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FROM THE PRESIDENT

I have frequently discussed the educational mission of the Naval Submarine League and its importance for our members. I now find myself being educated with more than passing interest on a new matter of serious consequence to the Submarine Service. The subject of my concern is the Gramm - Rudman - Hollings, budget-balancing by 1991, legislation. I haven't read the complete text of this bill so I don't claim to be an authority. But I do understand the "automatic" reductions that will occur if the executive and legislative branches of the government do not meet budgetary outlay ceilings. Additionally, after 1986 there will be no flexibility in shifting money within major accounts as there has been in the current process.

This legislation mandates equal percentage cuts down to the level of individual line items. In the wording of the legislation, each program is of equal importance to this country and each will take the same percentage "hit". I won't go into the "sequestered" provisions of this budget balancing act. The "automatic" phase is ominous enough to make my point.

My concern naturally centers upon the impact to the Submarine Service and its position in national priorities. I won't be glib and say that everything involving submarines is sacrosanct, however I do feel that a strong and capable Submarine Service is probably one of the few elements of our armed forces which can have an actual and psychological bearing on actual war-fighting as well as on war deterrence.

The bottom line -- in retaining this capability -- is well maintained and constructed ships, manned by crews of exceptionally well qualified and highly trained men. The recent unfortunate setback to the space shuttle program cannot be institutionally allowed to occur to submarines. The standards set for nuclear propulsion have slowly carried over to other Navy elements. There <u>cannot be any compromise</u> to these standards, be they in construction, operations, training, or people. However the process is underway which, carried to its end, will ultimately affect these standards. Your familiarity with Gramm - Rudman is vital. As a League member you should speak against any compromise to our first line of defense -- submarines. The consequences of not doing so are potentially disastrous. We must either adequately fund the Submarine Service or "ground" our submarines when they decrease in readiness standards. The submarine today is an extremely cost-effective weapon system, for any set of criteria. The money spent to keep submarines operating properly is the best and cheapest insurance this country can buy. It benefits every citizen and protects them as well. The Submarine Service must retain its proper and rightful priority in our national debate concerning budget-balancing. Let's keep it that way.

Chuck

FROM THE EDITOR

A letter in this edition of the Submarine Review suggests that there is a wealth of classified material in the open media of today. One merely has to read a few trade journals, the letter writer says, to reconstruct the "secret" elements of a military activity. This compromising of security matters he feels should be best avoided by submariners maintaining a "Silent Service." But is that wise?

Without an open dialogue on submarine matters, the "Silent Service" entered World War II badly handicapped as to: well-reasoned operating roles and tactics; weapon reliability; knowledge of their enemy; value of coordinated operations; and even the paint used topside. Before WW II, submarines were trained to be basically scouts of the battle forces -- not key elements in a war of attrition against surface ships. Unrestricted submarine warfare was suddenly ordered with virtually no discussion as to its implications. Attacks from below periscope depth, using sonar data only, were considered necessary in the presence of enemy surface ASW forces. Avoiding periscope depth in areas of enemy air activity was also accepted because of the supposedly high risk of being sighted and bombed. It was not recognized that there was a far better color for the topsides than black to gain invisibility. Use of the surface in daytime in a war zone was considered to be out of the question, and black topsides didn't help. Similarly, night surface attacks -- remaining on the surface for the great mobility created for the shooting of torpedoes -- had apparently not been considered. Wolf packs had not been contemplated, nor had weapon reliability been seriously questioned. The great efficiency of Japanese Naval forces was virtually unguessed at. The reading of recommended books on Japan by authors like Ambassador Grew, in retrospect, made one realize that such supposed authorities knew little about the samurai character of the modern Japanese military man, and that such books were better unread. That the Japanese could have developed a shallow-running air-launched torpedo, as well as many other technological innovations which caught the U.S. by surprise -- like the Long Lance torpedo -- had not been well considered.

As Dr. Edward Teller noted in a symposium in 1977, "Secrecy is counterproductive." He felt that, "one of the primary problems is excessive secrecy in defense, which repels the scientist." And that, "the United states has managed to keep ahead of the Soviet Union in exactly one technical field: electronics -- a field in which official secrecy has hardly been applied." Then, on the subject of submarines he decries the fact that nuclear submarines "are not yet produced in greater variety", mentioning in addition to warship types, the submarine tanker and cargo carrier "to maintain deliveries of heavy and massive materials to our forces fighting overseas." He notes that "in a truly serious conflict, submarines might be the only ships to survive in the long run."

The article on The Submarine Tanker, in this issue, would meet Dr. Teller's approval, since it is a form of breakthrough in the assumed requirement for secrecy regarding most submarine matters, that has been generally accepted by the submarine community with their "Silent Service" attitude.

Relying on discussions "among themselves" of submarine matters -- in a hold-close atmosphere -- to further philosophical ideas, new concepts, and technological innovations cannot be a satisfactory solution. "Among themselves" almost comes down to wardroom discussions, since dialogue in public places -- cocktail parties, symposiums, etc. -- would be ruled out by the danger of compromise of what are assumed to be sensitive submarine matters. And, wardroom discussions rarely find an avid tactician engaged in a dialogue with another competent tactician, or a strategist finding a similar interest in another officer with a great interest in strategic matters. It's awfully hard to find a kindred soul for an intellectual discussion on specific matters.

Only widely disseminated ideas through unclassified writings can bring together the usually rare but right people who can conduct a dialogue which tends to promote new principles and ideas within a profession.

The nuclear submarine force has not been without a base of highly competent writers -- George Steele, Ned Beach, Jim Calvert, Joe Synhorst, Dick Laning -- but they have been constrained in the past by the "Silent Service" position of their fellow officers. These "nukes" have recognized that all writing involves risk taking along with criticism by their peers, their seniors, by their wardroom associates, and in fact by the "Silent Service" itself. Submariners have always been a little suspicious of a person who actually wants to document his ideas. But these writers have seemingly realized that to move their profession ahead there must be an exchange of ideas through unclassified writings.

The lack of U.S. submarine innovation over the past 20 years -- while the Soviets have developed many new types of submarines and much new technology -- has been decried in recent media discussions and congressional hearings. This lack of innovation may easily be attributed to the past submarine policy of limiting as much as possible any unclassified dialogue about nuclear submarines.

THE BATTLE FOR POLARIS SURVIVAL

As the POLARIS missile fades into retirement, old timers are apt to reminisce about the early struggles for its birth and the several battles it had to fight as it proved its worth. One such battle never received much publicity. Yet it may have been one of the most crucial in the early survival of that significant contributor to nuclear deterrence.

In 1960 the Strategic Air Command (SAC) was the dominant force in nuclear deterrence and was pushing for the establishment of a Strategic

Command that would incorporate all strategic nuclear delivery forces. That would include POLARIS which was about to become operational. This idea was received with little enthusiasm in the Navy, which was not willing to have POLARIS come under the operational command of some other service. General Power was the head of SAC at the time. He frequently stated that although he had no great personal preference, he felt that since the nuclear war plans of the nation called for SAC to deliver about 90 percent of the megatonnage, it seemed logical that the new Command be headed by an Air Force officer, -- the head of SAC. This really drove naval officers up the wall. President Eisenhower finally resolved the issue by creating the Joint Strategic Target Planning Staff (JSTPS) reporting directly to the JCS but colocated with SAC and the Staff headquarters in Omaha.

This compromise solution directed the new Staff to coordinate all strategic nuclear weapons targeting for U.S. units and to integrate such planning with that of NATO forces. CINCSAC and the Director of the JSTPS was a dual-hatted Air Force general, with a Vice Admiral as the Deputy Director of the JSTPS to assure the joint nature of the Staff.

The SAC targetting system, adopted immediately, required the development of various probability factors for each type of weapon system -- for launch reliability, in-flight reliability, weapon detonation reliability and so on. Two of the most significant factors were weapon accuracy and survivability of the launching platform. All of these factors were combined into a simple mathematical value called damage expectancy (DE) which was computed for every weapon used in the target plan. It was obvious that a submarine system could enjoy a high survivability rating -- enabling it to score high mathematically in its contribution to the total deterrent effort. A weapon such as an ICBM with good accuracy but a relatively low probability of survival on its launch pad was not going to score as well as the less accurate POLARIS system that enjoyed a survivability factor of 1.0.

A survivable POLARIS was a threat, not only to the Soviet Union but in some ways to the position enjoyed by several of the weapons systems of SAC. General Power now became concerned with the POLARIS ability to perform. In the spring of 1961, the General directed that a war game be conducted by the JSTPS, aided by the SAC staff. The objective of the game was to test the survivability of the POLARIS system. Was the factor of 1.0 really justified?

To conduct the game, a chief umpire and associated supporting players were equipped with a couple of dice and the appropriate probability tables. A scenario was constructed to bring the Red and Blue forces together. Basically, the scenario called for the Blue force of POLARIS subs to be on missile launch stations in the Norwegian Sea, with Red forces deployed as their commander saw fit. Game time was started a few hours before "E" Hour -- the time for the launch of all POLARIS missiles. The test was to see if the POLARIS submarines could survive Red search and attack operations -- through the launch cycle itself. Any failure to do so would detract from the survivability factor and overall effectiveness of the POLARIS system.

Force composition was interesting. The Blue force consisted solely of three POLARIS submarines with 16 missiles each. The Red force was formidable: nine surface action groups with ASW capability equivalent to U.S. Navy equipment of the time; 1000 trawlers, each with a limited ASW capability allowing short range detection; 50 BADGER-type shore based bombers, 10 of which were loaded with 10 kiloton nuclear depth charges. The pilots of these aircraft were given the high altitude capability of seeing a POLARIS weapon emerge from the ocean surface, at night, from ninety miles away. Further, these pilots were then able to home on the succeeding launch of POLARIS weapons and deliver an attack against the mother submarine, using nuclear depth charges. Additionally, and very significant to the Red force, were 40 diesel and 9 nuclear attack submarines (SSNs). All Red submarines were given sonar capability equivalent to their U.S. counterparts and the Red nuclears had greater speed capability than the POLARIS boats. Neutral forces included 600 merchant ships that were plying the waters of the game area.

Since it was difficult to accept a Red force of such magnitude with virtually equal capabilities, there was considerable discussion as to the validity of the threat being used. However, submarine officers in the game felt confident about the invulnerability of the POLARIS force and acceded to the excessive claims of the SAC intelligence specialists who had constructed the threat. The submariners reasoned that the surface and air threats would not be a factor; that the game would hinge on submarine detections and since the U.S. platforms were much quieter, the likelihood of a Red submarine being in trail, within weapon range at "E" Hour, approached zero. A ground rule was that neither side could shoot before the start of hostilities at "E" Hour.

With the stage set, the game got underway. A period of almost six weeks was necessary to accomplish the few hours of wargame action involved. That action was an interesting experience, highly educational to those who participated and with a rather surprising outcome.

To commence the play, the Red and Blue team members located the units of their forces. The umpire team positioned the neutral force of merchant ships. One might expect that given the size of the Norwegian Sea and only three POLARIS boats to conceal, it would be highly improbable that any of the nine Red team SSNs would be located near a Blue team unit. Yet when Red and Blue team unit positions were compared by the umpires, a Red SSN and Blue POLARIS boat were in the same spot. The luck of the draw! The players of the game, not aware of this, were told by the umpires to move back on their tracks for a number of hours and the game was then commenced with the opposing submarines approaching each other for that chance encounter and tactical interaction which no one on the Blue side had ever expected -- a submerged dog fight. POLARIS was in trouble!

Both submarines, unaware of each other, approached the same position. They could only deviate by a logical command decision, taken after evaluation of sensor intelligence which was supplied by the umpire team. Their patrol plans would take them through the common point unless tactical circumstances provided cause for a diversion. The capability factors, so readily agreed to before the start of the game, were now in control. Probability of detection, equipment performance, sonar and environmental conditions, and external influences all became subject to the roll of the dice -- applying separate chance probabilities to each participant's perception of the situation. The Red and Blue submarine commanders were controlled in their actions by the information they were provided by the umpire team, who kept track of the movements of all units in a separate war room remote from the impending battle. Both commanders were being watched very closely for the correctness of their decisions -- decisions that might be interpreted as affecting the hazard to POLARIS. The real antagonists were now emerging, SAC versus the Navy, with potentially high political stakes riding on the outcome of a well-crafted wargame.

With the assumed equal sonar capabilities even though Blue was operating more slowly and quieter, both submarines made sound contact on each other at considerable ranges. By the time the opposing skippers had evalutated the meager information they were provided, they were within a few thousand yards of each other. The choice was clear, evade for Blue and trail for the Red. The latter knew that he could affect the strategic balance if he could trail for the few hours until "E" hour and get a kill, whereas the Blue had to evade to be able to return to his routine "alert" status. Although Blue was unaware of an impending "E" hour, he knew that maximum alert time was critical in his patrol. The level of strategic warning as provided from simulated intelligence reports had risen significantly due to increasing international tensions. So he felt a strategic as well as tactical urgency as he started to evade.

Fortunately for the POLARIS skipper, one of the 600 merchant ships (large, fast and noisy) had entered the area on a normal sea-lane track which happened to pass between the now tense submarines. The merchant noise, increasing as it closed range, drowned out the almost silent submarines. Blue, seeing a good thing and not yet willing to test his evasion skills against a potential enemy, left the area, masking his movements under the noisy merchant ship. He stayed with the merchantman for some time, heading in a southwesterly direction, then pulled out to the west to reestablish his alert status. He assumed that the probable nuclear contact had either never made a detection or was helplessly confused by the merchant gambit.

The Red skipper, frustrated by the merchant ship, quickly checked the local area. Unable to regain contact, he then followed the ship's noises in hot pursuit. He soon realized that he would never detect the Blue leaving the merchant ship's cover and decided to take the long view by setting up an expanding search which would give a reasonable chance of regaining contact before "E" hour. He first headed south for an hour or so and then west for several hours, assuming correctly that Blue would clear the area to regain alert status. Only the umpires were aware that the latitude line on which Red headed west, was the same line Blue had chosen earlier and where he was now sitting, in a passive alert status.

Blue, on hearing the searching Red closing from the east, decided to move slowly and quietly south off the track, far enough to let Red pass clear -- a routine patrol evolution. It became apparent, however, that Red was closing faster than expected and Blue, while comfortably off the track, felt it wise to reduce his noise level even further. Accordingly, he shut down his nuclear plant -- not a routine patrol maneuver.

Suddenly Red did the unexpected and turned south, on the exact longitude line on which Blue was positioned. Bingo -- a POLARIS on battery power, about to be run down by the opposition. The probability that the Red SSN would pick, for both its west and south search legs, the exact latitude and longitude lines on which the POLARIS boat had made his exit from the merchant ship should have been extremely low, but the unexpected happened once again. Red was heading directly for Blue. (Some players on the Blue team cried foul and mild expressions about collusion were heard, but they were ignored by the umpires).

It was only a matter of time until both subs were again in contact with each other. Correct management of the nuclear power plant became a crucial item for Blue, with the procedures for lighting off becoming an issue, challenged at every turn by the umpire team. Thus Blue was constrained to evade on his small capacity battery through the entire time it took to employ "safe" light-off procedures.

Full evasion, with no power for speed, presented a unique challenge to the Blue skipper. Decoys -- which helped confirm target presence to Red -- were used. Eventually, Red took the bait and followed a noise maker just long enough to open beyond his sonar redetection range before he realized his mistake. Blue had broken sonar contact and was finally "underway on nuclear power." In time, the independent evasion and search maneuvers of the two submarines resulted in separation beyond that of even chance detection. POLARIS was free once again.

