of the VMF ordered the Captain to abandon ship. At 1102 on 6 October 1986 K-219 sank.

The Investigation

The sinking of K-219 led to a criminal investigation that lasted nearly a year. As always, it was those who had tried to save the crew and the boat that were found guilty. The captain, the deputy political officer and the BCh-5 officer were discharged for failure to perform their duties properly. Of all the crewmembers, only Seaman S.A. Preminin was awarded the Order of the Red Star (posthumously). (By decree No. 844 of the President of the Russian Federation, 7 August 1997, Preminin posthumously was named a Hero of the Russian Federation.)

Credit must be given to the heroism shown by the crew, for the crew maintained a safe nuclear situation during an accident. Up to the moment the boat sank, the status of the fuel reactor cores and their controls was such that the possibility of nuclear and thermal explosions had been eliminated. The GKP and personnel correctly organized and carried out immediate damage control measures.

The vessel was brought to the surface. All compartments were hermetically sealed and a backpressure was created in compartments III and V. The port GEhU was brought on line, the compartments were inspected and personnel determined what problems had arisen in missile tube No. 6. Some crewmembers were wounded. Inspection of the compartments allowed the crew to evaluate the situation in compartment IV and to ventilate compartments IV, V, and VI. As a result of the measures taken, the situation on the boat was stabilized temporarily. Both of the GEhU operated at the designated capacities and the refrigeration machines were operating. The boat had electrical power and traveled at a speed of 13 knots to its meeting point with the MMF vessels. At the same time, though, the submarine's command did not take all possible measures to limit the extent of the accident and to prevent the vessel from sinking.

The special commission's investigation established the following:

1. The cause of the missile accident in tube No. 6 was flooding in the tube. The seawater destroyed the missile casing and caused rocket fuel components to enter the tube. The lack of irrigation in the tube and the fact that the tube cover's rack and pinion device had not been *undogged* (when the submarine was in a surface position) caused an increase in pressure and the explosion. This in turn caused the rocket fuel components to ignite and burn.

   The cause of seawater to enter the tube was not established. The tube cover possibly was not hermetically sealed, a result of mechanical damage incurred in the course of the submarine's operations.
2. The cause of the diffusion of nitrogen oxides from compartment IV, and the presence of gas in the stern compartments, was the multiple trips made by the damage control parties to compartment VI for the purposes of inspection, rendering assistance, ventilation, pumping the missile tube, and the emergency discharge of oxidant. When the pumps were started and the tube was being pumped, additional nitrogen oxides entered the compartment from the non-pressurized tube. This caused short circuits in switchboards No. 7 and

No. 8, which led to the fire in the compartment.

3. Due to the uncontrolled entry of seawater into compartment IV, the submarine lost longitudinal stability and buoyancy, and sank. Missile tube No. 6, which was non-pressurized in relation to the compartment, conjoined with outboard space through the outboard valves that remained open. This caused compartment IV to flood. Compartments V and VI were filled from compartment IV through the opened ventilation flapper valves between compartments IV and V, and between compartments V and VI.

After Thoughts

The short notice replacement of large portions of crewmembers on submarines can lead to tragic consequences. Unfortunately, this was not uncommon in the Soviet Union in the 1980s. On 23 June 1983, K-429 conducted a weapons firing check that cost the lives of 16 crewmembers and resulted in the sinking of the submarine. On board K-429 were 120 people, only 43 of whom were standard crewmembers. The others came from five different submarine crews.■

ENDNOTES

1.Norman Polmar, 1988, Guide to the Soviet Navy, Naval Institute Press, p.i.

2.Conversation with Captain Igor A. Britanov, Annapolis, August 5, 1998. Captain Britanov also claims that this article is the most accurate technical description of what happened to K-219. Lieutenant Commander Igor Fyodorov, Russian Navy Retired, was the interpreter during the conversation.

3.Jones, A. (Ed.) (1997), Chambers Dictionary of Quotations. Great Britain, Cambridge University Press.

The role of SSNs has changed, reflecting the challenges of the post-Cold War world. So, we are aggressively incorporating new technologies into the *VIRGINIA* Class. Optimized for the littoral, near-shore environment, these submarines will be the ***first in*** and ***last out*** to prepare the battlespace, launch land attack missiles, deploy Special Forces and more.

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ARTICLES

PREPARING FOR WAR: NOW OR LATER?

by Jerry Holland [1]

Rear Admiral Holland is a retired submarine officer who writes extensively on National Security issues.

Current concerns about the inadequate size of the Submarine Force parallel similar problems in almost all components of the nation's armed services. The situation has precedents in the last inter-war period between 1918 and 1939.

General Gordon Sullivan, then Chief of Staff of the Army, discussing the lessons of that earlier period observed, "Looking back into the twenties and thirties, those who kept their heads during the depression were those who were best prepared for war... The Army abandoned the tank because of cost...the Navy and Marines pursued amphibious warfare, keeping their head in the game. The scale of activity is less important than the paradigm."[2] His observation remains pertinent as the Navy faces heavy demands on existing forces in a period of rapid technological change requiring new equipment, techniques and organizational arrangements.

Modernization, which includes the development of doctrine and the adjustment of organizational relationships, relies on acquisition of new equipment and extensive experimentation in the field. These tasks, the purview of the services, have fallen on hard times as budgets constrain force size, restrict acquisition and reduce research and development. Major exercises focus on readiness for deployment or pursue the grail of "jointness"; exploration of long term improvements in service-related equipment, processes, and tactics is the loser in this equation.

One of the unplanned effects of the Goldwater-Nichols legislation is the dominance of the theater Commanders-in Chief (CINCs) in shaping the country's armed forces. By the nature of their office, the theater CINCs are totally concerned with the immediate needs in their areas of responsibility. Conservative by nature and

cautious by doctrine, the CINCs try to foresee every possible conflict in their theater and prepare to win any potential combat. Experience demonstrates that the CINCs' requirements for forces are insatiable. On the other hand, these commands have little personal or institutional stability, even in the theater, and their focus on the near term minimizes concerns regarding future technical improvements, new tactical processes or realignment of component organizations.

Today's perception that force size is inadequate, that more SSNs are needed now is based upon operational overload stemming from the demands of the theater Commanders-in-Chief as well as tasking from national authority. These demands reportedly are documented in a study by the Joint Chiefs of Staff which indicates a need for 20 percent more attack submarines than have been planned in the last Quadrennial Defense Review. This increase in force size, while close to the cockles of the heart of the CINCs—and through them the Fleet and Force Commanders—does not address the long term issue of the future design and use of submarines. As General Sullivan points out, money used to retain old submarines for current missions does not advance the operational art.

This conflict between force size and modernization is not unique to the Submarine Force. The current efforts of the Army to transform itself into a more agile force, Jeffrey Barnett reports, have "Two solutions...The first is to ask Congress for more money. That option has already run into resistance on Capital Hill. ... A second option is to increase the 'share' of the Defense budget that goes to the Army....If the Army tries to tax the other services to solve Army problems, an interservice fight is inevitable."[3] This condition is common throughout the Department of Defense. What Barnett describes is the reality facing all services and their component forces. Myriad high priority needs exist while the national defense budget, though increased markedly in this election year, will not provide significantly more money for defense.[4] Competition for resources between ships and planes, artillery and attack helicopters, missile defense and Ospreys, is fierce now and will grow.

At the same time, the NCA (National Command Authority) and the CINCs seem likely to continue to demand more than existing

forces can reasonably provide and modernization efforts—acquisition, tactical development and command processes—will be short-changed unless the individual components maneuver to maintain headway in this area.

The last period of prolonged peace, between the First and Second World Wars, offers some lessons for the present era. In the period from 1922 through 1935, naval forces were capped by a series of arms limitation treaties. Battleships, aircraft carriers, cruisers and submarines were limited in size and number. In addition to these constraints, though the country was economically prosperous through most of the twenties, expenditures for military purposes were niggardly at best. President Coolidge exemplified the general attitude when he suggested that the Army buy one airplane and the pilots take turns flying it.

Though dominated by *Battleship Admirals*, the Navy made substantial changes through this period in every category of ship and tactics except for the battle line. Ordnance sub-specialty was the aim of ambitious young officers and tales of how the *Gun Club* ran the Navy lasted well into the fifties. Yet this same period saw development of naval aircraft and their carriers, emergence of cruisers as main line surface warships and the creation of the submarine equipment that would be employed in the coming war. The activity of naval aviation holds easy-to-recognize lessons that do not carry emotional baggage for submariners.

Admiral *Billy Goat* Reeves, a surface warfare officer, as Commander, Naval Air Forces, developed the techniques for handling large numbers of aircraft on small decks as well as the tactical employment of air wings as integrated groups. His long tenure in fleet commands and that of Admiral William Moffet—Chief of the Bureau of Aviation from its inception in 1921 to his death in 1933—led to continuing improvements in both technical capability and tactics. With only three carriers, the twenty years between wars saw the development of the principles of high deck loads, rapid strike launching, and multi-carrier task force dispositions—fundamentals of the naval air war of 1942-1945. Expensive failures were tolerated as these pioneers sought to determine the technologies and processes that could be useful,

e.g., rigid airships, seaplanes designed for high level bombing, coordinated torpedo attacks by seaplanes and destroyers.

With battleship modernization stymied by treaty, the existing fleet left no room for new construction without dismantling existing first line assets, and surface warship design concentrated on cruisers. Though limited by treaty in both the size of individual ships and their armament, cruiser development was otherwise unhampered because the United States had so few at the end of World War I and the treaty limits—comparability with Great Britain—permitted many to be built. Funding limited construction; the numbers of cruisers allowed by treaty would never be authorized by Congress. Planners, designers and operators adopted a methodology of building successive classes of cruisers, each small in number, four or fewer ships. Each design sought to improve on the last while the steady construction rate—even though small—kept designers and yards functioning. This resulted in the existence of proven designs in hand by 1936 when expansion for World War II began, as well as a work establishment and procurement system in place to support the new construction.

Submarine design and construction followed a somewhat similar course. At the end of World War I, submarines were universally small, less than 1,000 tons, under-powered and lightly armed—small tubes and few reloads. Missions were limited to coastal defense and scouting, based on World War I Royal Navy experience. The German model of commerce raiding was rejected by policy makers, analysts and naval officers alike. An offensive role for submarines was not considered seriously even though as early as 1919 then Captain (later Admiral and Commander, Asiatic Fleet, 1941) Thomas Hart told senior admirals that Japan—the expected potential enemy—was the Great Britain of the Pacific and vulnerable to a submarine blockade. This reluctance to interdict shipping stemmed partly from the limitations of the machine and partly from the distaste for the U-boat campaigns of the First World War. [5]

The 1916 building program—which also produced the inter-war fleet of battleships—included construction of the S-class of about 850 tons surfaced. When Captain Hart led a force of these submarines from New London to Manila in 1921, the propulsion systems were a constant problem. U.S. manufacturers could not

produce engines that were up to the German standards of World War I much less than required for a trans-Pacific War. Powerful and reliable diesel engines remained a source of difficulty up to the beginning of the Second World War, coloring the debate between those favoring the smaller coastal boats and those in favor of 2000 ton *fleet boats*. The first post-World War I construction in 1924 produced the first three *V* boats of 2,000 tons. Later renamed USS BARRACUDA (SF-4 then SS-163), USS BASS (SF-5 then SS-164), and USS BONITA (SF-6 then SS-168), these under-powered ships were armed with six 21-inch torpedo tubes. However, their endurance—even when the engines worked—translated to a short operational radius. [6]

The next try produced a minelayer, USS ARGONAUT (SM-1) and then two *submarine cruisers*, USS NARWHAL (SS-167) and USS NAUTILUS (SS-168). With a surface displacement of 2,710 tons, these ships were armed with two six-inch deck guns: armament for commerce raiding where the submarine would surface, allow the threatened ship's crew to take to their lifeboats and then sink the merchantman by gunfire. All had a design range of 8,000 miles—enough for a Pacific campaign. Their design surface speed was 15 to 17 knots – enough to stay with the fleet in transit though with diesels that suffered from crankcase explosions, they could not be counted on to do so. Specifically exempt from the 1930 London Naval Treaty's limit of 2,000 tons maximum displacement, these ships continued in service into World War II. ARGONAUT was converted into the first special forces transport, APS-1, for the raid on Makin Island. As in the cruiser design, each class carried new ideas—not all successful, e.g., torpedo tubes mounted external to the hull. [7]

Exercises demonstrated these very large submarines were too slow to submerge, a liability even then recognized as a fatal flaw when threatened from the air. The most serious reservation was that at 2,700 tons not enough *submarine cruisers* could be produced to be an effective weapon against the Japanese Fleet or commerce because of arms-limitation treaty limits. [8] The London Naval Treaty of 1930 reduced the total submarine tonnage allowed to the United States, Great Britain and Japan to 52,700 tons each while prohibit-

ing construction of submarines over 2,000 tons.[9] By the thirties, the proponents of small submarines had been quashed. While both operators and designers favored a ship of about 2500 to 3000 tons, treaty limits meant that some compromise between size and numbers had to be made in order to build enough submarines to perform the scouting functions foreseen in the pre-war plans for fleet movements in the Pacific.

