THE

SUBMARINE REVIEW

JULY 1986

ARTICLES **PAGE**

A QUARTERLY PUBLICATION OF THE NAVAL SUBMARINE LEAGUE

openly discussed. We want our active duty members to find the REVIEW a professional and interesting medium. We also want it to fill other communication voids to our civilian and retired support family. Working together we can accomplish the above and carry out the NSL mission. There is no doubt of its need.

It is my pleasure to announce the formation of the Pacific Southwest Chapter under the leadership of Vice Admiral O. H. "Hap" Perry, Jr., UNS(Ret.). The Chapter will serve members in the states of California, Arizona, New Mexico, Colorado, Utah and Nevada and has an initial membership of 396 with 376 members residing in California. Hopefully, in time, a Northern California Chapter can be organized to allow more participation at chapter functions. Our sincere thanks also go to Bob Gautier for spark-plugging this effort.

Finally, I wish to convey the sincere gratitude of the NSL Directors for the superb services of the outgoing officers of the Hampton Roads and Nautilus Chapters. Dan Heflin and Bill Purdum have been very able, organizing, chapter presidents and have a lot to be proud of. We wish their successors Doug Blaha and Bo Bohannan every success in leading and expanding their respective chapters. The NSL is on the move and growing.

Chuck

P.S. Please read the letter you received from Rear Admiral Mike Colley, C.O. of the Navy Recruiting Command. The supply of eligible young men as NUPOC candidates is decreasing and it will be difficult to attain the needed numbers. The NUPOC program is the <u>best</u> college supplement program going but unfortunately few college leaders or counselors know about it. Please help push this vital submarine program.

FROM THE EDITOR

A purpose of the SUBMARINE REVIEW is to further the art of submarining. But should we be talking about a "skill" for operating submarines as an "art" rather than as a "science"?

Has not the advent of greatly superior technology in computers, nuclear powered submarines, long range sensors (including those satellite based) etc., changed submarining from an "art" to a "science"?

Seemingly, submarining today could fit into the definition of a "science", i.e. "a system based on scientific method and principles." It can be observed that today's war-simulating submarine exercises plus the scenarios used in systems analysis and computerized wargaming, appear to be amenable to "scientific method" -- producing a best kind of submarining. Seemingly, one has merely to crank into computers the best available computer-collated information on the enemy and the programmed computers can then spew out a best submarining solution -- based on programmed doctrine. Alternatives, responsive to questionable information, should also be made available.

Perhaps the complexity of today's technology forces the submariner to execute his skills in submarining through computer-aided decision making. Certainly, in today's peacetime environment, the computer-aided scientific method of submarining seems a best way to go, in general, for submariners.

How submarines are best operated in peacetime seems a relatively simple matter. Own submarine characteristics are well known. The potential enemy's characteristics and operating patterns are also seemingly well known. And the direction that a conflict will take is well guessed at. Hence, at the start of a conflict, "submarining" appears to be reducible to a "science". But from then on a seawar is likely to see many surprises both technological and tactical, while information on the enemy -- reliable or otherwise -- becomes scarce. This necessitates changes in our own submarine operating patterns -- if the history of past wars hold any lessons for today's submariners.

Interestingly, the former head of the Soviet Navy, Admiral Gorshkov, stressed a "first salvo" approach for the initiation of a seawar. His first salvo strategy appears well designed to produce a decisive effect, if successful, thus minimizing the effect of surprises on the further conduct of the conflict. This would tend to make changes in our own submarines' operating patterns -- after the start of a seawar -- merely academic.

But given an extended conflict at sea, it appears that submarining will revert to being an "art". As such, the development of submarining as an "art" seemingly involves a good deal of modernizing. This seems apparent from the existing suspicion that most of the submarine experiences of World War II -- particularly those involving creative tactics -- have little applicability to today's wartime nuclear submarine operations. And even the Soviets' "first salvo" initiation of a war is difficult to identify as another kind of Pearl Harbor.

Bringing the "art" of submarining up to date however, seems to have the same sort of continuity as the healing of people. Even the arts related to the humanities -- painting, music, writing, etc., with their radical departures over the recent decades -- nevertheless draw on the arts of the past, just as the art of healing today depends on medical lessons learned over many centuries.

Perhaps the meaning of "art" needs to be further clarified. The synonyms for the word "art" help understand its meaning: it's a "skill" which is derived from practice and knowledge; it's "cunning" which suggests ingenuity and subtlety in execution; it's an "artifice" i.e. a mechanical means for imitation; or it's a "craft" which relates to trickery or guile. But whereas "art" is all of these, it is even more. In its most distinct sense -- in contrast with these synonyms -- it implies "a personal, unanalyzable, creative power" to achieve the best results.

So what is the point in this grammar lesson?

Given that submarining is an "art", which the submarine successes in both World Wars I and II seem to confirm, the influence of a "creative power" in breaking away from peacetime-established doctrine is inherent to many of the big payoffs achieved by individual skippers. They exhibited craftiness, use of artifice, guile, cunning and particularly innovation against a competent enemy. But being innovative is not something an individual -- particularly a skipper of a submarine -- just turns on after the start of a war. The innovator is one who has a flair for innovation (and this should be a big plus in an individual's selection for the submarine service), has been nurtured in his profession by encouragement, has learned to take the risks which are likely to be involved, and has learned to balance those risks against the possible rewards or penalties. (If only penalties are indicated for innovation, the creative powers of an individual are likely to disappear.)

Innovation doesn't come without risk taking.

To summarize: submarining is a unique profession within the military profession in that, for the most part, each submarine skipper is isolated from external command. He can thus exercise his creative power with little or no interference in practicing his "art". A skipper's mind can efficiently over-ride the best of his computer solutions, and that's when -- according to past experiences -- the greatest successes are achieved. Recognition of submarining as an art and preparing individuals to best practice that art, may be the best way for the creative American individual to assert the expected dominance in this field of military endeavor.

MARITIME STRATEGY IMPLICATIONS FOR THE FLEET SUBMARINE

Between the world wars arms control treaties contained clauses restricting the use of the submarine against merchant vessels. In the Atlantic, the revolutionary submarine was expected to play at best an auxiliary role in the grand actions between battle fleets.

In the Pacific, the U.S. faced a different set of circumstances, and as early as the end of the First World War, submariners pushed for a submarine built to meet them.

The Navy committed itself to producing such a submarine. But not until the mid-1930s did a submarine capable of the performance the developers had in mind actually put to sea.