Nothing more significant occurred until "E" hour at which time all three POLARIS subs were on station and commenced firing their missiles. By this time, it was nightfall and the sky was full of Red BADGER aircraft, watching for POLARIS launches. The first launch from one POLARIS was eyeballed by the crew of a high flying BADGER about 90 miles from the launching submarine. Instantly evaluating the sighting, the BADGER turned directly toward the target submarine, descending in a high speed gliding attack, homing in on the periodic launches of the missiles. The Badger arrived in the vicinity of the submarine and dropped one of the ten kiloton nuclear depth charges, just as the twelfth of sixteen missiles was being fired. Then the umpire team became involved in a detailed damage assessment exercise, determining the exact location of the explosion of the depth charge, the exact location of the submarine, and the resulting damage. It was determined that while the submarine was able to survive, it was not possible to launch the last four missiles.

In the initial action of the Strategic Planning Staff in determining acceptable reliability factors for POLARIS, it had been agreed that launch and in flight reliability of missiles was 75 percent, that three fourths of the missiles (12) in each submarine should be successfully launched and reach the target. So it now became necessary for the umpire team in this game to throw the dice and see if the twelve missiles that had been fired were those that would impact on their targets. It was logical to assume that at least one of the twelve that had been launched would fail, thereby reducing the overall effectiveness of the POLARIS system. Just as the probability factors had worked against POLARIS in the early part of the game, they worked on the positive side in this monte carlo exercise. In the throw of the dice, all twelve missiles were deemed to be successful and the 75 percent reliability factor was attained. Since there were no detections of the other two Blue submarines, they attained their survivability factor of 1.0 and reliability of 75 percent was assumed.

The box score for the exercise was 36 missiles of a possible 48 launched, successfully reaching their assigned targets. This maintained the 75 percent reliability factor established in development and operations tests conducted at Cape Canaveral. Survivability of 1.0 was maintained, the misfires being the result of missile launch and in flight reliability, not submarine vulnerability. In short, POLARIS had survived the "search and destroy" efforts of a rather impressive enemy force. The Blue team had won, but not without a lot of frustration and unusual tactical actions -- not to mention some luck, both good and bad, which one will always encounter in combat.

At the conclusion of the exercise, briefing material was prepared and the umpire group presented the results of the war game to General Power. He listened intently. Upon hearing the conclusion, he commented calmly that the game had merely showed the results that could be obtained from one set of circumstances; that nothing conclusive about POLARIS survivability could be determined from that particular exercise.

An early battle won, POLARIS continued enjoying a survivability factor of 1.0 -- a significant achievement for ballistic missile submarines that has persisted for over 25 years and seems destined to continue for many more years to come.

Jerry Miller, Lou Neeb,
Kent Lee, Peter Fullinwider

IS THE SSN A MANEUVER WEAPON?

The answer to the title question is, "yes, the modern nuclear attack submarine is a very effective .... perhaps the quintessential .... weapon of maneuver warfare". We submariners should think this statement through, to decide what it means to our warfare strategy.

First of course, we should agree upon the meaning of maneuver warfare. It is the "high speed tiptoe", or "winning without fighting." It is the strategy or tactic that avoids a frontal assault, or direct contact in favor of an indirect end-around to strike unexpectedly at an enemy's vital point, looking for a mortal blow. Maneuver warfare surprises an enemy, upsetting his plan of attack and confusing his tactical picture, frightening him and robbing him of his will to win.

The German blitzkrieg campaigns of WW II were maneuver actions: rapid panzer thrusts that struck deep into the enemy's rear, eating up miles and nibbling at the enemy's confidence, living on captured gasoline and on the brilliance and nerve of the commander. This fluid, dangerous strategy cut through Poland, the Lowlands, and France in days, and handed Europe to Hitler.

When one thinks of maneuver one thinks of generals like Robert E. Lee, Erwin Rommel, and Douglas MacArthur.

Maneuver's opposite is attrition warfare: toe-to-toe, slug it out frontal assault. The guy with the stronger, more numerous forces, or the stronger will, wins. U.S. Grant was an attrition general. Secure behind overwhelming numbers, equipment, and industrial capacity, he plodded through. Lee could win the battles; Grant won the war.

Maneuver takes a mobile force, independent command, a simple plan, and nerve. Attrition takes superior numbers and the ability to accept considerable losses.

History is instructive: attrition is easier -- therefore much more common -- but maneuver almost always wins. The military writer Liddell Hart studied 260 campaigns in 30 wars and found that 254 were won by maneuver tactics.

A comparison of U.S. and Soviet navies is even more instructive. Our ships -- especially our nuclear subs -- are superior, very mobile, and capable of extended blue water operations. Our commanders are independent as well: ready to sail in harm's way with as little help from headquarters as possible. We are maneuver oriented by temperament, tradition, and design. The Russians, on the other hand, are apparently an attrition navy. Their fleet still emphasizes quantity over quality. Their tactics stress co-ordinated missile strikes and saturation of defenses -- attrition tactics. And their sailors and leaders are not encouraged to be independent in action.

So if maneuver tends to always win and we can do it, and the Russians can't, how can we insure that our war at sea is a maneuver war?

Various types of naval warfare may be separated into "maneuver" and "attrition." Carrier battle group strategy is maneuver: avoid an enemy at sea and strike -- at sea or ashore -- a surprised and poorly defended target. Carrier air defense is, on the other hand, attrition: killing enough enemy planes and missiles far enough away to protect the carrier's deck. Convoy warfare is attrition. Amphibious assault is both: maneuver while moving to the -- hopefully -- unknowing and unprepared beachhead, and attrition once the first troops step ashore and the fleet becomes tied to the support across the beach. And so on.

Here's the problem. ASW is mostly an attrition game: how many P3 flight hours, sonobuoys, depth charges, false contacts, flaming data, etc. equal one submarine kill? But the SSN -- the best ASW weapon -- is a maneuver platform. She is fast, covert, independent, and lethal. She can roam, independent of resupply and on minimum communications, for months. Her skipper can avoid battle and position himself almost at will, choosing the time and place of attack. And submarine skippers are maneuver commanders by nature and tradition .... happiest when free of direct control.

Yet, we "maneuver" submariners tend to be bent to the attrition - ASW mold -- expressing our trade in terms of exchange ratios, or how many days (weeks? months?) to sanitize an area. (A maneuver force can of course be reduced to an attrition role. We proved that with such dismal results in Viet Nam.)

The solution? We -- and no one else will do it -- should redefine our Navy submarine role. To the extent that we can fight a maneuver war, we will punish the Soviets. To the extent that we are forced into attrition, we will tend to lose significant numbers of submarines.

Examples of submarine attrition warfare:

- The SSN in direct support of the battle group. Though the SSN will be effective; she would be much more effective elsewhere. Happily, this role seems to be going away as towed array surface ships prove capable.

- The SSN in barrier or in open ocean search is tied to the exchange ratio numbers inherent to attrition. Each U.S. sub will probably shoot more Soviet subs, but the Soviets have more subs. We have better fish to fry.

If these "traditional" submarine roles are not appropriate, what are the correct maneuver roles? They are:

- <u>Forward Area Operations</u>. Submarine operations forward -- in the Soviet front yard -- is good maneuver strategy. Our enemy is most vulnerable there. We can work on his pathological concern for the defense of his homeland and his fear of the loss of his SSBNs. If the geography is chosen carefully, we can range at will, picking our targets and our exits. Meanwhile Ivan is driven into holding much, or most, of his navy in reserve to meet this threat.

- <u>Presence</u> When "presence" is discussed, one thinks first of aircraft carriers and battleships. These have proved their value over the past 40 years ... but we haven't fought a sea war in those 40 years. The only navy that has -- England's in the Falklands -- used the "presence" of her nuclear submarines to undermine Argentina's will to fight ... which we assumed is the ultimate goal of maneuver, earlier in this article. England used a few SSNs (four? three? none?), to establish a maritime blockade of the Falklands at the war's start. It worked. Argentina stopped resupplying her army in the Falklands by sea. After her cruiser GENERAL BELGRANO was sunk by submarine torpedoes. Argentina tied her ships up. The Argentine Navy was neutralized by British submarines.

Our Submarine Force can do the same. The Russian Navy is more powerful but just as susceptible to a submarine threat. Submarine "presence" is more effective than a surface ship's because the submarine can be anywhere -- ubiquitously. An enemy must expend enormous effort to cover all of his flanks. Witness the American ASW effort off the East Coast in World War II.

Add to this SSN "presence", the TOMAHAWK missile. The submarine can now elude enemy defenses and shoot not only at submarine and surface ship targets, but at targets ashore. Admiral Bob Foley, recent CINCPACFLT _and_ an aviator, correctly characterized the TOMAHAWK-equipped SSN as tomorrow's aircraft carrier. SSNs can launch TOMAHAWKs at an enemy's homeland targets virtually at will. Two or more SSNs can concentrate this kind of force. A submarine's TOMAHAWKs can neutralize air defenses for follow-on carrier air attacks. Submarine launched TOMAHAWKs can create a diversion far from the main point of attack.

Look at the words of the preceding paragraph. Diversion... concentration of force... evasion of defenses... these are all characteristics of maneuver. The SSN, especially with TOMAHAWKs aboard, has them all, if we will but wake up to it. The task remaining -- begging, really -- to the submarine community is to think this strategy and tactic through, and then to articulate it clearly to the nation. The results will follow.

CAPT Tom Jacobs, USN

PROPULSION IN THE POD -- FACT OR FICTION?

Figure 1. Is the Victor III fitted with a magnetohydrodynamic (MHD) propulsion?

In the past year there has been a lot of speculation about the use of the pod atop the sternpost of the Soviet VICTOR III attack submarine. Several periodicals have leapt to the conclusion that the pod houses some sort of silent propulsion system. In the foreward to Jane's Fighting Ships, 1985-1986, its editor implies that the pod may hold an auxiliary propulsor "of the MHD variety."

Magnetohydrodynamics (MHD) and Electromagnetic Thrust (EMT) have been actively explored for underwater propulsion since the early 1960s. MHD for this propulsion mode would use a magnetic field as a means to convert electrical energy to hydrodynamic energy. Basically, if an electric current and a magnetic field are maintained normal to each other, the result is a force normal to the plane of action of the current and the magnetic field. See Figure 2.

The distinction between this type of energy conversion and EMT is blurred, however EMT distinctly uses electrodes to generate the necessary electrical currents, while some MHD advocates have postulated systems which do not require current-generating electrodes to create the propulsive forces for driving the submarine through the water.

Electromagnetic Thrust

Of the two proposed systems, MHD and EMT, the latter has received the most attention by researchers in the 1980s. There are two possible

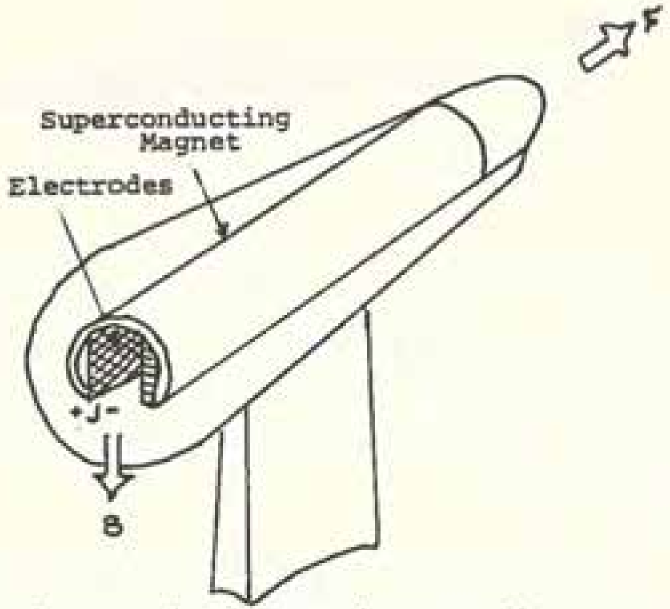


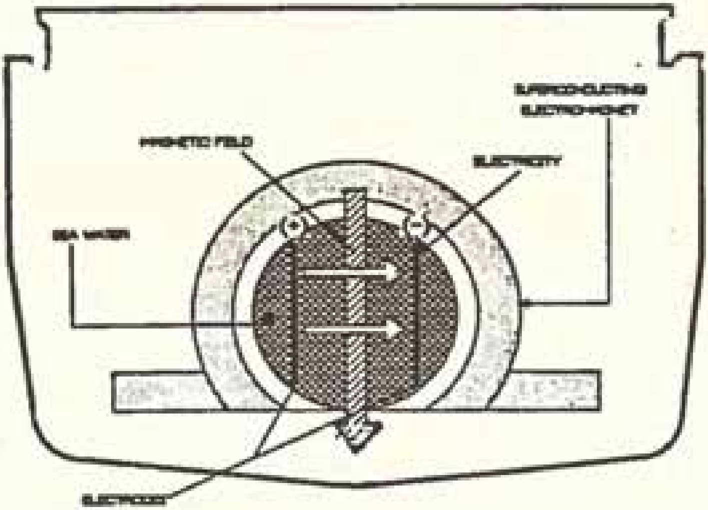
Figure 2. A pod with a d.c. internal field EMT propulsor

ways to build a system to fit the pod: the EMT internal duct propulsion using direct current, and the d.c. external field propulsion. The internal duct propulsion system uses a hole through the center of the pod through which water is thrust to propel the submarine. The force which thrusts the water is generated by the interaction of a powerful superconducting-coil-generated magnetic field and current flowing between two electrodes. Because salt water is a relatively poor conductor of electricity, to get the necessary current flow between the electrodes requires a high amperage flow -- resulting in large expenditure of electricity to achieve a significant thrust.

The application of this type of propulsor has been established by the Japanese. Two ship models have been constructed using the Japanese designed ducted propulsor shown in Figure 3.

Figure 3.

Schematic section of superconducting EMT system in a ship



Several problems however prevent this type of propulsion from being used in the VICTOR III pod. First and foremost, there is evidently no water intake in the VICTOR III's pod (as clearly shown in the recent Jane's publication <u>The Soviet Submarine Fleet: a Photographic Survey.</u>) However, even if such an intake existed, for a pod 9 meters long and 2.4 meters in diameter, the large magnetic forces and enormous power density involved in pushing a 5,800 ton submarine through the water, appear to be unreasonable. Extrapolating from the research done by Dr. Hummert of Westinghouse in a 1979 report to ONR, the pod would require greater than 1.5 megawatts of electrical power and a magnetic field of 5 Tesla (50,000 gauss) to move the submarine at 5 knots. Even with a more powerful magnetic field across the duct, for example, using a 10 Tesla field, at least 1 megawatt of electrical power would still be necessary to drive the submarine at 5 knots.

Since there is apparently no intake, the explanation above becomes somewhat academic. But there remains the possibility of an EMT d.c. external field propulsion system. In this type of propulsion, electrodes are mounted externally along the length of the pod, and an external magnetic field is generated, so that the interaction of the field and the electrode current will produce pressure gradients along the centerline of the pod. This pressure pushes the water between the electrodes, creating the propulsive thrust aft.

The problem is much more complex with the internal duct system. In the internal duct, having the high amperage current flow intersect the magnetic field at a right angle -- for the maximum, most efficient thrust force -- is not difficult. But in the external system it is impossible. The resulting magnetic field will not be uniform between the electrodes due to the curvature of the pod and, as the water velocity will vary with the strength of the local magnetic field, turbulence will be created. Using the multiple coil system shown in Figure 4, with a field strength of 5 Tesla and electrodes raised several inches from the pod's surface, a 5,800 ton submarine would still require nearly 4 megawatts of power.