These arms limitation treaties actually promoted innovation by forcing the reduction of the force size—in this case submarines too small and antiquated to see future service. [10]

The advent of the longer range submarine was accompanied in 1928 by challenges to the submarine's role as a harbor defense and scout vehicle in direct support of the fleet. Commander Thomas Withers, first as Commander Submarine Division Four and then at the Naval War College, opened the debate on submarine missions by questioning design requirements for new submarines. Arguing that the stealth characteristics of a submarine were better employed in independent operations, Withers wanted the Submarine Force cut loose from the battle line. The scouting role could be maintained but at a distance and without the direct supervision of what we now term Battle Group Commanders. Withers' arguments set the tone for an offensive role for the Submarine Force.[11]

Withers argument for independent operations meant reliability, improved habitability and endurance (range) were more useful than speed. Subsequent war games at the Naval War College emphasized these qualities as well as opening the door to considering attacks on merchant shipping. This lesson first came home to officers playing RED and ORANGE who either planned an offensive campaign against BLUE's lines of communication or prepared to defend themselves against such a campaign by BLUE. Over time in the games, the Rules of Engagement for BLUE evolved slowly from severe restrictions on attacking commercial shipping to encouraging operations against enemy convoys. [12]

Designers complained that the submariners could not agree on the characteristics they wanted for the submarine. The argument over ship size persisted, but the last of the *V* boats, USS DOLPHIN (SS-169)— a ship of 1560 tons, a four-inch deck gun and six 21-inch tubes—indicates that by 1932 the size, speed, and armament

trade-offs had been made. The last evidence of the quantity over quality argument, getting a maximum number of submarines under the treaty limits, was construction of two more small submarines, USS CACHELOT (SS-170) at Portsmouth and USS CUTTLEFISH (SS-171) at Electric Boat. These 1100 ton ships represent the smallest inter-war construction. After 1933 submarines grew. The PORPOISE class, begun in 1933 displaced 1300 tons with the standard six tubes but the design speed was now up to 19 knots. The next class, SALMON, built three years later, was 1450 tons with eight tubes. In 1939, USS TAMBOR (SS-198) established the specifications for the wartime boats: 1476 tons, ten tubes, 20 knots surfaced and 8.75 submerged. [13]

In his book on this period, Dr. Gary Weir cites three vital ingredients of the naval-industrial complex during the inter-war period that allowed the expansion and operation of the World War II Submarine Force: the commitment to a continual building program, a capable industrial base and an infrastructure dedicated to improving the capabilities of each class. The industrial base, then as now, included not just building yards but hundreds of sub-contractors needed to fit the submarines with everything from engines to galley ranges. The longest pole in this tent was not the design or the hull but reliable and powerful diesel engines. This was not a case of a commercial-off-the-shelf procurement: arrangements whereby the engines for boats built by Electric Boat were manufactured by a wholly owned subsidiary became so onerous that the Navy arranged to manufacture engines itself under license from a German firm. Dissatisfaction with the civilian contractors led the government to create its own design and building yards, Portsmouth and Mare Island Naval Shipyards. None of these prescriptions sounds new; however today's climate of budgetary constraint lends importance to the recognition that these ship construction efforts, not the maintenance of force sizes, permitted the Submarine Force of 1942 to fight the Pacific War with Gato class ships not S-Boats.

In the realm of tactical employment, the inter-war sailors did not do as well as their material counterparts. Submarines were operated timidly during exercises, often having to surface and show lights at night. As late as 1940 in Fleet Exercise 21, Charles

Lockwood lamented that the submarines were scattered along a scouting line rather than being used in independent offensive operations against the opposing fleet.[14] Exercises were structured such that the threats submariners thought they would face in a Pacific war turned out to be exaggerated:

1. In clear Pacific waters, at periscope depth the submarine was visible to aircraft;
2. Active sonar was a great threat;
3. Diesel engine noise made surface attack at night impractical;
4. Depth charges were accurate and lethal. [15]

As a result, submarine tactics were wrong and most submarine commanders were unprepared at the start of World War II. They did not grasp how stealthy they were, even when surfaced.[16]

In addition to continued equipment improvement, the tactical employment of that equipment needs to be tested in as real an environment as possible. Actual limitations need to be discovered and processes developed to use new equipment most effectively. This effort cannot be limited to the Operational Development and Test Force tests but requires years of effort and experimentation for any significant device. There must be room for failure—some designs are doomed from the start—CACHELOT and TULLIBEE for example. Many will be poor seconds—usually because of conservative or timid approaches—like BARRACUDA, MARLIN and SKATE. Except in unusual cases, limitations are unrealized until the ship or the equipment goes to sea: no vendor has a viewgraph listing possible failures.

What is important is that innovation is encouraged and failure tolerated. Also important is retiring the ship or discarding the equipment as soon as its inadequacy is recognized so that error is not perpetuated by throwing good operational money (OM&N) after poorly spent shipbuilding (SCN) funds.

Today the nuclear attack submarine has doomed surface fleets. Warships are not being built to combat other warships except submarines. Surface and aviation assets are aimed only at targets on the land—they expect no opposition at sea. ASW capabilities are purposely absent from new warship designs. No potential peer enemy exists. However this happy situation is not guaranteed to last. Even today the Navy's surface ships and Marines face

problems gaining access to a growing number of places. Unless access can be obtained, these forces will be frustrated in executing the missions for which they have designed and provided. The only reliable method of penetrating the littoral where access is contested will be with stealth vehicles. While undersea stealth has a permanency other forms envy, its characteristics are not immutable.

Submarine stealth will have to continue to be improved. Such improvement is a function of modernization and not of force size. Continued construction of ever more advanced submarines is a keystone to maintaining American superiority at sea and gaining access to defended littorals; time does not stand still and today's Virginia class is the mid-21st century's S-boat.

In summary, the circumstances of the day and lessons of the last inter-war period suggest that:

- There is some minimum force size necessary to maintain operational proficiency and to develop tactics appropriate to the time, the equipment, and the potential enemies.
- The CINCs' numbers do not reflect this minimum force size but rather their desire for an overwhelming superiority against any potential and imagined threat within their theater. To the CINC, every day is December 6, 1941.
- Modernization cannot be limited to research and development but must include fielding and failure; not only to find out how the technology works and what training is required to support it, but how service components ought to be organized and commanded to best use it.
- The services' view ought to be that it is 12 November 1918: the war has ended and no enemy is in sight. Now is the window for designing new classes of ships, putting new equipment to sea to be tried, improved and if justified, replicated.

The reality is that there is not going to be more money, or a shift in the division of resources by the Congress, or some overhaul of the Defense Department that will make more money available for submarines. The organization of the Navy for allocation of resources makes it difficult to shift significant sums across major program or warfare sponsorships. For example, recognition that

SSGNs are strike assets, not substitutes for SSNs, and so should compete for funds programmed for the Land Attack Destroyer and the Joint Strike Fighter, require a direction and commitment not seen since Admiral Arleigh Burke directed a ten per cent reduction in all Navy programs to pay for the initial increment of the Polaris program. [17]

In this somewhat bleak forecast, the Submarine Force should be large enough to:

1. meet the needs of strategic deterrence. This is a political judgment, not a military one.
2. discourage the construction of warships by other powers.
3. be an effective ASW force in the event another state attempts to interdict our sea lanes.
4. develop tactics and maintain operational proficiency.
5. test new equipment and to then develop procedures to exploit new devices and to demonstrate the limitations of equipment, processes and organizations.

The force size outlined above only marginally deals with the needs as perceived by the CINCs. Letting "...a thousand flowers bloom..." to determine the value of and create supporting processes for new technology is the opposite of the CINCs' needs. The CINC wants structure and fighting strength today—not experiments for tomorrow. Somehow the demands from national taskings and requirements for deployments must be contained so that the necessary long term development can take place. The enemy that matters is not a Balkan warlord or a Middle Eastern potentate but the undetected unforeseen threat to major national interests vital to the United States or its allies ten to twenty years in the future. This is an in-house problem: the tactical employment of submarines and their long-term potential are not likely to be recognized outside of the Navy, probably not even outside of the Submarine Force.

There is no formula that will instantaneously shift forces from high tempo operations to explore the potential for new equipment, new tactics or new organizations. But some of the lessons from the last interwar period—when there were few if any national taskings or emergency deployments—are still germane:

1. Capitalize on stealth: it will become more and more important as sensors improve and proliferate. Expect surface and

aviation officers to misuse or fail to use submarines in operations, war games and exercises. They have no experience in stealth as a feature of operations and generally do not learn how to employ stealthy vehicles before their time in command of them is over.

2. Continue to prepare to operate offensively. Withers was right. This does not equate to accepting unnecessary losses. See 1. above.
3. Examine lessons from operations and organizational designs carefully. Stealth vehicles operate best independently—by their very nature they require little direction and no escort or company. Organizing so that stealth vehicles are hamstrung or wasted by seniors unversed and uninterested in their advantages and limitations should be avoided where possible.
4. Sacrifice numbers for capability. Modernization, not force size, is the key to continued supremacy.
5. Don't compromise on reliability.
6. Invest time and resources in tactical development. Conduct exercises under real conditions and do not whitewash results.
7. Invest in knowledgeable and experienced people who are competent in the technologies they are supposed to employ. People who know how things work make the best commanders and tacticians. Nimitz was the one of the most respected authorities on diesel engines in the early twenties because of his experiences in submarines.

The modernization challenge facing the Submarine Force's leaders today is greater than in the lifetime of any submariner. But the future probably looked grim in the twenties when Hart, Nimitz and Withers looked ahead. Today as then, as General Sullivan instructed, "The paradigm is more important than the activity."■

ENDNOTES

[1] Dr. Thomas Hone of the Industrial College of the Armed Forces was instrumental in inspiring this essay, ensuring historical accuracy and providing references. Judgments and propositions are those of the listed author.

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ATTACK SUBMARINES AND NETWORK-CENTRIC WARFARE

by Phillip Thompson

Mr. Thompson is with the Lexington Institute, an Arlington, Virginia defense analysis firm.

When Charles Darwin formulated his theories of evolution, he probably wasn't thinking of the U.S. military. But there exists an analogy between the animal kingdom's evolution and the American military's ability to evolve and survive. Perhaps no weapons platform has shown an ability to adapt to environment like an attack submarine. Much like its organic counterpart, the shark, the submarine has, since its inception more than 400 years ago, evolved without drastically changing its original structure or purpose. And like the shark, the attack submarine has emerged as the ultimate predator.

In the modern era, submarines have transformed themselves from the role of harbor prowler to that of a nuclear hunter-killer. In the opening days of World War II, subs were restricted by power, endurance and the need to replenish oxygen, which made them vulnerable and incapable of sustained underwater missions far from port. In 1943, the German navy introduced the snorkel mast, which enabled subs to remain submerged at a shallow depth, which greatly reduced its vulnerability to surface or air attack while replenishing.

Technology advances in fuels developed as well, and by the end of the war, most submarines were powered by diesel engines rather than the more volatile gasoline engines. With the introduction of nuclear power, submarines were able to stay underwater indefinitely. Hull-design advances gave submarines more maneuverability and less drag, and communications technology enabled sub crews to communicate with the outside world without surfacing.

During the Cold War, attack subs reached what could be argued as the pinnacle of their lethality. Nearly silent and loaded with the most sophisticated tracking and targeting systems in the world, America's attack boats hunted for, found and followed Soviet

ballistic-missile subs, often without ever being detected. When not tracking enemy submarines, attack boats performed variety of underwater intelligence, surveillance and reconnaissance missions, many of which were clouded in secrecy for so long that only now, nearly a decade after the collapse of the Berlin Wall, are we able to grasp the complexities of these missions. Since the demise of the Soviet Union, the missions of this latter category have naturally increased in importance and scope. Indeed, contrary to the opinion of many critics who posit that without a prey, there is no need for attack submarines, information has become the submarine's latest prey, one with ramifications no less significant than the former Soviet submarine threat.

Network-Centric Warfare

The evolution of the attack sub from hunter of other subs to hunter of information places the sub community squarely in the center of *network-centric warfare*, a proposition that future battles will be reliant upon and tied together by myriad information networks. These networks will connect and control the array of weapons platforms available to naval strike forces and the platforms of other services—Air Force bombers, for example.

Submarines, obviously, possess enormous potential in the network-centric arena, especially in three areas: access; intelligence, surveillance and reconnaissance, or ISR; and strike.

Access

Access is the linchpin for submarine operations. Everything else a sub does or can do is predicated on the submarine's ability to gain that access. In today's warfare environment, in which area-denial capabilities are becoming the norm, nuclear submarines can more often than not guarantee access.

Perhaps even more significant is the ability of subs to allow access by the surface battle groups into defended littoral waters. For example, submarines can neutralize enemy subs, locate mines, and locate enemy missile batteries. Thus, an enemy's strategy of sea denial can be thwarted by submarines.

Intelligence, Surveillance and Reconnaissance

Information-gathering tasks are categorized as *intelligence, surveillance and reconnaissance* missions, or ISR missions. The ISR function is very similar to that of a satellite.

But many satellites orbit the earth in regular patterns, traveling east to west, which makes them very predictable. And because satellites are predictable, they can be fooled. One way to limit trickery by adversaries is with geosynchronous orbits, which allow satellites to remain over a designated point on the Earth—a suspected terrorist camp, for example. Still, the satellites are 22,000 miles away.