By 1919 the attention of naval officers in Washington had turned to the Pacific, where they expected sooner or later to be required to defend American interests against a military challenge from a restless and ambitious Japan. Captain Thomas C. Hart, head of the Navy's newly created Submarine Section, argued that in the event of a Pacific war, "the submarine will be an extremely valuable weapon for ..... operations against Japanese commerce. There is no quicker or more effective method of defeating Japan than the cutting of her sea communications."

But in 1919, U.S. submarines could not have performed such a mission. The American submarines of the First World War -- small, cramped and unseaworthy -- had barely been up to operating in the narrow seas around England. The postwar S-class submarine marked something of an improvement, but it was slow, limited in range, and alarmingly susceptible to accidents.

Indeed, an expedition meant to demonstrate the utility of the submarine in the defense of the Philippines wound up exposing the inadequacies of the Navy's most advanced operational vessel. On 31 May, 1921, Captain Hart put to sea from New London, Connecticut in the submarine tender BEAVER, bound for Manila in the company of 10 S-boats, a voyage he had proposed as chief of the Submarine Section 18 months earlier. Struggling after the BEAVER in a manner of ducklings pursuing their mother, strung out for a hundred miles on the surface of the sea in which no enemy lurked, bedeviled by frequent breakdowns, the S-boats barely passed a test far less severe than what they could expect to meet in wartime. Hart's voyage made clear that any submarine capable of finding employment in the Western Pacific had first to be capable of getting there.

Since before the First World War, younger submarine officers had urged the building of a fleet submarine -- a powerfully armed boat of great range, excellent seakeeping qualities and fast enough to act in concert with the battleship squadrons that composed the main striking power of the fleet. As Lieutenant Chester W. Nimitz had confidently predicted in a 1912 article: "The steady development of the torpedo together with the gradual improvement in the size, motive power, and speed of submarine craft of the near future will result in a most dangerous offensive weapon, and one which will have a large part in deciding fleet actions."

The fleet submarine had been conceived with Atlantic operations in mind. But in 1920 the Navy's Director of Plans advised the Chief of Naval Operations that "the design of our (submarine) craft should be such as to meet the conditions that will exist in a Pacific campaign."

The vast expanse of an ocean nearly empty of repair facilities demanded that an American submarine be designed with an eye to self-sufficiency. Japanese control of the Western Pacific would in all likelihood preclude an early challenge from the U.S. fleet. But a submarine capable of operating alone would have a good chance of eluding enemy naval forces and bringing the war to Japan's home waters. Such a weapon, a young submariner explained to the General Board, would be "able to lie off the enemy's ports and sink what shipping we could .....whether merchantmen or men-of-war." Indeed, the War Plans Division already envisaged for the submarine a vital strategic role in the event of a war with Japan. "Such an economic blockade," its 1920 memorandum concluded, echoing Hart's views, "would probably be the only way in which we could exert decisive pressure upon the enemy ...."

A speed of at least 21 knots on the surface had been regarded as the essential requirement of a genuine "fleet" submarine. But independent operations in the Pacific would require such qualities as long cruising radius, ruggedly designed machinery, ample stowage for ammunition and supplies, and habitability; but speed would need to be sacrificed to get them. Reducing the rate at which a submarine burned fuel, for instance, would increase its cruising radius. In fact, an ability to cover the great distances of the Pacific mattered less than an ability to keep the sea for long stretches of time. (In terms of fuel consumption, these qualities amounted to the same thing). For the longer a submarine kept station near an enemy's lines of communication, the more likely it was to encounter targets of opportunity in the shape of enemy merchant vessels.

How fast did the submarine in question need to be? According to experts in the Bureau of Steam Engineering, it required only "sufficient speed to overhaul the average merchantman or to escape from a heavily armed naval auxiliary." Sixteen to 18 knots, instead of the suggested fleet submarine's 21, were enough.

Trading three knots in favor of other qualities had immensely important implications. Conceived as an auxiliary to the battleship, the fast fleet submarine conformed to the ideas of Alfred Thayer Mahan, the strenuous advocate of concentrating force with a view to decisive engagement with the enemy fleet. Submarines made self-sufficient at the expense of speed, however, could be pressed into service of an entirely different strategy; the dispersal of force, characteristic of commerce-raiding, the "guerre de course" that Mahan had disdained.

A submarine capable of operating against Japanese seaborne commerce in the manner that submariners prescribed, remained a submarine of the imagination well into the 1930s. Important technological problems had to be resolved before such a vessel actually put to sea. Resolving these problems was complicated when the General Board recommended in 1921 that the development of naval aviation, a far more glamorous and open pursuit than the secret and furtive-seeming work of the submariners, be given priority over the submarine. And in a navy that continued to be dominated by battleship sailors, whatever the pretensions of aviators, guerre de course exerted considerably less appeal than the grand fleet actions dear to Mahan. Finally, national policy came to exclude the strategy advanced by Hart and other students of a Pacific war from the uses submarines could be put to.

The 1921 Washington Naval Conference had consequences that seemed to enhance the potential strategic value to the United States of conducting restricted submarine warfare in a Pacific campaign. The United States and Great Britain agreed not to improve the fortifications of their naval bases in the Western Pacific. As none of the American bases in the Philippine Islands, Guam or the Aleutians were adequately fortified, Japan's position in the Pacific region was greatly strengthened. The threat of an early American fleet intervention in the event of war with Japan was virtually removed. For all its firepower and mobility, the battle fleet at sea required massive logistical support from the shore, from bases relatively close at hand. But after 1922 the one major fortified naval base allowed the United States in the Pacific was Pearl Harbor, 4,850 miles from Manila and 3,400 miles from Tokyo Bay.

But the long-range submarine was meant to be free both of such impediments as encumbered the movements of the fleet and the circumstances that, in the wake of the Washington Conference, vastly complicated the making of war plans. Free of dependence on heavily fortified naval bases, able to avoid detection in enemy-controlled waters, the long-range submarine would be able, without delay, to take the war to Japan.

Designers and builders of warships have not always paid much heed to the opinions of the men who sail and fight them. Between the wars, however, submarine officers themselves exerted a considerable influence on the design and construction of the fleet submarine. That the most experienced submarine officers continued after 1922 to advocate building a long-range submarine does not mean that they set out deliberately to build a weapon incompatible with the rules of submarine warfare, or to circumvent the war plans of their own navy, which conformed to these same rules. Such considerations as naval professionalism, the challenge of problem-solving and a concern for their own safety, were all more likely to have influenced the submariners' recommendations on submarine design than an urge to meddle in policymaking.