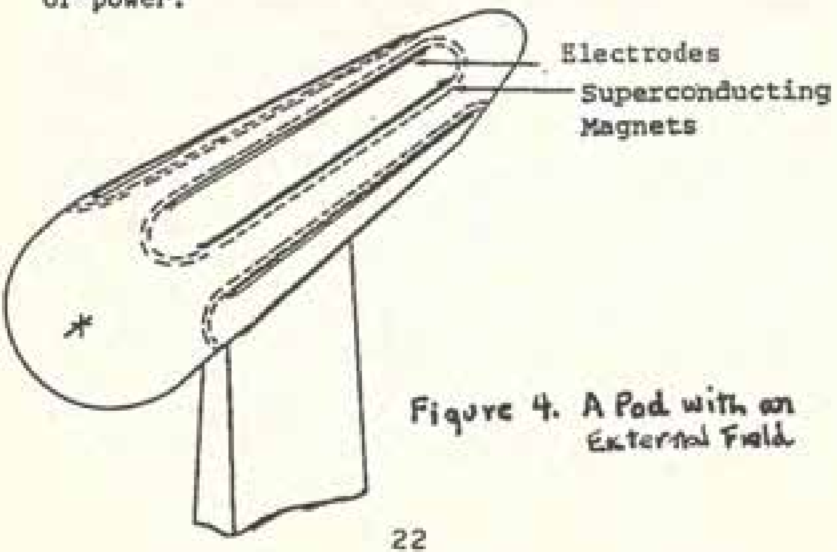


Figure 4. A Pod with an External Field

There is, however, good visual evidence that this type of raised electrode system is not used on the VICTOR III.

In both cases of EMT, the power estimates are very optimistic. They do not take into account extra drag for the pod, magnetic losses due to the faired surfaces of the pod, or any parasitic power consumed by the cryogenic cooling system, necessary to provide magnetic fields of the strengths required to move the VICTOR III.

Magnetohydrodynamics

Like EMT, there are two types of MHD propulsion concepts possible for the pod: internal duct MHD and free field MHD. An example of internal duct MHD is shown in Figure 5. This is the so-called "traveling wave" pump. A.C. electric current is used to create a magnetic field of varying intensity in the coils surrounding the sea water duct in the pod. This generates a traveling wave in a flexible membrane which encloses a ferromagnetic fluid. The pulsations, as they move down the length of the pod, squeeze out the water at the stern of the pod, providing submarine thrust. The ferromagnetic fluid is used to translate the magnetic field energy to hydrostatic energy and pushes the water. This system is plausible, though with drawbacks of its own, but is discarded for lack of visual evidence of an inlet for the pod.

The free field MHD propulsion system examined here was proposed originally by Owen Phillips 23 years ago. His system has coils generating a magnetic field radially outward from the pod. This magnetic field flows continually back towards the stern of the pod, as shown in Figure 6. The movement of the magnetic field (traveling wave), creates circumferential eddy currents which react with the magnetic field, to create propulsion forces on the surrounding waters.

Figure 5.

A pod with an internal duct MHD (traveling wave) propulsor.

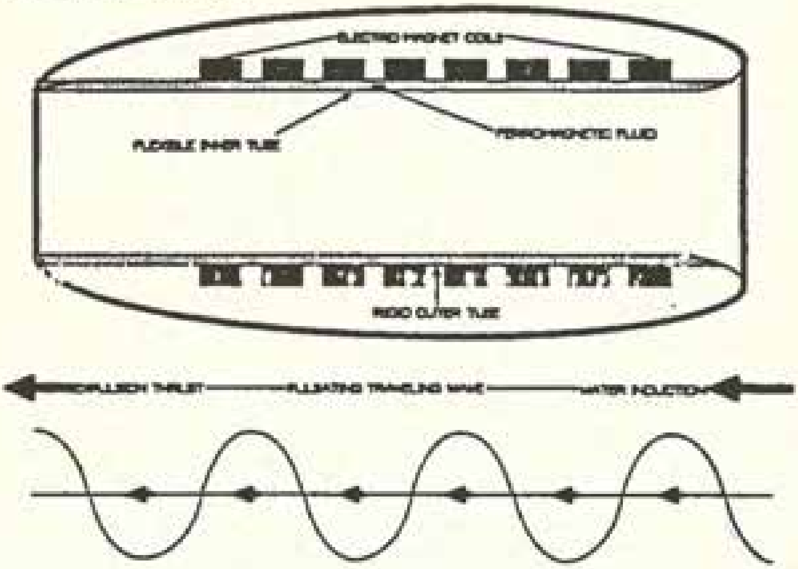
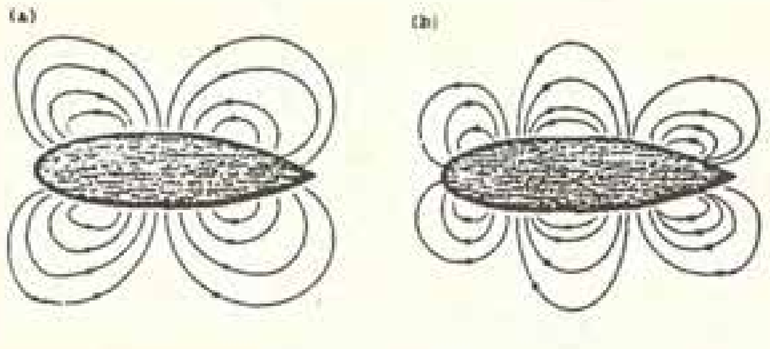


Figure 6

A pod with free field MHD. The field sweeps aft along the pod. (b) is approximately 1/4 of a cycle behind (a).



This system, if proven feasible, would require more than 2 megawatts at 5 Tesla to move the VICTOR III at 5 knots. This is, however, the only system of the four presented which has the external appearance which agrees with that of the VICTOR III, i.e. no intakes and no external electrodes.

There is a common thread through all of these proposed propulsion systems of EMT and MHD; they consume considerable amounts of power to move a submarine at only a slow speed. To supply such an auxiliary propulsion system of the MHD variety would probably require extra SSTGs or an all-electric main propulsion system for the VICTOR III.

Further practical problems plague the concept of using MHD or EMT auxiliary propulsion plants in the pod. First, the location of the pod makes it vulnerable in under-ice operations, as it is the first part of the submarine which would encounter ice on surfacing. Also, the structural strength required for the pod is at odds with the open interior needed for effective cryogenic cooling of the electromagnetic coils. This cooling is necessary to provide the strong magnetic fields of a propulsor. Second, a cryogenic support system will require room inside the submarine hull as there will be no room in the pod for compressors, pumps, condensers and liquid helium and nitrogen storage tanks. The cryogenic equipment will also provide a noise burden to the submarine.

Lastly, such auxiliary propulsion systems will generate a large external magnetic field. This has two disadvantages for a quiet submarine maneuvering on the auxiliary propulsor. With such a large magnetic field being generated, the submarine would be exceptionally vulnerable to detection by a Magnetic Anomaly Detection system.

The large magnetic field will also attract all sorts of magnetic debris which will cling to the pod and cause disturbances in the pod's magnetic field, additional flow noise and drag on the submarine.

There are many other problems which plague the designer who wants to put an MHD or EMT propulsor in a pod only 9 meters long and 2.4 meters in diameter.

It is clear that the technology exists to create an auxiliary propulsor of the MHD or EMT variety, but that the attendant drawbacks -- particularly power consumption, location of the pod and noise of the cryogenic support system -- make such a system questionable for submarines. As for an EMT/MHD propulsion system in the VICTOR III pod -- it seems unlikely.

David Brady and John Edyvane

SUBMARINE DISARMAMENT

Today, the interest in arms limitation centers on strategic nuclear weapons. In the '20s and '30s it was submarines.

Today, the reality of this search for an accord on the reduction of nuclear arms is that neither the U.S. nor the Soviets are likely to place significant limitations on any weapon systems that might conceivably provide a strategic or tactical advantage in a future confrontation. The failure of the five international naval disarmament conferences held in the interwar period (1919-1935) to either abolish or place meaningful restrictions on submarines, seems to confirm the little likelihood of a satisfactory nuclear arms agreement.

Beginning with the Paris Peace Conference of 1919 and ending with the London Naval Conference of 1935, the nations viewed the submarine in much the same way as the atomic bomb is viewed today. The submarine was morally abhorrent and became the key to achieving meaningful disarmament in other areas of naval construction. Yet no lasting agreement could be reached to abolish or limit its use and only a "fleet" submarine-tonnage could be agreed to, and then only by the United States, Great Britain, and France, while a maximum displacement per unit was agreed to by all nations.

The Paris Peace Conference of 1919 provided the first opportunity for the major powers to place limitations on submarines.

During World War I, Germany had come very close to achieving control of the seas through the use of its underseas fleet. As might be expected, Great Britain favored total abolition of the submarine at the conference. While the war planners in Washington defended the legitimacy of the submarine and its probable role in a future conflict, they were willing to accept universal abolition. France and Italy saw abolition as a policy of those nations that already possessed adequate navies and who were now attempting to "put the lid on" the other powers. The French and Italian position prevented unanimity regarding abolition. With the birth of the League of Nations, assured by President Wilson's agreement not to outstrip England in naval construction, the problem of aggregate submarine tonnage, size, and armament was left for the League to consider. In effect, nothing was accomplished except Germany was forbidden to have submarines. By 1920 it was clear that the League of Nations was unable to achieve meaningful disarmament in the naval area and within a few years Germany was rebuilding its U-boat fleet. This failure of the League made an international disarmament conference necessary if the rapidly expanding and costly competition in naval construction was to be brought under control.

The Washington Conference of 1921 was convened at a point in history when a number of important shifts in thinking had taken place. England was slowly realizing that she was no longer queen of the seas, and the United States was increasingly apprehensive about Japan's emergence as a Pacific power. Although the emphasis of the conference was on capital ships rather than auxiliaries, (as small combatants were classified), some attempts were made to deal with the submarine.

The conferees were able to reach an agreement on capital ship limitation but because of the wide variance in national submarine policies (was the submarine primarily offensive or defensive?) they were unable to reach an accord on submarine limitation. Once again, Great Britain lobbied for abolition while the others favored retention but could not agree on an acceptable overall tonnage for each nation. The United States supported the use of the submarine if rules of civilized warfare were applied. The problem of how many subs, and what size they should be, also blocked progress on the submarine question.

With both abolition and limitation of the submarine impossible because of the perceived naval needs of the various powers, the conference turned its attention to controlling the submarine by legislation. The result was the Root Resolutions, which set down the rules for conducting submarine warfare. Although approved as a separate treaty, the agreement was never ratified as France refused to sign. Thus the resolutions never became binding.

In the post Washington Conference period, building of the unrestricted ship-types --

particularly cruisers and submarines -- surged ahead and clearly indicated the need for a follow-on conference to deal with the submarine problem. The Geneva Conference was called for 1927, but only Japan, Great Britain and the United States chose to participate. Because of the incompatible British and American positions regarding the cruiser and the complex technical problems encountered in dealing with submarines, the conference was doomed to be the most unsuccessful disarmament gathering of the twentieth century.

The Geneva Conference failed completely as far as any substantive disarmament or limitation was concerned. A problem of major proportions was the fierce naval competition between Great Britain and the United States, with parity in cruisers the major issue. The submarine received much the same treatment as before. The attitudes of the three powers had not changed appreciably from what they had been at Washington six years earlier. The British still favored abolition but were willing to accept a settlement that would give her strategic superiority in relation to the United States and any European power, while Japan wanted desperately to improve her ratio of submarine strength to parity level with the United States and England. The United States favored limitation on the 5:5:3 basis thereby permitting this country to construct moderate sized, long range submarines better suited to operations against either the British or Japanese.

The conference foundered primarily on the cruiser parity issue. Overlooked by American naval men was the fact that the British demand for more cruisers was a reaction to the threat posed to her maritime lifelines by the large numbers of submarines being built by the French.

The London Conference of 1930 was called expressly to extend the limitation agreements reached in 1921 to auxiliary combat vessels.

Anglo-American rivalry had subsided due to the acknowledgement that each nation needed different types of naval armaments (e.g., large ships and guns for this country, and more but smaller vessels for England) to meet their particular strategic situation. The United States now supported England's case for abolition of the submarine thus reverting to the posture first adopted at the Paris Peace Conference of 1919. A second reason for this policy shift was the fact that Japan was replacing England as this country's primary threat.

Italy also supported complete elimination of the submarine, but abolition was conditional upon universal acceptance, which all powers recognized as impossible. France and Japan continued to support the submarine as a primarily defensive weapon and were, therefore, opposed to both abolition and drastic limitation in aggregate tonnage or unit size.

With abolition out of the question, a limitation treaty (52,700 tons of submarines) was signed by Great Britain, the United States and Japan -- thereby granting Japan parity in subs -- while all five nations agreed to a maximum 2000-ton displacement and 5.1" gun-size for submarines. The treaty also included an escape clause that permitted any of the signatories to disregard the agreement should any nation engage in construction that they thought threatened their security. In addition, Article 22 of the treaty established international rules to govern the submarine in time of war similar to the Root Resolutions. Ten additional nations eventually agreed to observe these regulations.

The World Disarmament Conference of 1932 proved to be a futile attempt at limitation even though it was in session for over two years. The deepening world-wide economic crisis, the Japanese aggression in the Far East and the rise of the

Nazi Party in Germany served to negate what little hope remained for a meaningful settlement of the armaments problem. In the United States, both military and political strategists favored either abolition or drastic limitation of the submarine, as they recognized the threat posed to the American fleet by Japanese submarines.

The international situation deteriorated rapidly during the latter stages of the conference with first Japan and then Germany withdrawing. Having failed to achieve any agreement on either land or naval disarmament, the conference skidded to a halt, hard up against the real world of international politics, national interests and fear.

The next international gathering for addressing disarmament was the London Naval Conference of 1935. All the major naval powers had assumed a posture of "all ahead, full" in naval construction in anticipation of a probable conflict. The United States stood with Great Britain and called for abolition of the submarine -- not able to foresee the vital contribution of the submarine to the American victory in the Pacific a decade later. Japan demanded parity in all ship types even before the first meeting. World conditions and the attitude of most of the naval powers made it impossible to negotiate a treaty for a reduction or even limitation in the size of navies. It was with this unfortunate commentary that the rather fruitless attempts to abolish or restrict the submarine during the interwar period came to an end.

From the Paris Peace Conference of 1919 to the perfunctory London Naval Conference of 1935, the only abolition of the submarine involved Germany, and even this proved to be of a fleeting nature for the Germans were constructing U-boats again, less than twenty years after the Treaty of Versailles. All other attempts to abolish the submarine met with complete failure. Great Britain preferred abolition of the submarine or, failing that, reduction to the lowest possible figure both in individual unit displacement and aggregate tonnage reflecting her dependence upon high seas trade for survival and her nearly disastrous experience at the hands of German submarines in the First World War. The United States' vacillating stand on abolition, tonnage-restrictions, etc., reflected both the change in potential enemies, -- the substitution of Japan for Great Britain -- and a changing evaluation of submarine usefulness. With the emergence of Japan as the most likely adversary, it was to the strategic advantage of America to either abolish or place restrictions upon the submarine. France saw the submarine as a great equalizer. It provided a much needed balance to the superior surface fleets of the other major naval powers. To France, the submarine <u>was</u> the balance of power in her dealings with the other naval powers, particularly England. Italy was primarily concerned with parity with her principal rival in the Mediterranean, and it mattered little whether submarines were abolished or limited as long as equality with France was a part of the bargain. Although Japan initially supported abolition of submarines at the Paris Peace Conference, she later rejected that position as she became more aware of the submarine's potential for furthering her Pacific ambitions and defending her empire against any encroachment by the United States.