Nuclear subs can settle to the bottom of the ocean and remain in place, undetected, near an adversary's coast for weeks, even months. They can monitor military frequencies, send special-operations forces ashore to conduct reconnaissance, and carry out a host of other intelligence missions without adversaries ever having any idea they are being scrutinized. And unlike spy satellites, subs can get very close to targets to collect, develop and transmit targeting data for a multitude of strike platforms. In fact, no other weapons platform in the U.S. inventory can guarantee access to the enemy's systems, communications and territory like a submarine.

Strike

That is not to say that all submarines have to offer to network-centric warfare is a steady supply of targeting data or raw intelligence. Subs, as weapons launching platforms, can be a recipient of such information to launch strikes.

Recent operations in the Persian Gulf and off the coast of the Balkans, along with strikes against suspected terrorist camps in Afghanistan, clearly demonstrated the submarine's ability to gain access to a theater and launch weapons against hard targets. While it is true that technology leaps could potentially have adverse effects on a submarine's capability to engage targets, the fact is that submarines are already playing a significant role as a naval strike platform, a role that could be enhanced and enlarged in the future.

This is especially true when the modular-construction design of the Virginia class attack submarine is considered. Designed to be tailored for the mission at hand, a Virginia class sub could conceivably exploit emerging payload technology that would complement the ever-growing sensor technology. As payloads, lethal and otherwise, become smaller and more efficient and the submarine's sensory reach is extended, the submarine could emerge as the premier strike weapon. Already, JIMMY CARTER, a Seawolf class submarine has been reconfigured with an *ocean interface* payload compartment amidships. This hourglass-shaped payload section will be capable of opening to the sea, mainly to facilitate *multi-mission* capabilities—classified research, development, test and evaluation for special-warfare missions. This type of flexibility, which in no way decreases the combat power of the sub, gives fleet and unified commanders an exceptionally powerful asset when assigned any number of missions.

As an example, a lone submarine, loaded with Tomahawk missiles, can cruise ahead of a carrier battle group, undetected, until it reaches a loiter point. Once on station, the sub can put ashore a team of special-operations troops to collect information while the sub crew collects information from its own sensors. With the ensuing target data thus developed, the sub can then launch a series of Tomahawk strikes against inland anti-aircraft missile and radar sites, effectively blinding the enemy and clearing the way for the carrier battle group. The submarine can then retrieve the special-operations force and resume patrol, or stay in the area to conduct ISR missions in support of the battle group.

Indeed, the regional commanders in chief consider the ISR mission of attack submarines so crucial that demand has far outstripped supply when it comes to having enough submarines for the job. This was evidenced by a recent study by the Chairman of the Joint Chiefs of Staff, which contradicted the findings of the 1997 Quadrennial Defense Review. The QDR mandated an attack sub fleet of 50 boats, well below the level deemed necessary by the CJCS. The latter study called for 76 boats by 2025, a level that many officials, both in and out of the Navy, feel may be impossible to reach without drastically increasing current shipbuilding production.

Challenges to Network-Centric Warfare

However, submarines also possess a serious drawback—they operate underwater, making transmission of data at speeds required for network-centric warfare difficult, if not impossible in some cases. This poses a significant challenge to the community, which sees itself participating in the exchange of information that creates the *common operational picture*, a real-time view of the battle-space.

The challenge exists because subs are limited by antenna aperture and bandwidth in how much information they can exchange. Simply put, submarines must be capable of transmitting and receiving data—including high-quality images that could be used for targeting—at speeds equivalent to forces on the surface. Current transmission rates enable sub crews to accomplish nearly all tasks and to utilize the Global Positioning System. At the same time, however, this rate is not sufficient for receiving images of the quality needed for precision targeting.

Currently, the Navy is developing next-generation antennas while it upgrades existing systems to bring submarines more into the world of network-centric warfare. An Extremely High Frequency, or EHF, antenna was installed aboard the USS Pasadena two years ago to give the sub a greater capability to work with carrier battle groups. The EHF systems enable direct communication between submarine and aircraft carrier.

Still, overcoming antenna limitations may require a "breakthrough in the laws of physics," said Rear Admiral Malcom Fages, who heads the Navy's submarine warfare division in Washington, D.C. "As long as we're operating with parabolic antennas and the laws of physics, we're stuck."

A change in the laws of physics aside, there are several potential solutions to the bandwidth dilemma, mostly conceptual. One possible answer is a phased array antenna for submarines similar to the Aegis radar used on surface ships such as the Ticonderoga class cruisers and Arleigh Burke class destroyers.

Also, floating antennas may provide a means of information exchange without sacrificing a submarine's stealth. Advanced

floating antennas are currently in the demonstration phase. They will allow two-way UHF satellite communications with at-depth subs at high data rates.

A similar solution would be to launch an antenna device from a submarine, again preserving the submarine's stealth while allowing for placement of an antenna at a crucial place and time.

A Force Multiplier for the Future

The submarine's access and its ability to harvest enormous volumes of information that can be processed into valuable intelligence makes the attack submarines one of the most significant *force multipliers* in today's information age. This is especially true in these times in which the American military practices a form of *aloof engagement*—using long-range, precision-guided standoff weapons to attack inland targets.

Natural Selection

At the end of its first hundred years as a modern American weapon, the submarine is far from being near the brink of extinction. Instead, it has climbed the evolutionary ladder to become the preeminent strike weapon of modern warfare.

In the animal kingdom, species thrive or die out by a process known as natural selection. In the world of warfare, the same dynamic is at play. Submarines face extinction, much like some species of animals, only at the hand of man.■

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U.S. SUBMARINE DESIGN IN THE 20TH CENTURY

by Richard Boyle

Innovation is a warfighting skill. Emergence of American submarines was made possible by the innovative genius of John P. Holland. During the 20th century, the U.S. Navy commissioned 454 conventional submersibles in 58 classes and 192 nuclear submarines in 19 classes.

In this brief review, noteworthy designs, ranging from revolutionary to failures, will be presented in order of hull number. Surface displacement (NSC) and submerged displacement (SUBD) are in long tons. Commentary will be offered, if salient, on selected characteristics. We shall concentrate on hull design and propulsion machinery. Limited space precludes coverage of sensors and most weapons. A short bibliography is appended. Design eras noted in Jackson et al (1986) provide a framework for design motivation.

Genesis: Coastal Defense Submersibles

	In Class	In Service	Length/Ft	L/Beam	SUBD Tons
Holland (SS-1)	1	12 Oct 00	53.8	5.17	74
C-1 Octopus (SS-9)	5	30 Jun 08	105.3	7.59	273
	Torpedo Tubes Fwd	Tubes Aft	Reloads	Subm Spd Kts	Test Depth Ft
Holland (SS-1)	1	-	2	6	75
C-1 Octopus (SS-9)	2	-	2	9	200

Boats in this era all had 17.7 inch torpedo tubes, gasoline engines and single hulls, HOLLAND was a body of revolution

(BOR) hull with a single screw designed for operation submerged. C-1 OCTOPUS had twin screws and two engines, which became the norm.

John Holland (1841-1914) was truly the *Father of the Modern Submarine*. His genius was underscored by appreciation of simplicity and common sense. Two of his diving principles were:

- A submarine should dive like a porpoise and rise like one.
- A submarine should have a fixed center of gravity submerged, and its water ballast tanks should completely fill.

All modern submarines still work the same way.

Early submarine design was dominated by Electric Boat Company (EB) (John Holland resigned from EB in 1904) and, to a lesser extent, Lake Torpedo Boat Company (Lake).

Simon Lake (1866-1945) has been characterized as *one of the finest examples of the Yankee inventor*. Early on, he espoused trainable torpedo tube nests in the superstructure.

The Diesel Revolution

	In Class	In Service	Length Ft	L/Beam	SUBD Tons
E-1 Skipjack (SS 24)	2	14 Feb 12	135.2	9.27	342
G-3 Tuna (SS 31)	1	22 Mar 15	161.0	11.25	468
K-1 (SS 32)	8	17 Mar 14	153.5	9.19	520
L-1 (SS 40)	7	11 Mar 16	168.5	9.69	548
T-1 Schley (SS 52)	3	30 Jan 20	268.8	11.88	1487
R-1 (SS 78)	20	16 Dec 18	186.3	10.33	680
S-1 (SS 105)	1	5 Jun 20	219.3	10.61	1062
S-2 (SS 106)	1	25 May 20	207.0	10.57	977
S-3 (SS 107)	1	30 Jun 19	231.0	10.58	1088
V-4 Argonaut (SS 166)	1	2 Apr 28	381.0	11.27	4164

	Torpedo Tubes Fwd	Tubes Aft	Reloads	Subm Spd Kts	Test Depth Ft
E-1 Skipjack (SS 24)	4	-	4	11	200
G-3 Tuna (SS 31)	4	2	3	9.5	200
K-1 (SS 32)	4	-	4	10.5	200
L-1(SS 40)	4	-	4	10.5	200
T-1 Schley (SS 52)	4	-	8	11.5	150
R-1 (SS 78)	4	-	4	11.5	200
S-1 (SS 105)	4	-	8	11	200
S-2 (SS 106)	4	-	8	11	200
S-3 (SS 107)	4	-	8	11	200
V-4 Argonaut (SS 166)	4	-	12	7.4	300

E-1 had two Vickers 275 bhp four cycle diesels built by New London Ship & Engine Company (Nelseco). With air blast injection. EB boats would have Nelseco engines until 1925. This class had the first bow planes.

G-3 was lake's first diesel boat. It was fitted with two Busch Sulzer 600 bhp two cycle engines. All subsequent Lake boats would have Busch Sulzer diesels.

K-1 and L-1 (both EB built) were provided with Nelseco-Machinenfabrik-Augsburg-Nürnberg (Nelseco-MAN) two cycle diesels which were very unreliable. During the Great War, we deployed four K-Boats and E-1 to the Azores and seven L-Boats to Bantry Bay, Ireland. Despite highly motivated crews, coastal boats with cranky engines simply were not up to the task at hand.

SCHLEY was fitted with two 17.7 inch twin trainable external tube nests, but this was not a success and they were removed. Four

Nelseco 1000 bhp diesels as built; direct drive with two in tandem on each shaft. Serious vibration problems. First double hull and endurance improved to 3000 nm @ 14 knots. Achieved 20 knots during surface trials, a *fleet* submarine goal. Seakeeping difficulties. All three in class laid up by 1927.

R-1 was our first class with 21 inch torpedo tubes. All subsequent front line U.S. designs would be fitted with 21 inch tubes, until current SEAWOLF.

In 1915, Constructor Emery S. Land was assigned to the Bureau of Construction and Repair (BuC&R) preliminary design office. He favored an open ocean submarine of about 800 tons NSC, not quite a *fleet* submarine. A partial double hull was considered preferable to a single hull for boats larger than 800 tons NSC.

In order to challenge EB and Lake design dominance, three prototypes were ordered to general specifications. EB (S-1), Lake (S-2), and Portsmouth Naval Shipyard (PNSY) (S-3) were allowed to develop their own detailed plans. S-1 was single hull; the other two were double hull. Despite having had six superior German war prize U-Boats in our hands since 1919, their characteristics were not factored into S-Boat designs. Fifty-one were delivered between 1919 and 1925 (EB 31, PNSY 11, Lake 9).

S-10 through S-13 (PNSY) had one stern tube and a total of nine reloads. S-48 through S-51 (Lake) had the same additional tube but 11 reloads.

Lake's Busch Sulzer engines worked well. Seven PNSY boats had Nelseco engines and four were built with U.S. licensed versions of MAN engines built at New York Navy Yard (BuMAN).

All other deficiencies were overshadowed by Nelseco problems. Vibrations at critical engine speeds caused crank shaft failures and damage to pistons, cylinders, and cylinder heads.

The Bureau of Engineering (BuENG) held EB/Nelseco responsible for a poor design. EB disagreed and stopped work on their boats in 1921. Production resumed in early 1922.

Simon Lake went out of business in 1924. EB received no U.S. construction contracts between 1925 and 1932.

Three *U-Cruiser* monsters were placed in service between 1928 and 1930, two at PNSY and one at Mare Island Naval Shipyard (MINSY). ARGONAUT (PNSY) was our only minelayer, carrying

60 Mk XI mines launched through two 40 inch diameter stern tubes. All three had two 6 inch deck guns. NARWHAL and NAUTILUS carried hefty torpedo loads.

Diesel Direct Drive (DDD) and Diesel Electric Drive (DED). DDD: two BuMAN 1400 bhp diesels. DED: one BuMAN aux engine driving a 300 kw generator. Two 1100 hp main motors. She was underpowered and ungainly submerged. Never used as a minelayer.

