THE

SUBMARINE REVIEW

JULY 1984

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A QUARTERLY PUBLICATION OF THE NAVAL SUBMARINE LEAGUE

THE SUBMARINE REVIEW IS A PUBLICATION
OF
THE NAVAL SUBMARINE LEAGUE

FROM THE PRESIDENT

At the May meeting of the Submarine League's Board of Directors, I was elected President of the League for a two-year term. My first order of business is to thank Shannon Cramer (who asked for an early replacement) for his excellent job as the first President of the League. His calm and well controlled hand at the helm has recognizably steered a steady course of progress since the founding of the Submarine League. Fortunately, Shannon has agreed to continue to serve-- now as a Director and Vice Chairman of the Board. It is also my privilege to announce that the Board elected Admiral Bob Long to replace Al Whittle as Chairman of the Board of Directors of the Submarine League. (Al's replacement was necessary after he took a job with Lockheed on the West Coast.) Losing former Chairman Al Whittle-- a main spark plug in getting the League started on the right foot-- seemed like a major setback. But with Bob Long aboard and each of you lending a hand, the League should be able to achieve the objectives which Al helped to outline and push for. Again, fortunately, Al has agreed to remain a member of the Board of Directors and will head up the Western Region of the League. In this role, Al continues to be a good contact for inputs to League matters. All other serving officers of the Submarine League and committee chairman were continued by unanimous Board consent. And, the state of League finances, as shown in the Financial Report published elsewhere in this Review, was very reassuring to a new President.

The Second Annual Symposium proved a highly successful affair with its warm-up night's singfest of submarine songs, it's all-day session of outstanding talks by our leading active-duty submariners and a candid, fraternal, banquet-talk by the top man of our submarine service-- the CNO.

All involved deserve a special thanks. Our Third Annual Symposium is now scheduled for 20 June 1985 at the Radisson Mark Hotel and Convention Center in Alexandria, Virginia. Put this on your calendar.

To wrap up these thoughts, I would emphasize the need to keep our League a vital adjunct to the submarine service. Keeping League members current on submarine issues and openly discussing past and new potential submarine problems, I feel, will make the members of the League stronger and more dedicated advocates of what in my opinion is the key to national security today-- submarines.

Chuck Griffiths

FROM THE EDITOR

More and more we see evidence of thoughtful veteran submariners wrestling with the problem of how, through the dialogue created within the Submarine Review, members of the Submarine League can help the submarine profession. The greatest challenge, it seems, lies in providing material and discussions which improve the art of submarining-- while still keeping such writings unclassified. A frank admission of problems encountered in past operations along with tactical errors made in battle seems possible now within these pages-- 40 years later-- and might be applied in some way to today's art of submarining. This is suggested in at least four of the articles in this Review.

Although it is easy to believe that nuclear submarining bears little relation to that conducted by diesel-electrical submarines, Musashi, the sixteenth century Samurai, would emphasize: "There should be no such thing as this is the modern way to do it".

The Soviets, interestingly, are not satisfied with an unclassified dialogue which is limited to their own war experience. To them it is so necessary to have an open discussion of submarine problems-- in order to develop a high level of war readiness-- that even active duty Soviet naval officers and some from the highest ranks are apparently encouraged to write about matters which further their skills in the use of the submarine. Still, they write unclassified in such a disguised fashion that we in the West are likely to discount what the Soviet writers are trying to tell their own naval people. For example; when writing about how Soviet coordinated torpedo attacks should be conducted, the writer will selectively cite unclassified descriptions of U.S. examples published in magazines of the West. The Soviet reader then is apparently expected to recognize that this is for today (even for nuclear submarines) the correct way to conduct a coordinated torpedo attack. A rebuttal to such a description would similarly reflect, selectively, that material which is citable from Western writings which would rebut the coordinated tactics described. Thus the Soviets write copiously and freely about how to improve their submarining. At the same time, we in the West pay little attention to what reads like the ruminations of envious copy-cats. It should be remembered that we in the U.S. paid the same sort of lack of attention before World War II to the occasional Japanese writings which inferred an intentness to gain a mastery of the seas. We, too easily, wrote off the Japanese navy as a service of "copy cats"-- doing a poor job of emulating our first-rate U.S. Navy.

More than 40 years later there still seems to be a tendency to believe that if the enemy doesn't do it our way, he's not being very smart or efficient.

This is not to say that it is desirable or recommended to use the Soviets' technique for open writing about military subjects. But the considerable volume of their unclassified writings suggests a desirability to have an active open dialogue on the art of war-- mainly because of the rapidly changing nature of warfare with the advent of new technology. Submarining is in a state of flux and seems to require a lot of thinking and discussion to make it best applicable to today's warfare. And it does seem possible to have an unclassified useful dialogue in the Review which can offer much to today's submarine profession. Historically sound principles of war which can be applied to today's submarine operations can be discussed. Similarly, fighting philosophies derived from personal war experience as well as from the writings of warriors of the past-- the Musashi-type of wisdom-- can be useful reminders for developing today's tactics. Showing how the oceans can be made more opaque to enemy ASW forces by skillful use of the ocean's anomalies should be a profitable area. And, recognizing the distinctive differences in the environments of war-- for nuclear war, war under the ice, shallow waters, third power wars, etc.-- can help alert submarine commands to the varying submarine problems likely to be encountered.

The creativity of today's very intelligent submariners in promoting the art of submarining can, it seems, be put into high gear with what appears to be an increasing thrust by the Review to produce stimulating articles.

THROUGH BERING STRAIT IN MID-WINTER

When I took command of the Sargo from Comdr. Dan Brooks, my first big job was to ready Sargo for her Arctic cruise. We had only a few months to install special equipment, test it, and train the crew for the Arctic operations. I'd been aboard Skate with Jim Calvert on her earlier trip to the Pole and had also studied the reports of Nautilus when Bill Anderson took her to the Pole via Bering Strait, so I knew some of the problems involved. But both Nautilus and Skate had made their Arctic cruises in the summer. It was thus imperative to know if our submarines could operate effectively in the strategically useful Arctic Ocean in mid-winter. And it was also imperative to see whether Sargo could be taken to the Pole via Bering Strait under the worst ice conditions.

Nautilus's course into the polar regions had been through the Bering and Chukchi Seas -- the shallow route into the deep North Canadian Basin, some 75 degrees north latitude. But even in the summer her way was blocked repeatedly by deep ice ridges extending as much as 80 feet down from the surface. Time after time she had been forced to backtrack and try new routes before she got through. And once, the boat, which measured 50 feet from keel to top of sail passed under an 80-foot deep ridge in 142 feet of water, leaving her only six feet of clearance above and below! Because Nautilus's sonar couldn't detect deep ice ridges until they were virtually overhead, Commander Anderson had broken off the mission, Nautilus returned to Pearl Harbor, was refitted with the proper equipment and eventually made a successful transit to the Pole.

Getting Sargo ready, made for the most hectic four months imaginable. Yard workers labored frantically, even on Christmas and New Year's Day, to finish the job on time. Then immediately after installation was completed, Sargo was off for sea trials. The inertial navigation system was tested, vertical ascents and descents were practiced, and the new iceberg detector was tried out. This was tested using another submarine in place of the ice ridges the Sargo would face. From these exercises we were able to check out the equipment, learn its range, estimate depths of "ice ridges", and familiarize ourselves with appearances of various objects on the scope of the overhead sonar.

We were ready to leave for the north when I got a pessimistic letter from an old friend from my days aboard Skate, Walt Witmann, the Navy's senior ice forecaster. He predicted, after reconnoitering the northlands, that the winter would be a particularly tough one. Bering Strait, the gateway to the Arctic from the Pacific side, might have such deep ice ridges it could be closed to submarine traffic. With that letter in my pocket I slept uneasily the last few nights before we cast off for the north. But I kept the bad news to myself.

One week out of Pearl, Sargo was surfaced. She had made good time underwater past the Aleutian and Pribilof Islands, and was nearing Saint Matthew Island in the Bering Sea, still some 1,800 miles from the North Pole. A navigational fix was needed before going under the edge of the ice pack, which was only a few miles north. In fact, I was much aware of ice as Sargo was cautiously surfaced with periscope and antennae retracted into the sail. Such caution moreover paid off. As Sargo broke the surface, chunks of ice bounced off her, making sharp rapping sounds on the hull. Seals cavorted about, and dead ahead was the solid edge of the ice pack. We were at the starting line and now our work had begun.

It was then we contacted the Staten Island, one of the five U.S. icebreakers. She was thirty-one miles to the north. Our orders were to rendezvous with her before we began the long and difficult Arctic exploration.

We closed with the Staten Island after a vertical dive out of the drift ice around us, and tested our iceberg detector and overhead sonar as we went. Close by the icebreaker, we established underwater telephone contact with her, then surfaced nearby. Commodore Robertson, the Royal Canadian Navy's top Arctic expert, and Staten Island's skipper, Comdr. Larson, came aboard for a one-day, under-ice demonstration on Sargo. Later, during the night as we cruised close to the Staten Island, the ice thickened directly overhead. Eager to transfer the two officers back to the ice breaker so Sargo could resume her transit through Bering Strait, I found that getting her back up through the heavy polar winter ice cap was no simple problem.

I found very quickly that Sargo couldn't surface where she hovered, because the ice had made up and shifted directly over her. Carefully, probing was begun upward with the sonar -- designed to show us the profile of the ice over Sargo. Mostly, heavy ridges of ice were found, crushed downward by pressing -- thus extending 15 and 20 feet beneath the ocean surface, but there was enough room to take Sargo to the surface.

Cautiously, Sargo was maneuvered below the center of the icy plain and began a vertical ascent with pumping and flooding of ballast to control her upward rate. (If the overhead ice was hit too hard, serious damage to the sail with its periscopes, masts, antennae, and other indispensable equipment might occur. If Sargo didn't hit hard enough, she wouldn't break through.)

Sargo bumped the underside of the ice. Nothing happened. She hadn't broken through. The sonar showed one of the 25-foot deep ridges of ice was closing in on Sargo rapidly. Quickly negative tank was flooded and Sargo dropped to a keel depth of 120 feet.

Again the surface ice was observed from below until a flat spot was found that seemed a likely exit hole. And again tanks were blown cautiously until with an echoing bump Sargo rammed sail-first through the overhead ice. Then there was nothing. Sargo was hung up. I ordered Lt. Fred Stelter to blow the ballast tanks. Almost immediately, with grinding and crunching sounds all around her, Sargo broke the rest of the way through the ice and into the air near the patiently waiting Staten Island.

I raised the periscope and saw the icebreaker 300 yards on Sargo's starboard beam. The only other thing I could see was solid ice all around. Opening the upper hatch, I went to the bridge and all but stumbled over the cockpit full of thick ice. When the cockpit was cleared it was evident that Sargo had broken through two feet of ice, the thickest any submarine had ever penetrated. On the after deck was an enormous block of ice five feet thick and measuring 15 by 20 feet -- a 13-ton ice cube.

After letting the Commodore and the Commander walk over to the Staten Island, Sargo was submerged. Full of confidence, we flooded tanks, dropping vertically toward the bottom, and steered northward. At dawn the next day, Sargo cracked through the ice forty-one miles off Saint Lawrence Island for a final navigational fix before running submerged through the shallow Bering Strait. The day was bright and so clear that the hills of Saint Lawrence Island could be seen. One long last look at the world above the surface was taken. We were not to see the sun again for twelve days after Sargo dropped out of this frozen polynya and headed into the Arctic night.

Slowly, Sargo cruised northward toward Bering Strait, keeping a keel depth of 100 feet. But the sea grew shallower and shallower as Sargo approached the fifty-mile strait that separates the U.S. from the U.S.S.R. By midnight she had crossed the 25-fathom curve and the soundings shoaled rapidly up to 126 feet. Sargo was passing under 20-foot ice ridges and avoiding the deeper ones, thanks to the effectiveness of the iceberg detecting sonar. Adding to the problems was the scarcity of soundings in this area. As Sargo cautiously cruised along with barely more than 25 feet above and below her, it was a matter of groping her way along to find a way through.

Then the overhead sonar failed. This left us totally blind to what might be above Sargo. The deep icy ridges that so frequently had threatened Sargo, as she wove her way northward toward the shallow Bering Strait, could no longer be detected. The ocean depth was a scarce 126 feet, leaving little leeway, so I gave the order to reverse course. With infinite care, our planesmen and helmsman brought Sargo about without tilting her. Sargo was backtracked for two miles before finding her way around the danger spot. With expert handling, Sargo turned 180 degrees without shifting her angle in relation to the sea bed. The slightest tilt could have resulted in her propellers grinding into the ocean bottom leaving her seriously disabled under the pack ice.

All this time the sonarmen worked feverishly to restore the all important overhead "eyes". And they were up to the job. With repairs completed, Sargo moved on, threading her way at very slow speed among the treacherous icy ridges above, as if penetrating a minefield. For the next thirteen hours Sargo twisted and turned tortuously in an ordeal of ice. As the ridges got deeper, Sargo eased down to within 20 feet of the bottom. Sargo passed under some ridges as much as 52 feet deep and avoided many deeper ones. At the end of that thirteen-hour trek Sargo was nearing the Bering Strait. I decided to surface -- if we could find a spot in this shallow sea.

The depth was 170 feet. I began maneuvering Sargo for a position to make a vertical ascent through a flat spot in the overhead ice. As Sargo moved, she suddenly began losing depth control and started sinking rapidly toward the bottom. Quickly, I ordered the main ballast tanks blown to check Sargo's descent. Then I ordered the vents opened so Sargo wouldn't bob corklike to the surface with its three-foot-thick ice. But the huge air bubbles which escaped so distorted the pictures of the overhead ice on the sonar that I ordered the boat down again to seek another skylight to burst through. It was two hours before one was found -- in a shallow 170 feet. This time Sargo made the vertical ascent smoothly. Up she went and her sail hit the ice. Just as before, she stuck! Fred Stelter, our diving officer, ordered the ballast tanks blown -- but gently. Sargo's sail then broke through three feet of ice. A new record. The hull took an up angle, then a down angle, then an up angle again and the bow crunched through the solid ice. Sargo's stern, however, remained below and she came to rest with a 4 degree up angle.

On the bridge I found the ice scattered about in huge chunks. Aft, the ice was even thicker, and it was this heavier ice that prevented Sargo's stern from coming up. But it was a great relief for us all to be above the ice again, even if briefly. We were only halfway through our shallow transit and the pressure on the entire crew was great.

A radar fix on Cape Prince of Wales, the westernmost point of mainland Alaska, was acquired. Next morning Sargo made a vertical dive from a standing position in the ice. Fred Stelter expertly dropped her down and leveled her off at 120 feet -- but the many hours in the ice had frozen the bow plane controls so they couldn't be used for the intricate depth control and trimming needed. Even using the bow planes, it was difficult enough to maneuver and maintain position. Without them it was almost impossible.

A new technique was developed very qu[illegible]. Sargo was cruised at higher speeds than heretofore and a maximum rudder angle of only 3 degrees was used. If a faster turn was required, resort to 5 or even 10-degree rudder might be made to dodge the rock-hard ice ridges overhead. But this meant blowing ballast tanks to keep off the bottom and counterflooding negative tanks to keep from smashing into the ice above. It was nerve wracking.

Once Stelter had Sargo down, she was jockeyed about warily for half an hour before a clear corridor could be found which headed in the general direction desired. Then for the next three hours, the depth continued at around 140 feet. About 20 feet of water between Sargo's keel and the bottom was kept until suddenly the soundings decreased to 10 feet below her keel. Then, just as suddenly they sloped sharply off to 55 feet before shoaling up quickly again to 40, 30, 20, 10 feet. The bottom was still rising when the diving officer on watch, Lt. Dave Phoenix, ordered the boat up 10 feet -- just in time. As he blew the main ballast tanks with the vents open, the boat surged up 10 feet. At the same time the fathometer registered only five feet below Sargo's keel. We braced ourselves to bounce off the bottom but the soundings went deeper again before Sargo could hit bottom. Many sighs of relief were breathed. The planesmen named the sea mount just crossed, "Tall Gonzales".