The generalizations derived from this study of disarmament, applicable to present and future attempts to achieve arms limitations are:

- Nations will agree to disarmament only to the point that it does not substantially affect their relative strength -- whether real or imagined.

- Nations will reduce armaments in a particular area -- weapons delivery systems, etc. -- if they retain either superiority or parity with a potential enemy.
- Nations will usually attempt to retain strength in the area of their most "prestigious" weapons.
- The perceived role of a nation, and the view of other nations relative to that nation, have a direct relationship to the position assumed at the bargaining table.
- Both domestic and international economic and political pressures may lead a nation to adopt or reject a weapon that may run counter to military or diplomatic advice.
- A shift in potential enemies can bring about a corresponding shift in disarmament policies.
- Limitation of a weapon depends upon universality of agreement. Given the many differences in national ideals, goals, relative strengths, etc., universal agreement is virtually impossible.
- Progress in disarmament <u>cannot</u> be isolated from other facets of international relations.
- Success in disarmament hinges ultimately on the willingness of nations to settle their political differences.

These generalizations about disarmament are hardly new, and they shed precious little light on the present disarmament problem. They do, however, reflect lessons learned. At the very least we must expect our diplomats and arms negotiators to carry them to the current bargaining sessions. We cannot afford to learn them anew.

Lawrence Douglas

THE SUBMARINE TANKER

In the early '70's there was great interest in economically transporting oil from the large oil finds in the Arctic to the markets in the U.S. and Europe. Either pipelines or marine systems seemed feasible. But, bringing the oil out by submarine tanker -- on a year-round basis -- appeared to be the most cost-effective approach. Consequently a design study of an Arctic submarine tanker was conducted by General Dynamics' Electric Boat Division to demonstrate the practicality of this approach.

Though this project never materialized, the evident value of such a submarine tanker for refueling oil-burning surface ships in wartime has kept this concept alive. A battle group of non-nuclear powered carriers and escorts, capable of being refueled from a submerged tanker -- on any course and at relatively high speed -- would greatly increase transit speeds while ensuring a vital underway replenishment capability, particularly in a conventional war environment of enemy ocean surveillance satellites and enemy long range cruise missiles.

The submarine tanker designed by Electric Boat was most economically sized to carry 250,000 deadweight tons of oil. With a length of 1,000 feet, an 80 foot draft, a submerged displacement of 360,000 tons, an operating depth of 1,000 feet and a sustained speed of 18 knots, this giant submarine could transit efficiently under the Arctic ice, through the restrictions in the Northwest Passage and readily avoid icebergs in Davis Strait.

Since this tanker could and probably would load its oil from a bottom loading pad, its total cycle of operations could be secure from enemy observation. Although designed for peacetime commercial use, it could be considered an asset to be activated as a naval auxiliary in wartime. Thus, an enemy campaign against such a vital element in U.S. logistics should have little chance of being successful. With the U.S. advocating a "forward offensive maritime strategy," the security of its critical refueling elements "under the gun" of enemy homeland defenses even moreso emphasizes the submarine tanker solution.

When the attractiveness of this submerged commercial tanker for wartime naval operations became evident, a further design study for the underwater refueling system was conducted. A probe and drogue system similar to that used for aircraft refueling from tanker aircraft was shown to be feasible -- the submarine positioning itself under the surface ship and pumping oil up through its telescopic probe into a bottom drogue on the surface ship. The safety factor in this method of refueling was particularly good because of the stability of the submarine under all sea conditions and the little movement of a surface ship drogue, positioned at its center of flotation.

The vessel is essentially a large, rectangular tanker-like ship hull with the long internal cylindrical pressure-resisting hull, usually associated with a submarine, centered within the outer rectangular hull. The central hull contains the living and control spaces, pumps and auxiliaries, and the propulsion machinery. Except for the free flooding ends of the ship, the remainder is filled with oil cargo in the loaded condition and sea water in the ballasted condition. The variable cargo tanks on either side are provided to compensate for the difference between density of sea water and the oil.

The propulsion is by twin screws driven by steam turbines. Steam is supplied by a pressurized water reactor, similar in design to

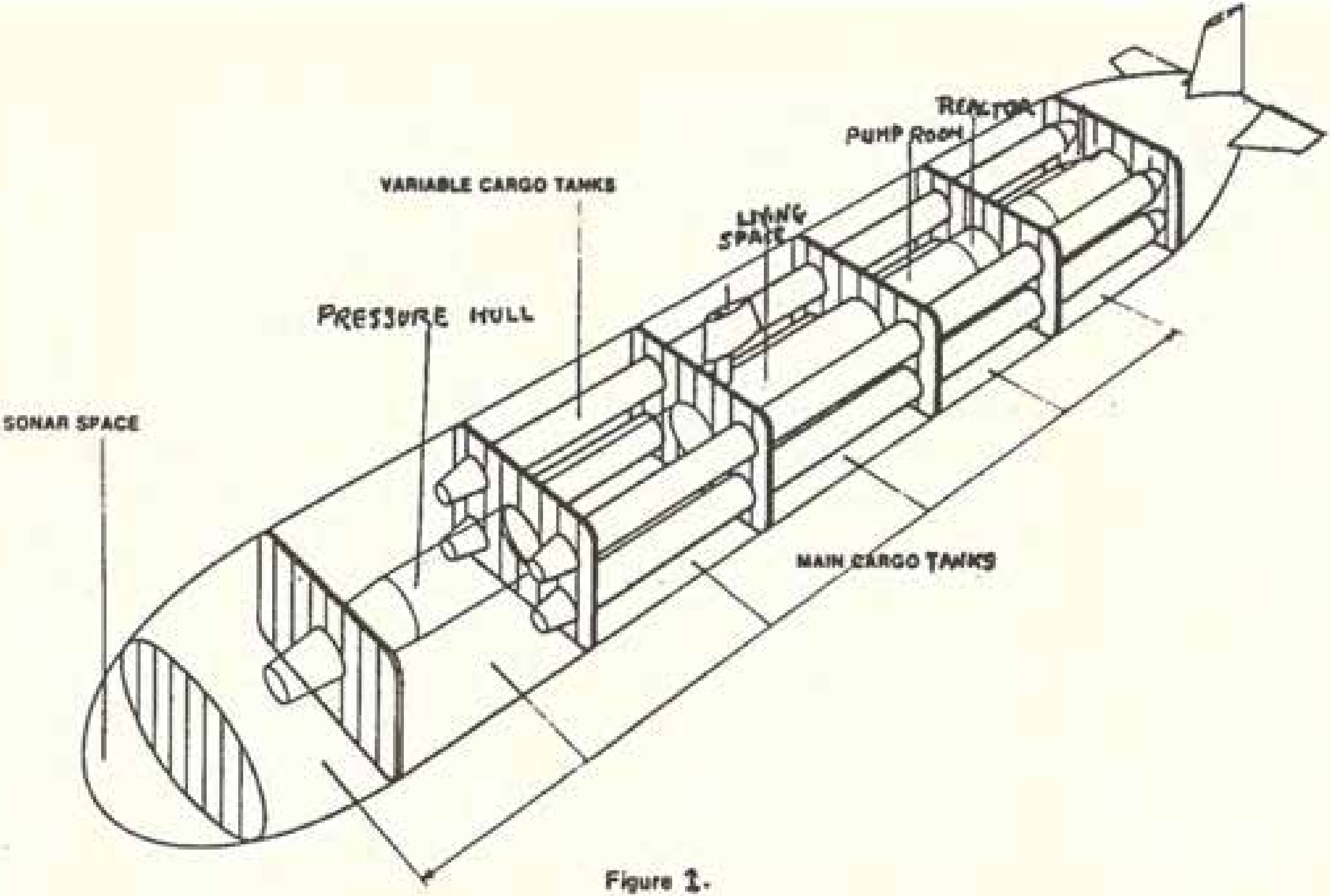

REACTOR
PUMP ROOM
VARIABLE CARGO TANKS
LIVING SPACE
PRESSURE HULL
SONAR SPACE
MAIN CARGO TANKS

Figure 1.

those presently in use for commercial electric power generation. The nuclear steam supply system produces steam for the two propulsion trains, each plant developing 37,500 SHP at the propeller for a total of 75,000 SHP. The sustained sea speed would be 18 knots.

The outer rectangular hull is longitudinally framed over transverse web frames and bulkheads not unlike a conventional tanker. The ship is divided to provide four main cargo tanks, a port and starboard wing tank, and a port and starboard center tank. The central pressure resisting hull is a ring-stiffened cylinder, 50 ft. in diameter.

A typical cross-section through the hull of the tanker is shown in Figure (2), the left view depicting the loaded condition submerged. The entire rectangular hull comprising the main cargo tanks, is filled with oil as are the four (4) variable pressure-resisting cargo tanks. All of the oil in the main cargo tanks would be at the ambient pressure of the outside sea water in this operating condition. The oil, being less dense than sea water, has a buoyant force, therefore the vessel must be heavy enough to maintain and operate at neutral buoyancy when fully loaded. This weight is largely in the hull-steel and pressure-resisting structures and enables the ship to get to the operating depth without paying a heavy price in fixed ballast for it. The right view depicts the "in ballast" condition submerged. The main cargo tanks are filled with sea water. The four variable cargo tanks are carried empty and at one atmosphere of pressure to support the weight of the ship. Briefly, the added buoyancy of these four tanks is necessary to support the weight of the ship when in the ballasted condition. It should be noted that, even though the same weight is carried, not as many barrels of sea water are carried as there is cargo oil.

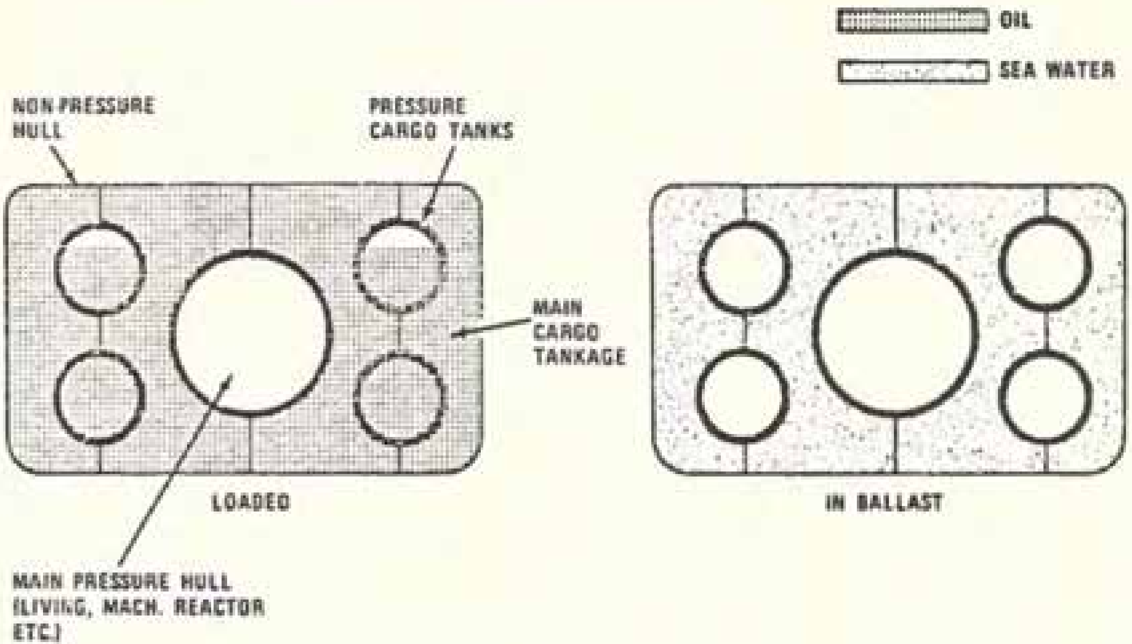

OIL
SEA WATER
NON PRESSURE HULL
PRESSURE CARGO TANKS
MAIN CARGO TANKAGE
LOADED
IN BALLAST
MAIN PRESSURE HULL (LIVING, MACH. REACTOR ETC.)

Figure 2.

A simplified explanation can be used to show how oil and sea water of various densities along with their differences can be compensated for, to make the submerged weight of the tanker, with or without cargo, equal to the weight of the water it displaces -- making it neutrally buoyant.

Submerging and surfacing operations are accomplished by taking on or expelling sea water from main ballast tanks just as the earliest submarines did -- as a matter of fact, in 1900 before the Wright Brothers flew at Kitty Hawk.

Controlling attitude and depth is through the use of bow and stern planes not unlike the familiar control surfaces of WW II diesel-electric submarines.

The shipboard cargo handling system for the submarine tanker is a self-compensating system. With this system, the ship's cargo tanks are always full of oil or full of water or some combination of the two.

This type of system offers a number of advantages, among them: it allows the tanker to be loaded or off-loaded at a submerged terminal facility; if surface facilities are used, it allows the tanker to dive immediately upon leaving the ice-free facility area; it eliminates oil vapors in the cargo tanks, thus reducing the explosion hazards commonly associated with the handling of oil cargoes; it reduces corrosion of cargo tank structures; and it tends to eliminate fatigue-stress on the surface ship-like structures which are caused by loading and unloading alternate combinations of tanks.

Perhaps the most important advantage is the high potential for this system to prevent oil contamination of the sea.

Figure (3) is a schematic diagram of the cargo system. On arrival at the loading terminal, the main cargo tanks are full of sea water. During the loading operation, cargo oil is forced into the top of each tank simultaneously by pumps at the terminal. The oil displaces the ballast water in the tanks, forcing ballast water from the bottom of the tanks to the sea. When the oil water interface approaches the discharge line, loading will be slowed and the ballast water passed into the expansion tank to allow separation to take place. Discharge to the sea is through a separate line at the tank bottom. An oil-water separator is indicated for the use in the final topping-off process, should large scale testing indicate the need.

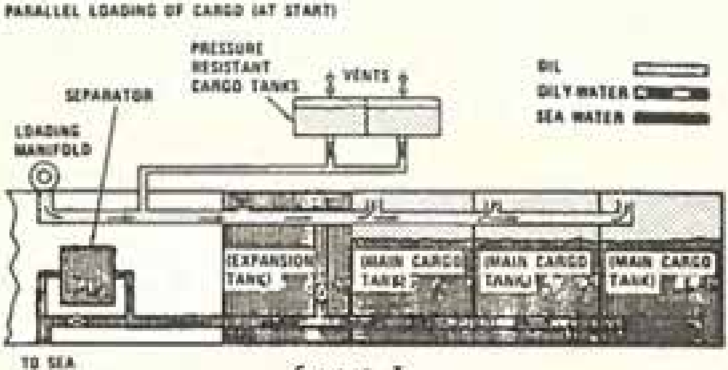
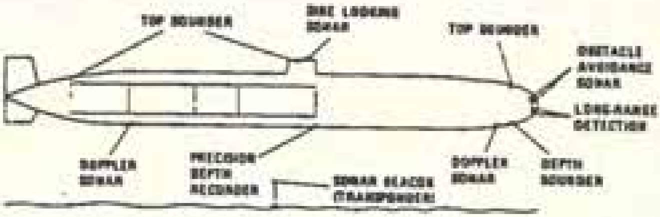


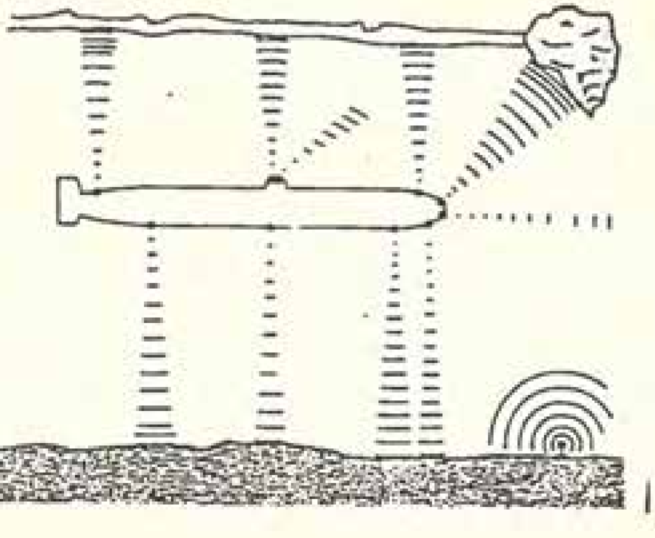
FIGURE 3.