Enhancement of Surfaced Performance: The Fleet Submarine

	In Class	In Service	Length Ft	L/Beam	SUBD Tons
V-7 Dolphin (SS 169)	1	1 Jun 32	319.3	11.24	2215
Tambor (SS 198)	12	3 Jun 40	307.2	11.27	2370
Gato (SS 212)	77	32 Dec 41	311.8	11.44	2410
Balao (SS 285)	119	4 Feb 43	311.8	11.44	2415
	Torpedo Tubes Fwd	Tubes Aft	Reloads	Subm Spd Kts	Test Depth Ft
V-7 Dolphin (SS 169)	4	2	12+3 (topside)	8	250
Tambor (SS 198)	6	4	14	8.8	250
Gato (SS 212)	6	4	14	8.8	300
Balao (SS 285)	6	4	14	8.8	400

In 1926 the Submarine Officers Conference (SOC) was established to advise on operational characteristics of submarine designs. Andrew McKee, a brilliant designer, came to BuC&R at

about the same time. This combination of operator inputs and design perspicacity gave BuC&R and BuENG a refreshing outlook. It was decided to adapt selective characteristics of U-135 (a successful WWI German U-Boat) to U.S. designs. Under the guidance of McKee, DOLPHIN (NSC 1718 tons) emerged.

DOLPHIN was a precursor to the fleet type submarine. Partial double hull. Max surface speed 17 knots. Surface range: 600 nm @ 10 knots. DDD and DED. DDD: two 1750 bhp BuMAN diesels. DED: two 450 bhp BuMAN diesels driving two 300 kw generators. Two 875 hp main motors and two 25 hp creep motors.

In 1932, a diesel engine competition was launched by BuENG. Three designs were accepted:

- General Motors (GM) 201A, a 12 cylinder two cycle V-type railroad engine
- Fairbanks Morse (FM) 38A 8, an eight cylinder two cycle opposed piston type
- Hooven-Owens-Rentschler-MAN (HOR), an eight cylinder two cycle double acting. (Double action means ignition both above and below the piston.)

All of the early versions of these engines had problems, but the HOR failures were devastating. Work horse replacements were GM 278A and FM 38D 8 1/8. The last of the 21 HOR boats was not re-engined until mid 1944.

In the late 1930s the SOC established characteristics of an ideal all purpose fleet boat. TAMBOR keel was laid on 16 January 39. Partial double hull, welded. Max surface speed 20 knots. Range on surface 11,000 nm @ 10 knots. DED with motor to shaft reduction gears. Four GM 16-248 1535 bhp diesels driving four 1100 kw main generators. Two aux generators. Four 1375 hp main motors.

The ultimate work horse submarine of WWII was the Gato class, and its design was frozen for mass production in 1940. That same year, BuC&R and BuENG were merged to form the Bureau of Ships (BuShips). Gato characteristics were about the same as TAMBOR, except that test depth was increased to 300 feet.

The Balao class had the same general characteristics as Gato, except test depth was 400 feet. Also, in 1944, new boats of the class were provided with slow speed main motors, eliminating noisy

reduction gears.

Toward the end of the war, Armand Morgan, who had been responsible for submarine design at BuC&R/BuShips since the late 1930s, observed: "[T]he leadership, direction, interest, and demands of the operating personnel were a major, if not the major, force leading to the success of our designs."

Emphasis on Submerged Performance

	In Class	In Service	Length Ft	L/Beam	SUBD Tons
Dolphin (AGSS 555)	1	17 Aug 68	152.0	7.86	930
Tang (SS 563)	6	25 Oct 51	269.2	9.91	2260
K-1	3	10 Nov 51	196.1	7.98	1160
Albacore (AGSS- 569)	1	5 Dec 53	203.8	7.53	1837
Nautilus (SSN 517)	1	30 Sep 54	323.7	11.70	4092
X-1	1	7 Oct 55	49.7	7.09	36.3
Seawolf (SSN 575)	1	30 Mar 57	337.5	12.20	4287
Skate (SSN 578)	4	23 Dec 57	267.7	10.71	2848
Barbel (SS 580)	3	17 Jan 59	219.2	7.56	2369
	Torpedo Tubes Fwd	Tubes Aft	Reloads	Subm Spd Kts	Test Depth Ft
Dolphin (AGSS 555)	1	-	-	N/A	N/A
Tang (SS 563)	6	2	18	18.3	700

K-1	4	-	4	8.5	400
Albacore (AGSS- 569)	-	-	-	25-29	600
Nautilus (SSN 571)	6	-	16	23.3	700
X-1	-	-	-	7	150
Seawolf (SSN 575)	6	-	16	20+	700
Skate (SSN 578)	6	2	14	18	700
Barbel (SS 580)	6	-	16	18.5	700

DOLPHIN, our only diesel battery boat still in service, is a valuable deep-diving asset for ASW and oceanographic research.

Submerged performance of the revolutionary German Type XXI boat was impressive. She could make 17.2 knots submerged and go 285 nm @ 6 knots on the battery. Evaluation of U-2513 and U-3008 began in September 1945. Performance reports provided some guidelines for our first post-war attack boat, TANG.

The two stern tubes were for swim-out torpedoes only.

TANG and three others were equipped with four GM 16-338 high speed pancake diesels rated at 1000 bhp each at 1600 rpm. Two boats were fitted with three FM 8-38A 6 3/4 high speed opposed piston engines with revised ratings of 1335 bhp at 1335 rpm. Neither engine design had been properly proof tested before installation. The pancake engines had the most serious problems, and all six boats were eventually re-engined with three FM 8-38ND 8 1/8 engines rated at 1500 bhp at 850 rpm.

Postwar planners envisioned lots of small killer submarines in barriers across the Greenland-Iceland-United Kingdom (GIUK) gap on guard against surging Soviet submarines. K-1 grew in size and sophistication as she emerged and lacked habitability for such a role, particularly in the unforgiving North Atlantic.

ALBACORE represented a giant leap forward in submarine design and return to a BOR hull form and single screw 50 years

after HOLLAND. As a research submarine, she took on many configurations for evaluation, and BuShips was given a free hand. Highlights included:

- Phase I: Cruciform stern with control surfaces aft of the propeller. Retractable bow planes.
- Phase II: Cruciform stern with control surfaces forward of the propeller. Bow planes removed.
- Phase III: X-stern with control surfaces forward of the propeller. Superb control and maneuverability.
- Phase IV: X-stern with control surfaces forward of two contrarotating propellers. Two lengths of shaft were installed to study effects of separation of the propellers. Closer was the best.

The influence of ALBACORE on future designs reverberated throughout the major navies of the world.

Dr. Ross Gunn of the Naval Research Laboratory (NRL) pondered the prospects of using nuclear fission as a source of energy for submarine propulsion in early 1939. He and Dr. Philip Abelson contributed to an NRL report (April 1946) on "The Atomic Energy Submarine". In June of that year. Captain Hyman G. Rickover was assigned by BuShips to lead a small group of colleagues to study power piles at Oak Ridge, Tennessee. On 9 June 1947, Admiral Chester Nimitz, Chief of Naval Operations (CNO), approved development of nuclear propulsion for submarines.

Design and construction of NAUTILUS was an enormous task, and it is truly amazing that she made it to sea just seven and a half years after Rickover first arrived at Oak Ridge to start the process.

All U.S. nuclear pressurized water reactor (PWR) systems work basically the same way, with some differences in natural circulation plants. A submarine thermal reactor (STR) uses water as a coolant and moderator to produce slow (thermal) neutrons in the core and sustain criticality. Reactor manufacturers are identified by the last letter in a reactor designator, e.g., W (Westinghouse), G (General Electric), and C (Combustion Engineering). Most engine rooms contain geared turbines driven by saturated steam delivered from steam generators in the reactor compartment.

NAUTILUS was fitted with an S2W power plant.

X-1, our only midget so far, was an important failure. Conceived at PNSY as a diesel battery craft, her design was turned over to Fairchild Engine Division of Fairchild Engine and Airplane Corp., and a peroxide diesel boat emerged. Highly concentrated unstabilized hydrogen peroxide was used to produce oxygen for running a diesel engine submerged. On 20 May 1957, an explosion in the peroxide storage bag in the bow section taught us that high concentration hydrogen peroxide has no place on a fighting ship.

SEAWOLF's reactor used sodium/potassium as coolant. Intermediate speed neutrons (SIR) were used to sustain fission. Arrangements to deliver superheated steam to the engine room failed because of metallurgy problems in the superheater. With only saturated steam available, SEAWOLF could not achieve design speed, and her S2G reactor was replaced with a PWR plant.

SKATE, a scaled down version of NAUTILUS, was fitted with an S3W plant, the first with vertical steam generators, which became the norm. Stern tubes swim-out only. On 17 March 1959 she became the first ship in history to occupy the surface at the geographic North Pole.

BARBEL, a militarized version of ALBACORE, became an essential precursor to SKIPJACK.

Final Transition to Nuclear Powered BOR True Submarines

	In Class	In Service	Length Ft	L/Beam	SUBD Tons
Skipjack (SSN 585)	6	15 Apr 59	251.8	7.95	3500
Triton (SSRN 586)	1	10 Nov 59	447.5	12.12	7773
Thresher (SSN 593)	14	3 Aug 61	278.5	8.79	4311
Tullibee (SSN 597)	1	9 Nov 60	272.8	11.69	2607

George Washington (SSBN 598)	5	30 Dec 59	381.7	11.57	6709
Jack (SSN 605)	1	31 Mar 67	297.4	9.39	4467
Lafayette (SSBN 616)	19	23 Apr 63	425.0	12.88	8251
Sturgeon (SSN 637)	37	3 Mar 67	292.3	9.23	4762
Narwhal (SSN 671)	1	12 Jul 69	314.7	9.54	5350
NR-1	1	27 Oct 69	146.0	12.17	700
Glenard P. Lipscomb (SSN 685)	1	21 Dec 74	364.8	11.55	6480
Los Angeles (SSN 688)	62	13 Nov 76	360.0	10.91	6927
Ohio (SSBN 726)	18	11 Nov 81	560.0	13.33	18750
Seawolf (SSN 21)	3	19 Jul 97	353.0	8.82	9150
	Torpedo Tubes Fwd	Tubes Aft	Reloads	Subm Spd Kts	Test Depth Ft
Skipjack (SSN 585)	6	-	18	29	700
Triton (SSRN 586)	4	2	9	N/A	700
Thresher (SSN 593)	4	-	19	28	800
Tullibee (SSN 597)	4	-	8	124.8	700
George Washington (SSBN 598)	6	-	6	22	700

Jack (SSN 605)	4	-	19	28	800
Lafayette (SSBN 616)	4	-	8	21	800
Sturgeon (SSN 637)	4	-	19	25	800
Narwhal (SSN 671)	4	-	22	25	800
NR-1	-	-	-	N/A	N/A
Glenard P. Lipscomb (SSN 685)	4	-	19	23	800
Los Angeles (SSN 688)	4	-	22	30+	N/A
Ohio (SSBN 726)	4	-	N/A	−25	N/A
Seawolf (SSN 21)	8	-	42	35	N/A

Marriage of nuclear power to the ALBACORE hull made SKIPJACK the ultimate leap forward. Powered by an S5W reactor, she was fast and highly maneuverable, but noisy.

TRITON was our only twin reactor (S4G) submarine. She was designed for radar picket duty, with emphasis on surface performance (27 knots). By the time TRITON entered service, the mission had been taken over by carrier-based aircraft. In 1960 she circumnavigated the globe submerged.

Noise reduction efforts resulted in two designs—THRESHER and TULLIBEE. Emphasis was on silence and ASW prowess.

THRESHER's engineering spaces were carefully designed for quiet operation. Her sail was much lower and smaller than SKIPJACK's. She was fitted with an S5W reactor, which became the norm until LOS ANGELES.

TULLIBEE, one of a kind, was equipped with an S2C reactor. She had a turbo-electric plant, which was very quiet. Her torpedo tubes were angled off the centerline to accommodate a large

spherical sonar array forward, an arrangement which became the norm.

GEORGE WASHINGTON was another magnificent marriage—that of a BOR nuclear powered hull with a weapons compartment of 16 vertical solid fuel ballistic missiles. A Skipjack class hull on the ways was cut in two and a missile section was inserted under the leadership of Commander Harry A. Jackson.

Conceived in 1955, fortuitous advances in technology and application of the highest possible priority under the leadership of Rear Admiral William F. Rayborn, resulted in a successful launch at sea by GEORGE WASHINGTON of two A-1 (1200 nm) missiles on 20 July 1960. This was an historic accomplishment that overshadowed introduction of any previous weapon system.

In a little over seven years and three months, 41 SSBNs had been commissioned.

JACK, a member of the Thresher class, had an innovative power train. She had contrarotating screws driven by a single turbine with contrarotating blade assemblies in the same housing. No reduction gears. Some observers have wrongly maligned the concept of contrarotating propellers. ALBACORE operated successfully with hers for eight years, and JACK's worked well. Speed can be significantly increased with them.

LAFAYETTE was an advanced SSBN which embodied improvements over earlier designs. Machinery quieting and better interior arrangements emerged. She was built to carry A-2 (1500 nm) and A-3 (2500 nm) missiles. Later launching equipment conversions were to C-3 (2500 nm) and C-4 (4000 nm) missiles.

STURGEON was an extension and improvement of the THRESHER design. A higher and longer sail provided space for more masts and antennae, and better seakeeping at periscope depth. She was very quiet. This class became a workhorse in the Arctic.

NARWHAL, a lengthened STURGEON, was fitted with an S5G natural circulation reactor and a direct drive slow speed turbine. No reduction gears. Very quiet at speed. No main coolant pumps running, and with scoop feed of cooling water to the main condensers, no circ pumps on. Very innovative and reliable power plant throughout a long life (29 years).