The first of the new submarines completed sea trials and joined a Navy still committed to War Plan Orange as its strategy for war in the Pacific. A 1934 memorandum on implementing the Plan instructed the Blue (U.S.) commander in chief "to operate submarines in accordance with the same international laws as are applicable to surface vessels." Submarines were to act in support of fleet operations, especially against larger enemy warships, to watch the harbors of the Japanese Mandated Islands in order to be able to report enemy fleet movements, and to defend Pearl Harbor -- duties that all appeared to conform to the rules on submarine warfare. The 1936 version of Plan Orange continued to prescribe for submarines the roles of watching enemy harbors, operating against the enemy fleet, and defending Pearl Harbor. The submarine force carried out these missions in tactical exercises with the fleet.

By 1939 the Navy was able to put to sea essentially the submarine that most submariners had advocated since 1919. "The radical increase in performance characteristics built into submarines now reporting to the Fleet," Rear Admiral H. G. Bowen, chief of the Bureau of Engineering, assured the CNO in January, 1939, "represents an advance over anything previously attempted ..... That these vessels have successfully passed trials and performed long shakedown cruises without serious derangement is a tribute to the inherent correctness of their design." Such submarines were easily capable of mastering the conditions that had nearly defeated Hart's arduous expedition of 1921.

This history of submarine development between the world wars suggests that when the authorities find in their hands a weapon system that promises to make the waging of war more efficient, they will use it accordingly.

[This article was digested from Professor John E. Talbott's prize-winning historical article, Weapons Development, War Planning and Policy: The U.S. Navy and the Submarine, 1917-1941 in the Naval War College Review, May-June, 1984.]

CONCENTRATION OF FORCE BY SUBMARINES

"Concentration" is a basic principle of warfare. At sea, in the past, it implied a "massing" of warships in close groupings in order to destroy specific enemy ships through a concentration of weapon fire. Then, with the advent of aircraft as weapon-delivery platforms, concentration was additionally achieved through a massing of aircraft over a battle area in order to overwhelm enemy targets by means of closely spaced attacks.

"Concentration" and "massing" have tended to be synonymous as a "principle of war".

With the advent of long range, terminal-homing antiship missiles, however, concentration of naval power has become achievable, not by the close massing of weapon-firing platforms, but by means of widely dispersed firing platforms which through coordinated weapon-fire can have their missiles "massed" at their targets -- achieving the effects of concentrated weapon force. Aircraft as well as ships and submarines can provide this form of concentration by attacks from several quadrants -- properly timed. Significantly, this "massing" of weapons can be against land targets as well as targets at sea.

A new form of "concentration" or "massing" at sea has developed.

Less easily recognized is how nuclear submarines with their great submerged mobility have a capability to produce concentrated torpedo fire -- and with a high element of "surprise" (another principle of war). Nuclear submarines can be "massed" for torpedo attack -- as well as for missile attack, just as surface warships of the past were tactically maneuvered to concentrate their weapon fire on major targets. A group of nuclear submarines, with their inherent covertness in attack, can thus provide a new quality of "concentration", significantly different from that offered by the wolfpack tactics of World War II.

This concentration of force, even if only conventional explosives are used, is achievable with long range "smart" missiles and guided torpedoes. It can have an overwhelming effect on enemy defenses, along with a far higher level of destruction and shock effect on an enemy's combat organization. Decisiveness in a sea action in a greatly compressed period of time, becomes likely. Thus, winning a sea battle in a single strike action appears to be possible.

Although a new kind of "concentration of force" through the use of missiles is produced by a form of air power, it is not identical to the concentration of weapon force achieved in WW II by the sequential attacks of manned aircraft -- using the aircraft's organic targeting capability. Nor would submarine wolfpack attacks of WW II -- with their organic selection of targets and use of short-range torpedoes -- tend to resemble the coordinated attacks of several nuclear submarines against pre-selected designated targets.

To understand how concentration of force has been achieved in sea battles of the past -- so as to appreciate the basic differences which emerge from the use of today's technology -- a brief look at several classical engagements appears appropriate.

"Concentration of Force" in the Past.

At Trafalgar in the Napoleonic Wars, the British ships-of-the-line under Lord Nelson's command were maneuvered to concentrate their gunfire on the two main flagships of the enemy. The closely grouped lead-column of British ships, with VICTORY of 100 guns and TEMERAIRE and NEPTUNE of 98 guns each, headed for the French flagship BUCENTURE to take her out of action. A second and lee-column of British men of war, led by ROYAL SOVEREIGN, maneuvered "to pass through the enemy line at the 12th ship from the rear" -- making the Spanish flagship SANTA ANA the target for the concentration of broadsides from the column of ships moving past her. The success of this British tactic to concentrate its weapon force on the major targets of an enemy's fleet established the British as the sea power of the world for more than a century.

In WW II, the classic "capping of the T" was effected at the Battle of Jutland by the main battle line of the British Grand Fleet. Crossing ahead of the oncoming German High Seas Fleet battle line, many of the British battleships were able to concentrate their gunfire against the lead ships of the German fleet -- forcing the seriously damaged German dreadnoughts KONIG and GROSSER KURFURST -- in the van of the German column -- to turn away. The poor accuracy of the British big guns which were used at very long ranges, resulted in only a low level of concentrated force on their targets, with consequent indecisive action.

At the Battle of Midway, in World War II, a new type of concentrated force was applied by manned aircraft. They were "massed" to deliver their short range weapons -- bombs, torpedoes -- in closely spaced sequential attacks. At 1024 on the morning of 3 June, 1943, seventeen dive bombers from YORKTOWN attacked the Japanese carrier KAGA and scored four bomb hits. Thirty three more dive bombers from ENTERPRISE obtained three bomb hits on both the AKAGI and SORYU. The fires created by the U.S. fragmentation bombs in use caused fatal damage to all three carriers. Later in the day, a final flight of U.S. dive bombers sank the HIRYU. About 17 planes per strike group -- each delivering a 1,000 pound bomb in quick succession -- wiped out all of the Japanese carriers in a decisive engagement lasting only a few hours.

Today, manned aircraft with standoff guided weapons should be able to provide an even higher level of concentrated force and over a shorter span of time. But the increased hazards to aircraft, causing high attrition of attacking units, plus the likelihood of the aircrafts' smart weapons being countered by electronic warfare measures, may seriously dilute the number of weapons arriving on target -- despite a "massing" of air platforms for an air attack.

The expendable, long range guided missile, however, if "massed" on high value targets, and delivered with a high element of surprise promises a heavy concentration of force which is not easily countered. And this concentration of force can be effected by only a few missile-firing nuclear submarines.

<u>Concentration of Force by Nuclear Submarines, Today</u>

It must be emphasized that a new quality of "concentration" in sea warfare is achievable by nuclear submarines and not by conventional submarines. It is the covert, mobility of the nuclear submarine which is essential to this quality, along with weapons which complement these nuclear submarine characteristics to produce "surprise" in attack. Thus a viable "concentration of force" -- in today's electronic warfare environment -- depends first on the capability of the nuclear submarine to covertly gain a favorable weapon-delivery position and then project weapons which in their trajectory are so covert that their target is given little warning of their attack -- making the countering of such weapons virtually impossible.