The crew was sized from a manning analysis. Based on the functions to be performed, thirty-nine men would operate this tanker -- but accommodations for 49 were provided to include cadets and trainees.

For piloting in confined waters of straits and sounds, some method of determining the ship's position very precisely with respect to shoals, under ice ridging, icebergs and other obstructions, must be considered. An acoustic system using today's advanced technology is logically used for this function. Figure (4) illustrates the various types of sonar apparatus that would be used and the type of information they would relate to the submarine operator. This equipment is essential in determining a safe path in the vertical dimension.



NAVIGATION Figure 4.



Both surface and subsea loading were studied and it was concluded that subsea is clearly superior because the hostile environment is not challenged throughout the life of the system. Figure (5) illustrates one of the submerged loading concepts. The loading pad would be built in a temperate area and towed up to the loading terminal location and submerged. It would then be piped to the beach with offshore pipelines similar to those in use in offshore producing areas.

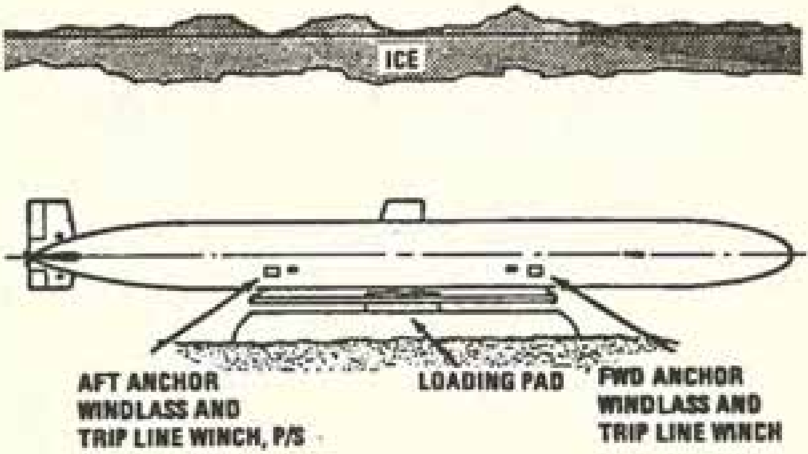


Figure 5.

The most practical loading technique is to bring the vessel down on the pad in a fixed location, maintaining slight negative buoyancy during the operation.

Ultimately, after the 250,000 ton tanker scheme was found wanting for customers, a 100,000 ton submarine tanker design was proposed to the Navy for fleet use. This was seriously considered, but a limited budget, which then was focused on a new attack submarine project, swept the fleet submarine tanker concept under the rug.

Pisces

DR. EINSTEIN'S TORPEDO LETTER

[Ed. Note: This letter by Albert Einstein reproduced from ASME News, Feb. 1986, contains an idea on how to improve a WW II torpedo. It was written when he was a consultant to the Bureau of Ordnance during the War. The problem posed to Dr. Einstein was apparently whether it was possible to have the torpedo explode when "at rest" on the side of the submarine -- the torpedo having been decelerated in 10 cms distance. But to do the job, because the deceleration solution is impractical, he suggests putting an air space ahead of the "fuse mechanism."]

January 4th, 1943

Commander Stephen Brunauer
Bureau of Ordnance
Navy Department
Washington, DC

Dear Mr. Brunauer:

You have asked me yesterday to submit to you in writing my proposition to bring about a position of the torpedo parallel to the wall of the ship, before the explosion. In working this out, however, I became aware that the realization of this method is quite impossible. It is impossible, namely, to bring the torpedo to rest in working on it on such a short length which is available; the forces are so tremendous that they must mechanically destroy the torpedo.

If v is the speed of a torpedo of the mass m, the negative accelerating force K, the way of acceleration Δ , then K is given by the equation

$$\frac{1}{2} m v^2 = K \Delta$$

If one puts f.instance $m = 100 \text{ kg.} = 10^5 \text{g}$

$$v = \frac{25\text{m}}{\text{sec}} = 2{,}5 \; \frac{10^3 \text{cm}}{\text{sec}}$$

$$\Delta = 10 \text{ cm}$$

one gets $K \approx 3 \cdot 10^{12}$ absolute units or 300 weight tons ($3 \cdot 10^5$ kg.). It is clear that the structure of the torpedo cannot stand this.

The torpedo has therefore to be brought to explosion before losing its speed. In 0,001 second it makes a way of 2,5 cm. To be sure, the explosion should be finished before essential parts of the torpedo undergo deformation. It can f.i. be arranged that the head of the torpedo can undergo a deformation of appr. 10 cm, without the rest of the torpedo being mechanically deformed. This frontal part should contain empty space (or a space containing only air) to avoid that its deformation produces a compression wave propagating backwards with great speed. The torpedo-head would then look like this

The empty space has the only purpose to gain a few thousands of a second between the time of contact with the ship's wall in which the fuse-mechanism comes into function and the time in which the explosion is finished.

Probably care has been taken already of those circumstances in the construction of the torpedos now in use. I am telling it only because I have no information about it.

With kind regards,
sincerely yours,

/S/

Albert Einstein

UNMANNED, UNTETHERED SUBMERSIBLES

There has been little tactical application of the possible wide range of unmanned submersibles, indicating that their development has held a low priority in Navy programs. Remotely piloted air vehicles (RPVs) have received a bit more attention -- mainly as targets for weapons testing and for tactical training of operational units. Yet, the concept of the remotely piloted vehicle including submersibles should have received a great boost because of the successes of RPVs in recent Mid-East actions involving Israeli aircraft attacks on Syrian surface-to-air missile defenses in the Bekaa Valley of Lebanon. There they showed their value in tactical applications despite their high likelihood of being destroyed during the prosecution of the mission for which they were programmed.

Because unmanned remotely piloted vehicles must be considered expendable, they must necessarily be of relatively low cost, of limited technological complexity, capable of self destruction to prevent compromise of their functions, and yet be able to convey information back to their originators before their destruction. This latter capability has not been developed for submersible platforms either in use, or for those which could be readily constructed from existing technology. Wire-guidance of torpedoes is the rare exception. Until solutions for this difficult problem of linking back information from the underwater environment -- unlike RPVs in the air -- are developed, most of the very attractive uses of unmanned submersibles must be put on hold.

Submerged RPVs should be considered as low-cost force multipliers, i.e. their use can greatly magnify the effects of manned platforms while reducing the risk to the manned systems.

To understand the potential role of the unmanned submersible in Navy applications, it might be useful to recall how the Israelis in 1984 used their RPVs in the ultimate destruction of most of the Syrian SAM sites while experiencing no losses to their manned aircraft. Much of this experience appears to be translatable to the use of unmanned, untethered submersibles of the future.

Israeli RPVs were first flown into the Bekaa Valley to covertly record then transmit back -- before their destruction -- the radar frequencies controlling the Syrian surface-to-air missiles, as well as to identify the location of the controlling radars. The RPVs also recorded the location of the SAM control centers and their procedures. This function alerted the Israeli command as to any changes in technology or tactical procedures which could have recently been introduced by the Soviet suppliers of the SAM equipment. When missiles were actually fired at the RPVs -- and this was encouraged by certain RPVs which were given the characteristics of manned aircraft -- the RPVs fired-at then broadcast, in real time, their experience. Later, a flock of RPVs were flown in just ahead of the manned aircraft going in for an attack on the missile sites, to act as decoys and to greatly reduce the probability of the manned Israeli aircraft being identified and tracked as missile targets.

It is reasonable to consider three distinct classes of unmanned submersibles that might fulfill naval tactical missions. The first are the small guided submersibles, the majority of which are either torpedoes, modified torpedoes (like mobile mines) or vehicles based on torpedo technology. ASW training targets and decoys resembling either torpedoes or submarines fall into this category. Such vehicles have limited tactical flexibility, are low in mission growth potential, are relatively low in cost and have little overall system complexity. (Modern torpedoes are another matter.) Potential interference of this class of submersibles with fleet operations is well understood and readily dealt with.

The second class of unmanned submersibles, although well developed conceptually, have not seen tactical application. These are larger submersibles which can be deployed by a wide range of platforms. Ocean bottom-search vehicles are the most viable members of this class. The RUMIC mine search vehicle might soon enter development and should be the most sophisticated vehicle of this class. The Autonomous Remotely Controlled Submersible (ARCS), of the Canadians, is a forerunner of the RUMIC. Covert search and reconnaissance, frequently in hazardous areas, is the primary role of the ARCS, which is designed to surface in order to deliver its information. The requirement that such submersibles be launchable from a wide variety of platforms ranging from helicopters to minewarfare craft places a limit on submersible size. (Submarine launched RPVs remain undefined for lack of their total system practicality.) Restricted by their necessary low cost, the medium size submersibles are also limited in their functions, tending to be single function in nature. Since such submersibles also tend to be used in direct support of fleet operations they are generally unarmed and should pose few coordination problems. Also, since such untethered vehicles have simple, short-duration missions within a clearly defined limited operating area, complex external command and control provisions are rarely required. Precise navigation and programmed control are however necessary, particularly where the submersible's mission is to search a hazardous area. Sophisticated onboard processing of sensor information and capability to alter mission objectives should rarely be necessary. Thus, since there are no high risk technical or operational problems to inhibit their development, early implementation of this class of vehicles is possible.

The third class of unmanned submersibles comprises long range autonomous vehicles. The missions of these submersibles would normally require a large payload capacity and long operational range. A 1982 Mine Delivery Vehicle study, for example, defined a vessel that looked like a small submarine.

High payloads and long operational radius of these large submersibles result in full load displacements of 10 tons -- about the lower limit -- with some designs reaching into the 100 ton range. The characteristics of these submersibles raise a complex set of operational issues. With few exceptions, these unmanned submarines cannot be deployed from support ships. The Mine Delivery Vehicle, for example, could only be launched from certain large amphibious ships such as the LSD. The most efficient approach is therefore to shore-base such a vehicle -- probably at an advanced submarine base. One study shows this type of vehicle to be about 70 feet long, 14 feet in diameter and with a net deliverable payload of up to 50 tons -- with a maximum radius of action of several thousands of miles. In addition to its weapon-delivery configuration, its payload bays could be configured to give the submersible a multi-mission capability. Such a vehicle should provide the U.S. Navy with a cost-effective augmentation to the manned vessels of the fleet.

There are at least three important jobs for the Long Range Autonomous Submersible: covert surveillance, tactical probes, and forward-area weapon delivery -- mainly mines. For the first mission of covert surveillance, the payload might include a TACTASS towed array if the mission were one of monitoring surface and submerged traffic through a choke point. Other sensors might be included to monitor radars and communication traffic. This capability could be applied as well for a mission for monitoring activity in port areas. Onboard processing of intercept data, pattern analysis and message composition could be handled by a computerized processor on the vehicle. The surveillance mission dictates low on-station speeds or the capability to bottom the vehicle and maintain station for periods up to as high as 90 days. Forward area deployments could extend into areas where defensive mining should be anticipated, or into port areas where ASW defenses -- bottom listening devices, ASW patrols, magnetic detectors, etc. -- present a high risk environment for SSNs over an extended period of time.

The second mission area for the long range unmanned submersible is the tactical probe. The Israeli RPV probes of the Bekaa Valley Syrian air defenses are illustrative of what might be accomplished by an underwater vehicle sent into a sea area of concentrated ASW activity. The probe might also explore the viability of harbor defenses as to sound listening devices, EW measures in operation, obstructions, anchorage protective measures, installations to protect against air and surface-to surface missile attacks, etc.. Submariners went into enemy harbors in WW II to sink ships -- and anchorages and ports will increasingly be the place to find the highest concentrations of enemy ships. But today the same job is likely to become too hazardous for the costly SSN -- even if it were probing for the eventual use of long range mobile mines. In any case, the necessary linking back of information -- before probable destruction -- remains the critical element in the probing system.

If the probe is designed to activate enemy defenses so as to discover actual weaknesses, the large submersible must be able to emulate an SSN's characteristics until put under attack -- while gathering and providing for the link back of information gained -- then become covert once more to protect the relatively high investment in such an underwater RPV. Designing such a "probe" is certainly a challenge for those who believe in the efficacy and value of underwater RPVs.

The third mission is weapon delivery. It offers the highest payoffs. It is also the one which is likely to be most worrisome for U.S. naval planners. A weapon-carrying, unmanned vehicle is a potential threat to friendly forces. Even the long range mobile mine might be accidentally planted in shallow areas where ships can blunder upon the misplaced mine. Certainly, errant weapons are the submariner's nightmare. Thus, the use of weapon-carrying autonomous submersibles will be viable only when they can be operated in modes which preclude their hazarding of friendly ships, including submarines. There is a development plan for the guidance and control system of a weapon-carrying large submersible -- a joint effort by the Marine Systems Engineering Laboratory of the University of New Hampshire and the Shenandoah Systems Company.

There are few missions for the autonomous submersible that do not require a route through waters utilized by the ships of the U.S. Navy and its allies. This creates the particular problem of not interfering with manned vessels engaged in fleet operations. This problem may be greater than that of designing and constructing such submersibles. Since most of the important large underwater RPV missions are in or pass through manned submarine operating areas, the coordination of such unmanned vehicles with that of operating submarines must be resolved by present submarine commands. Modern technology and the use of operational constraints similar to those used to coordinate the movement of ships, however, should be able to help resolve this problem.

Significantly, the subsequent manned air attacks in 1984 by U.S. carrier aircraft against Bekaa Valley objectives -- without the comprehensive use of airborne RPVs -- resulted in an increased effort directed towards increasing U.S. air operated RPVs. The production in numbers of advanced types of unmanned submersibles may however have to wait for world situations which call upon the escalated use of manned submarines. Until then, the development of concepts and prototypes need to be pursued if the cost-effectiveness of such unmanned submersibles is to be realized.

Richard Robinson

THE MISSING ELEMENT

The power projection doctrine outlined in the current maritime strategy is uniquely tailored to the capabilities of the nuclear attack submarine. It defines a mission in an environment which submarines have been operating in for many years. A significant difference exists, however, in the character of the command and control capability required to effectively respond to this mission. The dependence of the current strategy on an adequate command and control capability to support its implementation appears to be under-emphasized. This weakness could be a missing element in the chemistry of its content, and a limiting factor in the effectiveness of the submarine's role in supporting its objectives.

The submarine command and control requirement has always required special attention. While the one way multi-opportunity broadcast concept adequately responded to the post World War II operational need, technological advances in platform, sensor, and weapon capabilities, implemented in response to an increasing threat, mandated improvement.

The decision to deploy the sea-based POLARIS strategic missile system was supported by a major submarine command and control improvement program. This effort recognized that the credibility of this new deterrent system was directly related to our ability to convince national and world leaders that the capability to command this force was assured.