NR-1, the smallest nuclear submarine in the world, is a deep-diving highly maneuverable research and salvage craft.

GLENARD P. LIPSCOMB represented another effort to improve silent running with turbo-electric drive.

The Los Angeles class (62 units) is the longest peacetime submarine production run in our history. Beyond hull number SSN 719, 12 vertical launch tubes for Tomahawk missiles were installed between the sonar dome and the forward cap of the pressure hull. After SSN 751, retractable hull bow planes were provided instead of sail planes for *Arctic capability*. SSN 768 and later have better quieting and a few of the last units, including SSN 773, have pump-jet propulsors.

The mammoth Ohios have 24 launch tubes each. Four of the earliest units were built to handle C-4 (4000 nm) missiles and were not upgraded. SSBN 734 and beyond were built with D-5 (>4000 nm) capability, and SSBN 730 through 733 were backfitted for D-5. S8G natural circulation reactor.

The newest SEAWOLF (SSN 21) is an expensive and powerful submarine that was designed to fight the Cold War. She is powered with a pump-jet arrangement, and her reactor core will last the life of the ship. S6W reactor. Torpedo tube diameter is 26.5 inches. The 21st century is here. There is still time to assign traditional hull numbers to this class of three.

Overview

The first 100 years of submarining has been an exciting ride.

Sadly, however, we have suffered two tragic nuclear losses: THRESHER on 10 April 1963 and SCORPION on 21 May 1968.

Hammering away at diesel problems in the 1920s, '30s, and '50s was not a pleasant task.

In general, the reliability of reactor plants has been magnificent. *Burnable poisons* and other sophisticated design techniques have also extended core life from 26 months (NAUTILUS) to the life of the ship (SEAWOLF).

The post Cold War drawdown has forced retirement of perfectly good Los Angeles class boats with 15 years of life remaining. This seems irrational, particularly when the present number (about 56)

of attack boats is not enough to meet current operational commitments. An encouraging effort is in progress (July 2000) to refuel several 688s and thereby help maintain our inventory.

Electric drive, described *as significant as the change from sail to steam*, is the wave of the future. In June 2000, plans to introduce it were revealed. The first unit, a modified Virginia class, to be authorized in 2010, will be delivered in 2016.

Submarines have advanced in the past century from coastal craft to indispensable, stealthy and versatile *capital* ships. Hopefully, future innovation will recognize the value of maneuverability and produce a smaller, simpler and less expensive class to complement the heavy payload early Virginias.■

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SAGA OF PAMPANITO

by Leonard Dominic Stefanelli

As usual I read each copy of **THE SUBMARINE REVIEW** from cover to cover and find the articles informative, technical in nature, and extremely educational for bringing former submariners up to date. I am one those, having served on USS CATFISH (SS 339) in 1953/54.

The reason I take pen in hand is to amplify the interesting article written by Richard Thompson regarding USS TORSK (SS 423), a boat similar in age to CATFISH, and the fact TORSK had now been set aside as an integral part of the Maritime Museum in Baltimore's inner harbor.

Clearly I was pleased that such a memorial was established and open for the general public so that they may come to see, feel and hopefully acknowledge, understand and respect the sacrifices of the men who served on these magnificent ships, especially during World War II combat patrols.

The only other memorials with fleet boats which I have seen are in Charleston, South Carolina with CLAMAGORE (SS 343) and Fisherman"s Wharf here in San Francisco with PAMPANITO (SS 383).

The saga of PAMPANITO is one of the reasons I have elected to write. I say *saga* because one would assume that when the Navy *gave* PAMPANITO to the Maritime Museum she was taken out of the Vallejo moth ball fleet and towed to San Francisco and docked at the pier. Nothing could be further from the truth.

While on business in 1979, I was driving on Highway 5 in the City of Stockton, California through a huge agricultural district and the last place anyone would expect to see a fleet submarine. That is the actual place where I first saw her, docked on a remote dead end slough.

As an ex submariner, I could not believe what I was looking at, but with a little research I found the submarine was docked there as a last resort by the Maritime Museum. It was there because the Longshoremen's Union, led by the late, politically strong, Harry Bridges, did not want the submarine to become part of the San Francisco Maritime Museum because it was a:

"Weapon of war and had no business in the San Francisco Maritime Museum."

I was able to gain access to her, only to find all the hull hatches were welded shut. The reason was that people had been coming across the slough in boats at night and stripping all the metal they could extract.

After some effort, I was able to get permission to have the forward torpedo hatch opened and with hand lights we were able to gain access to the forward torpedo room. I was surprised and disgusted with what I saw inside this once wonderful machine. Clearly the midnight raiders had taken their toll. Just about every accessible valve had been taken or cut off with a portable torch or hack saw. Litter was everywhere as was graffiti and even beer and liquor containers. Bunks had been ripped, the helm and diving plane wheels were gone, air manifolds were stripped of their handles, plates were busted and the ship smelled of urine and feces. The SF Maritime Museum, who was the recipient of this wonderful vessel, had the presence of mind to weld her up, otherwise she would probably have been scrapped and scuttled by these vandals at the dockside.

Eventually, Mr. Bridges passed away and the opposition to PAMPANITO waned, but there was still feeling against the so-called *Weapons of War...* from the liberal community typically found in San Francisco. However, between the continuing efforts of the Maritime Museum, the Naval Submarine League, the Navy League, and many individuals who had access to the political powers within the city, PAMPANITO was finally given a home at San Francisco's famous Fisherman's Wharf, where thousands of tourists visit her each year.

Although getting the submarine to San Francisco was a significant task in its own right, getting her into condition to show her off to the public was an even greater challenge because of the wholesale scavenging that took place before the hatches were welded shut.

The Naval Submarine League organized volunteers that served on these boats--officers and enlisted men from all walks of life. They begged, borrowed and, in some cases, stole fleet submarine

parts from where ever they could find them. After many years of dedicated work, effort and commitment of the many volunteers, mostly former submarines, USS PAMPANITO gives the appearance she is almost ready to go back to sea. Her volunteer crew of dedicated men have restored her to fighting trim. Virtually every compartment has been restored and every piece of equipment replaced in original form.

In the last year or so, somehow this wonderful crew even found bunks for the after battery, which was sort of the final component. PAMPANITO even has the typical and unique submarine *smell* which I assume is a combination of diesel, hydraulic and lubricating oils, sweat, and salt air.

PAMPANITO starred in the Kelsey Grammar movie Down Periscope which was a *tongue in cheek* representation of the submarine service, but the film company who used her, helped to pay for her bottom repair and maintenance and had her hull painted, again recognizing and respecting the fact that the primary party responsible for the boat is the *crew* which should and must get all the credit.

Probably the most emotional experience that I shared with PAMPANITO was the Recommissioning Ceremony for her some years ago. Aside from the many dignitaries, including Admiral Richard O'Kane, I met several former submariners who served on CATFISH, one of whom was Joel Greenberg, who was the Weapons Officer when she was decommissioned in 1971. Commander Greenberg is now the President of the Northern California Chapter of the Naval Submarine League.

But at that Commissioning Ceremony, what turned out to be an exceptional and emotional experience was the fact that 63 members of PAMPANITO's World War II crew were present and on deck, plus three of the Australian prisoners of war that she picked up after the unfortunate sinking in 1944.

Needless to say while witnessing and taking a video of the event, I had a tear of pride in my eye, thus the primary purpose of this memo is to share with you the problems, work, and dedication to get PAMPANITO here in San Francisco and what had to be done to get her in a presentable form, to command the respect that she and all the people who served on PAMPANITO and her sister ships

deserve. No words in the dictionary can ever properly express appreciation and gratitude for a *job well done* to the many people who made this possible.

Mr. Richard Thompson in his memo explained the accessibility and desirability for the public to visit USS TORSK, and I am attempting to do the same thing, but I thought as an added caveat, it would be interesting for your readers to hear of the journey USS PAMPANITO had to experience, from the moth ball fleet in Vallejo to her present home in the great naval seaport called San Francisco.■

A THANK YOU TO THE LEAGUE

August 14, 2000

Dolphin Scholarship Foundation would like to express our appreciation for the opportunity to participate in the 2000 Naval Submarine League (NSL) Symposium held June 15th and 16th. This event provided us a forum to share information about our foundation and our scholars with NSL's many supporters.

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

Sincerely yours,
Kathy Grossenbacher
President
Dolphin Scholarship Foundation

BACK TO OUR ROOTS

by *LT Darren R. Poore, USN*

Lieutenant Poore's paper won The Naval Submarine League Essay Contest for Submarine Officers' Advanced Class 00030. He is currently Engineer in USS FLORIDA (BLUE)(SSBN 728).

In the year of our Force's 100th birthday, many of us have been reflecting on our history and on the great men and ships of our past that helped build the Submarine Force of today. We reflect on the growth of our fleet from its humble beginnings with David Bushnell's TURTLE of the Revolutionary War and J.P. Holland's creation in 1900 that marked the beginning of our service; and we marvel at the capabilities and dominance of the modern seas that our current boats enjoy. We remember with pride the gallant contributions of our fleet boats during World War II, and solemnly honor the 52 crews that lost their boats—and their lives—in the effort. We swell with pride at our all-important role in quietly ending the Cold War, and deftly reconfigure ourselves for the multi-mission tasking demanded by the New World Order.

But why now—or maybe a better question is—why are we *just now* reflecting on our history? Our force's history, and our Navy's history, is obviously valuable to us. Yet, it seems the majority of us have placed relatively low importance on our heritage until recently. Sure, we have our annual birthday balls, and officers take a naval history course at some point in our commissioning path, but how many of us can name even half of the eight submariners who were awarded the Medal of Honor and recount their honorable deeds? Who of us can recall the details of just five famous submarine exploits, or for that matter, any other naval war battles? How many naval traditions do you know the source of? Sure, there are a few of you history buffs out there, and I applaud you. The fact is that most of us have never really taken the time to study our heritage and appreciate the rich history and traditions of our proud service.

Observe our sister sea service, the Marine Corps. Few of us could argue that there exists any other organization more proud of its history than our brother Marines. From the Commandant down

to the last private to leave Parris Island, the Corps is ingrained with the heroes and battles that formed their heritage. As a battalion runs down the road, you will hear them sing of Chesty Puller and Daniel Daly. During a combined Navy-Marine Corps birthday ball a couple of years ago, I had the pleasure of watching a videotaped birthday message from Commandant Krulak to his fellow Devil Dogs. I watched as he walked through the battlefields of Belleau Wood, recounting the 20 day siege of the 4th Marine Brigade against two German divisions in World War I. He stood on the field in his cammies, grasping an M-16 and passionately describing how the Marines stood their ground against incredible odds and, though losing over half their numbers in the effort, seized the region and began the turning of the tide against the Second Reich. I watched the pride on the faces of Marines all around me, most of whom had never seen combat, but felt every bit a part of that winning team. When the General finished, all of them as one rose up and loudly grunted their approval and filled the air with the war cry of the Marines. They were ready for battle right there and then. I realized then that this heritage, held deeply by every leatherneck who wears the blood stripe, is a big part of what holds this tight-knit brotherhood together and binds them as one for the rest of their lives. Tell me history is not important.

We have our own heroes. Men like J.P. Holland, Emory Land, Horace Hunley, Dudley *Mush* Morton, Sam Dealey, Dick O'Kane, Gene *Lucky* Fluckey, Mack, and Admiral Rickover are all legends to us. From ingenious innovation and design to courageous tactics in the heat of battle, men like these have built the legacy that is our Force. We have much to be proud of, much to reflect on, and plenty to learn from.

The CNO, in the interest of furthering one of his own goals of preserving our heritage and fostering a greater sense of pride in our history, put out an initiative last year creating two standard celebrations a year—our birthday of October 13 and the Battle of Midway on June 4. Admiral Johnson sees these important dates as the "centerpieces of our heritage," to help us remember the heroes of our past who gave us the Navy we have today. He realizes that it is often the remembrance of our forerunners and heroes of the

past that can bind us together and help us remember why our service is so important. And while we may never see another Midway, or the shoot and dive tactics of our predecessor submarine shipmates of that war, we will definitely produce more heroes for the future who will continue our tradition of valor and sacrifice in the name of freedom.

How can we work to instill a deep pride and understanding of our history within our shipmates and ourselves? Simply put, we do what warriors have done from the beginning of time—when stories of brave deeds were told around the cooking fires and passed down from fathers to sons. We must first inform ourselves and then establish methods by which to pass down what we have learned to every new sailor of the 21st century and beyond. There are a lot of resources out there—from numerous books, films, and websites to fellow shipmates that have actually been there and are still here to tell us about it.

We who are leaders should strive to find ways to integrate submarine history lessons into our training plans. We get so bogged down in required training topics that we cringe at the thought of adding more training, even when it could be so beneficial and yes, even fun! Imagine the use of POD trivia, individually assigned mini-research projects, or just brief recounts at the end of a departmental training topic. On my last boat, our XO used to read a passage from an old WWII submarine diary at every dolphin pinning. It definitely lent an air of nostalgia and pride for everyone there—especially those brand new submariners. If wouldn't take much to create a growing pride in who we are and the elite group of sailors to which we belong.