Immediately after the climb over Tall Gonzales, word got to the crew quickly of our narrow escape. After that, virtually everyone huddled around the iceberg detector to watch Sargo being conned around the overhead ice ridges. Alternating at the conn with me were my executive officer, Lt. Comdr. Bill Yates, and my engineering officer, Lt. Comdr. Ned Dietrich. Watching the ice detector reassured all hands as they saw how ice ridges were spotted and a course was plotted

...... each one.

With the tight squeeze behind, Sargo transited Bering Strait late in the afternoon and by early evening had crossed the Arctic Circle without ceremony. Our objective, the North Pole, was still 1,400 miles off. Sargo ran north all that night, and on the thirteeth day out of Pearl Harbor things went routinely for the first time in a week. As Sargo continued north the water got deeper -- 180 feet. Seldom had 30 fathoms looked so invitingly deep to a submariner. With the deeper water and the simple transit, the bow planes were worked -- trying to free them from their icy bonds. Frequent manipulation was used to loosen the frost-bound controls. But it wasn't until later that the bow planes were finally freed.

The next day was the fourteenth out of Pearl and a navigational fix was needed. But at this point, the bow planes still weren't freed. Without that gear we had to resort to frequent blowing of ballast to make a vertical ascent. The air bubbles unfortunately threw off the sonar so that when Sargo tried to surface through what appeared to be thin ice, she couldn't poke through. The ice was thicker than the instruments indicated. Sargo was dropped out of that spot, and some hours later, after the bow planes finally were working properly, and after one more unsuccesful attempt to crack through the ice, she surfaced through a skylight only 13 inches thick.

The brief time on the surface allowed a navigational fix, radio reports were made, and two of our divers plunged into the 29-degree water for 22 minutes. It was their first cold water dive. While in the water, they checked the malfunctioning garbage ejector and removed a flattened can that had jammed it closed. Later they made other repairs.

Next day, Sargo resumed her northward course. The bow planes were again frozen but this was of little worry as the 50-fathom curve and then the 100-fathom curve were passed. Speed was increased to 16 knots as Sargo zigzagged her way toward the top of the world.

Shortly, the iceberg detector failed. So on the following day Sargo was surfaced through 7 inches of ice in a 600 by 2,000 yard frozen polynya. Repair of the iceberg detector was then begun. Working in twenty below zero weather, two men at a time worked in half-hour shifts to dismantle the train mechanism and get it below for repairs. The heavy support beam under the detector had to be cut before it could be lowered to the deck below. During this, there was a screeching and groaning of ice as it was being forced up and over the Sargo's main deck. After 40 hours, with the training mechanism finally gotten below, Sargo dove and continued on towards the Pole.

At 0934 on February 9, Sargo passed 350 feet under the North Pole, searching for an opening. A small one was discovered and Sargo smashed through 3 feet of ice and surfaced just 25 yards from the Pole. It was 33 degrees below zero as we raised the Hawaiian State flag alongside Sargo. When Sargo attempted to dive that night she was frozen in solid. It took 30,000 pounds of extra ballast to tear her loose and start her plummeting toward the bottom. But a trim was gotten easily as Sargo circled the earth in seven minutes. That's real easy when so close to the Pole. Then Sargo headed South -- the only possible direction to go.

Enroute South, the ice detector was jury rigged with another sonar, and later Sargo rendezvoused with Ice Island T-3, drifting in the Beaufort Sea and manned by a crew of scientists. After a few tests with the scientists, Sargo headed back for Bering Strait.

Just before entering the Strait, Sargo was surfaced through thick ice and a navigational fix taken. Then Sargo dropped out of the ice into 155 feet of water and cruised at 7 knots into Bering Strait-- 24 feet off the bottom. The deep ice ridges began to appear, but evading them was tougher because of the shortened and distorted ranges provided by the jury-rigged detector. Later, when a pair of deep ridges were spotted 500 yards ahead, I ordered a course to take Sargo between them. At 125 yards, the ridge off the port bow looked very deep while the one on the starboard side had disappeared. I altered Sargo's course 15 degrees to starboard and WHAM! The boat heeled to port as it was shoved down 25 feet, with a 6 degree down bubble. The collision alarm was sounded and conn rang up "all stop". With the depth guage reading 148 feet -- almost on the bottom -- I ordered "back two thirds" then ordered ballast tanks blown while leaving the vents open. As Sargo came up, "ahead two thirds" on one shaft was rung up and depth control was regained. Sargo was clear of the ridges and all compartments reported "no damage". It was a close call.

After that, the iceberg scope was left on long scale, and ice ridges were maneuvered around while still 600 yards away. Additonally, Sargo cruised 16 feet off the bottom. But late on the next day, a solid wall of ice was spotted 800 yards ahead. Scanning the huge ice ridge showed no openings, so Sargo was steered parallel to the ice wall for a long period until she was able to skirt around its end -- and resume base course.

There was just one trouble spot left -- Tall Gonzales. I planned to leave this pinnacle 5 miles off but then the inertial navigational system chose to get out of line a bit. Despite my calculations for set and drift to compensate for the system errors, soundings showed the bottom shoaling up rapidly under Sargo. So I reversed course and headed for deeper water just as the boys put the inertial navigator back on the line. The corrected equipment showed we were clear, and although another field of heavy ridges loomed ahead, Sargo dodged her way through and out into improved ice conditions, where she later surfaced for examination of the damage to the sail. The top of the sail was dished in, one of the scopes couldn't be raised, and the side of the bridge cockpit was pounded aft and in. We were just plain lucky.

On February 25, Sargo cleared the ice pack after 6,003 miles and 31 days under the ice. At which, one crew member said, "The only ice I want to see for a long time is in a tall glass."

The success of this risky peacetime mission could only be attributed to the many high skills, courage and well trained reactions of many officers and members of the crew of the Sargo.

John H. Nicholson

COMMENT

(Ed. Note: An advance copy of Admiral Nicholson's article was sent to F.C. Lynch, Jr. for his comments)

Nicholson's paper on under-ice operations is exceptionally good. How valuable it would have been for us in 1940 if we had something like that to tell us what sort of problems we were going to face, and how one boat was able to handle them.

I have done a lot of thinking as to the proper role of the Submarine League, and in what way it can be of help to those on active duty. I have written many drafts in trying to express my ideas. I am dissatisfied with what I have produced, however I am beginning to get a focus on a solution.

This focus is illustrated by Nicholson's paper. I suppose it has something to do with tradition- or the problems others have faced, and how they handled those problems. And how, in retrospect, those problems appear to us now and, again in retrospect, how we think those problems should have been handled.

Perhaps the greatest penalty being paid for all the spectacular advances in technology is that the greater the advance the less applicable the past appears. Tradition has gone by the board; it is a brave new world with no emotional linkages to the past.

This is a penalty in that it practically assures that the same mistakes will probably be made all over again. But it is not wholly the fault of the brave new world. What they have been told of the past is mostly in terms of successes; the problems and the failures have not been covered in the history that they know about.

And then there is the problem of knowing how to behave in battle. This is a new kind of history for us, although the English in particular have used it as a training device for centuries. Pride in combat tradition has been an important element in the success of British arms over those centuries.

This is not to say that the British are braver than we, but it is to say that they have far more and better combat role models than we. Our military history tends to glorify rather than critique. We have glorified some submarine skippers in WW II, but they are not role models. What they did and why they did it are not presented in such a manner that a skipper of today can identify with one of them when he is faced with a combat decision.

This is an area in which the Submarine League could operate effectively. It should be the curator of submarine history and traditions. This doesn't sound very sexy, and I doubt if the interest in it would be very broad. But it is badly needed.

WHAT SUBMARINES DO BEST AND THE WEAPONS THEY NEED

The need for submarines and submarine weapons in the U.S. Navy is highly sensitive to the missions the nation expects these submarines to undertake if called upon. In this paper are examined the missions, proven and unproven, which drive the need for submarines and their weapons.

The history of the underwater war of 1939-1945 is particularly relevant because it was the last time that submarines were in a major action. (The Falkland's War saw too little submarine action to provide a good base for weapon usage.)

In 1939, the first U-boat commanders were directed by the German Naval High Command by message to: "Commence hostilities against Britain forthwith." It is important to note that with regard to merchant shipping, the campaign was initially directed to be waged "in accordance with the revised issue of the Prize Regulations until such time as danger areas are declared." The regulations were those of the London Protocol (1936) which provided that unescorted merchant ships could be sunk only after being stopped and searched and after measures had been taken to ensure the safety of the people aboard. As the war progressed, several honest errors were made, tankers became exceptions, and by May, 1940, German submarines no longer bothered with protocols.

In the pre-World War II U.S. Navy, submarine commanders had to sign a detailed statement indicating their agreeement to abide -- in times of war -- by the protocols and other internationally accepted modes of behavior. But by the time Pearl Harbor was attacked, emotions had heated up and passions ran high. The first wartime command to U.S. submarines in the Pacific was: "Execute unrestricted (air and) submarine warfare against Japan." The lesson is clear: weapons of war are not necessarily used for the purpose for which they were designed.

The lessons of war are many and depend to a large extent upon the viewpoint of the person drawing the conclusions. The foremost observation is that the most successful mission accomplished by submarines in World Wars I and II was the sinking of merchantmen in areas denied access to air and surface forces in spite of the fact that they were neither designed nor intended primarily as merchant raiders. Figure 1. illustrates this point.

Table 1

SHIPS SUNK BY U.S. AND GERMAN SUBS
WORLD WAR II
(Approximate)

	Merchantmen	
	No. of Ships	Tonnage
U.S.	1200	5 million
German (WWI)	4800	11 million
(WWII)	2800	15 million

While there is no intention to downgrade the submarine's ability to sink warships, their greatest success was by far against the merchant fleet. U.S. submariners generally will argue that the priority in the U.S. Navy was assigned early in the war to sinking warships. This emphasis was later shifted to merchantmen. Notwithstanding, there can be no question that the results against the merchantmen were far superior, about 10 to 1 in tonnage. Furthermore, whatever the reasons, U.S. carrier air forces sank about 15 percent more warships than did U.S. submarines. The principal conclusion is that submarines have a demonstrated capability to sink merchantmen far beyond any other capabilities they may have demonstrated or for which they were designed.

The second conclusion to be drawn for our purposes from World War II, the last war in which submarines in large numbers were used in anger, is that it takes many submarine torpedoes to conduct submarine warfare. While there are many extenuating and intricate explanations, the facts are that great numbers of torpedoes were used as shown in the following table:

TOTAL NUMBERS OF SHIPS SUNK AND TORPEDOES FIRED
BY U.S., BRITISH AND GERMAN SUB FORCES
WORLD WAR II

Nation	Ship Sunk	Torpedoes Launched	Ratio
U.S.	1314	14,748	11:1
British	1040	5,121	5:1
German			~ 4.5:1

Thus, from about 4.5 to 11 to 1 is the range of ratios of the number of torpedoes launched in anger to the number of ships sunk.

The third major conclusion from the underwater action of World War II is that surface forces and air forces killed about the same number of enemy submarines while submarines killed by comparison many fewer.

The following table (calculated in 1958 and said to contain a few minor errors) shows the breakdown of enemy submarine sinkings by nationality of submarine sunk, and by the character of the attacking Allied Forces.

Table III

SUBMARINE SINKINGS BY ALLIED FORCES
WORLD WAR II

Allied Forces	Submarines Sunk German	Japanese	Italian	Total
Surface	248	69	38	355
Aircraft	356	13	13	382
Surface/Aircraft	46	9	5	60
Submarines	22	25	19	66
Miscellaneous	109	14	10	133
TOTAL	781	130	85	996

Of submarines sunk by submarines, all enemy submarines but one were either surfaced or in the act of surfacing/diving when sunk. There was one case of a submarine (British) which sank an enemy submarine (U-boat) while both were completely submerged. Six Japanese submarines were sunk by U.S. submarines while the former were in the act of surfacing or diving; 19 more were sunk on the surface. The location of submarines sunk by submarines was generally in areas over which Allied forces did not have control. These included offshore enemy submarine training areas, enemy submarine training areas, enemy-air controlled lanes, etc.

The three conclusions I want to carry forward from World War II in summary are:

1. Submarines did a highly effective job of killing merchantmen, and, to a much less extent men of war, mostly in areas denied access to other forces.

2. It took in the order of 5-10 torpedoes, or more for every ship a submarine sank.

3. Submarines did not demonstrate the capability of killing submerged submarines.

To what degree do these conclusions apply to Submarine forces of the world today?

There appears to be every reason to believe that conclusion 1. -- capability against merchant ships -- is probably true today and will remain true for the foreseeable future. With regard to torpedoes, the higher sophistication and capability of today's MK 48 torpedoes should require fewer numbers of torpedoes per ship kill, perhaps 3 to 4 instead of 11, but there is no irrefutable way to determine such an estimate. Lastly, the third conclusion does not hold today. There is no question that today U.S. submarines have the capability to sink submerged submarines. Short of actually fighting a war in which submarine ASW was conducted in anger, there probably is little more the Navy could do to demonstrate this capability. Submarine ASW capability has been proved by analysis, by exercise and under relatively realistic conditions.

How ASW came to be a primary mission of submarines is worthy of description considering the fact that in World War II, of the almost 1,000 enemy submarines killed, a high percentage of them were killed either in port or at sea, caught on the surface - usually in periods of low visibility, detected by the emerging radars of the time, and operating in a benign countermeasures environment.

It is no secret that internecine forces are always at play between the various tactical divisions within the U.S. Armed Forces. Those between the air, surface, and submarine forces in was developed.

3. The ballistic missile submarine (designated SSBN) was developed and deployed.

4. Some of the special missions became less attractive in stark reality (e.g., sea-planes for ASW disappeared from the Navy).

5. There were complicated command problems (e.g., SSRs were under the operational command of the surface forces and not the submarine forces.

6. A real threat-- the Soviet submarine force-- became a rallying point for the Navy in Congress. Hence anti-submarine warfare became the best game in town.

All of the above developments, in combination, resulted in the decision in late 1960 and early 1961 to redesignate all submarines "counted" for force level purposes to be designated as SS or SSN, depending only on their propulsion plant. In addition, there were the SSBNs, and a few AGSSs (having little combat capability and not counted in force levels.) One of the principal arguments used to make the changes in designation was that all submarines now had an ASW capability and therefore, in view of the Soviet submarine threat, the primary mission of all submarine forces was anti-submarine warfare. The submariners had consolidated their position and raison d'etre, and had clearly identified a credible threat. Their hand was further strengthened by the decision to develop and deploy the SSBN. During this period of development and deployment, the submarine force still represented only 5 to 6 percent (growing to 8 to 11 percent) of the personnel in the Navy and was getting about 25 percent of the Navy procurement and R & D budget.

What is the general nature of the submarine threat?

There are about 800-900 submarines in commission world-wide, of which the submarine levels of major submarine nations are shown in the table, along with the number such nations had at the beginning of World War II.

Table IV
SUBMARINES IN COMMISSION IN 1984
AND AT BEGINNING OF WORLD WAR II.
SELECTED NATIONS

Nation	Beginning of World War II	1984
USSR	200(1)	371
US	112	130
China		122
UK	58	31
France	77	24
Germany	56	24
Korea		19
Egypt		16
Turkey		15
Japan	65	14
Norway		14
Sweden		12
Greece		10
Italy	84	10

(1)Estimates as high as 280 have been cited.