Dedicated strategic command and control program management, a comprehensive research program, and intensified communication training initiatives were key parts of the strategic command and control enhancement program. The VLF upgrades, TACAMO, floating wire and buoy antenna, and ELF projects initiated in this era form the backbone of the system in use today.

Communication improvements for attack submarines have not enjoyed the priority of the strategic initiatives. While some "flow down" benefits occurred in broadcast and floating wire antenna systems shared by both SSBNs and SSNs, no significant support for SSN command and control improvement occurred until the late 1960s. At this time the "SSN Escort" concept focused attention on the SSN tactical communication need.

An SSN tactical communication workshop sponsored by ARPA at Lincoln Laboratories late in 1970 provided the foundation for a comprehensive SSN communication improvement effort. A baseline program of radio frequency, acoustic, optical, and antenna research initiatives evolved from this meeting. Projects recommended included: expendable communication buoys, communicating floating wire and advanced towed buoy antenna systems, an integrated (Air-SSN-DD) acoustic communication system, high speed store and forward on demand satellite communications, and research on submarine laser communications.

The sponsorship of these initiatives was initially provided under the authority of OP-02 -- Deputy Chief of Naval Operations for Submarines. It soon became apparent, however, that the SSN command and control improvement program directly impacted the characteristics and capabilities of the other platforms on the ASW team. It was not surprising, therefore, to experience resistance from surface and air sponsors to allocate funding for platform improvements dedicated to improve the command and control of the SSN.

A multi-platform sponsored coordination effort was required. This was accomplished in 1975 through the establishment of the Coordination in Direct Support Program, under the sponsorship of the Director of Command and Control (OP -094). The contributions of this program, until its disestablishment in 1982, were significant. The program served as a forum to validate and prioritize program expenditures and provided a value judgement focus on the impact of Command and Control improvement on the effectiveness of coordinated ASW operations.

The disestablishment of the Coordination in Direct Support program reflected a lack of warfare sponsor determination in support of communication improvements which has been a longstanding Navy problem. Programs which produce ships, aircraft, and weapons understandably enjoy higher priorities. This has forced many command and control improvement efforts to be justified on fleet needs and deficiencies on a "catch up" basis rather than in "consonance" with the development of new warfare platform capabilities.

The situation faced by the submarine force today in supporting the power projection strategy is much the same as that faced at the time POLARIS was deployed. The TRIDENT, TOMAHAWK, SSN-688 and SSN-21 programs represent powerful new capabilities which can and will enhance the effectiveness of the Navy's maritime strategy.

But, the full potential of these capabilities may not be attained without major improvements in our submarine command and control capability.

This improvement should begin with establishment of single point submarine command and control program management authority within the systems command and the CNO staffs. It is understood that the new Space and Naval Warfare Systems Command Organization will re-establish a dedicated submarine program manager. This position should be utilized to focus and direct the broad spectrum of submarine program activity.

Equally important to strengthened program management is the need to establish an integrated and dynamic communication development program. This must focus top level technical attention on improvements which directly support the submarine's contribution to the current maritime doctrine.

This program should address as a matter of importance questions of improved antennae: the mast mounted, expendable buoy, floating wire, and towed buoy systems which bridge the critical sea/air interface and are vital links in our capability to communicate. They serve a function in the SSN external command and control similar to that which the towed sonar array serves in passive acquisition and tracking. Has our best technological attention been applied to achieve optimal antenna capabilities and configurations? What applications from the fields of robotic, deep ocean exploration and high speed integrated circuit technologies can be applied to improve the reliability of current systems and expand capabilities?

The risk to a supporting SSN exposed in a communicating posture is as significant now as it was in the days of "sub-air" coordination. This risk must either be accepted or minimized through attainment of effective low risk command and control for the role of the SSN to be of maximum value.

The submarine community must become more vocal and supportive in many of the ongoing Navy command and control upgrade programs which have the potential to support the SSN mission. The capability of the terminal planned for submarine use in the milstar satellite communications program should be carefully reviewed to insure that this most survivable system will optimally support the flexible targeting and shore connection requirements to accomplish SSN missions in the power projection strategy.

In 1958 and again in 1970 special efforts were required to insure that the submarine communications capability was adequate to meet the challenge of important new mission requirements. The current maritime strategy poses a similar challenge and justifies a need for special attention.

The "Silent Service" motto which so appropriately describes the quiet professionalism of our warfare community can no longer apply as well to our attention to command and control. It is time for us to recognize the importance of this requirement and increase the content of this element in the chemistry of our capabilities developmental program.

Dan Donovan

LETTERS

RUSSIAN SUBS IN WW II

Commander Compton-Hall's letter on the Oct. 1985 book review of Russian Submarines in Arctic Waters seems to have gone a bit overboard. He calls the book "a straight PR/propaganda effort, thoroughly unreliable and stocked with gross exaggerations of success" -- "easily disproved with certainty." And, that the reviewer of this book was taken in by the book's disinformation.

As the reviewer, my main purpose was to point out to our own submariners the trials and tribulations in the Soviet submarine force which were so similar to our own. While I realized that the accuracy of most war stories is suspect, I feel that in fact, Kolyshkin's description of submarine successes for the northern submarine force during WW II are relatively modest. For example, only one Nazi sub was mentioned as having been sunk, winning the skipper a highly-rated medal, while Compton-Hall notes that at least two German subs were sunk by the northern sub force, and other medals were awarded to skippers for sinking a couple of merchantmen. These are hardly gross exaggerations.

Additional support for the Russian submarine effort is in the account of the Russian S-13's sinkings in early 1945 -- detailed by Michael Martin in his story of the sinking of the WILHELM GUSTLOFF, in the Retired Officer magazine, January, 1986. As related, the German's GUSTLOFF, a 25,000-ton ocean liner with 6,050 people aboard (an official count) was sunk in the Baltic by the S-13's torpedoes. Then, it is noted that in February the S-13 sank the 17,000-ton GENERAL STEUBEN with a loss of 3,000 lives, and in April the GOYA was sunk by a submarine's torpedoes with a loss of life of some 7,000 people. It was also noted in this account that S-13 held the tonnage record for Russian submarines. This was a modest score, but not to be casually written off, as Compton-Hall would try to persuade SUBMARINE REVIEW readers to do -- with his statement that "by any standards, and shed of niceties, the Soviet submarine record in WW II was appalling."

Paul Loustaunau

SWIFT TURNOVER

The January 1986 issue of THE SUBMARINE REVIEW contained an article that fell far short of what you generally include. The need for additional phone lines to inport SSNs is not a surprise or a subject of debate. I personally know that a tender CO and Squadron Commander find that personal visits to the ships by their shop supervisors rather than desk-borne phone checks are beneficial to getting the job done correctly. It also works best when the submarine JO shows interest in what's going on by occasionally visiting the Repair Department offices on the tender or base.

Anyone who thinks that an "official turnover (to a relief crew) could be carried out within hours of (an SSN's) return to port" is not familiar with the complexity of today's nuclear submarine, has no concept of the legal requirements for operating nuclear plants or safeguarding classified material, or perhaps had a momentary loss of memory of what went on during his twenty-four years of riding submarines. The Blue and Gold crews have been working on streamlining the turnover procedure for 25 years. If that 3 day ordeal can now be "carried out within hours of return to port," then I certainly salute those marvelous young officers and men we have down on the waterfronts.

Captain C. G. Foster, Jr., USN(Ret.)

AN MHD TRANSDUCER

In reading the latest Review, I found the article on new submarine power plants most interesting, particularly the speculation on use of seawater MHD for propulsion. I have a patent, the result of some research done at McDonnell by my group in the dim dark past on an MHD type of sonar transducer.

Using Lorenz effect to drive the seawater core of the transducer, we were able to get good results at low power for limited sound transmission through the water with reasonable efficiency. The work in this area, slanted toward propulsion, did run into problems of basic physics and chemistry, in particular the effect of electrolysis due to the rather strong current required through the water. This added to the already serious problem of cavitation which occurred in the low pressure area at the front end of the beast. We concluded that, far from being quiet, this method of propulsion would be extremely noisy for any useable thrust, even using the extra field strength of super-cooled magnets. Maybe someone has come up with the answer to these problems, but I've seen no indication in the literature.

Rue O'Neill

THE SSN-21 AND THE U.S. MARITIME STRATEGY

Phoenix served up some rather heady wine in his article, THE SSN-21 and U.S. MARITIME STRATEGY, by underestimating the upstream technological miracles and the high degree of Soviet cooperation, that will be required in order for SSN-21 to perform the various missions described.

Considering the basis of the author's contentions relative to the U.S. maritime strategy, can we rely on the Soviets to provide SSN-21 with a target rich hunting ground -- in the so called bastion -- after the onset of hostilities? For them to allow this would be precedent setting in the misuse of sea power.

Russians are aware that historically, naval warfare is won through offensive -- not defensive -- action. Submarine campaigns in particular proved to be most productive when stealth was used to offset enemy control of the oceans surface in the forward areas. Soviet assets, VICTOR III, OSCAR, MIKE and SIERRA feature high speed, long range, low radiated noise and excellent weapons to perform effectively in the broad reaches of the oceans. There, with the aid of space-based surveillance systems and organic onboard sensors, these Soviet submarines should have excellent locating information on U.S. surface forces. Why then, would the Soviets permit their "free rides" to combat zones -- particularly when their access to U.S. carrier battle groups extends oceanwide? Logic dictates otherwise. Prepositioning of Soviet SSNs along anticipated routes of U.S. surface forces before the onset of hostilities will make the most effective use of this asset.

Given the U..S. "predilection to permit a foe to strike the first blow", as stated recently by Admiral Al Whittle in a recent speech, the Soviets can prevent U.S. destruction of their SSNs in Russian home waters simply by moving them out to sea before the shooting starts.

Further, Phoenix departs from a pure bastion theory with establishment of a requirement for SSN-21s to "ensure control of the worlds ocean for logistic resupply of engaged forces." However, the technological advances required to perform many of the described SSN-21 tasks will indeed be remarkable.

Although the U.S. maritime strategy is not Phoenix's child, it is worthy to note that the last time our Navy bet everything on it's anticipation of the opponent's plans instead of on known capabilities, the result was a Pearl Harbor. We would do well to remember that.

CAPT D. M. Ulmer, USN(Ret.)

A SILENT SERVICE?

In my new career as an independent consultant I've had to deal with military information which was advertised as very classified and extremely sensitive. Since my training as a "nuke" has hopelessly contaminated me with the irrational notion that one shouldn't talk about a subject he doesn't understand, I felt obliged to learn about various subjects from open literature.

There was no lack of defense-related journals from which I could compile a great deal about the "classified" projects I was a consultant for. In fact, the first "deliverable" to one of my customers was a compilation of all that I'd been able to piece together about their "secret" field of endeavor. The last paragraph contained some rather smug remarks about how well the "Silent Service" has managed to keep their business out of print and among themselves.

When I subsequently tuned in on conversations in public places like Providence's Greene Airport, the plane taking me to Washington, and then the concourse at National Airport, what I heard relative to SUBACS, the SSN-21 and weapon and sensor characteristics embarrassed me as a submariner.

As a young submariner, I remember my XO taking a JO seriously to task for mentioning TOTO, the "tongue of the ocean," at a wardroom party. It was used in regard to submarines going there for sound trials. Even though such matters have passed into the public domain, I still have twinges of concern when words such as "towed array" or "narrowband" are used in public.

The submarine service still has an enviable reputation for not airing their problems or their secrets in public. I would like to think, with a little effort on the part of all of us, we can still personify the image of "where did you go?" - "Nowhere!;" "What did you do?" "Nothing." We certainly ought not come down on those who write fascinating pieces of fiction, but perhaps we should speak harshly to those whose prior duties make them feel qualified to be "technical advisors" to such authors.

[Ed. Note: This letter was sent in unsigned and appears to be a tactful appeal to shut down the SUBMARINE REVIEW for the sake of having a "silent service," which is better off that way. Fiction indeed?]

WW II EXPERIENCE -- USEFUL TODAY?

I think it's appropriate to comment on the differences between submarining in our days and in the modern nuclear age. The REVIEW at times seems to infer that the nuclear skippers can benefit from the experience of those of us who took diesel submarines to sea against the enemy in wartime. However, there is a vast difference. It is somewhat analogous to the shift from sail to steam -- only in reverse. The sailing ship was slow and ineffective but she was self-sufficient and could keep to sea for long periods. A naval officer was first a seaman, next a warrior and never much of a logistician. The steam warship became much more effective but she lost her self-sufficiency. She was tied to her refueling facilities. Power could carry her through situations where sail was helpless and the need for good seamanship diminished.

In the nuclear submarine the need for seamanship, as we knew it, has dwindled close to zero. The officers come directly from the Academy through nuclear school to the boats. In the latest "SHIPMATE" the Superintendent stated that cross-training between surface and submarine navies is no longer practical. These officers are not seamen in the proper sense of the word. They dive when they pass the forty fathom curve and are divorced from the surface for their whole cruise. They are, perhaps, "undersea men."

The principles of command responsibility remain the same, of course. So I feel that the present submarine commander is not likely to appreciate any lectures on these principles from the old "fire-eaters" of World War II.

F.D.W.

THE MELEE

Recently I took a bus load of Navy Leaguers to MacDill Air Force Base for a briefing on the tactical training Wing which provides qualification for all F 16 fighter pilots.

This focused attention on the dogfight for aircraft, and my attention on the submarine "melee."

John Leonard's article has a lot of serious thought and we should heed the advice therein. I differ somewhat from his approach which he defines as "a confused, general hand-to-hand fight, a rumble, a free-for-all, a dog fight, or a firefight." I just don't believe that our sub vs sub tactics will ever degenerate into this kind of mass confusion involving even possibly a large number of subs on both sides.

Air superiority is gained or challenged by such tactics and US Air Force tactical training is guided by such circumstances. For example, in a plane at mach 2 the pilot will shoot himself down (traveling faster than his weapons!) before he can attack the enemy. The pilot cannot afford even a split second to look down at his gauges -- so the plane has a pod which projects <u>all</u> information onto his canopy. He looks through it.

The phrase used at the last Submarine League meeting was "submarine submerged superiority."

There may be more than 2 or 3 subs battling each other in the "melee", but I think it will be very much controlled, precise and cautious -- and while <u>tracking</u> more than one enemy, the attack will involve but one sub at a time -- but being ready to shift quickly to the next target.

What this implies, is constant training in the skillful use of all available detection instruments, correlating tactics to achieve a favorable attack position for whatever weapon system is selected.

Chuck Yaeger approached his training of pilots with this philosophy, demonstrating that even with planes which are marginally inferior, it would be possible to engage the enemy and "wax him" -- one plane at a time.

I accept the premise that the enemy will have subs as quiet as ours, that they will have sonars as capable, and a variety of good weapons. Therefore we can expect chance encounters.

With the judicious use of decoys and a crew that has trained again and again in the immediate response to a contact, I have sufficient prejudice to believe that our subs will have an advantage.

Leonard says "Our ability to sustain a significant edge over opposing submarines is strictly dependent upon technology and tactics." Absolutely! I recall with great clarity the special missions of COs like Al Kelln, Steve White and others who evolved the tactics and the skillful use of detection and surveillance systems. I trust the same effort is being applied today.