Spelled out, this implies a nuclear submarine capability to quietly close (while at the same time not producing detectable non-acoustic signatures) a weapon launch position. Then, missiles of low, radar cross-section can be put in trajectories where they are not likely to be detected until they are very close to their target. Similarly, torpedoes can be employed which are so quiet (and without significant non-acoustic signatures) and sufficiently fast, that they can intercept targets with little advance warning.

Importantly, whereas submarine-launched long range cruise missiles appear to complement reasonably well the nuclear submarine's capability to concentrate force on enemy targets (and they do have good utility today) in actuality they appear to have been developed for use by conventional submarines. Their range, programmed guidance and terminal-homing features indicate the use of such missiles from a submarine platform of low mobility and one which is likely to alert an enemy target well in advance of a missile's arrival if an attempt is made to develop a tracking solution and close the range over a considerable period of time. The built-in counter countermeasures in today's missiles would also indicate a belief that the element of surprise is likely to be compromised and hence complex organic electronics are necessary to ensure a hit. As designed, the long range cruise missile is a weapon of opportunity which must be launched despite little tracking data on an initial contact -- since it is seemingly believed that a failure to attack quickly will result in a lost opportunity. This is a reasonable conclusion for conventional submarines but not nuclears.

This anomaly in submarine weapons is more easily recognized in the torpedoes in use and those planned for the near future. The present high-speed, noisy, electronically complex submarine torpedoes are so designed because it is assumed that the firing platform cannot readily gain a good attack position, and that attempts to do so will tend to compromise the submarine's covertness and facilitate an enemy's electronic countermeasuring of the torpedo. It is the low mobility of the conventional submarine which is being reflected in these torpedo characteristics. The conventional submarine has great difficulty in attaining a favorable attack position without being detected, hence a high speed torpedo gives the best chance for attack success -- though the probability of hitting is probably low where electronic countermeasures can be brought into play. Thus, the feasibility of concentrating force with such a combination of platform and weapon appears to be so poor that "concentration" by submarines has not been emphasized.

The ASW standoff, missile-carried torpedo or depth charge is also premised on a firing platform which must launch on a distant contact because it is presumed that the firing platform has such low mobility that the initial contact cannot be developed and hence rapid attack is therefore necessary -- or the opportunity lost. A nuclear submarine, however, can develop a long-range contact through several regained contacts until, at shorter ranges, the probability of weapon kill becomes reasonably high -- and this can be done without alerting the enemy target.

Importantly, "concentration of force" is a quality to be developed further in nuclear submarines because of their great promise to dominate sea warfare. But, complementing weapons and the development of supporting systems are necessary to realize this potential.

Submarine concentrated force is dependent upon a synergism of broad ocean surveillance systems as well as reliable long range communications, highly accurate geographic positioning and external command and control for coordinating the actions of several submarine firing platforms. Surveillance systems include SOSUS, radar and Elint satellites, electronic intercept vessels, (AGIs), observant fishermen, etc. Satellites play a major role in geographic positioning and satellite communications as part of a redundant network of communications are necessary to provide the command and control which makes possible a level of concentration of force which can produce decisive results in a sea action.

These systems make possible the coordination of submarine firings so that weapons from several submarines or from submarines in concert with other weapon-firing platforms can be "massed" against major enemy targets, while producing a high element of "surprise" in weapon attack. In the case of missiles, a low trajectory after submarine launch along with sea-skimming in the terminal-homing phase of flight, tend to ensure that their detection is likely to be only in the last few seconds before arrival at an enemy target. In the case of torpedoes, the antiship torpedoes which are quiet and of relatively high speed in their trajectory can also be effectively "massed" against high value targets through the coordinated tactical maneuvering of several nuclear submarines. (Noisy antiship or antisubmarine torpedoes in an environment of enemy electronic countermeasures are likely to produce a diluted "massing" of weapons on targets.)

"Surprise" in weapon attack, it should be noted, is of considerable importance where weapons are dependent upon electronic guidance -- because with ample forewarning of their approach, an enemy target using EW measures has a good chance of decoying or destroying the attacking weapons.

Why be interested in a "massing" of weapons against enemy submarines when a single torpedo hit can do the job on a single submarine. For one-on-one situations, "massing" is evidently of little importance. But for situations involving groupings of enemy submarines or groupings of enemy submarines in company with surface units, a "massed" attack by several nuclear submarines may be the only way to come out of the engagement as a winner. The likelihood of initial success by a single covert submarine against a group of enemy submarines, should be good. But the ultimate result is likely to be a form of suicide. For a submarine navy which is greatly outnumbered by their enemy, this sort of attrition might be too costly as to its ultimate effect on a war.

Attaining a submarine capability to concentrate force against an enemy combination of forces -- using torpedoes -- is somewhat hampered by the risk of collision between friendly submarines, the possibility of attacking own forces, the susceptibility of torpedoes to be countered, the need for long-range relatively secure submerged communications and the wherewithal for an adequate command and control activity which can coordinate several nuclear submarines in their concentration of torpedo force. Significantly, having this operational capability should be greatly assisted by the need of an enemy grouping of submarines for their own underwater communications, IFF measures, and doctrinal patterns of operations -- all of which tend to make the enemy's operations overt and more vulnerable to torpedo attack by several coordinated submarines.

On the other hand, the capability to concentrate missile force on a grouping of enemy ships should be far more easily attained. Stand-off delivery ranges are likely to be at least ten times greater than for torpedoes. The risk of collision with own forces should be virtually non-existant. Delivery of weapons should be from geographic quadrants designated by an external command authority. And, evasion-safety after firing should be easily solved by doctrine. IFF for individual friendly submarines is less likely to come into play in such situations. Even the missile-carried ASW standoff weapon should produce a simplified capability for concentrating ASW force against a grouping of enemy submarines.

Increased standoff weapon-delivery range seemingly tends to increase the submarine concentration of force rather than dilute it -- contrary to use of concentrated force in the past. Even long-range covert torpedoes should produce this result.

The most interesting and probably the most decisive use of submarine concentrated weapon force can result from a near-simultaneous use of missiles at long range against major targets, coordinated with torpedo attack from other nuclear submarines -- much closer to the same targets. The damage accruing from missile attack will tend to assure torpedo hits -- even with torpedoes which normally might be countermeasured by the enemy. And, torpedoes proved to be, in World War II, the most efficient weapons for sinking ships.