In 1939, the Soviets had over 200 subs from whose force very little was heard in the next six years, but a great deal has changed. The Soviet Navy is better trained and more aggressive. The world-wide objectives of the Soviet government are clearer. The USSR is a superpower.

How can these submarines threaten U.S. security? I think it is clear that submarines can sink merchantmen and the Soviet force could indeed pose a threat probably sufficient to make it very difficult for the 500 ship merchant fleet owned by the U.S. and whatever other ships could be brought into service from the aging reserve fleet and the "flags-of-convenience" fleet. The threat to our warships is existent, particularly if cruise-missiles are used, but the capability is far from demonstrated as is, for example, the threat to our warships from aircraft armed with air-to-surface missiles. Finally, the threat of attack to the U.S. itself from Soviet ballistic missile submarines is real enough but no decision or commitment has been made to systematically reduce this threat. Without some kind of world-wide, 24-hour localized surveillance by forces ready to launch weapons instantaneously, together with boost-and mid-phase intercept and terminal ballistic defense systems, there is little hope of reducing the threat of submarine ballistic missile attack on the U.S. by ASW alone to a point where damage to the U.S. could be seriously reduced.

Where does that leave us?

1. U.S. submarines can sink merchantmen. There are about 1,723 Soviet merchantmen, about 600 auxiliary naval ships, and an additional number of Soviet large fishing vessels.

2. U.S. submarines may be able to deal with some degree of success with Soviet men of war; while the Soviets have the same potential.

3. U.S. submarines have developed a highly sophisticated ASW capability.

4. The U.S. needs weapons of appropriate quality and sufficient numbers.

Today the U.S. submarine force and its weapons are designed primarily for ASW. The capability against merchant and combatant ships is accepted as a by-product.

The Mk-48 is the best ASW weapon design to date and it has been continuously modernized. ADCAP will be an improvement aimed at dealing with the newer Soviet submarines. Both are "optimized" against the submarine; both may be used against surface ships, although their sophistication is not needed for that mission. The requirement for anti-submarine use drives the cost and makes it probably 2 to 4 times what a weapon designed for anti-surface ship use would cost.

There is then the question of the numbers of weapons! A short review of the Navy's system of producing the so-called non-nuclear ordnance requirements (NNOR) is in order, for a better understanding. The NNOR system is a quota system. The target set is defined and then a subset is arbitrarily allocated to each U.S. force. For example, the 1,200 some Soviet combatant ships and auxiliaries are arbitrarily allocated to U.S. forces for attack and sinking; so many to subs, so many to aircraft (with bombs), so many to aircraft (with missiles), so many to cruisers, so many to destroyers, etc. Then, theoretical reliability figures are applied and the number, say, of MK-48's is calculated accordingly. The false target problem is essentially ignored.

If that system had been used in the late thirties, U.S. submarines would have had available for World War II only 2,000 to 3,000 torpedoes at most and not the 15,000 it actually used. This leads to the conclusion that not only are U.S. present submarine weapons misfitted to the whole target set in a systems sense, but also that the method used to calculate stockpile requirements is woefully inadequate from a readiness point of view, albeit practical from a budgetary and programmatic viewpoint.

A comprehensive submarine weapon study is needed; however some simple arithmetic can bound the requirements. Table V shows approximations as to torpedo requirements calculated for two assumptions regarding the percentage of enemy ships that U.S. subs may have to attack. Again false submarine targets severely impact the requirements.

Table V
Simple Arithmetic

For Merchantmen and Auxiliaries	50%	100%
Ocean: A Minimum of 3-4:1	2,550	6,800
Coastal: A Minimum of 2-3:1	1,000	6,000
For Combatants		
A Minimum of 4-5:1	600	1,500
For Subs		
Positive Identification- 2-3:1	350	1,050
Considering False Targets (MK48's needed)	1,400	4,200

In WWII, 1173 Torpedoes were just plain lost; 940 in the 52 subs sunk and 233 in the bombing of Cavite; but no account is taken of such possible losses.

Thus in 1984, as we look at the next 20 years, there appears to be a clear path for improvement in the strategy for stockpiling of submarine weapons. Conceptually, a family of submarine weapons is indicated.

First and foremost, there is a need* for a weapon --a torpedo would do-- specifically designed to sink surface ships, particularly merchantmen. It seems that such a weapon could be produced in the quantities needed at a fraction of the cost of ADCAP. A practical goal is three to five times the number of surface ships which submarines could be expected to kill. For starters, if one assumed that sinking one-half of the Soviet merchant and combat force is a reasonable planning goal, we would need a minimum of about 6,000 such weapons; the upper bound of such an inventory would be about 10,000 to 15,000 -- which would take care of all Soviet merchant and combatant fleets using the five-to-one ratio.

Second, the MK-48 and ADCAP in the numbers planned could be reserved for use against submarines and, to a lesser extent, warships. There are about 600 to 700 such ships in the Soviet Navy. A moderate number of Harpoon/Cruise Missiles could assist in the warship attack role.

Third, a simple weapon could be fielded for a submarine to protect itself from ASW fixed-wing aircraft and helicopters. Several tests of this type of weapon have been successfully conducted since World War II and there is no technical impediment to the deployment of a simple, effective and inexpensive weapon system for this purpose.

Fourth, a modern mining capability would round off the weapon arsenal for U.S. submarines. Enough attention has not been paid to this inexpensive unique and effective method of conducting naval warfare.

Additional consideration should be given to (1)a new mission and (2)a special heretofore unavailable option for submarine weaponry.

The new mission would involve submarine participation in the outer air battle, one of the difficult problems associated with U.S. surface systems. The geometry associated with detection and intercept of Soviet Backfire/Blackjack bombers armed with air-to-surface missiles, on strike missions against U.S. surface ships, is such that U.S. warning time and reach of defensive weapons is inadequate. A system should be thoroughly examined whereby U.S. submarines in the forward areas, on command, would act as launch platforms for surface-to-air missiles to predesignated spatial windows for subsequent control by some external system (satellites, high flying aircraft) to intercept Soviet bombers long before reaching their launch positions.

Lastly, there is a new need, in the submarine family of weapons, for a disabling weapon. The Falkland/Maldive action and the resultant sinking of the Argentine cruiser Belgrano, with the subsequent loss of about 500 personnel, has highlighted at least the political need in special circumstances of a way to disable a ship, put it out of action and yet not result in needless loss of life. For other than humane reasons, a disabling attack would be of great value. The possible environmental damage to friendly shores and fisheries (e.g., in the Mediterranean or Persian Gulf) caused by the sinking of supertankers might far outweigh the possible military value of such sinkings. Furthermore, the option to disable does not close the option to sink.

These six weapons, anti-surface, Mk 48/ADCAP, submarine self-defense against aircraft, mines, outer-battle launch-and-forget and a disabling weapon, developed and deployed in a systematic and balanced way would ensure that a submarine force is ready for modern warfare. The greatest deficiency moreover is the anti merchant ship weapon.

D.A. Paolucci

SUBMARINE ENGINES

As the submarine force plots a course to the year 2000 and beyond, we should reflect on the tactical, strategic, and design factors which bear on the art of submarining. ADM Watkins, the CNO, points out that new submarine weaponry is opening exciting new roles. The TOMAHAWK cruise missile extends submarine standoff anti-ship attack range by a factor of four to five. A variation of this weapon will provide the submarine with a powerful land attack capability. Surprisingly, while we seek to expand the role of submarines, we have elected to concede to the Soviet Union a continuing three to one numerical advantage. This dichotomy will place considerable pressure on American tacticians, strategists, and designers to provide the ways and means by which we may preserve our edge in submarine warfare.

The qualities of our submarines are closely tied to their engines. This is not surprising, since any craft that seeks to break away from the surface of the earth is dependent upon unique engines. The lightweight gasoline engine was the key to the first practical aircraft. Gas turbine and rocket engines now extend our ability to operate above the surface of the earth. While far less spectacular than the gasoline engine, the electric storage battery provided the first practical means of operating below the surface without access to the atmosphere. The early art of submarining highlighted the conservation of battery energy. The nuclear engine has largely removed this energy constraint. We now analyze the value of expending energy (speed) rather than the value of conserving energy.

The energy revolution brought about by the introduction of nuclear power deeply affects submarine tactics, strategies, and design. Understanding of these effects is important in planning our future course. The discussion which follows will touch upon each of these topics.

<u>Tactical Factors</u>- The submarine found its niche in naval warfare as an inexpensive means to defeat the speed and firepower of surface ships. Its tactics are those of stealth; the submarine

seeks to remain undetected by its opponent. Engine selection is critical. As the means of detecting naval targets advance, preferred engine characteristics change. Originally, the submarine remained submerged during daylight hours to avoid detection by the human eye. Electric propulsion served this purpose well, but submarine batteries required recharging. For many years, submarines would surface at night and recharge batteries by using diesel engines. The development and application of radar reduced the security of surface operations. Introduction of the snorkel quickly followed. Although the modern non-nuclear submarine has not been defeated in combat, the added operational degrees of freedom offered by the nuclear engine have made nuclear propulsion the focal point of U.S. submarine development.

Americans have been quick to put nuclear engines to use. This exploitation has included increased speed, as found in our attack submarines, and increased firepower, as incorporated in our strategic submarines. We intend to develop nuclear submarines which combine both increased speed and firepower. This raises a fascinating tactical dilemma: submarines originally served as an inexpensive means of defeating the speed and firepower of other naval ships; will the submarine serve as an inexpensive means of defeating the emerging speed and firepower of submarines? Is a powerful submarine the best counter to the powerful submarine? Or, has the powerful nuclear submarine created a niche which remains to be filled?

If submarines are to serve as the means to defeat powerful naval opponents (submarines, surface ships, and aircraft), they must continue to practice stealth. It is well known that the tactics of stealth in submarine warfare now emphasize one's ability to hear and avoid being heard. The quiet engine/hull combination is important with respect to an ability to hear and an ability to avoid being heard. With considerable attention to detail, nuclear submarines have become progressively quieter. However, success in stealth is a relative matter.

In the world of underseas weapon systems we find two extremes, the mine and the nuclear submarine. The individual mine has no engine; it is the quietest weapon system. The nuclear submarine, with its powerful engine, may be quiet, but certainly not as quiet as a mine. The well-designed, constructed, and operated non-nuclear submarine fits somewhere between the nuclear submarine and the mine. It is of interest to note that ADM Doenitz, Commander of the German U boat service during World War II, recognized a tactical similarity between the non-nuclear submarine and the mine; he referred to the U boat as the "intelligent mine". If stealth is the essential tactic in undersea warfare, the mine, the "intelligent mine", and the nuclear submarine may all be key players. The niche that any of these stealth options may fill is dependent not only upon tactical qualities, but upon strategic usefulness.

<u>Strategic Factors</u>- Strategies deal with where, when, and how power is to be used in support of national objectives. In America, strategies reflect the hardware preference of the individual services. Over the years, we have seen the emergence of a bomber strategy, a missile strategy, a battleship strategy, a carrier strategy, and so on. The key to a strategy may be found in its planning assumptions. For example, we might select the following assumption made by Dr. Norman Friedman in testimony before the Senate Armed Services Committee: "future conflict is likely to occur in unpredictable places, far from home, and probably without nearby bases". This assumption creates a niche for the speed and endurance of the nuclear engine, whether in surface ships or submarines. Only such

capabilities would allow us to respond to surprise conflict in remote corners of the world.

The foregoing planning assumption could be revised along the following lines: "future conflict will occur in predictable places, far from home, and with nearby bases". This second assumption conforms precisely to the conditions existing at the time Japan attacked the United States in 1941 and when Argentina attacked the Falklands in 1982. Both events were predictable, since long periods of tension existed prior to the attacks and neither the Americans nor the British had committed sufficient military power to discourage the attacks. This second planning assumption does not argue for a specific hardware preference. There could exist a role for the mine, the intelligent mine, and the nuclear attack submarine.

If we are asked which came first, the planning assumption or the hardware preference, it is safe to assume the preference came first. This American pattern of behavior makes it quite difficult to introduce an innovative product in times of peace.

Design Factors- The naval designer seeks to create useful naval products. The designer judges product usefulness in terms of capabilities and cost. A major portion of his task relates to the process of balancing engines and armament- the more expensive the engine, the greater the pressure placed on the capabilities to be achieved by the engine and armament together.

The submarine designer's task may be illustrated by considering the three following engine packages:

A. Battery,
B. Battery/Diesel,
C. Battery/Diesel/Nuclear.

Remember that every nuclear submarine carries a diesel and battery as backup power source.

Of the three options, package A is least costly. The designer, beginning with a battery, realizes that the resulting product will have limited mobility and operating endurance. The product, therefore, may be both specialized and expendable. Combining a battery with a single warhead, the designer may define a mine or a limited range, quiet torpedo.

Package B is the medium cost option. Since the diesel engine may be used to recharge the battery, the resulting product, a submarine, can emphasize reusability. In this case, the armament may be increased to permit multiple attacks, thereby balancing product capabilities against investment cost. The designer, when working with the battery/diesel package, need not be driven to a multi-role design in order to balance capabilities and cost.

Engine package C is the most powerful and the most expensive option. The designer has found a natural application of package C in the fleet ballistic submarine (SSBN). The armament of strategic ballistic missiles could be rationally expanded to balance the capabilities and cost of the engines. The SSBN is the least expendable, most heavily armed ship ever designed.

In some non-strategic missions, there is a practical limit to the armaments which may usefully be carried on a single submarine. This is particularly true for a submarine which specializes in anti-submarine warfare. In this case, the submarine attack capabilities are limited by its ability to detect, classify, and localize submarine targets. For a given state-of-the-art, there exists an effective upper limit to the sensor and weapon package which may be supported. Consequently, submarine designers of ASW specialized submarines, whether using engine package B or C, tended to back off on speed and power in order to bring the engine into balance with the armament. The SSK and SSKN, TULLIBEE, are examples of such specialists.

Greater speed and power is more easily justified within the context of a general purpose submarine. When the ship and shore attack roles are added to that of anti-submarine warfare, the ceiling on useful armament loads is removed. The submarine designer may select armament levels including anti-ship and land attack missiles which can balance any engine package. The general purpose attack submarine will tend to become larger and more powerful as one generation succeeds another.

This survey of the submarine design factors recaptures the submarine dilemma: The submarine, through advancing engine technology, has evolved from a David to a Goliath- are we to abandon all interest in Davids to defeat Soviet Goliaths? The answer to that question will lie in the decisions we make about new engine research and development. Our American enthusiasm for speed and power should not cause us to exclude the development of more modest engine packages; packages which may be useful in future naval Davids.

<u>Summary and Conclusions</u>- The revolution which resulted from the introduction of nuclear propulsion in attack submarines may have effects on U.S. naval power that are not commonly recognized or discussed. These effects include the following:

> <u>Design</u>- in our drive to justify higher submarine speed, the designer is forced to balance the increases in engine investment against larger, more capable armaments. This pattern will

commit us to a numerically inferior force of powerful, multi-role submarines.

Tactics- The submarine established its niche in naval warfare as an inexpensive means of defeating powerful surface ships. With nuclear engines, the submarine itself has become both powerful and expensive. It has vacated its original niche.

Strategy- Strategic assumptions are tailored to accept the attributes of the new, powerful attack submarine; the strategic assumptions which accomodated the pre-nuclear submarine have bee abandoned. In other words, Goliath has superceded David.

Americans are quite properly advocates of nuclear engines in submarines. The submarines of World War II had great leverage in terms of counterforce requirements. The powerful nuclear submarine will increase this pressure. Unfortunately, the concept of submarine leverage is a two-way street. If we concede to our opponents a continuing numerical advantage of three to one in submarines, it could prove that it is we Americans who have a leverage problem. Should this be the case, there remains a niche for an affordable, dedicated (not multi-role) means of stopping powerful Soviet submarines. Submarines are most suited to this task. How well they accomplish this task requires equal consideration of a choice of weapons and a choice of engines. Above all, we must preserve the opportunity to choose.