Arnie Schade

IN THE NEWS

o *Jane's Defense Weekly* of 18 January describes the new Commander in Chief of the Soviet Navy, Admiral of the Fleet Vladimir N. Chernavin - who replaces Admiral Gorshkov. Born in 1928, "his career centered on submarines and he advanced from lieutenant and navigator aboard a submarine to becoming the Commander-in-Chief of the Northern Fleet in 1977." In 1962, he led the first major cruise of Soviet nuclear submarines under the Arctic, developing new methods for communication, navigation and surfacing from under the ice. Shortly after that he was criticized in Morskoi Sbornik for "mistakes" in training. But a few months later he was described as a "good officer" indicating he was back in the good graces of the political community. He was graduated from the Naval Academy in 1965, and from the Voroshilov Academy of the General Staff in 1969. While in the Northern Fleet, Chernavin contributed regularly to the Soviet military press. As a submariner he particularly emphasized the significance of the ocean-going submarine. "Throughout his career, Chernavin operated submarines in the Northern Fleet with almost complete operational and tactical autonomy, having responsibility to determine the specific operation profiles of the submarines according to their technical performance." In early 1982, Chernavin launched a debate with Admiral Gorshkov on the future art of war for the Soviet fleet. Unlike Admiral Gorshkov who was credited with believing that the Navy should have an independent art of war, Chernavin evidently felt that only a complete integration of the fleet and particularly the submarines into a combined arms command -- would not necessarily lose the operational autonomy of the fleet -- but would "integrate all naval knowledge on armed struggle within the framework of a unified service." This thesis was consistent with the views of Marshall Ogarkov who saw the need for a centralized and unified high command under which the Soviet Navy would be a subsystem within the organizational framework within the combined-arms armed forces.

o Recent selection of submarine captains to the one-star rank of Rear Admiral were: Pete Chabot (a Material Professional), George W. Davis VI, Henry McKinney, David Oliver, Arlington Campbell, and Walter H. Cantrell (a submarine E.D.O.)

o Defense Daily of January 9 tells of the Navy's plan to have about 30 new SSN-21 nuclear attack submarines. Captain Al Carney, the executive assistant to the Navy director of RDT&E, is quoted as saying the inventory objective "is about 30 ships" at a cost of "at least $1 billion per copy." This cost of about $30 billion for 30 ships can be compared to the estimated cost of $31.6 billion for 66 SSN-688s.

o The Washington Post of 25 January notes that retired VADM Lando Zech Jr., a former skipper of Albacore and Nautilus, has been named by

President Reagan to replace Nunzio Palladino as Chairman of the Nuclear Regulatory Commission effective June 30. Lando Zech's last Navy assignment before retirement in 1983 was as the Chief of Naval Personnel.

o On Tuesday, January 21, 1986, VADM Bill Behrens, Jr., retired, died of a heart attack in St. Petersburg, Florida. One of the Navy's most decorated officers of flag rank, he was promoted to Rear Admiral at the age of 43 and later became the youngest submariner to make Vice Admiral rank. As skipper of the SSN SKIPJACK, he pioneered the operations of the Navy's first truly high speed nuclear submarine.

o An article on the Stirling closed cycle engine, in the Submarine Oldtimer Comrades Assoc. News, 1985, notes that its present state of development appears to preclude its use as a primary form of submarine propulsion. However, a combination of this non-air breathing engine along with diesel propulsion in a hybrid system "is under serious investigation in a number of countries." This conceptual approach seems to combine the advantages of a conventional submarine with an extended quiet, operational, submerged-endurance at low speeds "while conserving battery power for a sprint capability."

o An article in the Paterson Star Ledger by Scott Ladd tells of the acquisition of John Philip Holland memorabilia by the Paterson Museum in January. Holland's 31 foot submarine and his first 14-foot craft are joined by some 889 additional Holland documents, sketches, photos, correspondence and the inventor's hand written diary collected by Edward Max Graf over a 40-year period. With the donation, the museum now contains nearly 3,000 documents and photographs that once belonged to the late inventor, making it the nation's largest repository of original submarine memorabilia. Holland's first craft, resembling an iron kayak was tested successfully in the Passaic River. The oil-powered vessel moved underwater for a half-hour. The larger submarine, weighing more than 19 tons, is cigar shaped and closer in shape to modern submarines. It was launched in New York harbor in 1881. Holland later formed the Torpedo Boat Company, an enterprise that grew into the General Dynamics Corporation. The new Holland documents will be made available for research and scholarly review.

o <u>Defense News</u> of January notes that defense companies that have been approached to build the low-cost (no more than $200,000 per unit) antiship torpedo have not shown any interest in this Navy project. The Navy sent their draft specifications to several companies last October, but none have responded -- on the basis that the torpedo, as described, could not be built so inexpensively and produced by mid-1986. At this point, the Navy is soliciting ideas from torpedo producers on the kind of low-cost antiship torpedo they might produce to do the job. Gould, Westinghouse Electric, and Honeywell have indicated an interest in developing an antiship torpedo for a stockpile of about 2,000 units, and be low-cost yet effective against merchant ships and enemy support ships.

o An article in <u>Navy News and Undersea Technology</u> of 17 January by Paul Bedard tells of new Navy plans to install the eight torpedo tubes in the mid section of the SSN-21 -- four on each side -- instead of in the nose of the SSN-21 new design attack submarine. The change was apparently made after a decision that a large spherical array in the bow of the sub would not leave room for the torpedo tubes. The eight torpedo tubes are planned to be 30 inches in diameter allowing for a quiet, swim-out of torpedoes. In addition to having twice as many torpedo tubes as the Los Angeles-class attack submarines, the SSN-21 is expected to carry up to

50 torpedoes or other tube-launched weapons.

o *Defense Daily* of 10 January has a report attributed to Admiral Kinnard McKee, that a new method of building U.S. submarines will be initiated with the construction of the SSN-21. The new method, being partially used by General Dynamics' Electric Boat Division will see submarine hull sections built with their interior equipment virtually completed before the sections are joined together. This methodology was developed by Nazi Germany in 1942 to accelerate the U-boat building schedule. The Germans, who built about 30 boats a month, had the sections of these boats built all over Germany, then shipped by rail and brought rapidly together in the port areas -- mainly at night because of the intense bombing by the Allies of the German shipyards. Newport News is credited with initiating a $300 million program to provide this capability, while the Quonset Point yard of General Dynamics will perfect this technique for submarine construction. Design of the SSN-21 from the beginning to require construction in this fashion is the Navy's goal for the SSN-21.

o In subsequent testimony by Admiral Kinnard McKee to the Congress he is quoted as saying, regarding the Navy's requirement for attack submarines: "The number that has been around for years on what you really ought to have is on the order of 130 to 140 (SSNs)." He is credited with admitting that the number to be bought (100) is what can be "afforded."

o A *Defense Daily* item of 9 January, on the Soviet's submarine programs notes that Navy officials have told the Congress that it appears that the Soviets have completed their Victor III-Class SSN program with the launching of the 20th unit and intend to succeed it with the Akula-class submarine, first launched in 1984. "We think this is the submarine they are going to build in big numbers", a Navy Admiral is quoted as saying. The Akula displaces 8,000 tons and is 107 meters long. The Akula and the Mike are so advanced, they may still be in the research and development phase." The Mike is 110 meters long, displaces 9,700 tons, and can fire the SS-N-16 standoff ASW missile and "possibly the SS-NX-21, a land attack sea launched cruise missile". The Soviets also introduced the 8,000-ton Sierra-class SSN, "capable of shooting cruise missiles (similar to TOMAHAWK), as well as torpedoes and advanced weapons." Also in the Soviet arsenal is the Oscar-class attack submarine, which is believed to carry the SS-N-19 antiship cruise missile. It was estimated that the Soviets have "some 35 to 40 submarines under construction today" and are expected to launch "about 9 or 10 each year."

o A Navy release announced that the name of the first SSN-21 will be SEAWOLF. This makes a return to the tradition of naming submarines after marine creatures. Two previous subs have been named SEAWOLF. The first, a diesel boat, was high on the list for total numbers of Japanese ships sunk in World War II before she was lost in 1944. The second was one of the first of the nuclear submarines. It had a liquid-metal (sodium) reactor making it unique. This SEAWOLF will be retired from service in 1986.

o Navy News and Undersea Technology of 6 December, 1985, tells of a study by the Institute for Defense and Disarmament which concludes that the Soviets, in response to the forward U.S. offensive naval strategy outlined in "The Maritime Strategy" delineated by both Secretary Lehman and Admiral Watkins, is countering the U.S. offense by sowing a vast number of mines around Soviet port areas and around the bastion areas used by Soviet ballistic missile submarines. The study identifies a particularly effective mine in use as the Cluster Bay. "It is a moored, rocket-propelled torpedo with a detection mechanism which actives the mine when the acoustic signature of a U.S. sub is detected. An active sonar then guides the torpedo to its target." The study further notes that the Soviets deploy mines on older submarines and surface ships and carry some 5,300 mines for Arctic sowing, and 4,600 in the Pacific.

o <u>Navy News and Underseas Technology</u> also reports on "the brisk international trade in submarines in 1985." Bangladesh bought an undetermined number of ROMEO-class submarines from China. Libya bought 4 AGOSTA-class boats from Spain. Libya reportedly received a number of FOXTROT submarines from the Soviet Union. The Soviets upgraded the 8 FOXTROTS sold to the Indian Navy and transferred one or two ROMEO subs to Vietnam. The Norwegians bought a number of Type 209 boats from the Germans, and Sweden purchased a number of R-2 MALA two-man mini subs from Yugoslavia. Australia is negotiating for a conventional submarine design co-production agreement with a West German and a Swedish firm, for production of a number of boats in Australia. And Israel is putting out a request for proposal to build three diesel boats.

o <u>The Washington Post</u> of 31 December reports that the Soviet Union had 96 space launches in 1985 compared to the 17 for the U.S. (9 of the U.S. launches involved the space shuttle.) The Soviets in 1985 continued to stress the ability to locate ships on the oceans with satellites -- with 5 ocean surveillance satellites and three electronic intercept satellites. A five-year comparison of U.S. and Soviet launches shows the 96:17 ratio to be consistent with previous years.

o The ALASKA (SSBN 732) was commissioned on 25 January. After shakedown operations this TRIDENT submarine will be transferred to the Pacific fleet -- in about September. The Alabama (SSBN 731), a similar TRIDENT submarine, was transferred to the Pacific fleet in February.

o A Navy release of February 12, 1986, told of the Nuclear-powered NR-1 joining the search for parts of the space shuttle CHALLENGER, on the bottom of the ocean. The NR-1 can operate to 2,375 feet, and maneuver on the seabed while searching for and recovering bottomed objects. Maneuverability is provided by ducted thrusters -- two forward and two aft.

o A Navy release, January 29, 1986, told of the U.S. Navy and French Research Institute for Exploitation of the Sea signing a French-American Memorandum of Understanding providing for the mutual rescue of deep submersibles. Covered by this agreement are the U.S. SEA CLIFF and the French NAUTILE, the world's two deepest diving submarines. Both vehicles can operate at depths of 20,000 feet. The agreement states that should either submarine become disabled and cannot surface, its counterpart will be sent to retrieve the crippled sub from the bottom.

o An article by Eric Margolis in the Wall Street Journal, February 21, 1986, tells of stepped-up Soviet efforts to utilize the polar ice cap as a means to move their SSBNs to firing positions off northern Canada as well as to provide a covert route for attack submarines down to the sea lanes of the North Atlantic -- eluding the Norwegian Sea SOSUS System and bypassing the G1-UK gap. In the first instance, the SSBN can breach the ice and fire their missiles south on a flat trajectory that allows the U.S. only a few minutes warning -- rather than the 30 minutes upon which a U.S. nuclear retaliatory strategy is based. In the second instance, Soviet attack submarines can sail due north out of Kola Gulf, cross under the polar ice cap to the vicinity of Ellesmere Island, then thread their way through Jones or Lancaster Sound and into Baffin Bay. Continuing south through Davis Strait, they can arrive in the North Atlantic astride the main convoy route to Britain. The back door is now evidently wide open to the Soviet submarines. If war broke out tomorrow, many Soviet subs could appear without any warning along NATO's most important supply artery.

GOVERNMENT AFFAIRS

THE FY 87 SUBMARINE-RELATED R&D PROCESS

The last report on Government Affairs dealt with the Navy's 1986 research and development programs for submarines. As the 1987 budget starts through the legislative process, the R&D programs remain essentially unchanged but the focus is being changed, particularly for the recently formed Space and Naval Warfare Systems Command. This Command's procurement functions have been transferred to the Air and Sea Systems Commands of the Navy. In addition, OP-098's R&D functions -- with VADM Al Baciocco's title lengthened to Director Research, Development and Acquisition -- now clearly include the job of managing the transition of technology from basic research to operational development. This also emphasizes the importance of thoroughly testing the applicability of technology to practical problems before starting programs for specific applications. The two main themes of changed focus and proof of concept thus characterize the approach to submarine R&D, today.

The changes at the Space and Naval Warfare Systems Command indicate that the objective is efficiency and improved span of control. Transferring hardware procurement functions to Naval Air and Naval Sea Systems Commands was aimed at freeing the Space Command to concentrate on space warfare systems' relationships and systems engineering. Consistent with this, the Space Command took over the Director of Naval Laboratories' job and the eight in-house Navy R&D centers (labs). In addition, responsibility was assumed for the Navy work at four university laboratories; at Penn State, the University of Texas, Johns Hopkins and the University of Washington.

The proof of concept approach is well exemplified by the program titled "Submarine Hull Array Development (Advanced)." In the January REVIEW, it was noted that $13.2 million had been requested for FY 86 -- for this element -- while the House/Senate joint committee settled on a figure of $8.2 million. Today the Navy's FY 87 request is for about 8 million dollars. This hull array element is just one building block in the continuing development of submarine sensors. This process has resulted in trial of a Wide Aperture Array now undergoing tests in the USS AUGUSTA (SSN 710). The Array resembles the PUFFS array that was installed and tested in USS BARB (SSN 596) during the 1960's.

The Wide Aperture Array has three arrays mounted on each side of the submarine; at the bow, midships and at the stern, comprising a precise base line. Its functions are mainly for target localization -- not necessarily for target detection. (There is no single sensor that can do the whole job from long range detection through localization, to approach and attack.)

This method of proving concept and testing it before embarking on a formal development program is being carried out within the focused system of the SSN-21 and in consonance with many of the SSN-21's efforts.

Another example of a successful system progression through the R&D process can be found in the development of the Submarine ASW Standoff

Weapon -- SEA LANCE. The concept was formulated in the late 1970s. Work on it was fully funded in the 1986 R&D budget at about $75 million. For FY 1987, the request is $118.4 million. But by this time, the program has entered the next phase of the development cycle. In the 1986 budget, the program was titled generically and was in the 6.3 category of Advanced Development. But in 1987 it became a specific program, SEA LANCE, and was put in the 6.4 category of funding -- Engineering Development. It was this weapon system which the Senate Armed Services Committee questioned as to the Navy's commitment. The Secretary of the Navy then provided a written commitment to fund the program so as to achieve the structured date for initial operational capability.

The two examples cited above are easily identifiable as submarine development projects. They are not however totally submarine-unique since they benefit from other R&D efforts and have been developed with other programs in mind. The Wide Aperture Array has benefited from general advances in acoustic processing. The ASW Standoff Weapon. on the other hand, has been designed so it can be used by other platforms and against other targets.

Making increased use of cross-program technological information to enhance both the effectiveness and efficiency of the Navy R&D process is obviously an immediate intent of the recent reorganization moves. Rear Admiral Chuck Brickell, the Director of Undersea & Strategic Warfare & Nuclear Energy Development (OP-981) recently described the main advantages of this technology approach as "getting more out of the basic physics by being able to dig deeper" and "achieving synergism by integrating across the spectrum of Navy needs." Thus, not all R&D done for submarine applications will be as easily identifiable as the Wide Aperture Array and the Standoff Weapon. The job is to match the stated needs of the operational commanders with available technology and then initiate a systematic process for program development.