Summary

As appears evident today, the use of "concentration" -- a "massing" of torpedoes or missiles -- is uncertain and fragile in seawarfare. But the payoff in decisive results could be great, if such kinds of attacks were put together with a good element of "surprise" being generated. Enemy defensive efforts against the concentration of force generated by several nuclear submarines might initially prevent a decisive effect from being achieved by coordinated attacking submarines. But, as at Midway, follow-on strikes with missiles or torpedoes, are likely to encounter exhausted enemy defenses which then permit the destruction of the submarine weapon-targets. Or, as at Trafalgar, the enemy is caused to "strike-her-colors" and submit to mop-up operations.

The "principles of war" dictate an appreciation of the potential of the nuclear submarine as a major player in determining the outcome of a sea war.

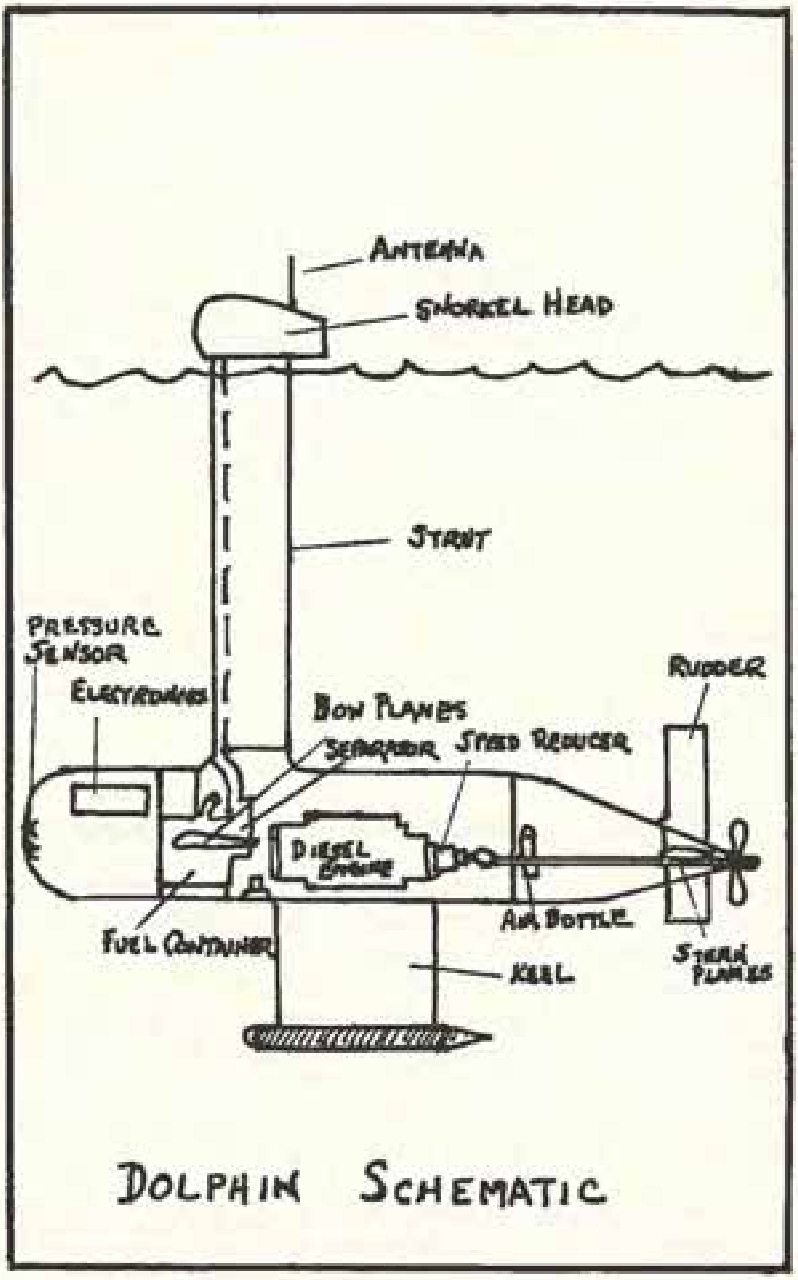
Phoenix

DOLPHIN -- AN AUTONOMOUS SEMI-SUBMERSIBLE

[Ed Note: In the October, 1983 SUBMARINE REVIEW, a design for a 54-knot manned semi-submersible -- to be used for ASW missions -- was described. In the April, 1986 REVIEW, several kinds of autonomous unmanned submersibles were suggested for a wide variety of missions. The DOLPHIN described here, combines both kinds of concepts into an existing, practical vehicle for an important mission.)

The DOLPHIN (Deep Ocean Logging Platform Instrumented for Navigation) has been produced by the Bedford Institute of Oceanography -- with five

Dolphins now available for mapping the ocean floor.



DOLPHIN SCHEMATIC

The DOLPHIN is a semi-submersible (see illustration) capable of making 15 knots in order to maintain a 12-knot bottom survey speed for at least four hours. However, its endurance has proved to be about 20 hours. It is powered by a 120 hp marine diesel, and can stably operate continuously in 10-foot breaking seas -- which have a minimum period of six seconds. Control of the DOLPHIN is by a UHF radio link within a line of sight range of up to about 10 km. Its diameter of 39 inches, length of 19.5 feet and displacement of about 2.5 tons are adequate for carrying remotely controlled echo sounders, positioning systems and control systems for this semi-submersible.

As shown in the illustration, the radio antenna receives command data and telemeters data back to a control console on the mother ship conducting the bottom survey.

The snorkel head of fiberglass contains a float valve which prevents the ingress of water if a wave washes over the top of the snorkel mast at any time.

The snorkel mast or "strut" is about 3 hull-diameters in length, making the running depth at least 3 meters and causing the wave-making resistance of the submersible to become negligible.

The verticle distance between the center of buoyancy and the center of gravity of this submersible is .45 of the diameter -- creating adequate static stability. This equates to 17.5 inches for the 39-inch diameter hull and is achieved through the use of a lead keel of 550 Kg weight.

There are five compartments: forward ballast; fuel tank; sealed engine-room; rear ballast; and engine exhaust and tailshaft.

The strut is fitted with rotating faired segments which are necessary in order to maintain hydrodynamic stability during turns at high speeds. The bow planes operate independently of each other and are used for roll and pitch control. The DOLPHIN is designed for a maximum depth of 60 meters.

Commands from the operator on the mother ship to the semi-submersible are received by the onboard radio-receiver which feeds directions into the DOLPHIN's control systems. Command signals include operational depth, heading, and vehicle attitude, both in terms of pitch and roll.