J.S.L.

GO FOR IT...WITH DIGITAL

Recent upgrades in hardware within the weapons systems of our submarines have been achieved through state of the art technology replacements. Significant among these upgrades has been a replacement of analog systems with digital. A major step of course was the digitizing of the BQQ-5 Sonar System followed by the conversion of the MK 113 mod 10 analog fire control system to MK 117 digital system. There have also been major advances in digitizing of ESM equipments throughout the Navy which have benefited the WLQ-4, 6, and 8 ESM receiver/ analyzer systems. These are fully computerized and semi-automatic but lack advances into microchip techology. Submarine satellite commuinications have also benefited from digital advances ushered in by the Navy Fleet Satellite system. But satellite communications suffer from research and development lead time which keeps application forever about 10 years behind system deployment.

There are several reasons for this technological upgrading. Most significant is real-time data computation and increased system capacity. Additional advantages for digital vice analog technology are greater reliability, increased accuracy, ability to expand an installed system for multiplex operation, and the relative ease of system upgrading and modification as future technological advances are made. For next generation SSN sonar and fire control systems, microchip technology with increased miniaturization and even more rapid computing capability may show even more significant advantages than those realized today.

Certainly, increased signal processing is a major operational improvement which must be made if we are to improve system and platform capability.

If digital technology is so ideal for sonar, fire control and ESM, why not use it more in Communications and Command and Control? The rate of introduction of digital technology into all facets of submarine electronics has not been uniform, probably for several reasons. Submarine sonar, fire control and ESM equipments have generally developed as unique submarine systems without universal applications elsewhere in the Navy. Most Navy-wide Communication and Command and Control equipment has been developed with multiple platforms in mind. They were thus treated differently in conceptual stages. This, of course, does not explain why digital technology is not used now, it merely describes why its use has been neglected until now. Morevover, most electronics engineers are quite familiar with analog technology; it's what they learned in school and what they are comfortable with when called on to design new systems.

Are there other advantages of digital technology which make it an even better candidate for future systems -- which have not yet been capitalized upon?

Several ideas come to mind which have immense potential to improve other submarine systems:

o The use of separately sensed "noise monitoring" or noise measuring circuits, where this data is subtracted from a signal plus noise circuit, holds great promise for receiving weak signals that are masked by electromagnetic interference. These noise measuring circuits involve complex calculations that only digital technology is capable of handling in a real-time environment.

o Once digitized, signals can be stored in shift registers and simultaneously processed -- the processing outputs applied to the (stored) data from which they were derived. This provides truly "simultaneous" response to changing signal environments. (In simple language, digitized communications are virtually unaffected by atmospheric disturbances, have an increased security in transmission, and can be received with far greater speed and accuracy.)

o Extra functional components can be used within a circuit card, where certain devices have a high failure rate but have built-in spares which can be switched to when a component fails. This can greatly increase reliability -- resulting in a "no fail during lifetime" capability within a system.

o Increased resistance to heat, vibration and power supply failures is also essential for lifetime reliability.

Digital technology appears amenable to building a new system (with proper initial design) in such a way that future technology advances can later be made by card or module change-out to the same equipment -- or by software changes within the existing equipment. It has already become apparent that much of the cost involved in a future system is its integration cost within its platform. Improved design, using digital system engineering, can however result in evolutionary upgrades at significantly less cost than for wholesale replacements.

What does all this mean in the world of submarine systems?

First, we need to look closely at all submarine electronic systems for next generation equipment and actively weigh the pros and cons of digital in each equipment. Certainly, communications equipment with the added requirement for cryptographic coverage should be identified for digital switchover. The capabilities and capacities of most ESM equipment would also be greatly improved with upgraded digital technology.

Next generation equipment needs to: be more responsive to technology advances; more reliable in operation; and demonstrate greater speed and capacity. Digital technology may well be the way to get there.

RADM. W.D. Smith

SLIPPERY SKINS FOR SPEEDIER SUBS

The Soviets have the fastest subs in the world. Very possibly they have already begun to exploit new and sometimes bizarre ways of coaxing extra speed out of submarines by reducing the skin-drag of their submarine hulls. Such techniques are also being sought by the U.S. Navy through U.S. universities, and industrial and Navy research laboratories. Examples of such methods of drag reduction: hulls that pump out a mucus-like secretion or release clouds of microscopic bubbles; hulls that are heated from stem to stern; hulls covered with fine grooves; even hulls with soft skins that subtly change shape -- a trick some scientists think dolphins may have developed. The object of the latest research is to reduce skin-drag turbulence, a factor that contributes nearly half of the overall drag a submarine's engines must overcome in driving the vessel forward.

As Michael Reischman of the Office of Naval Research explains it, skin drag results from tiny turbulent eddies that swirl chaotically within a "boundary layer" of water, only a fraction of an inch thick, as it moves along a hull. Ordinarily, a boundary layer of water (or air, in the case of airplanes) is invisible -- but it is real enough to pose some of the thorniest problems in physics. In explaining the behavior of boundary layers, scientists say that the molecules of a fluid that come into direct contact with a moving solid surface tend to adhere to it and get pulled along at nearly the same speed as that of the moving surface. These molecules drag along neighboring molecules, but farther away from the skin the pull on the fluid is less, so it moves more slowly. At the outer edge of the boundary layer, fluid molecules are traveling at less than one per cent of the speed of the molecules touching the solid surface. Although layers of fluid at different depths may slip smoothly past each other in what is called laminar flow, they may also get tangled up, creating turbulently swirling eddies.

The behavior of turbulence in boundary layers remains one of the great mysteries of science. Turbulence is made up of an infinite number of random microscopic events that are unpredictable by their very nature. Within this chaos, however, eddies coalesce into drag-producing bursts that seem to erupt at fairly regular intervals, like the rhythmic flickers of a candle flame in still air. Why and how does this semblance of order arise spontaneously from a disordered system?

Despite scientists' bafflement at the theoretical aspects of turbulence, they have discovered new ways to reduce or even prevent it in the boundary layer.

In 1975, Soviet scientists began publishing reports of experiments in which they claimed to have achieved drag reductions of nearly 90 percent by pumping ordinary air through a porous plate. Some of the current American work is based on the Soviet reports.

A submarine equipped to use micro-bubbles would have a double hull, the outer layer consisting of porous metal or some similar material, with compressed air between the two hull layers. Since the air supply aboard a submarine is limited, and since all gases seem to work equally well, the bubbles might conceivably consist of steam generated as a by-product of the propulsion system.

Bubbles rise, of course, and if they were expelled from the upper surfaces of a submerged boat they might rise above the thin boundary layer where they reduce skin-friction drag. But at even moderately high speeds, the bubbles seem to remain in the boundary layer long enough to do their job.

Why does it work? No one knows for sure, but, says Reischman, who supervises some of the Navy's research contracts, "when the air bubbles get in among the little turbulent eddies in the boundary layer, I believe that those eddies get kind of confused and forget what they're trying to do. The natural process of turbulence generation is sort of interrupted by the air in the fluid."

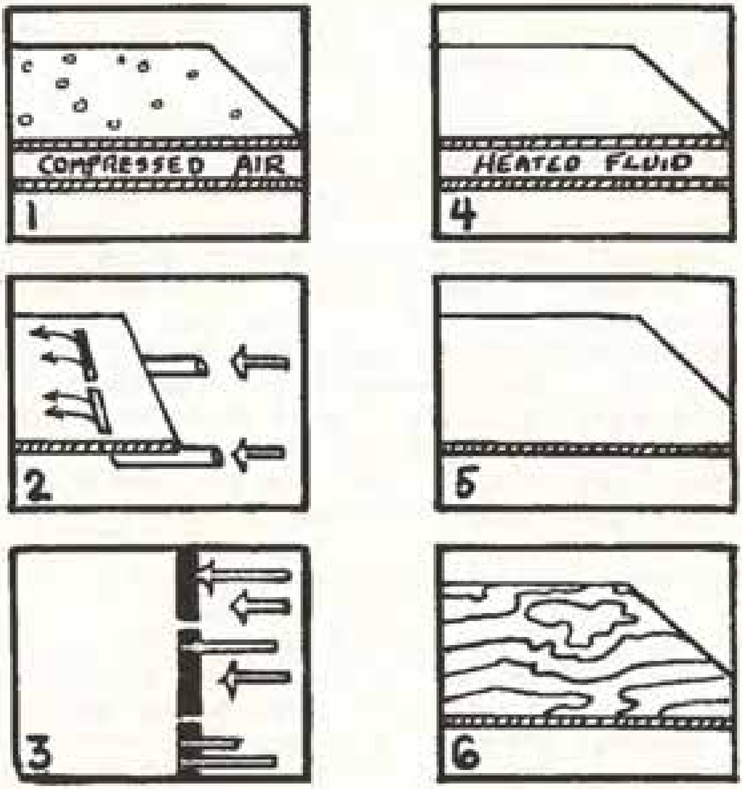
Another approach that has excited scientists involves the injection of liquid polymers into the boundary-layer flow. Since the dawn of history, sailors have recognized that slippery hulls slide through water better than ordinary ones. (Ancient Phoenician efforts may have included the application of animal tallow to wooden hulls.) But the small drag reduction afforded by simple lubricants is more than off-set by the fact that they are quickly washed away, especially in sea water. A better technique seems to have been developed by fish, which have skins that secrete mucus continuously. Scientists have long surmised that mucus secretion helps fish swim faster with less effort.

The theory led to searches for an artificial substance with some of the characteristics of natural mucus. In the 1970s, researchers in several countries (including the Soviet Union and Great Britain) hit upon the family of long-chain, carbon-based molecules called polymers, which are also the basis of plastics. One of these, polyethylene oxide, can be dispersed in water to produce a liquid almost indistinguishable from water except for its slightly slimy feel. Polyethylene oxide is now the object of intense scrutiny by the Navy. Scientists found that when even as little as 150 parts of polyethylene oxide per million parts of water is injected into a pipeline, the drag of the pipe wall on the fluid passing through it drops dramatically, so that fluids can be pumped faster with less work.

Could polymer ejection from a ship's hull into the surrounding water also reduce drag? In the mid-70's, the Soviets took the lead, publishing a series of papers claiming success. Results of the U.S. Navy's latest series of tests are secret, but the scientists involved say they are extremely encouraging. One of them speculates that some Alfa-class submarines -- the fastest in the Soviet fleet -- may already be squirting polymers from their skins.

In practice, a submarine would probably eject polymers through a ring of slots around its hull near its nose, right at the spot where a turbulent boundary layer normally forms. The liquid would flow back along the entire length, perhaps reinforced by additional rings of slots farther back. Gerald Lauchle, the polymer project leader at Penn State, says drag reductions of up to 35 percent have been achieved for the flow of fluid through pipes.

One obvious disadvantage: submarines don't have much room to spare for storing polymers. ONR's Reischman notes, however, that polymer ejection need not be continuous, and that it could be used for emergency bursts of speed. Why



1 MICROBUBBLES
Compressed air between a sub's hull and its porous outer skin forces bubbles into the water

2 POLYMERS
A liquid polymer is pumped into the water through slots girdling the hull

3 SUCTION
Some of the water streaming past a sub is sucked into hull slots and expelled at the vessel's stern

4 HEAT
The outer skin of a sub's double hull is heated by fluid fed from the boat's nuclear reactor

5 RIBLETS
Thin grooves running lengthwise along the outer skin of a sub reduce boundary-layer turbulence

6 FLEXIBLE COATING
A "compliant" coating on a hull changes shape to cancel the drag of turbulent bursts

polymers reduce drag remains a puzzle, but some speculate that the long molecular chains may somehow interfere with the tiny fluid eddies that combine into drag-producing bursts.

While some scientists develop microbubble and polymer injection, which suppress turbulent bursts in the boundary layer, others are working on ways to prevent the onset of turbulence altogether. One promising method involves sucking fluid out of the boundary layer while it is still non-turbulent, or laminar, so as to delay turbulence until the boundary layer passes the end of the hull. NASA's approach for airplanes, has been to drill microscopic holes near the leading edges of flying surfaces and bleed air out of the boundary layer through them. The air passes under the skin of the plane and exits at the tail. The Navy is working on a comparable idea for submarines.

Still another approach involves heating the entire surface of the hull to about 70 degrees Fahrenheit warmer than the surrounding surface. The heating changes the rate at which the viscosity of the water varies with the distance from the hull, and this produces a smooth laminar flow in the boundary layer. Hull heating would be feasible only for a vessel with energy to spare, but the nuclear power plants used by submarines must dump excess heat anyway -- heat that could be put to use.

Unfortunately, this technique doesn't work in the field. The reason, according to Mohammed Gad-el-Hak is that the ocean contains swarms of small organisms called plankton, and when these run into the laminar boundary layer of a vessel moving through the water, they trigger turbulence, nullifying the beneficial effect of hull heating. It may seem strange that such tiny objects could so greatly affect the drag of a big ship, but Gad-el-Hak notes that even crushed insects do the same thing to airliners. Is there a solution to the plankton problem? Says one of the scientists involved, "I can't even comment. The whole subject is one of the most sensitive Navy secrets."

Scientists and engineers, both naval and aeronautical, have long regarded perfectly smooth skins as vital to drag reduction. Designers demand joint-free surfaces, flush riveting, and mirrorlike polishes for their aerodynamic and hydrodynamic creations. But the latest research has turned up surprises. In January, NASA's Langley facility reported experiments showing that, in fact, fine grooves extending along the surface of a moving skin seem to reduce drag better than perfectly smooth finishes. Jerry Hefner says, it turned out that certain fast-swimming sharks have small patches on their skin -- dermal denticles, they're called -- which are covered with little ridges running along their surfaces in the direction of the water flow." Others have noted that the parallel grooves covering part of a baleen whale's skin may alsoc reduce skin drag, allowing the whale to swim faster with less work.

Langley's experiments have caught the Navy's eye, and naval scientists are already hard at work on the riblet idea.

Another direction for reducing drag is being pursued by Alfred Buckingham of the Lawrence Livermore Laboratories. He has put to work a Cray supercomputer to discern patterns in turbulence that could help speed up America's submarine fleet. If, for example, a turbulent burst could be predicted with even partial accuracy, the hull skin under it might be made to change shape in anticipation, perhaps canceling the burst's drag effect. Buckingham believes that this might be accomplished with a flexible, or "compliant" coating -- one that would form little dimples just ahead of the approaching bursts. (Buckingham and others speculate that the dolphin's skin may do something like this.) He has suggested that such a coating on a submarine's hull might have a fairly stiff outer membrane, backed by some supporting structure and filled with a gooey fluid.

The Navy likes the idea enough that it has spent the past several years testing a variety of compliant coatings. None of them have worked so far. The main problem seems to be a lack of theoretical understanding of turbulence.

To those who contend that no real progress in skin-drag reduction can be achieved until the mathematical underpinnings are unraveled, Gad-el-Hak of Flow Research, replies, "True academicians would say that theoretical understanding must precede practical results, but if that were strictly true, the ancient Egyptians could never have built the pyramids." There's a theoretical approach and an engineering approach, and the truth falls somewhere in between.

"Anyway, I think we're going to see some pretty fast submarines."

THE ANTISHIP TORPEDO

The big warships being built by the Soviets indicate an intent to contest control of those seas vital to U.S. interests. The Soviet Navy can no longer be considered a sea denial one. It should now be recognized as having a fleet which can move out into the major sea lanes of the world and temporarily wrest control of vital sea areas from the navies of the West-- and use them for Soviet benefit.