Similar tactics can be taken in our accession training programs. From individual self-study plans to lectures on famous battles and submariners, our accession programs can go a long way in building that initial foundation of pride in our heritage. Those wanting to join our Force should feel from the very beginning that they are becoming part of a proud community with a rich and exciting history.

It is my belief that the Submarine Force needs to adopt a deeper appreciation for the history of the Force and of the men who made it what it is today. We should celebrate our heroes and events that

have shaped our Force and helped build the greatest submarine Navy in history. We should reinforce our foundations within every submariner; from the day they report to Submarine School to the day they leave the Navy. As we continue to look forward into the next century of submarining, let's not fail to look back at the paths we have taken to get where we are today. If we are able to do this, we will only serve to strengthen the bonds that exist between us as submariners.■

POINT-COUNTERPOINT

THE ENEMY [BELOW] ... THE BRASS ABOVE

by J. Michael Brower

Reprinted with permission from the June 2000 issue of the Naval Institute PROCEEDINGS.

Whatever he did wrong, Richard Nixon got it right in his 1982 work *Leaders*. "Of all the changes taking place in the new world," he wrote, "one that will have a particularly dramatic impact on future leadership is the crumbling of those barriers that in the past have held women back. The woman candidate for a top executive office still has to overcome a residue of the old presumption that such positions are a male preserve. But as more move up, the presumption will fade." Secretary of the Navy Richard Danzig's October 1999 rebuke of the "white male preserve" that bans females from U.S. submarines echoes Nixon. Like the ban on women in professional baseball, the Navy's is an arbitrary rather than a skills-based policy. Nevertheless, the Navy's uniformed leaders retain all the gender cards. Admiral Jay Johnson, Chief of Naval Operations, sets the stage for rapprochement with the Tailhook Association while opposing women on submarines under any conditions. The Navy's military leadership is keeping the Silent Service a male preserve by banning women outright.

What female submariners really threaten is existing power relations. While top admirals and their horse holders maintain that putting women on submarines constitutes an insurmountable logistical challenge, many women possess just those attributes submariners actually seek: sociability, high emotional development, lower aggression levels, compliant physical features (i.e., height, build, etc.), and acute common sense. It is not sexism to posit that many women possess these qualities. Ablution, bunk and watch assignments, and risks of fraternization and harassment can be managed by Navy leadership under orders to make it work. But overcoming those hurdles would be dress rehearsal for the ascension of the female into some of the most important operational

positions in the Navy. The fundamental issue is less about managing privacy in the head and more about keeping everyone at the top male.

The U.S. Navy's difficulties with females on submarines might be solved with all-female crews, were it not for the Catch-22 used throughout the armed forces: women can't have the job without experience, and because they are barred from the jobs, they cannot gain the experience. The result is that there is no prospect for a woman to command an Army division, a Navy submarine, become a Commander-in-Chief (CinC) of a combatant command or a service chief of staff —let alone Chair(person) of the Joint Chiefs.

The Pentagon's Defense Advisory Committee on Women in the Services (DACOWITS) recognized the potential contribution of women on submarines and recommended "assignment of the most highly qualified personnel regardless of gender." Critics decried the cost of modifications to accommodate females—ignoring that changes to current nuclear powered attack (SSNs) and ballistic missile submarines (SSBNs) would cost $3 to $5 million each—fractions of the costs of the submarines. The same critics also dismiss the European submarine fleet experience—where minimum accommodation alterations have been made and women work alongside men without degrading operations. The crews simply have adapted.

In the Royal Swedish navy, women have been serving on submarines for more than ten years and have had no significant problems. Privacy issues are managed by discipline rather than by reconstructing submarine space; women and men make do with the available room. And in the Royal Norwegian Navy, a woman already has commanded a submarine. In all cases, going co-ed has not reduced operational effectiveness—quite the reverse.

In the Pacific, while Australia has used women to support combat operations in the past, only with its emerging policy of tolerance of females aboard submarines is it fully recognizing its debt to female warriors. In 1998, ten women sailors and one officer commenced Collins class submarine training and qualified during the spring of 1999. Australian government policy discriminates against service women, however, by barring them from direct

combat—when the Israeli Army has opened all positions, regardless of gender.

President Bill Clinton has opened tens of thousands of previously restricted jobs to service women. In the case of integrating crews on submarines, the place to start would probably be SSBNs , which typically provide each sailor with a private bunk. Gender integration could be accomplished either permanently or temporarily with an eye toward training all-female crews. This latter solution might placate those who object to women serving on submarines—the combatants still barred to women. While women have trained on ballistic missile submarines, Admiral Johnson will not permit women to be assigned to them, ostensibly because of fears of male crew reactions to women aboard.

Life in America is replete with double standards. Females can engage in combat as law enforcement officers, but in the ultimate law enforcement institution, the military, they are restrained from combat by law. Even so, 13 American women were among the 375 U.S. service members who died during Operations Desert Shield-Desert Storm in 1991. Enjoining servicewomen from combat did not keep combat from them. In the U.S. military and the society it reflects, women are both openly and subtly dissuaded, even legally restricted, from work they can do.

The idea that submarines cannot accommodate females is an all-wet red herring, as several allied navies have demonstrated. Once women have put themselves through the most vigorous, combat-related, red-badge-of-courage situations, there can be no rationale to restrain them from the highest levels of command. It is time to allow qualified women to serve in all capacities for which they have both the aptitude and the interest.

If trends in allied submarine forces are an indication, gender-neutrality aboard American submarines is the wave of the future.■

SAVE THE SUBMARINES FROM DISINGENUOUS DACOWITS DESIGNS

by Ms. Elaine Donnelly

Reprinted with permission from the May 2000 issue of CMR Notes, a publication of The Center for Military Readiness. Ms. Donnelly is President of The Center for Military Readiness.

Ignoring common sense and compelling advice from Navy experts, the Pentagon's Defense Advisory Committee on Women in the Services (DACOWITS) recommended at its spring 2000 meeting that female officers be assigned to Ohio class (Trident) ballistic missile submarines (SSBNs). The 36 member committee, largely composed of civilian women, also pushed the Navy to begin taking steps to assign women to the new Virginia class attack subs, which are considerably smaller than the Tridents. A legislative amendment offered by Representative Roscoe Bartlett (R-MD) would block implementation of the DACOWITS proposal, pending sufficient time for congressional review.

This edition of *CMR Notes* summarizes major points regarding the issue that have been made in several comprehensive studies and reports—all of which were pointedly ignored by the DACOWITS. The most authoritative review was done for the Navy in 1995 by the highly respected firm, Science Applications International Corporation (SAIC). The SAIC report, titled "Submarine Assignment Policy Assessment", was withheld from public view until 1999, when the Center for Military Readiness obtained a copy and began publicizing its findings.

This article also quotes a slide presentation made by Navy Captain Bob Holland at the DACOWITS' fall 1999 meeting, and a written *Navy Response* to the committee's *Request for Information* that was provided at the committee's spring 2000 meeting.

1. The size of a submarine is roughly one-half that of a 747. Passengers spend only a few hours on a 747, but submariners live in prison-sized quarters for weeks at a time. SSBN *boomers* stay submerged for as long as 77 continuous days. SSN attack subs deploy for as long as six months at a time,

with infrequent port calls.

- Alterations for co-ed crews would: *"further reduce existing below-standard conditions (for both genders); or require the removal of equipment as a space and weight trade-off, which would result in reduced operational capabilities of the ship, or in the extreme, require lengthening of the ship to obtain additional space and weight margin. This option would be very costly."* (Navy Response)

2. Problems inherent in the DACOWITS' incremental proposal could only be *solved* by gender-integration of **all** subs. Permitting female officers on larger Ohio class SSBNs first would eventually lead to full gender integration on **all** classes of submarines, including the smaller but more numerous Los Angeles class attack subs (SSNs).

- Limiting women to one class of submarines would create an unworkable career path. The Navy's response to the committee noted that: *"One of the principle tenets of submarine officer detailing is the general intention that officers serve on both types of submarines in order to broaden their experience in each."*
- At the same time, because Tridents are thought to provide a better quality of life, female assignments to SSBN *boomers* alone *"...may be perceived as an inequity within the community, by both officers and enlisted sailors."* (Navy Response)
- A Trident-only plan would also create an unfair perception of *tokenism. "...[A] two-tiered system that separates the career paths of female and male submarine officers would be unacceptable because of [the] management requirements and the career limitations it would impose..."* (SAIC)
- The DACOWITS is either willfully ignorant on this point, or deliberately cynical in trying to mislead Congress. Either interpretation destroys the credibility of the tax-funded feminist committee, which will later argue that it is unrealistic and *unfair* to assign only female officers, but not enlisted women, to all classes of submarines.
- The DACOWITS was informed in a briefing last fall that career opportunities for women specializing in nuclear propulsion are readily available in other high-tech classes of

ships, such as Nimitz class aircraft carriers.

3. Separate quarters for women would further cramp living spaces on all submarines—which already fail to meet CNO habitability standards for surface ships—to an intolerable degree.

- Unencumbered space in sleeping areas and sanitary facilities is about one-half to one-third that afforded to crewmembers on small surface ships. On attack subs, it is not unusual to *hot bunk* about 40 percent of the crew. *"Hot bunking, wherein three crew members share two bunks in shifts, is standard operating procedure on attack submarines. The total living area for more than 130 people is equivalent to a medium size house."* Some sailors prefer to lay down mattresses in noisy torpedo rooms, rather than hot bunk. (SAIC)
- Fifty enlisted submariners use each shower, compared to 25 sailors on surface ships. An enlisted person has less than half the storage space (3 vs. 7.5 cubic feet) of surface counterparts. Space between bunks measures only 18 inches, compared to 24 inches. Submariners must turn sideways to get by each other in passageways that are only 27 inches side. (Navy Response)
- *"In both the Los Angeles and Seawolf classes, modifications which attain compliance with the [habitability] standards may not be possible without lengthening the ship..."* Re-assignment of scarce sanitary facilities to female sailors—restricting, in many cases, 50 percent of facilities to 10 percent of the crew—would cause inequities for the men. Cross-rank, single-gender berthing arrangements would disrupt prerogatives of rank in an already stressful environment. (SAIC)
- According to preliminary work done on the new Virginia class attack submarines *"...additional facilities for women would require an increase in length from the baseline design and even then, the facilities were not fully compliant with the [habitability] standards."* (SAIC, quoting Naval Sea Systems Command)

- Virginia class attack subs were designed to be smaller than the Seawolf, to reduce costs. Extensive redesign, as demanded by the DACOWITS, *"would have two negative effects: further degrade habitability for both genders and require removal of operational equipment reducing warfighting effectiveness."* (Navy briefing paper, quoted by the *Washington Times*, May 4, 2000)
- Ship alterations to accommodate women would cost approximately **$5 million** per attack submarine, *not counting* redesign costs of approximately **$15 million** per class, plus *"required system changes and associated costs."* The Navy's *minimum* estimate is **78 times** more per crewmember than comparable alterations on carriers. ($313,000 vs. $4,000) In addition, the *opportunity cost* of taking submarines off line for extensive alterations would be a devastating blow to the already overburdened Silent Service. (Navy briefing slides, fall 1000, and Response to the DACOWITS)
- Redesigning submarines would rob scarce maintenance funds, currently short about **$220 million**. Maintenance work on 15 ships was canceled this year. Without additional funds, critical work on 25 other ships, plus 18 more, will be skipped or scaled back next year. (*Navy Times*, May 22, 2000)

4. More importantly, current estimates of cost do not reflect the operational hazards of degrading undersea performance characteristics and combat capabilities, which are vastly different from the surface fleet.

- A submarine is analogous to an *undersea aircraft*, which patrols the oceans for months at a time, unsupported and undetected in an environment more hostile than space. Even the smallest emergency, such as an electrical fire or seawater leak, poses an immediate threat to the entire crew. (SAIC)
- The crew lives in and around equipment—an existence that has been compared to living inside a clock. *"Critical electronic, hydraulic, and high pressure air systems pass through submarine berthing spaces."* Redesignation of space designed for operation equipment could *"potentially [impact] the ship's endurance and/or mission capability."* (Navy

Response)

5. Current estimates of cost do not reflect the impact of predictable health and safety problems, including heightened risks of gynecological emergencies and birth defects. The following medical issues were discussed in detail in the SAIC report, but omitted in the Navy's recent response to the DACOWITS:

- Certain atmospheric elements that are not harmful to adults, such as carbon monoxide (CO), cannot be eliminated from the closed environment of a submarine. Toxic elements present a real threat to a female sailor's unborn child: *"The fetus is most sensitive and at the greatest risk in terms of the toxicological effects of the environment during the first three months of gestation...[E]ven moderate carbon monoxide exposure could decrease the oxygen transport capacity of maternal and fetal hemoglobin and result in interference in fetal tissue oxygenation during important developmental stages."* (SAIC)
- Ruptured ectopic pregnancies are also life-threatening and untreatable by a medical officer (usually not a doctor) in a sub's closet-sized sick bay. (SAIC) Mandatory pre-deployment pregnancy tests would make sense, but feminists reject them as an infringement on women's rights.
- According to the Center for Naval Analysis, the unplanned loss rate for female sailors on surface ships (23 to 25 percent) is more than **2-1/2 times** the rate for men (8 to 10 percent)—most often due to pregnancy and other medical conditions. Proportional losses on submarines could compromise stealth missions, and have a devastating effect on morale and readiness. (*Washington Times*, March 8, 1999)
- A ship's captain who is faced with a female sailor in acute medical distress, or a pregnant sailor who fears birth defects due to CO and other toxic elements in the atmosphere, might have to order an immediate, unexpected trip to the surface. Mid-ocean evacuations, accomplished by means of a basket dangling from a helicopter, would be extemely perilous for all concerned, particularly when the sub is operating in deep

ocean or under polar ice.