Sensors shown at the upper left of the diagram measure the position and heading of the vehicle, and signals from the sensors are compared in the central microcomputer with the commands from the radio. Error signals are generated as a result and actuate the electro-hydraulic valves which control the hydraulically operated planes and rudder which control the vehicle. In order to ensure stability, rate of change signals, derived from sensors and from error signals, are mixed with the error signals so as to provide damping. Finally, the positions of the hydroplanes are measured and fed back so as to give proportional control.

The depth of the vehicle is measured by a pressure sensor which is mounted in the nose of the vehicle and fed from ports located at points on the nose such that venturi effects have no impact on the pressure measurement. A vertical velocity signal is generated from a vertical accelerometer, the signal from which is integrated. The depth error signal, controls the forward hydroplanes acting in unison; these hydroplanes are located at approximately the centre of mass and centre of pressure of the vehicle.

Roll of the vehicle is measured by a pendulum inclinometer mounted in the vehicle, and the output is used to control the forward planes differentially. The pitch of the vehicle is measured by a second pendulum inclinometer, the output of which controls the rear hydroplanes. The rudder is controlled by the output from a directional gyroscope which measures the heading of the vehicle.

Other functions on the vehicle are operated by direct command. The operator can send a signal which directly operates a small motor driving a lead screw which slowly opens or closes the throttle of the engine thereby giving a direct control of speed. The ballast tanks are controlled by valves which allow air to vent from the tanks and other valves which blow air from the high pressure air supply into the tank. All of these operations are directly operated via the radio link.

A number of safety features are incorporated into the vehicle. They range from relatively simple devices such as automatic engine shut-off (in case of overheating or lubricating oil failure) to sophisticated routines to stop the engine, set the hydroplanes to climb, and blow the main ballast tanks (in case of malfunction of radio control link, excessive water level in the engine room, etc.). If, because of some malfunction, the vehicle descends accidentally to a 10 metre depth the automatic stop-routine is triggered; as a further safety precaution, if the vehicle reaches a depth of 20 metres, an emergency valve is opened which blows high-pressure air directly from the air supply into the ballast tanks.

The operator controls the vehicle and is kept informed of its performance by a command console. The console is based on an IBM personal computer and a series of controls are provided for the various functions listed above. A joystick control operates the heading by moving it laterally. When the joystick is left in its central position, the vehicle continues on a constant course. The depth of the vehicle, the engine speed, and the static angles of pitch and roll have continuously variable controls whilst functions such as venting air from the ballast tanks are controlled by on/off switches.

All the data are converted to an appropriate digital form for transmission to the display console.

First tests took place in Indian Arm, a fjord near the ISE factory at Port Moody. When initial diving trials, controlled by the operator, were carried out, a technique for automatic control was developed in which the required depth was set on the control console, the ballast tank flooded and the engine speeded up, whereupon the vehicle dived automatically to the correct depth. At the end of the dive, throttling back resulted in DOLPHIN surfacing gently as speed diminished to zero.

During sea trials it was found that when DOLPHIN was running into seas, it ran on a horizontal line and the waves had no effect on its vertical position but when running with the seas it tended to follow the water surface. This is not serious as adjustments are built in to accommodate the effects of vertical movement.

Initially, just over 14.5 knots was achieved but the design speed of 15 knots was achieved by means of a redesigned propellor. Radio interference caused by equipment on the mother ship CSS BAFFIN interfered with the control transmission but this was cured with an antenna filter.

Once all DOLPHINs have been delivered to the Bedford Institute of Oceanography, a continuous programme of mapping all year round will be possible. Conditions can be extremely difficult and the stable platform provided by DOLPHIN will give increased accuracy and greater endurance together with reduced manning requirements.

DOLPHINs fitted with 220hp British Sabre engines are under test at sea. These will provide a further dimension to the use of high speed asymmetric, dynamically stabilised vehicles to be used as instrument platforms.

[This article was digested from one prepared by the Bedford Institute of Oceanography for Underwater Systems Design -- March/April, 1986.]

THE "K" BOATS - "K" as in Calamity.

This is a story about a class of steam driven submarines the British laid down in 1915. Seventeen of the "K" class were commissioned. At that time and for long after the first world war the existence of this class was a closely held secret. They were by far the largest, the fastest, and the most technologically advanced submarine of that time.

The "K" boats were almost equal to our Fleet boats of WW II, but the "K" boats could make 24 knots on the surface while the top speed of the Fleet boats was about four knots less.

This speed was made possible by a power plant of 10,000 horsepower,about half again that of any submarine until the Nautilus, some forty years later.

The "K" boat had two steam boilers, two geared turbines, a large battery and four electric motors. As a most fortunate afterthought, a small diesel engine was added which enabled many of the boats to get home when the boiler room was flooded.

This power plant was a brilliant design for a surface ship. But for a submarine there were just "too damned many holes". There were two funnels, each five feet high, two feet in diameter and hinged to lie flat when submerged. In addition there were four air intake holes of over three feet in diameter.

The valves for these holes were operated mechanically, a tremendous advance in the "state of the art", but one for which there had been no operational experience.

Admiral Jackie Fisher, the First Sea Lord at the time the "K" boats were being considered, wrote "The most fatal error imaginable would be to put steam engines in a submarine." But technology was in the driver's seat at the Admiralty. The apparent need for a fast submarine to support the fleet overcame all arguments Jackie Fisher and the submariners could muster.

Prior to 1910 the French had built thirteen steam submarines with reciprocating engines. Jane's Fighting Ships commented on this class: "Their great defect is that a great deal of inconvenient heat is given out when they submerge and the actual time of submergence is rarely under 12 minutes." The diving time of the later "K" boat was just under 5 mimutes in contrast to one minute or less for diesel submarines.

No one was more convinced that a steam submarine was a stupid idea than the stoker in the boiler room. He stood watch no further than a few feet from the boiler. The heat and the noise were a taste of hell.

In any kind of sea the stoker wore oilskins to protect himself from the great quantities of water that poured down the ventilators. Often this water caused flarebacks which killed several stokers and singed eyebrows on most of the others and flooded boiler rooms caused many unexpected dives. Several "K" boats had boiler room fires from the oil that floated on top of the water.

At the sound of the diving hooter the stoker shut off the oil to the boilers, stopped the fans and pumps, and lastly clambered over the boiler to shut off the steam. Then, in a state of collapse from the heat, he staggered through the twin doors of the airlock and sealed off the boiler room.

The large flat foredeck of the K-boat tended to cause it to dive unexpectedly when at high speeds in heavy seas. It also caused a loss of control when diving.

As a boy of 18, the future King George V was taken for a dive in K-3 soon after it was commissioned. Control was lost as the boat submerged in 150 feet of water. The bow dug into the bottom and the tail rested well out of the water with the screws spinning. After 20 minutes the boat was able to free itself and come to the surface. Luckily the water in the North Sea was shallow. Otherwise the K-3, as well as many other K-boats would have been lost in uncontrolled dives.