With this thrust, a Soviet surface fleet of 250 big warships, 600 auxiliaries and 1700 merchant ships become certain targets, if a major war at sea is generated. That places a need for a large number of antiship torpedoes for submarine use. The stockpile of MK 48 torpedoes is far too small to permit their being wasted on most surface ships. Moreover, to use the very costly, highly complex MK 48 for a relatively simple firing situation --such as is presented by a surface ship-- is certainly not a cost effective way to conduct a war at sea. An antiship torpedo of far simpler design at a fraction of the cost-- and more tactically reliable than the MK 48, is thus indicated. Remember that the British submarine Conquerer's skipper-- with Tigerfish torpedoes aboard (like the Mk 48, grossly overpriced and overdesigned for the job)-- preferred to use the simpler, MK VIII torpedo to sink the Argentine cruiser Belgrano. He realized that in war, his Tigerfish ASW torpedo was not the best weapon for this surface ship. Other possible targets, those of particularly high speed, like SES, hydrofoils or wing-in-ground warships would also be inappropriate targets to shoot at, and their destruction should be relegated to missiles. Thus, an antiship torpedo need not be designed for all surface target situations. To do so, would probably make the cost of the antiship torpedo prohibitive.

In considering a new antiship torpedo, two things should be remembered, historically. In the gestation of the MK 48 torpedo-- in the 60's-- it was planned to be a surface ship's ASW weapon. It was not planned to be a submarine ASW weapon! That was a fall out. Nor was it considered as an antiship weapon. The Soviet surface fleet in the 60's presented no great threat to U.S. ships on the broad oceans of the world, hence there seemed little need for an antiship torpedo. But U.S. surface ships badly needed a replacement for the MK 44 torpedo to meet the rapidly growing threat of the Soviet's submarine force. So the MK 48 was designed by U.S. surface ASW people to be basically used from surface ships against submarines-- not for submarines against submarines. Since surface ships were noisy, their antisubmarine attacks were overt. The MK 48 was thus more importantly a fast torpedo, even if noisy. Because of its speed, it could successfully close and hit even alerted subs under surface ship attack. Therein lies the genesis of the MK 48's anti-surface ship problems which stem from the jury-rigged wire guidance system, the preoccupation with giving it even higher speeds regardless of the additional noise generated, and its badly impaired passive capability at its high operating speed.

It would thus appear that a new antiship torpedo might avoid the pitfalls of faulty past torpedo philosophy. That is, some basic principles inherent to a good submarine antiship torpedo need not be violated in the name of economy, duality of purpose, need to use new R&D, immediacy, incompatability with weapon loading, etc.-- all the excuses mustered to justify a less than optimum weapon.

Some of the principles behind good antiship torpedoes are herein addressed. Some are not obvious to non weapon-oriented planners-- who also see little chance that such a weapon would be used in war in "our time." But to the submariner who feels he is likely to have to employ a new antiship torpedo against a resolute and competent enemy, such principles should have meaning and urgency.

This weapon must be designed primarily to be <u>used in war</u>. As such, it should not specifically be designed for exercise shots for peacetime training. It should particularly be designed for expendable use in conflict. Large numbers of ship-targets call for antiship torpedo stockpiles of considerable size. Hence, the cost of the antiship torpedo should be reasonably low. This means that to adapt a warshot torpedo for exercise use may be too costly a matter. Special exercise torpedoes which simulate the warshot may be the practical solution. (To use a MK 48 as an exercise antiship training weapon-- with its possibility of being lost-- inhibits the exercise situation and reduces the training achieved.)

A new antiship torpedo must similarly be designed for the environment expected in war. This implies both the geographical and tactical environment in which the torpedo will be used. On the one hand, lessons from World War II would indicate that the blue waters of the ocean are not used exclusively by surface ships. In fact, shallow waters were used by surface ships-- particularly merchantmen-- to reduce the enemy submarine threat posed. In shallow waters, today's submarines should be less of a threat due to their greatly reduced passive detection capabilities against surface ships-- lacking convergence zones, little or no reliable bottom bounce paths, and reduced direct-path detectability due to frequently high sea noises. (In the Falklands War the high biologic noises and the shallow sea areas out beyond the Islands markedly reduced the British nuclear submarines' detection capability.) On the other hand, World War II experience showed that torpedo attack on surface ships usually resulted in their initiating some countermeasures. On sighting the wake of a torpedo, a merchant ship frequently tooted a two-blast whistle signal meaning "I am being attacked to port," or a one-blast signal meaning "to starboard". This greatly localized the area from which the torpedoes were launched and generated rapid counter actions by other ships in the group. Noisemakers were dropped off ships (usually depth charges), courses were altered, and ASW escorts whether surface or air, hurried to the general locale of the submarine. If a warship was put under attack, the WW II steam torpedoes used produced such solid noise spokes on the enemy's sonar scopes as to result in a frantic broadcast, "Incoming torpedoes on bearing - True." This was transmitted over a primary tactical circuit to all ASW units in company. Then, an ASW aircraft would sometimes wing its way over the attacking submarine and drop a bomb nearby. Surface ship "foxers" were often activated, false bubble targets were put in the water, active sonars were keyed to create additional noise in the ocean. (One thing that can be counted on today is that if an incoming torpedo is detected by a Soviet warship, the warship will, as one possible example, launch a massive decoy bubble-target astern and then swing away to escape the attacking torpedo. This puts the false target between the warship and the torpedo, while an ejected noise maker would drown out the warship's screw noises preventing passive acquisition by the U.S. torpedo.) A detected torpedo gets tactical response from a competent enemy!

Thus, an antiship torpedo should be wakeless. Its necessarily shallow use in shallow waters prevent a wake-making torpedo from being run deep to mask its bubbles. Torpedo wakes cause accurate and timely countermeasures as well as providing a good localizing of the firing submarine.

Similarly, a torpedo should be quiet and covert in its launch and in its attack. A torpedo is a slow weapon which allows a possible defensive response measured in minutes rather than a few seconds-- as with the mach-speed homing weapons of today. Even at 60 knots, it takes five minutes for a torpedo to close a target from 10,000 yards. A target has more than enough time to activate an effective bag of countermeasures. Surprise is the essence of successful submarine attack with torpedoes. A noisy torpedo only compromises this essential element for success. Strangely, submariners today seem satisfied with torpedoes which tend to alert their targets early in an attack. Yet, their nuclear submarines which shoot torpedoes combine a high degree of mobility with great stealth. Understandably, noisy torpedoes require high speed in any firings, to chase down an evading target, because it was quickly alerted. But no significant penalties accrue in peacetime as a result of using a torpedo which is lacking in the element of surprise. In wartime, however, a noisy torpedo is likely to cause trouble on all sides and even overhead while targets will use countermeasures to prevent the torpedo from hitting. Such countermeasures are likely to be too costly and in too short supply to be used in peacetime exercises. Hence no experience as to their effects is gained.

So, importantly, a torpedo should be designed without a wake and with little noise, in order to minimize the probability of its being countered. It is not enough to build counter-countermeasures into a torpedo. The enemy has too many options for introducing new counters which might be unrecognized by a programmed torpedo.

The range of the antiship torpedo need not be great. The high mobility and covertness of today's submarines makes possible a nearly optimum positioning for torpedo firing with a high element of surprise. (The British nuclear submarine Conqueror moved into just such a position for the firing of its old MK VIIIs against the Belgrano despite her being escorted by two Argentine destroyers. Two DD's were, traditionally, a good protective force for a single cruiser-- until the advent of the nuclear submarine. Against more efficient ASW surface forces, however, greater firing ranges than the 1000 yards used by the Conqueror, may be required. But the ranges will still not be considerable.) With the expected good airborne ocean surveillance systems in operation, the approximate positioning of high value ships in groupings of ships should be generally known well in advance of torpedo attack. This makes for simplified, reliable submarine tactics which minimize the chances of being detected while making an approach on a group of targets. Use of torpedoes at well beyond 20,000 yards may seem attractive for the reduced risk entailed. But the chances of hitting with a noisy weapon should be low, and the likelihood of counter attack great. Cross bearings taken on torpedo noise could lead the enemy back to the submarine's firing position making very long range shots even more hazardous. At ranges of 40,000 yards, for example, it would seem more practical to use missiles against high value, well protected warship targets.

The speed of a covert antiship torpedo need be no more than about 10 knots more than that of its potential targets. With this differential of speed, a weapon attacking with a high element of surprise should close even those targets which are defensively manuevering wildly at their highest speed. Again a very few ships may have sufficiently high speed to make a 10-knot differential impractical. But to design a torpedo for this unique situation would probably make the antiship torpedo too costly.

The warhead of an antiship torpedo should be as large as is feasible within the constraints of submarine torpedo tube use, the torpedo range required, and its necessary speed.

Although the Conqueror could effectively use a non-homing straight running torpedo in a war situation, something better in the way of trajectory control of the torpedo and its ability to home on a target seems indicated for the torpedo of future years.

It should be recognized that the fire control solution for a surface target will normally be far more accurate than for a submarine target. The surface target makes far greater noise and is more likely to be locked into a pattern of movement which simplifies its being tracked. Broad ocean surveillance is also likely to reveal patterns of ship movements and patterns of ship formations. Thus, a quiet torpedoe's passive homing device should readily acquire a surface ship's noise both because of its consistent loudness and because the torpedo is run at a depth where it searches only in azimuth to detect the surface ship's noise. Running the torpedo at a speed below cavitation of its propellers and skin reduces the need for an active homing capability in the torpedo. With a good fire control solution, a homing torpedo can be launched to intercept a target with the passive homing device keeping the torpedo on a course for interception-- but with a slight bias to insure hitting forward of the screws. The active homing capability should only be activated when the passive homer is countermeasured-- which may happen in the last few hundred yards of its attack. Since active homing compromises the element of surprise, it should be only a fall-back system of no more than a few hundred yards in range capability. Similarly, wire guidance is not recommended for the antiship torpedo-- to keep cost low. For those tactical situations where wire guidance appears necessary-- and they should be few-- the MK 48 with wire guidance seems to be a cost effective solution.

While still being consistent with the principles involved in a good antiship torpedo, the cost of such a torpedo can be held to only a fraction of that for an ASW torpedo. This appears to be achievable within the framework of today's torpedo technology. A 43-knot, non-cavitating, battery driven, 21" torpedo, of 20,000 yards range and with a 1000-pound warhead, with a greatly simplified passive and active homing capability is indicated. Such a weapon can be developed today and should cost in the several hundred thousands range rather than well over a million-- as estimated for today's highly complex ASW torpedo.

Keep it quiet, keep it wakeless, keep it simple as a warshot, and give it a big bang. Then the submarine will have a weapon which can be skillfully used with reduced risk against the best of enemy ASW opposition.

Phoenix

THE BONEFISH IN WWII

At a dedication of the Bonefish Memorial (symbolized by a MK 14 torpedo) at Bangor, Washington on 16 March 1984, Tom Hogan, Bonefish's first skipper, summarized her war exploits. After telling of the Bonefish commissioning he outlined her short history:

"Beginning with a patrol in the South China Sea in September and October of 1943, Bonefish sank 4 freighters, 2 transports, 1 tanker and a schooner. One of the freighters was a bonus — it ran across two of the torpedo tracks intended for a transport. We had a close shave with the schooner in Makassar Strait. She had new sails and was really a beautiful boat. I thought she was a coast watcher. So I put Bonefish off her beam at about 150 yards, from where we peppered the schooner's water-line with the 20 MM gun. When we started firing she stopped, let her sails down, and 7 natives were visible up on deck. The natives launched a boat, got in it, and moved off away from the schooner. Bonefish was then conned alongside the schooner and started to send an officer aboard to inspect her when the schooner began sinking on an even keel, very slowly. At that time 39 Japanese soldiers came up from below decks and jumped overboard. They would have slaughtered anyone who had boarded her. When the boat sank, we just went off and left the soldiers in the water.

"On Bonefish's second patrol in the Celebes/Borneo area, we sank 2 freighters and a destroyer-type escort, and damaged a minelayer by gunfire. On this patrol there was very poor torpedo performance. On one night surface attack, 6 premature explosions were experienced in a 10-fish attack.

"For the third patrol, Bonefish was again in the South China Sea. By this time, January and February 1944, the Japanese were fully aware of the danger of night surface attack by radar-equipped submarines. Where possible, they would bring their convoys into protected anchorages overnight and proceed at sea during daylight hours with surface and air escort. Cam Ranh Bay, the former French Naval Base, was one such convoy anchorage in our area. So we gave it our full attention and got some results in spite of very rough seas.

"On this patrol we sank a very large tanker, a medium freighter, and a schooner. We also got two hits in a tremendous ship, a converted whale factory with a raised deck platform on which were 26 Zero-type aircraft. It was damaged alright but Bonefish was driven deep by a plane and a destroyer for about an hour. When we came back to periscope depth, it was not in sight. Later it was found that this outfit made its way to a reinforcement of Burma.

"Bonefish was in the Celebes area for the fourth patrol. She sank 2 freighters, a tranport, a tanker and the DD Inazuma. It was during this time that the Japanese were forced to send their fleet to this area to be near their fuel supply for training naval aviators. US Naval Intelligence lost track of the Japanese Fleet after they left Manila. U.S. Seventh Fleet subs on patrol were then diverted to watch certain areas which it was expected the enemy would use for their carrier air training. We were told to watch Tawi Tawi Bay, a former U.S. Navy Fleet anchorage near the Northeast corner of Borneo in the Sulu Archipelago. Consequently, Bonefish received orders to look into Tawi Tawi on 12 May 1944. As Bonefish began her night transit of Sibutu Passage submerged-- due to a full moon-- we sighted and attacked a formation of 3 tankers and 3 destroyers southbound. One tanker and one DD were sunk and then the Japs chased Bonefish back out the northern end of Sibutu Passage. After charging batteries, Bonefish was submerged at daylight and started south back through the Pass. We sighted a patrol of 2 DDs. Also, 2 planes were sighted to the south of Bonefish-- apparently searching. Bonefish was taken to 150 ft. and kept going, coming back to periscope depth every 30 minutes for periscope observations. At about 1130 when passing 100 ft. coming up for an observation, the sound man reported many light, high-speed screws and depth was held at 90 ft. Meanwhile light, then heavier screws passed directly over Bonefish headed south. After the ships had passed, Bonefish was brought up for a look. There they were-- what every submariner dreams of-- the whole enemy fleet. But only one torpedo was left onboard and it had been flooded so many times that I didn't trust it. So Bonefish was taken north and that night a report was sent on what we had seen. Headquarters ordered us to keep in contact with the enemy and report daily. This we did for 12 days.

"Tawi Tawi Bay is a large bay about 10 miles across and enclosed on the south by a coral reef. The procedure established for each night was: after charging batteries to go in as close as possible to the reef and beam the surface search radar into the Bay and plot the positions of the enemy's surface craft on our chart. Then, after daylight, we would identify by sight what had been plotted from the radar. The U.S. Fleet Mooring Chart was used for that Bay. It had markings for moorings used by the U.S. Fleet. To my surprise, I found that the Japanese were also using those same mooring positions. So it was very convenient for our intelligence report to refer to the chart, reporting what was in each position. There were six carriers which would anchor at night, with 2 or 3 of them out operating by daylight every day.

"At night Bonefish would be steamed south about 20 miles to send a reconnaissance dispatch, and charge batteries. Then she'd return to her hole south of the reef before daylight. The first night after sending a dispatch, she stayed more or less in the same spot while charging batteries. After about an hour, a destroyer came out to investigate. Bonefish was dived, and the DD finally went back towards Tawi Tawi. I got to thinking they had probably pinpointed us by Radio Direction Finder. The next night Bonefish was 15 miles south and the batteries charged. The reconnaissance dispatch was sent and Bonefish waited right there. Sure enough, about an hour later, along came the DD. Again Bonefish dove and got away. I surely wished for some torpedoes.