6. It is unfair and unwise to impose unnecessary and unresolvable social and management problems on the submarine community.

- The unplanned loss of *any* sailor from a small-crewed submarine, which requires 100 percent manning for continuous 18 hour shift cycles, imposes considerable stress on fellow crewmembers. Properly trained replacement personnel, who are usually not available even on surface ships, would be even more difficult to find and place on high tech submarines. With limited berthing available, replacements would have to match in terms of gender as well as qualifications. (SAIC)
- Recent experience indicates that inappropriate relationships, ranging from harassment to sexual attraction, will occur and be known to the entire crew. Displays of affection are sure to undermine morale and discipline, since there is no effective way to separate the people involved, short of evacuation. Unplanned surfacings due to inappropriate personal behavior, as well as medical/pregnancy emergencies, would further compromise the mission. (SAIC)
- Unrelenting stress and absence of personal comforts and privacy place a premium on morale and cohesion of the crew. There is no fresh air or communication with the outside world, except for 50-word familygrams that are not private (SAIC) Divorce rates in the submarine community are already very high. Further stress on families, combined with predictable unplanned losses and non-deployability problems, could worsen personnel shortages, instead of improving them.
- Norway, Sweden, and Australia assign a few women to small submarines, but brief coastal deployments are nowhere near as demanding as U.S. requirements. On small, 30 person Swedish subs, men and women change clothes, bunk and shower in the same spaces. "Love relationships" occurring while underway are conducted "professionally" and are treated with wary acceptance. (*Navy Times*, July 5, 1999)
- Such arrangements are incompatible with sound personnel

management practices, as well as American cultural values. Civilian policymakers play with fire when they throw ordinary human beings into an emotionally volatile, 100 percent oxygen environment, and then insist there be zero tolerance of sparks.

Conclusion

In its response to the DACOWITS, the Navy summarized its position: *"Due to their very unique space limitations, equipment density, and design constraints in an extended mission requirements environment, submarines cannot provide the necessary privacy to properly accommodate mixed gender crews. The Navy's decision regarding the assignment of women to submarines has been reviewed, determining that no new information has become available from the Women at Sea program, which would provide a basis for changing the policy."* (Navy Response)■

NOT IN OUR SUBMARINES

by ADM C.A.H. Trost, USN(Ret.)

A submarine officer, Admiral Trost was Chief of Naval Operations, 1986-1990. Reprinted with permission from the September issue of the U.S. Naval Institute Proceedings.

After reading the commentary by J. Michael Brower in the June *Proceedings*, I concluded once again that too much has been written about women in the military—or, in this case, women in submarines—by too many people who know too little about the subject.

In his article, Mr. Brower rehashes many of the arguments he and others already have put forth—e.g., women can do the job; other nations assign women to submarines; and the problem can be managed by Navy leaders under orders to make it work. (Actually, dealing with complex personnel issues demands leadership, not management skills.) He concludes: "If trends in allied submarine forces are an indication, gender-neutrality aboard American submarines is the wave of the future." Gender neutrality? This sounds like unwanted—and unneeded—surgery. To use old submarine lingo: We've *lost the bubble*. The voices of experienced military leaders are being overridden by faulty social philosophy.

The true issues are not:

- Whether women can serve capably and productively in our military forces. They can; they have been; and they continue to do so.
- Whether women are smart enough (we know they are), or capable enough (they are), or physically strong enough (no one can argue that certain jobs are more difficult for personnel of smaller stature or less physical strength, regardless of gender).
- Whether submarine leaders can handle the leadership challenge. Like their counterparts in other branches, they'll do their very best.

In my view, the only real issue is: What is the impact on

military (combat) readiness of assigning women to certain positions, including placing them in units where they can be directly exposed to the horrors of combat or POW status or in current so-called *all-male bastions* such as submarines.

Proponents of women in submarines say it's simply a case of removing "some operational equipment" to make room for the "inexpensive" modifications required to house a mixed-gender crew for lengthy periods of submerged operations in an area smaller than the passenger cabin of a Boeing 747. To compound this situational unawareness, these proponents blithely dismiss the compelling fact that this "equipment" removal will degrade the submarine's combat capability. Further, these same *experts* say that the impact on crew morale, motivation, and retention stemming from the views of submariners' wives is irrelevant. Have they talked to many submarine wives? Their views do matter—big time!

When our armed military forces face their next hostile challenge, let's hope that we have maintained our prior focus on combat readiness—not on the attainment of fantasy-driven social-engineering goals or political expediency.■

REFLECTIONS

MEMORIAL DAY ADDRESS

Submarine Contribution and Losses in World War II

by CDR Clayton K. Morse, USN(Ret.)
Village of Millbrook, New York
Parade and Ceremony
May 29, 2000

Last year, Major General Bill Augerson, USA, MC(Ret.) honored by name every citizen of our community who had given their lives for our country as members of the armed services, both in war and in peace. Today, we again honor those men and women who made the supreme sacrifice.

Last month marked the 25th anniversary of the end of the war in Viet Nam. Today, we honor the men and women who served their country in Viet Nam and those who made the supreme sacrifice.

Next month will mark the 50th anniversary of the beginning of the war in Korea. Today, we honor the men and women who served their country in Korea and those who made the supreme sacrifice.

This year marks the 100th anniversary of our nation's Submarine Force, as it was in April 1900 that the U.S. Navy took delivery of USS HOLLAND, with its crew of nine, to become our nation's first commissioned submarine of the modern era. Recognizing this anniversary, we will, today, honor the men who served our country in submarines in World War II, and who made the supreme sacrifice.

SEA LION, S-36, S-26, SHARK(I)...

In December 1941, with our Pacific Navy lying in broken steel at the bottom of Pearl Harbor, our country was in serious trouble. In the Japanese, we faced a determined enemy, and an enemy who was winning. However, the Japanese attack of December 7th missed four important targets: (1) our aircraft carriers (which were at sea), (2) our reserve fuel tanks, (3) the Pearl Harbor Naval Shipyard, and (4) our submarines...a miss the Japanese would come

to regret.

PERCH, S-26, S-39, GRUNION, ARGONAUT...

No nation on the globe was more dependent on ocean shipping than Japan. Neither foodstuff for civilian consumption, nor raw materials for industry in the home islands were sufficient. Japan's lifeline was its 6 million ton merchant and naval auxiliary fleets, which brought raw materials and oil from islands such as the Dutch East Indies to the homeland, and transported troops and supplies to the Army, as it expanded the bounds of the Japanese Empire by force.

AMBERJACK, GRAMPUS, R-12, TRITON...

At the time of the attack, the Pearl Harbor-based Pacific Fleet had 22 submarines, and the Asiatic Fleet, based in the Philippines, had 29. Most of these submarines were in a category I'll call *early fleet boats*.

During the 1920s and early '30s, submarine design supported only the missions for using submarines as fleet auxiliaries: coastal defense raiders, picket ships, elements of a battleship screen, scouts, and search and rescue. It is a credit to the visionaries of the Navy, supported by Congress and the President, who identified the larger need for larger boats, capable of conducting independent strike operations, thousands of miles from home base for periods of 30 to 60 days.

Therefore, at the beginning of the war, not only had early classes of fleet boats already been procured by the Navy, but also that which would eventually be the principle platform for sinking the enemy, the Gato class, was being built.

PICKEREL, GRENADIER, DORADO, RUNNER...

On December 7th, four submarines were already in a patrol status: two near Midway Island, and two near Wake Island, both islands eventual Japanese targets. On December 11th, USS

GUDGEON got underway from Pearl Harbor fully loaded with weapons, fuel and food to transit to the Straits between the main Japanese Islands of Shikoku and Honshu to conduct an offensive strike war patrol in the heart of Empire waters. Her patrol would last 51 days.

During succeeding days the remaining Pearl Harbor based submarines were underway for both Empire Waters and the Marshall Islands...all on extended, offensive strike patrols.

SCULPIN, WAHOO, GRAYLING, POMPANO...

In the Asiatic Fleet on December 8th and 9th, 18 submarines put to sea for war patrols in the waters surrounding the Philippines.

The first submarine lost was USS SEA LION which was in overhaul at the Cavite repair facilities near Manila. Japanese bombs got it on December 10th before she could get herself put together enough to be towed to a secure harbor. Four crewmembers along with an officer on SEADRAGON, a nearby sister ship, died during the attack...the first submariners lost in the war.

Several boats pressed home attacks on the Japanese fleet as it carried the invasion force to the Philippines, letting the enemy know early he would not be unopposed. The first confirmed sinking of a Japanese ship was delivered by USS SWORDFISH on December 15th against ATSUTUSAU MARU, a 8663 ton freighter.

CISCO, S-44, CORVINA, CAPELIN, SCORPION...

As America went to war, so it was that the production of submarines increased dramatically to meet the requirements of the war in the Pacific. Submarines rolled off the ways, primarily at Electric Boat in Groton, Connecticut, Portsmouth Naval Shipyard in Kittery, Maine, and Manitowoc Shipyard in Wisconsin.

To man the boats, volunteers were sought. Of the 250,000 young men who volunteered, 24,000 (less than 10 percent) were selected and made it through the training pipeline. Typically, after enlistment, a young man would spend about four months in training: at Navy Basic School; at Submarine School in Groton; perhaps four weeks in a technical school (such as school for

machinist mate, engineman, electricians mate or torpedoman); and then on to the boats, joining either a crew about to embark on a war patrol, or a boat in new construction.

Training was rigorous and a certain type of individual was wanted. In a Gato class submarine a crew of 72 men and 8 officers had to live in a pipe about 300 feet long and 20 feet in diameter for periods of up to 60 days. Even though most men had specialized ratings, for ship's safety and combat flexibility each crewmember had to know the other man's job. A yeoman might be called during battle to operate the trim pump to trim the boat; the ship's cook might be assigned to operate the air manifold to surface the boat.

The average age of the skippers was about 30; the chiefs, mid to late 20s; the enlisted crew, early 20s, with some as young as 17 and 18 years old. The younger men were about the ages that the graduating seniors are now from Ben Boice's cross-country team, or the graduates from the 1999 Blazer championship basketball team; and the average crewman, about the age of many of the guys I see most mornings having coffee in front of the Millbrook Deli. Those are the people who manned these boats.

GRAYBACK, S-28, GUDGEON, TULLIBEE, TROUT...

Pacific submarines were directed by Vice Admiral Charles Lockwood. His Operations officer, who expertly planned the war patrols of 288 submarines, was Captain Richard Voge. Captain Voge had been skipper of two submarines, including SEA LION, which had been bombed pier side in the Philippines.

More than 1600 war patrols were conducted in the Pacific. After the first few months of the war, almost all were initiated from Pearl Harbor (often with refueling stops in Midway or Guam), or Freemantle and Brisbane, Australia, and Alaska.

The boats would usually transit to their patrol areas on the surface. When in area they would remain submerged during the day and surface at night to charge batteries. Attack tactics varied with the situation: (1) submerged attacks using torpedoes; (2) surface attacks using the 3-, 4-, or 5-inch deck gun; and (3) night surface attacks against protected targets and their escorts using both

torpedoes and the deck gun. Submarines also operated together in wolf packs, laid mines, delivered supplies to guerrilla forces ashore, rescued personnel from ashore, and rescued over 500 downed aviators.

The danger to the submarine and her crew were mines, enemy aircraft (attacking out of the clouds before the surfaced submarine could dive), and depth charges by hostile enemy destroyers charged with protecting the high value ships the sub was attacking. Crewmembers lived in constant anxiety of a surprise attack on their boat. In a 1943 human interest article about submarine life published in the national newspapers, an interview of one submariner, MM2 Henry Burch of Oklahoma City, went like this:

> "Funny thing about depth bombs" drawled Burch, "sometimes you feel them, sometimes you don't. You'll find yourself brought to your knees, and a wave of weakness will flash over you, and you'll know a depth bomb has hit somewhere. There's dead silence when you're waiting for the bombs to hit around you. Everyone speaks in whispers as if they're afraid the [Japanese] would hear us. Yet the morale is always good."

ROBALO, FLIER, HERRING, GOLET, DARTER...

And indeed, their morale was good. Why? Because each man, each crew, each commanding officer **knew** the value of what they were doing to aid the war cause. What did they accomplish? Here's what:

Pacific submarines sank a total of 1,314 ships. Over 1,100 of these were merchant ships (severing Japan's resource lifeline). Also, of note, are the warships sent to the bottom: 8 aircraft carriers, 1 battleship, 11 cruisers, 23 submarines and 43 destroyers (the archenemy of the submarine in World War II). In all, submarines sank 5.3 million tons of enemy shipping. Compare this to the 6 million merchant tons that I said Japan had at the beginning of the war. **Ninety-five percent** of Japan's merchant marine personnel became casualties. Two hundred and seventy-six thousand Japanese (sailors and army troops) drowned because of

submarine attacks on their vessels.