In the development of computers for future submarine needs, this technique is used as well as the building-block approach for building a system by initial concentration on components -- then hooking them together to perform a given function. Submarine sensor systems are using standard Navy computers as signal processors. Though the present computers are not submarine-unique, there is a design effort in those being developed toward meeting specific submarine mission requirements. Such computers will be expected to be fully compatible with submarine systems, i.e. the interfaces will match those of the submarine fire control system and there will be flexibility for expanding submarine needs. Rear Admiral Brickell used the example of building a beam-forming network from arithmetic processors -- the beamformer being one step in the target information path from hydrophone through signal conditioner to the display and end use. The arithmetic processors that form the network are therefore a critical development item and the introduction of Very High Speed Integrated Circuits into those arithmetic processors is an important development -- increasing the computational power and significantly reducing the size of computer units. But as they are introduced as processors in the beam-forming networks, the basic computer system does not have to be changed to accommodate this feature.

In general, the computers that are being designed as the brains of Navy systems will provide for flexibility, changed functions, and growth in system requirements through the utilization of new software rather than through hardware replacement.

Perhaps of greater immediate interest are several large programs that are specifically related to submarines. These programs are all in the 6.4 funding category of Engineering Development. The following table lists the program elements and gives the request for funding over three fiscal years; the current, the requested budget year and the next follow-on year.

(in millions of dollars)

Item	FY 86	FY 87	FY 88
SEA LANCE		118.4	130.9
Sub Sonar Devel.	38.9	52.7	44.7
Sub Combat Sys.	199.5	316.6	277.2
Sub Tactical Warfare System	38.5	47.1	41.2
SSN-21 Devel.		256.6	224.9

These five submarine engineering development programs account for seven percent of the total Navy R&D request for FY 1987 ($10.58 Billion).

It should be noted that the FY 87 budget request contains a substantial line item for SSN-21 development. This is a direct reflection of the focus earlier noted. It is further understood that the FY 88 Navy R&D budget request will start a new line for continuing generic submarine research and development.

CAPT Jim Hay, USN(Ret.)

BOOK REVIEWS

U BOATS AGAINST CANADA:
GERMAN SUBMARINES IN CANADIAN WATERS

Michael L. Hadley. Kingston and Montreal: McGill-Queens University Press, 1985. 345 pp., notes, index.

War in the North Atlantic in a German U-boat is not for the weak or timid. Nor is war in a small antisubmarine ship fighting both the sea and the enemy below. Far too little is known about the Canadian inshore defense against submarines in the approaches to Halifax, deep in the Bay of Fundy, or in the St. Lawrence River, where submarine penetration reached to within 172 miles of Quebec. For the armchair warrior, Captain Michael Hadley, RCN (Reserve), provides ample material for a saga of heroism and self-sacrifice, of terror, repugnance, and delight.

When World War II opened in September 1939, Canada had two destroyers in Halifax to cope with Germany, four in Esquimalt to deal with Japan. None had asdic or radar. The Canadians, nevertheless, carried a major burden of the war, much unappreciated by her powerful neighbor to the south. In the Battle of the Atlantic, the Canadian Navy provided 48% of the convoy escorts between North America and Europe, swept mines, supported the Africa and Normandy landings, patrolled the Mediterranean and Caribbean, and aided the U.S. in escort duties between New York and Cuba.

For the enemy, the war meant unspeakable hardships, and infrequently, German ineptness. Putting intelligence agents ashore in Canada was comic opera. Agent Langbein was landed near St. John, New Brunswick on 14 April, 1942 with a cumbersome radio transmitter, $7,000 in large, old-fashioned American dollars and a few $2 Canadian bills. The money, long withdrawn from circulation, could be negotiated mainly in bordellos. When funds ran out, he gave himself up to Naval Intelligence. Agent Janowski, landed on the Gaspe Peninsula on 10 November, 1942, made himself immediately prominent through the same outdated currency, his carelessness with Belgian matches and cigarettes, his claim to have arrived on a non-existent bus, and his distinct body odor after 44 days submerged -- well known to diesel submariners worldwide. Taken into custody the day he landed, he was immediately turned into a double agent via his radio contact in Hamburg.

If their human operatives failed, the Germans had more luck with their technological "agents." Fourteen unmanned weather stations were planted in Arctic and subarctic regions. Of two others planned for Canadian wilderness areas, one was lost enroute when U-807 was sunk off Bergen, Norway; the other, in northern Labrador, was not discovered until July, 1981. Canadian stations failed to detect the outgoing signals, but on a number of occasions, strangely, they were subject to intense jamming by a German station.

The story of submarine and antisubmarine warfare on both sides is one of incredible courage and few rewards. The Atlantic, its fog and violent seas, freezing rain and ice, made for unspeakable hardship. Sharp temperature gradients and saline layers, strong currents and irregular seabeds, made conditions for detection of submarines the worst possible. It is a great tribute to the allied effort that of 30,000 ships convoyed from 1942 to 1945, less than 1% were sunk. And a tribute must go also to the persistence of the U-boat service when losses passed the merely prohibitive. The U.S. submariner suffered the highest mortality of any service branch, with 20% casualties, 3500 men in 52 submarines lost. But in the U-boats, 20% survived -- 718 submarines were lost with 29,000 killed and 5,000 taken prisoner of a total force of 39,000 engaged. Late in the war the life of a U-boat averaged only 50 days.

U-Boats Against Canada offers a dramatic account of men at war. Unfortunately, the author's style does not make for easy reading. Much of the information must be mined from the text, where it is all but lost in excessive detail and haphazard organization. The reader learns much of submarine and antisubmarine tactics but not without considerable effort in piecing the story together. Captain Hadley made a painstaking search of war patrols, action reports and newspaper morgues. So, the analyst will fare better than the casual reader.

P. R. Schratz

Reprinted from U.S. Naval Institute Proceedings, March, 1986, with permission.

ELECTRONIC WARFARE

By Mario de Arcangelis, Blandord Press, Poole-Dorset 1985. Distributed in the United States by Sterling Publishing Co, Inc., 2 Park Avenue, New York, NY 10016.

Rear Admiral de Arcangelis, Italian Navy (Ret.) has produced an important and useful book, particularly for the active-duty military man. By tracing the history of electronic warfare (EW) from its origins to the present, he has provided a base of historical experience from which can be derived perspectives and sound rules for the development of EW technologies and for their eventual use in peace and in conflict.

The Admiral demonstrates an excellent capability to sift out the facts from a welter of guesses by the media and then produce a good coherent story -- one which is sufficiently credible to provide an appreciation of the impact of electronic warfare on conflict situations of the past. Some errors appear, but they are not overly important to the EW lessons learned from his accounts. For example: the author states that "American subs in WW II had to surface in order to pick up radar signals." Or, German subs attacked convoys on the surface because of their fear of ASDIC detection by the allies.

Although submarine operations, compared to other naval actions, appear to be least susceptible to enemy EW efforts and submariners seemingly have less opportunity to determine the outcome of naval engagements by using EW, there are important lessons in this book which should be appreciated for what they can offer to competent submarining -- today.

The earliest example of electronic warfare, as retold by the author, deals with the EW decisions made by Admiral Rozhestvensky in the Russian-Japanese War. His decisions demonstrate how a commander who is not well versed in the technology and tactics of EW can unwittingly cause the defeat of his command. The Russian Admiral, when entering the Strait of Korea, had his fleet maintain radio silence so that his ships could covertly slip by Togo's fleet and get to Vladivosok for voyage repairs -- after an 18,000 mile voyage from the Baltic. With very low visibility, as his fleet closed Tsushima Island, his chances for avoiding a major fleet engagement with the Japanese appeared good. But his ships were sighted by a single Japanese cruiser, which tried lengthily to get a contact report to Togo's headquarters. Radio ranges in 1905 were very short, most naval transmitters were of low power, a technique for jamming radio signals had just been discovered and direction finding was still undeveloped. Nevertheless, Admiral Rozhestventsky turned down urgent requests from several of his units to jam the weak enemy radio broadcasts. Eventually, Togo was apprised of the location of the Russian fleet. He then sortied his fleet and destroyed the Russian warships -- winning one of the most decisive naval victories of history.

The "Channel Dash" of the German battleships SCHARNHORST and GNIESENAU, in another chapter, describes a well planned massive use of EW measures for a short period of time -- sufficient for the battleships to reach their destination in Germany. To sortie from Brest and get successfully past the solid network of radars in eastern England was viewed by the British as an impossible task. But the Germans had become skilled in electronic warfare using ELINT, "window" (chaff), high power jamming adapted for frequency shifting by the British, and other innovative measures. What this incident suggests to the American submariner is the similarity between this "Channel Dash" and a Soviet "First Salvo" strategy for the initiation of a general war at sea. What might our submariners expect? A short term flooding of the oceans around battle groups with "noise" and false targets. A jamming of active sonar transmissions wherever possible? A rapid destruction of communication satellites? An all-out jamming of VLF transmissions? Radio deceptions to cause our submarines to initiate broadcasts of information? Deception to cause our submarines to act overtly and give away their location? The obvious lesson in this chapter is that the effect of EW in battle cannot be underestimated and that effective countermeasures must be preplanned and mustered so that response is not paralyzed in the opening moments of a naval operation.

The U-boat battles in the Atlantic detailed in another chapter, pointed up the failure of a German strategy which directed German submarine operations from a far removed, land-based command center. This required long messages which could be DFd by the allies with their loop direction-finders -- sufficiently locating the German submarines as to make them fall prey to a concentrated allied ASW effort. Squirt transmissions late in the war only provided a short respite for the U-boats, as the DFing stations quickly learned how to make a quick "fix" and expand the compressed messages for their rapid decryption.

The lesson of both minimizing the length and the overtness of submarine communications as a principle of sound submarining may be overly emphasized today -- as it virtually denies coordinated operations with other forces. Compromise, such as was demonstrated by underwater communication between submarines in WW II, still seems to apply for joint or combined operations today, despite the added risk imposed. Significantly, the present Soviet strategy for employment of their submarines by remote command and control, seems to offer a valuable US EW opportunity to capitalize on what could be -- at least it was to the Germans in WW II -- a critical weakness.

In the 1973 Yom Kippur War, the author suggests that the Israelis, overconfident because of their highly successful past uses of electronic warfare, failed to properly estimate their enemy's EW capabilities. The total surprise gained by the Arabs in their attack on 6 October was near fatal to Israel. The need to properly and comprehensively understand enemy EW measures which can affect submarine operations and the requirement to evaluate the possible technological innovations which might be brought into play are evident from the accounts of EW in the Arab-Israeli Wars. What is more, it is shown that technological innovation "no matter how marginal" is effective in its initial use.

The author's account of the Arab-Israeli missile-boat battles in the 1973 Yom Kippur War, tells a good story of Israeli EW countermeasuring actions against incoming Arab Styx missiles -- "None of the 52 Styx missiles launched against Israeli units hit their target." The subsequent Israeli hitting success with their shorter range Gabriel missiles also showed a good grasp of EW.

The Israeli's version of first, the battle against Syrian boats, and then 2 days later against Egyptian boats was to the effect that they first passively detected the Arab boats' search radars then when the Arabs' firing signals were intercepted, the Israelis knew the Styx missiles were on the way and the Israeli boats were able to activate their ECM systems and confirm the direction of missile attack by passively tracking the Styx's homing radars -- and decoying away the attacking missiles. Then by closing at high speed, the Israelis were finally able to pick up the Arab boats on their radars and accurately launch their Gabriel missiles. The Arab boats, with inadequate ECM systems could not respond with the same level of missile countermeasuring action -- with fatal results. What is indicated for submarines using antiship missiles, like HARPOON or TOMAHAWK, is the need to be covert in firing such weapons so as to maximize surprise in the missile attack and thus minimize the effectiveness of enemy ECM measures.

The author mentions the extensive electronic intelligence gathering effort of the Soviets at sea, using their large fleet of ELINT ships -- ever-present at U.S. fleet exercises, wherever. Many submarine emissions are thus likely to be monitored by the Soviets. Even in peacetime it must be recognized that the Soviets are waging a form of electronic warfare.

A chapter on "Infrared" alerts the submariner to the increasing use of passive infrared detection systems. For the detection of submarines close to the surface? For detection of the wake of thermal torpedoes? For the use of periscopes at night? Definitely. Etc.

The final chapter on "Electronic Warfare in Space," in addition to delineating Soviet efforts to develop an anti-satellite kill capability, tells of the efforts to develop high energy lasers and charged particle beam weapons -- probably to destroy an enemy's nuclear warhead ballistic missiles in flight, as well as U.S. satellites. That the author says there have been 8 experiments involving the propagation of particle beams from the Soviet manned space station SOYUZ, and that there is additional evidence that an attack on a U.S. target satellite using a high energy laser was made from SOYUZ. The U.S. realized, the author states, "that they are 10 years behind the Russians in the field of killer satellites." This is certainly sobering evidence that the Soviets oppose President Reagan's SDI program, primarily because they don't want the U.S. to close their present lead. In this light, submarines offer a means for "strategic defense" against an enemy's submarine launched ballistic missile threat by developing the means to neutralize SLBMs before or while in their boost phase -- in inner space.

Clearly, potential present submarine commanders, those developing new submarine technologies, and electronic warfare specialists, would be well advised to keep this book close at hand as a reminder that, in the words of Admiral Arcangelis, "Electronic Warfare is an irreplaceable instrument of success both in offensive and defensive operations."

W.J.R.

[Ed. Note: Comments submitted on this Book Review are included herewith:

"Perhaps the reason why submariners have less opportunity to use EW measures is due to little present effort to coordinate submarine tactics with other friendly forces at sea.

"The reviewer's discussion of minimizing message length and maximizing covertness of communications makes two points: (1) The U.S. Navy's emphasis on reduced submarine communications may have caused it to give up too much in the way of coordination of submarine operations with those of other friendly forces. It should be added that if and when our navy decides to enhance coordination of the operations of aircraft, ships and submarines, then attention will have to be paid to EW; (2) Submarines used underwater communications during WW II. During WW II, the U.S. Navy also developed wolfpack tactics for two and three-submarine wolfpacks. In the 1950's, such wolfpacks, operating submerged, conducted many exercise attacks against friendly carrier task groups. This involved acoustic and radio communications by these submarines and provided some opportunity for prosub activity.

"The last paragraph closes with the enjoinder that people who design and operate submarines and those who plan submarine operations should keep EW in mind. To this I add a hearty, "Amen," and the hope that perhaps even more emphasis on the submarine aspect of EW in this Book Review might help make this point."]

Vito Vitucci

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Pat Lewis

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The Naval Submarine League has obtained some very good colored pictures of nuclear submarines suitable for framing. They range in size from 8 1/2 x 11, 11 x 14, and 24 x 24. These photographs are available free to NSL members. The primary intent of this program is to judiciously distribute the photographs to locations where they will have a reasonably large viewing or to give them to individuals or organizations in return for their expressions of support. The photograph supply is limited but their effective use and distribution is part of the mission of the NSL. Additional supplies will be obtained if a positive feedback is received. Contact Pat Lewis with your orders.
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NAVAL SUBMARINE LEAGUE

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NAVAL SUBMARINE LEAGUE
Box 1146
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(703) 256-0891

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- Avenue to keep current on submarine issues
- Ability to contribute to public awareness of submarine capabilities
- Association with a dedicated group of people
- Invitation to Annual Meeting
- Forum for exchange of thought on submarine matters

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Persons residing outside the U.S. please remit additional $10.00 per year for mailing cost.

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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