"Later, we got word to be clear of that area on the 26th of May. The Harder was directed to come in and relieve Bonefish. The Harder had been life-guarding for a combined U.S. carrier air strike against Surabaja, Java. She was fresh out of port and had a full load of torpedoes. I sent a dispatch to Sam Dealey and told him what Bonefish had been doing and added, "if you are careful, you can get yourself a DD." Well, he was, and he did. He got 5!

"This action, together with that of the Puffer at the north end of Sibutu Passage in sinking a destroyer and tanker loaded with plane spare parts, led the Japanese Fleet Commander to leave Tawi Tawi early.

"I left the Bonefish when we returned to Perth. I was relieved by an old and good friend, Commander Larry Edge.

"On Bonefish's 5th patrol, she was in the same area as her 4th. Two small freighters, a large tanker, and 5 miscellaneous small craft were sunk while a second tanker was damaged.

"On her 6th patrol, during September and October of 1944, two large tankers and one freighter were sunk with 2 medium freighters damaged. After a thorough overhaul and installation of much new equipment in San Francisco, Bonefish made her 7th patrol in the East China Sea. She had only one attack opportunity and did no damage. However, she took two Japanese prisoners from a downed enemy plane and did some recconnaissance work off Korea.

"A part of the new equipment installed in San Francisco was a piece of sonar equipment to be used primarily for locating small objects-- mines. In the spring of 1945 with more submarines available for patrol and fewer targets, Admiral Lockwood, Commander Submarines Pacific Fleet, decided to have some submarines penetrate the mine fields in Tsushima Strait and cover the heretofore virgin territory of the Japanese Sea. Much planning and training was done by the submarines with this equipment, and nine boats in three groups of three boats each were ordered in-- in June 1945.

"Bonefish, under Commander Edge, successfully transited Tsushima Strait on 5 June. Bonefish redezvoused with Tunny, the Pack Commander, on 18 June, and the sinking of one large transport and one medium freighter was reported. Edge then requested permission to conduct a submerged daylight patrol in Toyama Wan. Having received permission, he departed for Suzo Misaki. Bonefish was never seen or heard from again.

"Japanese records of anti-submarine attacks mentioned an attack on 18 June in Toyama Wan. A great many depth charges were dropped and wood chips and oil were observed to surface. This, undoubtedly, was the attack which sank Bonefish.

"It can be considered that Bonefish is symbolic of the efforts of all units of the submarine force which had such a tremendous impact on the outcome of World War II. In dedicating this MK 14 torpedo to the memory of Bonefish and her crew, we recognize that she was but a part of the combined efforts of all."

Captain Tom Hogan

SUBMARINE SCHOOL OFFICER TRAINING

The Submarine School's Mission Statement has been rephrased many times since the School was founded in 1917. Presumably most versions, however, resemble the 1984 mission:

- -Prepare prospective submariners for submarine duty.
- -Prepare submariners for their next job.
- -Prepare submarine crews for war (as the most effective deterrent to prevent it).

Over the years, officer training at Submarine School has been dynamic to meet the changing requirements of an evolutionary Force. As a result, officer training for submarines is markedly different than most seniors experienced as junior officers.

It is useful to look at a brief history of

Basic Officer Submarine Training before reviewing what we teach our officers in formal school training today.

Submarine Officers' Basic Course History

1959-73	6 month Basic Course taught to officers prior to their initial submarine tour. Course was in two versions: "diesel" and "SSBN". This was the only formal course for submarine officers (dept. heads and below).
1973-76	6 month "diesel" and SSBN curricula continued for non-nuclear trained accessions. A 5 week indoctrination course was offered to nuclear trained officers.
1977-79	10 week Basic Course curriculum taught to all officers. Diesel curriculum dropped. 1 week Officer Submarine Orientation Course offered to all non-nuclear trained officers.
1980-83	Basic Course extended to 12 weeks to accomodate the 2-week Navy-wide, Leadership, Education and Management Training (LMET) course. 1 week Orientation course was offered as an add-on for non-nuclear trained officers.
Early 1984	Basic Course extended to 14 weeks in major course revision which emphasized submarine fundamentals, relative motion and "mental gym". 1 week orientation course continued.
Late 1984	Basic Course shortened to 13 weeks as a result of the LMET curriculum change (1 week in Basic Course and 1 week in Submarine Officers' Advanced Course vice 2 weeks in the Basic Course).

In addition to the major course revisions summarized above, there have been a series of changes-- some subtle and some significant-- in the purpose of the Basic Course.

In the 50s and early 60s, officers who attended basic submarine training were usually sea experienced junior officers who had qualified as OODs and completed at least a division officer tour. Usually these officers had made a career decision, were competent in shiphandling and problems of relative motion comprehension, and could manipulate Maneuvering Boards (with grease pencils and in their heads). Submarine School, therefore, had a different purpose, not to mention a different type of submariner to teach. Qualification of prospective Diving Officers was more important than preparing Officers of the Deck.

Submarine School was then expected to prepare young officers for the transition to submarine duty.

Today the challenges and the students are completely different. Still, the recently approved 2 week extension of the Basic Course adds much material which to a great extent is a modernization of the daily TDC and "think on your feet" exercises conducted 20 years ago.

The Basic Course for Officers

Today's Basic Course student starts an officer's classroom day at 0730. Classes end at 1630 but some labs are conducted in the evening because of scheduling demands on tactical training devices. Homework assignments add one to three hours to the day.

A breakdown of the course, as taught in 1984, follows:

TOPIC AREA	CLASS & LAB HOURS
LMET	40
Ship Systems	29
Submerged Ship Control	50
OOD/OPS/Nav	44
Damage Control	17
Sensors	43
Weapons	18
Fire Control	144
3M/Quality Assur.	22
Division Officer	17
Supply	10
Exams/Quizzes	30
Admin/Clearances	34
	498

While a comparision with the 1970's course can be misleading, oldtimers will nonetheless be interested in how much (how little?) has changed over the years. Topics are listed in the following table:

Basic Course Comparison In Scheduled Hours
(Class Plus Lab Hours)

	70s	84
Tactical	152	144
Executive	143	111
OPS (Comm, Sonar, Intel, ESM)	131	43
Weapons	80	18
Engineering	81	46
Admin Topics	32	22
Supply	17	10
LMET	0	40
Electrical	15	0
Miscellaneous	35	34
Exams/Quizzes	35	30
	721	498
	24 wks.	13 wks.

Salty, grey-haired submariners who suspect that life in general, and Submarine School in particular, may not be nearly as demanding as it was in the "old days" would be very satisfied with the demanding tenor of the Basic Course and the enthusiastic appetite of our prospective submarine officers for knowledge and responsibility.

Seven Basic Course classes convene each year. A typical class size is 100 officers, including LDOs, Supply Officers, EDOs and 1120s. Today's Basic Course objectives are to:

- -be immediately ready to serve as a functioning:
  - -Fire Control party plotter/plot evaluator.
  - -MK 81 analyzer "MATE" operator.
  - -Division Officer.
- -be ready to qualify as Diving Officer and Contact coordinator.
- -be proficient in mental analysis using thumb-rules to solve tactical problems in LOS parameters, range, Ekelund range, three minute rule, reciprocals, doppler, and periscope operations.
- -have a basic understanding of submarine safety, systems, weapons and sensors.
- -possess a basic level of seamanship and relative motion comprehension to support Officer of the Deck qualifications.
- -feel a "member of the club."

The Submarine Officers' Advanced Course

Although the Submarine Officers' Advanced Course has been in existence for over 10 years, only in the past year has the Force realized its objective of 100% attendance in the course by all officers enroute to their department head assignments.

The Advanced Course has become increasingly important and demanding over the years. It provides an opportunity to teach the officers our corporate knowledge. It is a post-graduate course in submarine warfare.

Since today's submariners' initial assignments might give them experiences ranging from a TRIDENT in new construction, to a 585 class refueling overhaul, to a 616 class SSBN conducting deterrent patrols, or to a 688 class SSN on extended operations, the Advanced Course becomes an opportunity to even out (and share) the knowledge gained by officers with such diverse backgrounds.

The Advanced Course began as a 26 week course in 1971. Today it is being changed to 22 weeks. Most of the changes in the Advanced Course have been piecemeal rather than wholesale revisions. The course has become more difficult as the School has tried to accomplish more objectives in a shorter time period.

The current Advanced Course objectives are:

- to develop the tactical expertise of each student to the level of a skilled Fire Control Coordinator at Battle Stations.
- to upgrade the student's knowledge of the threat and improve his proficiency as Officer of the Deck and shiphandler.
- to complement the technical knowledge attained in the initial submarine tour and prepare students for the management responsibilities of submarine department heads.
- to develop the professional knowledge of students to the level of a submarine department head.

Recent revisions to the Advanced Course curriculum include added Arctic Warfare training, additional emphasis on modern sonar systems employment, submarine sound quieting, anti-ship and land attack TOMAHAWK employment, more practical navigation work and daily mental gym. The 2 week Leadership, Education & Management course taught in the Basic course is being revised so that 1 week is taught in the Basic Course to prepare officers for their division officer duties and a second week of this course is taught during the Advanced Course. This second week course is being revised to take advantage of the students' fleet experience.

In 1985 it is anticipated that analog fire control system training will be deleted from the Advanced Course and taught on a stand-alone basis to officers assigned to submarines so equipped. In its place, training on the Combat Control System (MK 117 FCS modified for TOMAHAWK use) will be added.

Nine Advanced Course classes convene each year. This is up from four less than two years ago. Class size is 20-30. The 1984 course breakdown is as follows:

TOPIC AREA	CLASS & LAB HOURS
Adv. Tactics/Weapons Employment	195
ASW	9
Navigation	93
EW & Intelligence	64.5
Operations	53.5
Administration	18.5
Sound Silencing	6
Sonar	80
Weapons	67.5
Fire Control	62.5
LMET	40
Exam	20
TOTAL	709.5

Sixty officers are involved in teaching the Basic and Advanced Courses.

Captain W.P. Houley, USN

BOMBS VERSUS TORPEDOES

A 1975 article entitled "Forecasting in Military Affairs", by Y.V. Chuyev and Y.B. Mikhaylov, helps to explain why the Soviets make their submarines the dominant offensive force of the Soviet Fleet. The systems analysis course is being revised to take advantage of the students' fleet experience.

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Exam	20
TOTAL	709.5

Sixty officers are involved in teaching the Basic and Advanced Courses.

Captain W.P. Houley, USN

BOMBS VERSUS TORPEDOES

A 1975 article entitled "Forecasting in Military Affairs", by Y.V. Chuyev and Y.B. Mikhaylov, helps to explain why the Soviets make their submarines the dominant offensive force of the Soviet Fleet. The systems analysis investigation used by the two Soviet authors arrives at a simple answer -- submarines use torpedoes and torpedoes do the most damage to surface ships.

The purpose of the referenced analysis was to determine the effectiveness of damage inflicted on British cruisers during World War II, as a result of enemy naval gunfire, aircraft bombing attacks, torpedo attacks, and mine explosions. From the results, recommendations were derived for the most effective system of cruiser defense. "In the investigation, the effectiveness for the damage was defined as the number of months needed to repair and bring a cruiser back into service. The maximum loss was estimated at 36 cruiser-months, i.e., the time required for the construction of a new cruiser in place of one that had been sunk. The statistical data are given in the following table":

Type of damage sustained	Weapons used to inflict damage				Total
	Shells	Bombs	Mines	Torpedoes	
Cruisers sunk	3	9	1	11	24
Cruisers damaged	18	56	9	19	102
Total number of cruisers put out of action	21	65	10	30	126
Cruiser-months lost:					
As a result of sinking ...	110	320	40	400	870
As a result of damage ..	30	90	60	180	360
Total	140	410	100	580	1230
Percentage	11	34	8	47	100
Lost cruiser-months accounted for by each case of a cruiser being put out of action	7	6	10	19	10

"An examination of the data given in the table shows that more than half of the cruiser casualties (out of the total number of cases of cruisers sunk or damaged) were caused by aircraft bombing attacks. Therefore, at first sight it seems that the main problem was to improve the ships' air defense systems. However, a more detailed analysis shows that the number of cruiser-months lost when a cruiser was put out of action was highest as a result of torpedo attacks, since the damage sustained in this case was three times more serious than, for example, as a result of bombing. Moreover, a study of the damage resulting from bombing attacks shows that the majority of cruisers sunk in this fashion sustained damage below the waterline as a result of the explosion of bombs dropped in the immediate vicinity of the ship."

"Thus, more than half of the lost cruiser-months was due to underwater damage of the ships' hulls. Therefore, it could be concluded that the underwater part of new cruisers should have better protection."

*This analysis was taken from Methods of Operations Research, by Philip M. Morse and George E. Kimball, published in the U.S. at New York, MIT Press, 1951.

THE KAITEN MINI-SUB

The most formidable torpedo in any nation's arsenal in World War II was the Japanese Type 93, or Long Lance, as it was called because of its extremely long range. This weapon could carry a half ton warhead for 11 miles at 49 knots, or a fantastic 22 miles at 36 knots. It was principally a cruiser and destroyer launched weapon, but its range and speed were so great American commanders frequently attributed the source of a torpedo attack to an undetected submarine.

The Type 93 was developed by the Japanese in complete secrecy in an attempt to offset the perceived Anglo-American advantage in capital ship tonnage resulting from the 1922 Washington Naval Treaty. The Japanese were able to achieve the great range and speed of the Type 93 by using pure oxygen as the oxidant, rather than compressed air, as was the case with the standard Whitehead torpedo design then in use in most navies. Other navies had experimented with oxygen, but had given up on it as being inherently too unsafe after a series of disastrous explosions. The Japanese persevered and ultimately mastered the techniques of handling oxygen by meticulous attention to design detail, elimination of all sharp curves in oxygen feed piping, purging to eliminate all oil and grease from the oxygen system, and using compressed air to start the engine before switchover to oxygen.

The Type 93 showed its effectiveness early in the war at the battles of Java Sea, Sunda Strait and Savo Island. At Tassafaronga in November 1942, a Japanese task force under Rear Admiral Tanaka sank the USS Northampton and badly damaged three other cruisers exclusively with Long Lance torpedoes. Among American and allied ships sunk or badly damaged by the Type 93 were the cruisers USS Chicago, Vincennes, Houston, Salt Lake City, Northampton, Boise, Juneau, Portland, New Orleans, Pensacola, Minneapolis, Helena, Honolulu and St. Louis; HMAS Canberra and Perth; HMNS Java and DeRuyter; and HMS Exeter. The smaller submarine version of Long Lance sank or finished off USS Juneau, Wasp, Yorktown and Indianapolis. Despite these successes, as the war continued the Imperial Navy experienced irreplaceable losses of cruisers and destroyers from which to launch the Type 93, and damage to the Americans consequently decreased. In an effort to reverse this misfortune, in 1944, the Japanese began to convert

Type 93 torpedoes into miniature submarines by adding a pilot station and a double sized warhead. The mini-sub would be carried by fleet submarines and be launched submerged close to the intended target, thus correcting for the shortcomings of earlier mini-sub models which had to be launched on the surface far from the target. The new weapon was given the name kaiten, which means "sky change", and presumably was intended to convey a sense of revolutionary change in the direction of Japan's naval fortunes.

The kaiten was the brain child of a pair of mini-sub pilots, Lieutenant (j.g.) Sekio Nishina and Lieutenant Kiroshi Kuroki. They conceived the idea in 1942 but were repeatedly put off and were not given a go-ahead for another year, and then not until they had submitted their proposal signed with their own blood. Still the Japanese Navy Ministry dithered and didn't become serious about deployment of kaiten until after the disaster of the battle of Philippine Sea in June 1944.