In all, submarines accounted for 55 percent of the enemy's maritime losses. Amazingly, this was caused by a Submarine Force that comprised 1.6 percent of the Navy!

And even more noteworthy is that that small cadre of submariners produced seven who were awarded the Congressional Medal of Honor (O'Kane, Fluckey, Cromwell, Gillmore, Ramage, Dealey, and Street), accumulated over 200 Navy Crosses and Silver Stars, and ran missions whose crews were awarded 49 Presidential Unit Citations, and 53 Navy Unit Citations.

SEAWOLF, GROWLER, HARDER, TANG, SHARK(II)...

But the Submarine Force paid a heave price for its success. Fifty-two of our 288 submarines were lost. Because of the nature of operations, these losses often included loss of the entire ship's company, in a remote area, far distant from friendly forces. That's 80 men, 80 who made the supreme sacrifice. Not all men were lost with their boat. Some escaped their stricken vessel only to be captured, and succumbed while prisoners of war.

In all, of the 16,000 men who made patrols, 3,505 died. That was an astounding casualty rate of 22 percent, the highest for any branch in the U.S. military during the war.

So it is the names of the 52 lost submarines with which I have been punctuating each section of my address today. It is a way of honoring them and those of their crewmembers who died while carrying the battle to the enemy. What sort of people were these heroes who gave their lives for their country? I say they're not unlike the boys who graduated from Ben Boice's cross country team; not unlike the graduating seniors from the 1999 Blazer basketball team, not unlike the guys I often see drinking their morning coffee in front of the Millbrook Deli.

ESCOLAR, BARBEL, ALBACORE, SWORDFISH, KETE...

Historian Thomas Roscoe summarized well the efforts of submariners in World War II when he wrote:

"The valiant efforts and incomparable achievements of United States Navy submarines cannot be summarized in statistics. Neither graphs nor percentages could measure the leadership of an Admiral Lockwood, the genius of a Captain Voge, the skill of such commanders as [Mush] Morton or [Dick] O'Kane, the courage of **every** submarine crew. But the American submarines of World War II need no encomiums. From mess attendants to admirals **all** were captains courageous. Their war record speaks for them and liquidation of the Japanese Empire stands in evidence."

TRIGGER, SNOOK, LARGATO, BONEFISH, and BULLHEAD

That's 52. Fifty-two submarines lost; 52 submarines that were the duty stations and homes to 3,505 men who remain on eternal patrol.

The last submarine to be lost, BULLHEAD, went down with her entire crew when she was surprised by an enemy aircraft on August 6th, 1945, the day the first atomic bomb was dropped, eight days before the Japanese government agreed to surrender terms and 3-1/2 weeks before the formal surrender on board USS MISSOURI in Tokyo Bay.

On the subject of the atomic bomb drops, I offer another quote by historian Roscoe. Referencing Japan, he wrote: "He who lived by the Samurai sword, died by the submarine torpedo...the atomic bombs [at Hiroshima and Nagasaki] were the funeral pyres of an enemy who had [already] drowned."

And finally, back to Pearl Harbor in December 1941, here is what Admiral Chester Nimitz, who was commander of all naval forces in the Pacific, recounted after the war about that critical period:

"When I assumed command of the Pacific Fleet on 31 December 1941, our submarines were already operating against the enemy, the only units of the fleet that could come to grips with the Japanese for months to come. It was the Submarine Force that I looked to to carry the load until our great industrial activity could produce the weapons we sorely

needed to carry the war to the enemy. It is to the everlasting honor and glory of our submarine personnel that they never failed us in our days of great peril."

And indeed they did not fail us. Today we honor the 3,505 submariners who made the supreme sacrifice to preserve our way of life and who remain on eternal patrol.■

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LETTERS

THE SUBMARINERS ASSOCIATION

15 June 2000

Rear Admiral A.J. Whetstone, CB (President)
17, Anglesey Road
Alverstoke, Gosport
Hampshire, PO12 2EG

Dear Admiral Cooper,

Centennial of the United States Navy Submarine Force.

On the occasion of the hundredth anniversary of the United States Navy's Submarine Service, I have been requested by the Submariners Association, representing those who have served in Royal Navy submarines, to send to you and all members of the U.S. Naval Submarine League, our congratulations on the great achievements of the Submarine Service of the United States Navy in peace and war.

As the first submarines of the Royal Navy's fledgling Submarine Branch were of the USN Holland design and our two services have worked closely together in two World Wars and, more recently, in the Cold War successfully to contain Soviet maritime expansion, we are delighted by this important occasion in our big brother's history.

We would also wish you all some most successful and enjoyable celebrations of this momentous anniversary and look forward to your continuing success and our lasting friendship.

Yours sincerely,
/s/ Tony Whetstone

REQUEST FOR INFORMATION

10 July 2000

I am writing to **THE SUBMARINE REVIEW** at the suggestion

of the Director of the Royal Navy Museum regarding a submarine matter.

During the Korean War I was the ASW staff officer to COMDESRON 8 (as you would call it!), in HMS COSSACK. You may remember that U.S. Naval Forces operated from Sasebo, in Japan, where CTF 95 flew his Flag, and the British and Commonwealth forces from Kure. Once or twice, however, my ship visited Sasebo for R&R, and it was on one such occasion that I heard the story of a submarine—presumable American, though we did have one or two British submarines in the Far East—entering Sasebo Harbour submerged and surfacing inside, much to the surprise/consternation-/annoyance of CTF 95! Have any of your members any knowledge of such an event?

I am asking this only because I am writing my memoirs, including 35 years in the Royal Navy (I am nearly 80) and it seems a good tale to include—if true! I cannot believe I dreamt it, but maybe some American officer was pulling my leg!

Yours sincerely,
Captain Charles Fetherston-Dilke, RN(Ret.)
Keeper's Cottage
Maxstoke
Coleshill, Warwickshire B46 2QA

LOSS OF O-9 SUB IN JUNE 1941

August 27, 2000

To Whom It May Concern:

The recent loss of the Russian submarine brought memories of the loss of one of our subs in June 1941. My father was aboard the sub and I would like to gather information on anyone that might have been in the service and knew him prior to the sinking of the submarine.

His name was Sam Sonnenburg and was a Chief Electricians Mate on O-9 and had previously served on USS LAWRENCE.

Thank you for any help you could supply me with.

Sandra S. Sonnenburg
sonnenburgss@hotmail.com

BOOK REVIEWS

HELLIONS OF THE DEEP
THE DEVELOPMENT OF AMERICAN TORPEDOES IN WORLD WAR II

by Robert Gannon
Publication Date: 6/14/96
Penn State Press, 820 N. University Dr.,
PSU, University Park, PA 16802; $35 + shpg.
(814) 865-1327; fax (814) 863-1408

Reviewed by Tom Pelick

This is a story about the scientific exploration of underwater sound principles and the application to signal processing systems. This led to the development of the first U.S. acoustic homing torpedoes.

After WWII began in Europe, Vannevar Bush convinced President Roosevelt that if the U.S. were to become involved in the conflict, technology would be a major factor. The National Defense Research Committee, NDRC, was formed to provide technology research. At that time the Navy was using older torpedoes that were straight runners. Success depended on the attack submarine being on the surface and close to the target to ensure that the calculated lead angle would be sufficient for the torpedo to hit the target. When the U.S. entered the war, the submariners found that there were problems with the Mk 14 torpedoes. Researchers found problems with the depth calibration and the exploder firing pin design.

Robert Gannon's book describes the technical development of the torpedo during WWII. He weaves in personal stories about the men who were members of one of the finest research teams during WWII and their contribution to the technology which played a major role in winning WWII.

The book describes the torpedo program at Newport, R.I. and the research at the Harvard Underwater Sound Laboratory from 1941 to 1945. The technical community consisted of these laboratories plus industrial giants such as General Electric, Bell

Labs, Western Electric, and other research teams. They helped to solve the Mk 14 problems, and they developed the electric propelled torpedo (the Mk 18), passive homing torpedo (Mk 24), and an active homing system, which was incorporated into the Mk 37 torpedo after WWII.

Robert Gannon describes the process of gathering qualified research scientists to work on these special projects. He tells the spell binding story about the dedication of these scientists to the technological development of underwater warfare. The U.S. torpedo changed from a relatively inferior weapon (compared to the enemy torpedoes) to that of a highly technical sophisticated weapon.■

Robert Gannon is a Penn State Associate Professor of English (emeritus), specializing in science writing, and is a contributing editor of Popular Science magazine. He has spent three years researching the material for this book. He has conducted many interviews with the scientists from the Harvard Underwater Sound Laboratory.

SEAPOWER AND SPACE

by Norman Friedman
Naval Institute Press, Annapolis, MD 2000
$42.50, 336 pgs., 30 photos, 30 line drawings
ISBN 1-55750-897-6

Reviewed by Dr. Richard B. Thompson

Norman Friedman has written a splendid addition to his outstanding series of warship design histories. In Seapower and Space he details the vital importance of space systems to present-day naval warfare. This is a subject of surpassing importance, especially for the Submarine Force.

As he has in his previous design histories, Dr. Friedman describes the development of space and naval warfare systems as a co-evolutionary process, wherein spaceborne systems evolve in response not only to new technological capabilities, but to new threats as well. Thus the Soviet radar and passive ELINT ocean reconnaissance satellites (RORSAT and EORSAT, respectively)

were developed in part because the radar horizon of Soviet naval aviation aircraft was limited enough to bring them in range of a carrier battle groups's combat air patrol. The tandem of EORSAT and RORSAT provided over-the-horizon targeting for missile-armed supersonic bombers (and submarines), requiring the development of the F-14 fighter and Phoenix missile to fight the Outer Air Battle, and later the development of U.S. space-based surveillance capabilities to alert the battle group to incoming threats. Dr. Friedman tries very hard not only to detail the technical developments themselves, but also to reconstruct the thought processes that drove the decision making of the developers. In this reviewer's opinion, this is useful as well as fascinating, as we now know that in some cases the Soviets perceived the tactical employment of our systems and their relative importance much differently than we did.

The book has 14 chapters, beginning with an introduction and brief summary of satellite characteristics, followed by a chapter on booster development in the U.S. and Russia. Three chapters discuss the advents of precise navigation systems and satellites as applied to the U.S. Polaris missile system; satellite and other long-haul telecommunications; and optical, radar, and passive electronic reconnaissance satellites. These chapters are all among the best short treatments of these subjects I am aware of. My only complaint is the dearth of illustrations compared to Dr. Friedman's previous design histories, which may be forgiven inasmuch as many of the U.S. and Soviet spacecraft have not been illustrated publicly.

The heart of the book deals with the emergence of the Soviet naval threat employing space-based targeting, and the development of U.S. space-based assets in response, particularly satellite communications, ocean surveillance, and ultimately netcentric warfare. Dr. Friedman makes abundantly clear not only the advantages we enjoy in navigation, communications, and reconnaissance with satellite systems, but that the new style of netcentric warfare is nearly impossible without them. In particular, fusing data from many sensors into an integrated picture is very difficult if the sensors do not know where they are with respect to the battlespace and each other, updating such a picture in detail at any useful speed requires high bandwidth, multinode, jam-resistant, low probability of intercept communications; and over-the-horizon

targeting and guidance for cruise missiles requires space-based terrain contour mapping or GPS guidance. All this has made the Navy the principal user of U.S. space-based assets among the armed forces. Moreover, the Navy is also a large user of non-U.S. space-based assets, consuming more than three million minutes of INMARSAT satellite telephone time in 1995, with the demise of the Iridium system, the Navy will increasingly rely on international satellite systems.

The book contains 48 pages of notes to the text (in very fine print), a glossary, a bibliography, and a useful index. I enjoyed the descriptions of a number of systems I had not seen described in any detail, including the Spasur system, HULTEC radar fingerprinting, the U.S. and Soviet ocean reconnaissance satellite systems, and the BRIGAND bistatic radar development. The book uses only open source material, with the information on classified U.S. systems coming in part from Soviet and Russian sources.

This book is of importance to the Submarine Force and its supporters for three reasons. First, it is a lucid description of a number of technical developments whose value has often been obscured by the hype surrounding them. Second, it makes abundantly clear that space-based assets are important or indispensable to the Submarine Force's ability to carry out several important missions, including strategic deterrence, precision strike, intelligence collection, and mine countermeasures. The corollary is that the Submarine Force and the Navy must assure that future space systems meet their needs, which would appear unlikely if space asset development and operation were controlled by the Air Force exclusively. It also suggests that the Navy should be enthusiastic supporters of space systems. Finally, it is the reviewer's opinion (and not the author's) that space-based ocean reconnaissance for the purposes of search and targeting is now much simpler than when the U.S. and Soviet Union were developing their respective ocean reconnaissance systems, in particular because high resolution imaging infrared sensors and the computational power for image analysis and target recognition is now much more available than 15 years ago. If so married to a missile-firing submarine, such a capability could place surface vessels at risk essentially anywhere on earth, and indeed nothing that floated would be safe. As Dr. Friedman points out, if that time comes a few decades hence, submarines will be all that are left.■

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