Soon afterwards, K-3 was again embarrassed. While steaming at ten knots with a fresh breeze on her beam she shipped water down the funnel. This extinguished both boilers and before the vents could be closed the boiler room was filled with water. She returned to port on her diesel engine.

The Admiralty attributed this casualty to "personnel error" and stated that repetitions would be prevented with "experience gained." The Admiralty was so committed to the "K" class that design faults were never admitted -- it was always human failure. Correction of critical weaknesses were not considered, while many boats and lives were lost in repeated but correctable casualties.

However, there was one instance where the Captain was not considered at fault. The K-4 was on an anti-submarine patrol in the Orkneys. To protect his boat from the heavy seas the Captain took refuge in a cove. The awkwardness of the K-boat caused it to go aground. But the Captain later testified that a rat had eaten the relevant part of his chart -- and he got away with this excuse.

The "K" boats were classified as "submersible destroyers." They were fitted with depth charges which were never used.

In addition to depth charges they carried four bow and four amidship torpedo tubes with two more tubes topside in the superstructure. On the main deck were two four-inch guns and one three-inch gun for anti-aircraft firing -- a respectable armament even for a destroyer of that time.

The "K" boat was designed to be a tactical unit of the Fleet. In a battle between two fleets the K-boat was to use its high speed to get ahead of the enemy fleet and dive for attack.

This appeared practical for war games, but in the real world the limitations of the "K" boat made this an expensive non-solution. In fact the only time a "K" boat engaged the enemy in World War I was in an attack on a "U" boat when its torpedo hit but did not explode.

The "K" boats were said to "have the turning radius of a battleship, the speed of a destroyer, and the bridge of a picket boat."

Towards the end of the war, the misfit between the K-boat and other units of the Fleet was illustrated in living color in what was to be known to the submariners as "The Battle of May Island."

A practice deployment of the Fleet was ordered on 31 January, 1918. Part of the fleet was to deploy from the Firth of Forth. This detachment consisted of three battleships, four battle cruisers, some 25 destroyers, and two Flotillas of "K" boats. In all there were forty ships in a line ahead formation that stretched for 30 miles. There were four boats in one submarine flotilla and five in the other. Each flotilla had a light cruiser as its flotilla leader. Ships were stationed 400 yards apart and speed in the channel was 16 knots. The flag was in the lead ship, a cruiser. Astern was a flotilla of submarines which was followed by a squadron of battle-cruisers, then another flotilla of submarines and finally a squadron of battleships. The larger ships were surrounded by destroyers.

Deployment started after dark. That afternoon a seaplane had sighted a submarine off May Island which was at the harbor entrance. The flag ordered speed to be increased to 22 knots after leaving the harbor defenses.

All ships were darkened except for a blue stern light -- to be shone at half brilliance. Soon after departure a light mist decreased visibility to a point where seeing these blue lights was a sometime thing.

As the first flotilla of submarines left the harbor defenses their speed was increased to 22 knots. Immediately afterwards the navigation lights of several unknown ships were suddenly seen dead ahead of the leading "K" boat. These unknown ships were actually a formation of mine-sweepers which had not been informed of the fleet deployment.

The K-17 went 'hard a starboard.' The rudder jammed and remained jammed for 6 minutes. Navigation lights were lighted and after the rudder was free the K-17 attempted to rejoin the unseen formation. However in the mist K-17's running lights were not seen by K-22 until too late and she rammed the 17.

Both ships flooded forward. A message was sent out and signal flares were fired continuously. But with no effect. Fifteen minutes later the battle-cruiser squadron roared down on the two sinking boats. One destroyer passed but 10 feet from the 22. That was soon followed by a battle-cruiser which swung to avoid but hit K-22 with her stern. Thirty feet of tanks were swept off the K-22 but she was able to remain afloat.

Twenty minutes after the first collision, their flotilla leader, the cruiser ITHURIEL, had finally decoded their distress message and, with the remaining three subs following, turned back to the area of the collision. A message was sent to the oncoming battle-cruisers -- but for some reason this was never received.

ITHURIEL and her subs actually steered head-on to the battle-cruiser formation. Eventhough the ships were passing each other at forty knots in low visibility, by some miracle and much weaving there were no collisions.

Following the battle-cruisers came the other submarine flotilla led by the cruiser FEARLESS. They also had no knowledge of the situation. FEARLESS saw navigation lights of unidentified ships ahead but these indicated that FEARLESS had the right-of-way. FEARLESS kept her course and speed until it was too late. K-17 was trying to change course but her sluggish turning circle was just not adequate. At the last minute FEARLESS tried to avoid but her bow went deep into the K-17 just forward of the conning tower. K-17 sank seven minutes later. FEARLESS was followed by K's 4, 3, 6 and 7 in that order. Each was unaware of what was happening. When FEARLESS stopped, K-4 slowed, turned on navigation lights and swung to port. The next ship, K-3, also came left and barely missed K-4. The third ship astern, K-6, turned right to avoid K-3 and rammed the unseen K-4 with such force that her bow was locked in K-4's hull. As K-4 sank it was carrying K-6 down with her. At the last moment K-6 wrenched herself free. (Serving on board K-6 was Midshipman Lord Louis Montbatten who later had other experiences with sinking ships.) Next in line, K-7, swung right to miss K-6 but ran over the spot where K-4 was sinking. K-7 was able to miss the conning tower, the only part of K-4 still showing, but scraped over the sinking bow.

As the battleships and their destroyers went through this area at 22 knots there were several near misses but no more collisions. However many lives were lost as ships ploughed over the spot where survivors were in the water.

The Court of Inquiry placed total blame on five of the submarine captains. The Captain of K-22 was held responsible for being rammed by INFLEXIBLE because the K-22 lay on INFLEXIBLE's track. This in spite of the K-22 being partially flooded and standing by the K-14.

At this point, work was stopped on the eight remaining K-boats. But technology was still in the driver's seat. Three of the hulls were completed with diesel engines and each was fitted with a 12-inch battleship gun. They were named the "M" class and called "submersible monitors."

Jane's Fighting Ships reported: The gun is loaded and laid to a high angle. The boat is then dived 12 to 20 feet leaving the muzzle above water. There is a bead on the gun's muzzle so that the gun can be sighted by periscope and fired. Reports are not available on M-1's operations so that its performance is a matter of conjecture."

Of the 20 "K" boats, which includes the three converted to "M" boats, one sank on trials, four were lost in collisions, two disappeared and one sank alongside a pier. There were sixteen major and countless smaller accidents. The loss of life was appalling.