The first deployment of kaiten was against allied warships in Ulithi Atoll on the night of 19 November 1944. The submarine I-47 launched four kaitens, led by Nishina carrying with him the ashes of his comrade Kuroki, who had died in a training accident. Nishina penetrated the anchorage and sank the fleet oiler Mississinewa in a blaze which lighted up the whole anchorage. The other kaitens made no hits.

Unfortunately for the Japanese, the promising beginning at Ulithi was the high point of kaiten history. Besides Mississinewa, the only other serious damage to a U.S. ship by a kaiten was to the destroyer Underhill which lost its bow and later had to be sunk. Japanese submarines sortied thirty times on kaiten missions, each carrying four to eight kaitens on deck. Eighty kaitens were launched, but a greater number had to be back-hauled due to malfunction. Eight submarines were lost on kaiten missions and ninety-six pilots gave their lives in combat or training.

The Undersea Warfare Museum at Keyport acquired a kaiten mini-sub last winter and is in the process of restoring it. This interesting combination of torpedo and submarine should be an important reminder that innovative advancement in weapon technology is not the exclusive province of the western world.

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A TORPEDO CALLED ALICE

You say, why call a torpedo "ALICE." As an old Chief Torpedoman told me, "Son, torpedoes are like women. Treat them with tender loving care and they will run Hot, Straight and Normal."

Today, ALICE resides in the Torpedo Factory Arts and Crafts Center on the Alexandria, Va. waterfront. Her record book tells why this MK 14-3A #64220 torpedo is an appropriate tourist attraction. Pay your homage, boys, to a fine piece of machinery!

But, back to Alice's active duty career. On 7 and 8 November 1944 she passed the proof range acceptance tests at Piney Point, Maryland. Then she was shipped out to the Pacific Fleet to hopefully sink a Japanese carrier or battleship, autographed with a "Sink 'em All" inscription by loyal workers in Alexandria. Alice served honorably on board submarines ENTEMEDOR, MENHADEN, STICKLEBACK and GUITARRO and after the war was shipped to Mare Island for a needed overhaul and finally to San Diego for storage in the ready locker. In 1959, Alice traveled to Yokosuka where she remained in a "ready" USN torpedo facility until 1965 when she finally was sent back to the Sub Base in New London for some ordalts and such. Then followed honorable tours of duty on board SEA ROBIN, CORPORAL, BECUNA, JALLAO, J.K. POLK, T. ROOSEVELT and SAM HOUSTON from 1966 to 1977, interspersed with visits to submarine tenders CANOPUS, HOLLAND, SIMON LAKE, HUNLEY and NEREUS. Very little is recorded of Alice's performance as a deterrent on board diesel and SSBN submarines. She proudly carried her 960 pounds of HBX in a warhead, but was never fired in anger.

You might say, that's enuf of Alice, but in honor of her long service, something should be said about her operating performance. Since Alice was never fired as a warshot, we have a record of her functioning as an exercise shot for which she was fitted with an exercise head and set to run under the designated target and then to surface after the exercise run to be picked up by the firing submarine or recovery vessel. To be quite candid, Alice rated about a 3.5, which was not bad, having first been fired in an exercise from MENHADEN on 30 August 1951 off San Diego at a destroyer escort target. Alice ran, "HSN". Stickleback fired Alice in '52 on a wake test. Then, upon return to NLon, she was fired twice in 1966 by SEA ROBIN--yes, both "HSN". BECUNA shot her four times between 11 and 24 May 1966, 3 of which were normal runs, but on 24 May, she ran erratic for reasons unknown (we men can appreciate an occasional erratic run...). But then, in June 1966, JALLAO fired her twice for normal runs. Finally, she finished her tour of active duty, happily, in the forward torpedo room racks of many proud submarines until 1977 when she was retired to the Naval Weapons Station, Yorktown until her resurrection for display in Alexandria.

Now, you see why I called her "Alice". She was dedicated, dependable, served a useful purpose, didn't hurt anyone and now has an honorable resting place.

Capt. Carl Groneman

DISCUSSION

ISSUES, CONFLICT, AND THE LEAGUE

Conflict in life is inevitable. The bad news is that it can cause crisis. The good news is that it can create opportunity. The key to progress is conflict resolution. Unresolved conflict in important issues leads to hate, discontent and no progress. Resolved conflict leads to new and important directions and can magnify cooperation. Please note! Conflict and its resolution will determine the course to future goals; the level of cooperation will determine the speed for getting there! So what for the Naval Submarine League??

Some important issues surfaced at the recent annual meeting of the Naval Submarine League (May 1, 1984). These included:

-the number of United States attack class submarines has been set at about 100 since the early fifties. In view of the increasing ability of the attack boat to contribute to our country's maritime defense, is the number too low?

-the level of the R&D budget for submarine warfare is $700M per year. This is approximately x% of the total Navy R&D budget and y% of the DOD R&D budget. Given the increasing number and type of Soviet submarines, the known committment of the Soviet submarine force to an aggressive quieting program, the need for U.S. submarine forces to become competent at rapid deployment of individual platforms in large scale group operations in order to oppose similar mass movements by Soviet naval forces, the need for increased accuracy in over-the-horizon attack, the need for long range detection and classification in highly noise-cluttered areas, and given the predicted collapse of the time dimension in future sea warfare and the expansion of the space dimension- is this budget enough?

-are there enough weapons in the submarine inventory to fight a war of the type assumed? Recent tactical exercises have indicated the importance of firing torpedo spreads! The base of factual knowledge on how many weapons it takes to inflict lethal damage is weak. Maybe the stockpile should be larger!

-is there too much "freedom-of-speech" in the Submarine Review, the quarterly publication of the Naval Submarine League? Articles on alternate power plant design (diesel, hybrid fuel-cell, magneto-hydrodynamics) or on inadequacies in operational readiness (need for systematic training) may run counter to words being said by the official submarine Navy to each other, and rather importantly to the Congress at budget time. So the question arises--how can the Naval Submarine League achieve its fourth objective, "to provide a forum wherein the views and perceptions of the membership can be focused and examined" without hurting its third objective-- "to encourage mutual understanding and a close working relationship between American society and those United States Government segments responsible for the acquisition and employment of submarines"?

To resolve the four issues above, and other equally important issues which certainly exist, one answer is <u>not</u> to ask the active duty officers, now on the line as submarine leaders, to cooperate more fully with the League. No one who has heard about the Benefactors briefings by the Admirals White, Thunmam, and McKee, or has attended the League meeting in which some of the above plus Hoffman, Kauderer, Scott, Bacon and others have spoken, can be anything but impressed by the willingness and enthusiasm of these people to support the League. Nor is the answer to stifle the style and content of the articles in the Submarine Review organized and edited by Bill Ruhe. The magazine is as professional as can be and has thoughts in it every bit as good as the Naval Institute Proceedings or the Naval War College Review.

To resolve the four issues above and others, there is an answer which is--- to periodically do so and publish the consensus (i.e. the resolution of the conflict) as a set of annual planks in the Naval Submarine League Platform. It would be a sort of "sense-of-the-League" statement, for example, for the year 1985 and beyond.

Summarized, the following is proposed on the all important subject of ISSUES, CONFLICT and the LEAGUE:

1. Acknowledge the absolute essentiality of the past high level of cooperation given by the active duty members of the League to League objectives.

2. Insist on the continuing worth of the four League objectives (awareness of need for a strong submarine force, close working relationship with U.S. government segments, greater communication, and a forum for views).

3. Urge even more forum-type membership participation at League meetings and in articles for the Submarine Review.

4. Annually publish a set of statements which the majority of the League believes to be true. Supporting logic must clearly be evident if others are to take the views seriously.

The Submarine Review and an ANNUAL PLANKS AND PLATFORM should be seen clearly in terms of their differing contents. The Review is the forum for debate and beginning focus. It represents the views of individuals, but stated within the bounds of fact and logic. The ANNUAL statement would be what the League as a whole thinks is important for the coming year or two or more, stated for example in 1985.

Frank A. Andrews

SUBMARINE ORAL HISTORIES

The reader is reminded that recorded history can mislead. This is not to deny that many published sources are essentially accurate. On the other hand how many of us in making reports have not omitted happenings that seemed historically unimportant or would have damaged individuals?

Many historically important military incidents remain truthfully recorded only within the memories of certain seniors. Thus, oral histories can be important, although with age goes a flawed memory of a recalled event. Despite possible flaws, oral histories offer many benefits:

-The relater is apt to be more frank than he was while in the service.

-More time becomes available for recollection, consequent discussion and eventual verification, and

-The political aspect of what is related is usually not current.

In my case, my oral history would include some submarine related items which may be of interest to this readership.

In 1937 I decided on trying for a submarine career. This decision was made while on TAD at the Naval Academy. It was made at the dinner table of the Superintendent of the Academy, a former Fleet Commander and past member of the General Board. The Admiral stated that aviation, while challenging and financially attractive, would be a short-lived career because on reaching 40 one would be too old to fly. Submarines, on the other hand, he said were an increasingly innovative and challenging field. The new Fleet Submarine, he assured me, would provide an important advance screen for our battleship force. Submarines would remain at periscope depth all day making 3 knots-- conducting a periscope search for the enemy. At night the submarine would make 21 knots on the surface. This routine was possible because the battleship's speed would be 12 knots. But I never had the opportunity to observe this role of the submarine.

Post WWII days were dull because there was no obvious potential enemy. The Russian submarine seemed to be the only threat but the U.S. submarine had little ASW capability. An example of the general attitude towards the importance of submarines was that a submarine was allowed only 2 weeks per quarter of its operating time for type training. The rest of its operational time was scheduled for "services."

Imaginative tasks were sought. Anything. One submarine for example was sent to the South Pacific and ordered to conduct a submerged covert photographic surveillance of the harbor of a small island. The C.O., a highly regarded WWII skipper but having little interest in his mission, conducted the periscope photography on the surface. When the film was developed, the picture showed the submarine's foc's'le and included a view of the C.O. looking over the side up forward. Another dreamed-up task had four submarines sent to the Arctic to investigate the icecap. Upon arrival they found that a strong southern wind kept the large ice chunks, which varied in size from that of an automobile to a small house, packed solidly. On the submarines' return the following day to take a more lengthy exploratory run beneath the icepack, the wind had reversed. The ice floes were then widely scattered and were too dangerous to penetrate at periscope depth. It was another unprofitable operation.

How then did ASW become an attack submarine's primary mission? Actually, only two factors were considered. First, the snorkelling submarine, developed by Germany near the end of the war, provided an easily detected and classified contact. Second, post-war inspection and trial of the passive sonar system aboard the German cruiser Prince Eugen had disclosed a low-frequency array of large transducers which provided a far better passive detection capability than previously known and had given the Prince Eugen the capability to dodge several enemy air-launched torpedoes.

The big question for me as an average submariner was, "Why did our experts have to learn this from the enemy? And not until after the war?"

Later, a large array of low frequency transducers was wrapped around the conning tower of the U.S.S. Flying Fish-- a member of SUBDEVGRP 2 at New London. Tests and evaluations were begun and success resulted. Immediate steps were taken to install similar sonar systems on the bows of the newest submarines. Active sonar modes were included.

The SSK was born at that time. Immediately, ASW became the primary mission for the attack submarine.

Innovative tactics were introduced. One, which depended on secure underwater communications-- hopefully to be developed-- was "coordinated attack." Two submarines were given a patrol area greater than twice the size of usual areas for a signal submarine to operate in. The two subs then conducted coordinated search across probable enemy tracks. When one sub made a detection the information was passed to the other submarine. A barrier consisting of the two attack submarines was then established, oriented to a true bearing line from the target. The barrier line could be changed as the attack situation developed. Use of these tactics resulted in greater effectiveness for each submarine. Successful attack then depended upon the submarine target's maneuvers and his snorkel cycle. Unfortunately a covert communications capability was never realized and coordinated attack tactics were dropped.

Another ASW tactic, highly popular with COMSUBPAC, was the SSK-AIR concept. Initial detection by an SSK ("the Killer Submarine") in a barrier of SSKs, would frequently be at ranges too great to enable an attack to be made during the target's snorkeling period. Accordingly, a VP aircraft, assigned to a patrol area parallel to the submarine area, would be contacted by radio and given a true bearing and estimated range to target from the detecting sub. The VP rendezvoused overhead with the submarine and then proceeded to the contact, using the bearing and range given. A sonobuoy search was conducted and if successful, attack was simulated. This concept seemed highly attractive when presented to interested seniors. Consequently, COMSUBPAC's

Training Officer, uncertain of the concept, managed to get several submarines to conserve their type training time (only 2 weeks per quarter in the mid-1950's). Then he scheduled a 10-day exercise in the Hawaii area. Local shallow areas were supposed to simulate the Kuril Island exits. Submarine and adjacent VP patrol areas were designated. Two target submarines then made continuous transits through the SSK area, simulating Soviet SS in and out of the Okhotsk Sea. Attack opportunities were plentiful. Unfortunately, the results were dismal. More false targets were attacked than real targets. And the SSK-AIR concept was dropped in the Pacific. It was later picked up for a short time by the Atlantic forces.

Submariners had worked hard during WWII and had learned a lot. There were some failures. So looking back there was a lot to be learned:

- Too much blind faith had been put in weapons which didn't deserve such faith-- due to lack of realistic tests and evaluation.
- There was a lack of imagination with regard to tactics, e.g., night surface attack tactics were developed piecemeal.
- There was a failure to develop sensors that had available technology, e.g., low frequency passive sonars.
- There was an unrealistic appreciation of demands on personnel, e.g., 3 section watches on a continuous basis.
- There was an acceptance of inadequate equipments, e.g., unreliable engines and air compressors, inadequate air conditioning systems, etc. One wonders if such mistakes have to be repetitious.

K.G. Schacht

LETTERS

TORPEDOES

-I agree with R.R.R.F.'s article about torpedoes in the Review. He is talking about a quiet electric propelled torpedo with a little less speed. We have been paying far too great a penalty to get those last few knots.

As a suggestion: to perform the mission described (with the torpedo sending back information on the target) a system is needed that brings back much more acoustic information over the communication link. Wire has a too limited bandwidth but a glass fiber link opens up great possibilities and should be developed. All raw acoustic information could be brought back and processed on the submarine using the larger submarine computer and giving the submarine a much better picture of the tactical situation.

M.H.R.

SOVIET SUBMARINE TRENDS

SOVIET SUBMARINE TRENDS is a provocative piece of work. The idea of searching out the differences between U.S. and Soviet trends and then asking "why is this?", is an elegant approach. It should provoke an analysis of the dimensions of what the "threat" truly is.

The two major differences in the direction of trends were those types of propulsion and fineness ratios. The other trends identified seem to be in the same direction for both the U.S. and the Soviets.

The quantitative differences are of interest, but they concern the "hows" and not the "whys". It is the "why" that determines strategy, not only the strategy of operations, but also the strategy of weapon procurement and design. And it is the U.S. strategy of design that seems to be flawed.

But it could be asked whether it is the Soviet's strategy of design that is flawed. Or is it ours? Of course it could be that neither is flawed in that each design strategy is best for the intended operational tactics and strategies. And so the critical question is this- "What are the strategies and tactics which the Soviets are designing their submarines to perform"? They are obviously different from those which we assume in the design of our submarines. Are they making a mistake, or do they plan to use their submarines in a way that is different from the operations we are preparing to counter?

F.C.L.

THE GENERAL BOARD

I found F.C. Lynch's article fascinating for its contrasts between how the Navy of 1927 did business and our approach today. He stated first: "In the General Board approach it was determined what the needs of the operational commander were, and then goals were set for technology."

Lynch then stated: "Today it is first determined what the technology has to offer, and then scenarios are developed to make best use of this technology." I have to disagree with Lynch on this point. Perhaps we wouldn't be as well off relatively as we were in 1927 if we let new technology drive us to new scenarios, but we would be better off than we are now. Because in truth we are not letting new technology influence our choice of scenarios. What we are in fact doing is letting old scenarios narrow our bureaucratic vision of which new technologies we should be trying to exploit, and how best to exploit them. We are limiting ourselves to technologies that do not threaten the old ways of doing business. This leads to an inordinate concentration on marginal improvements, which has been given an appropriate name— "gold plating."

Whatever faults the old General Board might have had, it would appear that it served us well in designing the Navy that fought WW II. From Lynch's description of the old General Board it seems that the operational commanders had much more clout with the Bureaus in Washington than their successors do today.

No one likes to think seriously of a major war, certainly not a nuclear war. But we as professional officers are paid to think seriously about nuclear war, whether we want to or not. Perhaps we need a new General Defense Board, charged with thinking seriously about what we would in truth need to have in the way of new operational concepts, and new hardware to implement those concepts, to be able to prevail at sea, on land, in the air, and in outer space against the Soviet Union in a global nuclear war. Such a Board might be composed of eminent senior professionals, divorced from the modern day Service "Bureaus", and empowered to advise the Secretary of Defense on the merits of new technology applied to new operational concepts for carrying out realistic war plans in the nuclear age.

Captain Charles C. Pease, USN

THE SEMI-SUBMARINE

My thanks to Victor T. Boatwright for his kind review of my Proceedings article, "Sink the Navy!" I would like to clarify several points and respond to his comments:

-First-- the artist's sketch in the Proceedings was not my concept. It does not show the type of ship that I would want to see the Navy build as a semi-submersible. My concept would not have a bow typical of current destroyers. It would be more like a submarine, optimized for subsurface operations, but able to operate in heavy seas on the surface. I would favor Boatright's near-surface semi-submersible, based on SWATH technology. Such a design seems worthy of Navy R&D money for a prototype. It would greatly reduce observables above the waterline. Its small "sail" could be hardened and "stealthed." It would have the added advantage of being propelled by fossil fuel, hence producible in greater quantities.

-Second-- I am more concerned with how we are failing to exploit our present submarine technology, than I am with the possibilities for semi-submersibles. Submarine tankers and dry stores auxiliaries, using the designs that General Dynamics conceived to move North Slope oil under the polar ice cap, and SAM ships-- perhaps using derivatives of Trident-- are the first order of business.

Some first steps in adopting new technology have been made. Our traditional way of doing business with submarine torpedo boats was improved when nuclear propulsion was improved. A quantum leap forward was made by producing the SSBN for a mission that the Navy had not had before. But since Admiral Burke had the foresight, the drive, and the bureaucratic clout to push the Polaris program to fruition, nothing has been done to exploit U.S. technology with concomitant operational innovation. Marginal improvements to existing operational concepts have been the order of the day.

One factor contributing to this reluctance to embrace operational innovation has been the existence of the Key West agreements on roles and missions. To attempt a serious assessment of new operational options available because of technical change, would invite a critical review of intraservice and interservice roles and missions, an endeavor which none of the services really feels secure enough to permit. Granted, there has been some movement; the memorandum of agreement between the navy and air force on maritime roles and missions is a step in the right direction. But that agreement is analogous to two channel swimmers dipping their toes in the water.

Captain Charles C. Pease, USN

ARCTIC OPERATIONS

The interest being generated in Arctic submarine operations made me dig back into my scrapbook for the news accounts of SubPac's first big Arctic venture. The Honolulu Advertiser of June 25, 1946 says that four submarines of the Pacific fleet, "will invade the polar ice pack next month as part of a program to prepare U.S. Naval forces for possible operations across the frozen top of the world". The article also notes that "the revolutinary expedition, titled 'Operation Iceberg'...will take place mainly in the icejammed Chukchi Sea"..."The Trumpetfish and Blackfin will leave Pearl Harbor in mid-July and join the Cusk and Diodon which leave the same date from San Diego." (The operation was commanded by Comdr. L.P. Ramage, Com Sub Div 52)...The article also noted that a fifth submarine Becuna was "already in the ice pack gathering advance data for the 'iceberg flotilla.'" Then another article in The Advertiser of Aug. 23, 1946 tells of the return of this "flotilla" to Pearl Harbor after their 9000-mile cruise. Comdr. Ramage is quoted as saying on his return "the cruise was very routine, with no extremely cold weather, the lowest temperature being 40 degrees." He noted that "we didn't contact any icebergs since there are none in that area," and that "the ice was three or four feet high-- about half way up the sub." Rear Admiral McCann, COMSUBPAC stated: "This exercise was merely to familiarize ourselves with the northern area, and to find out the effects on ships and men in Arctic waters."

I would note that the diesel boats involved were not required to operate under the ice for any extended period of time, but were used merely to assess the operations of such boats in ice-clogged waters in the summertime.

L.P. Ramage

INDIAN OCEAN SINKINGS

Brooks Harral's review of "Axis Submarine Successes" suggested that Japanese submarines had some notable successes in WWII, particularly in the Indian Ocean. In Mochitsura Hashimoto's book "Sunk', the author includes a box score of Allied merchant ship losses to Japanese subs in the Indian Ocean. This shows that 80 Allied vessels were sunk (a great many in the Mozambique Channel) with the loss of only two Japanese submarines--one at Penang by a British sub and one in the Maldives by destroyers. Also, as many as 25 different Japanese subs seem to have made war patrols in the Indian Ocean during the War.

D.E.K.

IN THE NEWS

-A torpedo tube launched version of the Soviet SSN-X-21 land attack cruise missile is expected to be in service in 1984, as noted in Jane's Defense Review, Vol 4, No. 8, 1983. This weapon "makes every Soviet submarine a potential strategic weapons carrier". The article also says, "It is believed that the first Soviet warships to be fitted to carry these missiles (like Tomahawk) will be Yankee class vessels which have been withdrawn from service as ballistic missile submarines". The weapons are "considered to be armed solely with nuclear warheads, with a yield in the 200 KT range". Also, that "its accuracy is considered to be better than the 1-2 miles of the previous generation of Soviet cruise missiles".

-An AP wire note of 15 May notes that the current Jane's Defense Weekly shows a photo of the new Soviet Oscar-class 14,000-ton, missile-firing submarine with its 24 tubes for SS-N-19 antiship missiles, and "what naval specialists believe is a towed sonar system". The Oscar's missiles are credited with a range of 833 miles, and it is believed "pose a significant threat to NATO convoys".

-On March 21, 1984, a Soviet nuclear-powered Victor I class attack submarine collided with the U.S. aircraft carrier Kitty Hawk in the Sea of Japan. Although, the Kitty Hawk's task group had purportedly held contact off and on with this submarine for a considerable period of time, when it surfaced under the Kitty Hawk the carrier had lost contact with the sub and the Soviet boat was evidently uncertain as to Kitty Hawk's location. The Soviet sub steamed off under its own power while the damage to Kitty Hawk, at first considered to be slight, required docking repairs.

-An article in Defense Weekly, March 26, 1984, by Richard Barnard, comments on the Kitty Hawk-Soviet sub collision and ASW conditions in the Pacific. In comparing Pacific ASW conditions versus those of the Atlantic, the author notes that in the Pacific "tracking Delta IIIs" (Soviet SSBNs) has proven a far more onerous task. The location of the subs is unknown for unacceptable periods of time, (due to the Navy's lesser surveillance capabilities in the Pacific). "To make matters worse", the author says, "the Delta III does not represent the epitome of Soviet quieting. The Oscar cruise missile sub and the Victor III attack boat are far better".

-The Indian Government has taken up an option to buy four German Type 209 submarines from HDW after ordering two more for delivery in 1986. (The 209 is the type of diesel electric submarine used in the Falklands War by the Argentines.)

-Aerospace Daily of 14 March 1984 tells of unclassified testimony given by RAdm. John L. Butts to the Congress. Butts is quoted as saying that Soviet emphasis on under-the-ice submarine operations seems to be aimed at "ensuring survival of enough SSBNs to constitute a formidable strategic reserve" in war. "In their view" according to Butts, "the ice pack eliminates two threats-- air and surface attack." And they can "make maximum use of the material obstacle presented by acoustic conditions there." Butts also reportedly said that Soviet shipbuilding trends include a shift in priority from SSBNs to large numbers of nuclear powered attack subs and emphasis on larger subs-- that can carry more weapons and operate away from their bases for longer periods". Interestingly, Butts notes that "Doctrinal differences in readiness, lead to the regular deployment of a small percentage of Soviet naval forces, about 15% away from their home waters. To the Soviets it's more important to be ready to go to sea than to be at sea." (The sudden and rapid deployment of 90 subs and about 200 Soviet ships in the massive fleet exercise held in April would confirm this capability.) Butts further comments, that Soviet readiness philosophy emphasizes maintenance and in-area training rather that extended at-sea operations. And, that their in-area training exercises "feature weapon firings at very high rates". Additional subjects addressed were: a) A new sub-launched ballistic missile, the SS-N-23 was put into flight testing in 1983, (A bigger missile than the SS-N-20 of the Typhoon with bigger warhead and greater range); b) The Soviet space program "will assume an even more important role in the navy's ocean surveillance and over-the-horizon targeting efforts "as subs with new, longer range missiles enter the Soviet fleet"; c) The Soviets are believed to be "working on two submarine-launched, surface-to-air missile systems." d) A Soviet, Extremely Low Frequence (ELF) system for communications with submerged submarines "has been in development for some time". (The U.S. Navy's ELF system with a transmitter in Wisconsin has been under test for many years.)

-Sea Power magazine of May 1984 notes in their First repeater column that the Soviets face the same obsolescence problem for their warships as that faced by the U.S. in the '60's and early '70's. Whole classes of cruisers, destroyers and submarines are reaching the end of their 20-30 year operational lives, it is noted. For example: "Over 80% of diesel-powered attack submarines are 20 years old or more."

-In a Sea Power interview with General Vessey, Chairman of the Joint Chiefs of Staffs, General Vessey notes that Soviet military spending is increasing, despite reports to the contrary, but that the rate of increase seems to be slowing. (The cost of Soviet submarine new construction seems to be increasing year by year, while a slow down in this increase is less evident.)

-A Jack Anderson column in the Washington Post of 8 June 1984, says that "a CIA report notes one important use of trained dolphins is to attach intelligence collection packages and other devices to enemy submarines." (Ed. Note: The "other devices" probably implies tattle-tale markers for keeping enemy submarines localized.) The column also claimed that dolphins were used in the Vietnam War to destroy enemy frogmen-- demolition experts. And that 60 North Vietnamese were killed by dolphins, armed with hypodermic needles attached to CO_2 cartridges.

-The U.S.S. Minneapolis-Saint Paul (SSN 708) with Commander Ralph Schlichter as CO was commissioned on 10 March 1984 at the Sub Base, New London. The USS Salt Lake City (SSN 716) and 27th of the 688-class submarines, with Captain Richard Itkin as CO, was commissioned on 12 May 1984 at the Naval Station, Norfolk. The Hyman G. Rickover (SSN 709) is to be commissioned on 21 July 1984.

-An Environmental Impact Statement on the disposal of defueled submarine reactor plants was released by the Navy on 4 June 1984. This EIS identifies land burial of the spent reactors at Federal waste disposal sites as the preferred option over deep sea disposal.

-The U.S.S. Seadragon (SSN 584) of 2850 tons was decommissioned on 12 June at the Sub Base, Pearl Harbor. The 24-year old submarine pioneered the exploration of the North Pole region. Under the Captaincy of Commander George Steele, Jr., in August of 1960 Seadragon made a first submerged transit of the Northwest Passage. Seadragon steamed more than 500,000 miles during her 24-years of service and was refueled three times.

-The CNO, Adm. James D. Watkins, was the principal speaker at the Submarine School, New London, graduation ceremonies on 30 March 1984. Admiral Watkins concluded his remarks with the thought that, "A credible maritime strategy of peace through strength would be impossible without our submarine force." Some 100 submarine officers graduated from the basic and advanced courses at the Submarine School.

-Ground was broken on 28 March at Groton for the USS Nautilus Memorial and Submarine Force Library and Museum. The Memorial is expected to open to the public in 1986. Nautilus, decommissioned at Mare Island in 1980, will be returned to Groton in 1985-- where she was built at the Electric Boat Division of General Dynamics in 1954, and homeported for the next 25 years.

-In April the Deep Submergence Vehicle Sea Cliff (DSV 4) tested her new titanium hull to a 15,000-foot depth. Her previous steel hull was replaced by a titanium one at the Naval Shipyard, Vallejo. Her 20,000 foot operating depth capability allows exploration of 98% of the world's ocean floor.

-Trieste II (DSV 1), the Navy's first deep submersible was inactivated on 17 May. In 1960, Trieste went to a record setting depth of 35,800 feet in the Challenger Deep. At her inactivation, Adm. Watkins the CNO noted in a dispatch that "During a 26 year career you (Trieste) have recovered millions of dollars worth of valuable equipment, earned several unit commendations, performed hundreds of unique scientific studies and ushered in a new era of submarine technology."

-The Patrick Henry (SSBN 599) was decommissioned on 25 May after 23 years of active service. The Patrick Henry built at Electric Boat Co. was the second "Skipjack" class nuclear powered attack submarine to be converted to a strategic ballistic missile submarine-- an SSBN. At her decommissioning, Adm. Foley, CincPacFlt noted: "That her missiles were never fired in anger is ample evidence of the success of her mission", (deterrence of nuclear war).

-Your Editor attended the Memorial Day service on 28 May at the Sub Base, Pearl Harbor. In a stirring, nostalgic ceremony with Captain George R. Stubbs, CO of the Sub Base as the principal speaker, the submariners who were lost on the 52 boats that went down during World War II were "remembered" and "honored". Before a wall containing lei-draped bronze plaques of each of the 52 subs-- each plaque inscribed with the names of the submariners lost in action-- and at the foot of a white obelisk which clearly marks the location of this Memorial, Captain Stubbs concluded his remarks by saying, "We must refine the art of submarining to ensure our readiness so that we will not add a single submarine plaque to this memorial through not being ready for combat." A bell was tolled as the name of each lost submarine was read.

Writing for the Submarine Review is a labor of love for the Submarine Profession and the Submarine Service. However, the Board of Directors approved the awarding of three honorariums for the past year for articles published in the Review. The selection of articles for this recognition was based on their contribution to the objectives of the Naval Submarine League and to the profession of submarining.

The distinguished articles selected for the first year of the Submarine Review were: Hamlin Caldwell's Arctic Submarine Warfare; Frank Andrews', The Evolution of SubDevGroup Two; and Richard Laning's, Submarine Command in Transition to War.

Also, a maximum of three distinguished articles will be selected annually by a committee from within the NAVAL SUBMARINE LEAGUE Symposium. An honorarium of up to $400 may accompany each selection. In general, one article per year will be selected to receive the maximum honorarium, and the others a lesser amount.

NAVAL SUBMARINE LEAGUE
FINANCIAL REPORT
31, March, 1984

ASSETS

Cash		$36,678.57
Equipment, fixtures	$12,992.42	
Less De-	1,215.09	
		$11,777.33
		$48,455.90

LIABILITIES

Salary and taxes payable	$1,998.41	
Symposium 1984 fund	2,489.93	
		$4,488.34

FUND BALANCE

Beginning balance	$11,296.15	
Change in balance	$32,671.41	
		$43,967.56
		$48,455.90

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

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The content of articles is of first importance in their selection for the Review. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the Review. Initially there can be no payment for articles submitted to the Review. But as membership in the Submarine League expands, the Review will be produced on a financial basis that should allow for special awards for outstanding articles when printed.

Articles should be submitted to the Editor, W.J. Ruhe, 1310 Macbeth Street, McLean, VA 22102. Discussion of ideas for articles are encouraged, phone: 703-356-3503, after office hours.

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.

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