In summary: No opportunity came to test these ships as a tactical unit in war. Many were the times they went to sea with the Fleet and as far as keeping up with the big ships and taking tactical positions they were an unqualified success. But it must be remembered that the K's were asked for by the Grand Fleet; they were not a product of the submarine branch nor were they the submariner's idea of what a submarine should be.

Frank C. Lynch, Jr.

SUBMARINER LOSSES OF NAVAL ACADEMY GRADUATES IN WORLD WAR II

This survey covers the U.S. Naval Academy classes of 1924 through 1945 and is felt to include all of the Naval Academy submariners who lost their lives in World War II while serving in submarines.

Of the 375 submarine officers lost in the operating submarine environment during WW II, 161 were graduates of the U.S. Naval Academy. (Ed. Note: The extent to which Military Academy officers have borne the brunt of losses in a war has been of considerable interest to historians. In this sense, the losses in submarines of Naval Academy grads was disproportionately high in the first two years of World War II -- when 26 U.S. submarines were lost. However, in the next 18 months -- when 26 more subs were lost -- the Academy grads' losses were somewhat lower than that of the non-grads. This is explained by the fact that in the beginning of WW II, the officers on the subs were almost exclusively Academy men. But in the last two years of the War -- despite the fact that virtually all of the skippers were from the Naval Academy -- U.S. submarines carried only 2 or 3 Academy grads out of the 7 or 8 officers onboard.

The overall cost of the submarine effort was high -- 375 officers and 3,131 enlisted men were lost. With a base of 16,000 officers and men who manned the 288 submarines, a casualty rate of 22% is readily apparent, the largest of all branches of the U.S. Armed Forces during World War II.

The 161 officers from the Academy constituted 42% of the 375 officers lost. The remaining 214 officers came from the reserves and from the enlisted men who were promoted to the officer ranks. This study in no way underrates their contribution. Without their assistance, the submarine effort would have foundered.

By rank, the USNA submarine losses were one Captain, 21 Commanders, 50 Lieutenant Commanders, 64 Lieutenants, 18 Lieutenants (jg), and 7 Ensigns.

Numerically, the greatest losses for the first four classes by rank order are 20 from '42, 18 from '39, 15 from '43, 14 from '40. Percentage-wise (percentage lost of qualified submariners) the greatest losses for the first four classes by rank order are 28.0% for '40, 23.0% for '28, 21.7% for '39, 21.6% for '36.

Of the 161 Academy men lost, nine were casualties of unique incidents in which the submarines were not sunk. A brief for each follows.

- Samuel Howard Hunter, Jr., LT(jg) '38 -- USS SEADRAGON (SS 194). In the Cavite Navy Yard on December 12, 1941, SEADRAGON was undergoing refit while alongside SEALION. A Japanese bomb that hit the SEALION spewed off fragments that penetrated the conning tower of the SEADRAGON, instantly killing Lt(jg) Hunter. Hunter was the first submarine casualty of World War II.

- Howard Walter Gilmore, CDR '26 -- USS GROWLER (SS215). In the vicinity of New Hanover (Bismarck Archipelago), CDR Gilmore was mortally wounded on February 7, 1943, while ramming a Japanese patrol vessel at 17 knots. He ordered the GROWLER to dive ("Take Her Down") while he lay on the bridge with a dead assistant OOD and a dead lookout nearby. GROWLER, severely damaged, was saved by his heroic action.

- William Wadsworth Williams, Ensign '43 -- USS GROWLER (SS215). Ensign Williams was the assistant OOD on the bridge during the ramming of a Japanese patrol vessel in darkness on February 7, 1943. He and the remaining lookout were dead when the mortally wounded commanding officer ordered "Take Her Down." See entry of CDR Gilmore, above.

- Thomas Fort Williamson, LCDR '32 -- USS S-31. While enroute Dutch Harbor from the Kuriles on August 31, 1942, LCDR Williamson, the CO, was killed by an explosion of a defective recognition flare.

- Reginald Marbury Raymond, LCDR '33 -- USS SCORPION (SS 278). LCDR Raymond, a prospective commanding officer, was killed on the bridge of the SCORPION on August

29, 1943, by an enemy bullet in a gun battle with a Japanese coastal defense craft.

- Willis Edward Maxon III, LT(jg) '43 -- USS SKATE (SS 305). LT(jg) Maxon was seriously wounded by strafing during SKATE's lifeguarding assignment off Wake Island on October 6, 1943. His wounds did not appear fatal and SKATE continued her operations. Two days later his condition worsened and he died on October 8. His death was not in vain, however. SKATE was the first submarine to perform a successful life-guard mission, rescuing a total of six aviators.

- Paul Walker Pinson, LT(jg) '44 -- USS CABRILLA (SS 288). CABRILLA, on her seventh war patrol, was on station in the Kuriles. After a severe depth charging and after eluding several patrol vessels, CABRILLA surfaced. LT(jg) Pinson was ordered to make an inspection of the top-side for damage. While on the main deck, he was swept overboard and was lost despite all efforts to rescue him -- on April 7, 1945.

- Montrose Graham McCormick, LCDR '39. Plane crash. LCDR McCormick is included here because he made several war patrols and he never left the operating submarine environment. Pursuant to orders promoting him from the XO of one submarine to CO of another, he died enroute in a plane crash in the Asiatic area on April 19, 1945.

- John Thomas Beahan, Ensign '45 -- USS BLUEBACK (SS 326). Ensign Beahan was the most junior of the 161 Academy officers who were lost in the submarine service during World War II. He was instantly killed at 2200 on July 10, 1945, by an accidental discharge of a .50 cal machine gun. He was buried at sea with appropriate honors on July 12, somewhere in the Java Sea between Surabaja and Sunda Strait.

I have excluded the loss of Admiral R. H. English, COMSUBPAC, and four of his staff officers from the table. To make the record complete, however, the story of their loss is included. Admiral English '11, CDR J. J. Crane '26 Force Engineer, LCDR J. O. R. Coll '27 Force Gunnery and Torpedo Officer, CDR W. G. Myers '26 prospective relief for CDR Crane, and Captain R. H. Smith '20 COMSUBRON TWO, flew to San Francisco to attend a series of conferences. The plane, a Navy-manned PanAm Clipper, was unable to land in San Francisco because of dense fog. In searching for a lake landing site, presumably Clear Lake, the Clipper crashed into the mountains near Boonville, about 90 miles northwest of San Francisco, on January 19, 1943. Their loss was a devastating blow to the submarine effort in the Pacific.

Omitted from the table of losses are those USNA alumni who were captured by the Japanese when their subs were either scuttled or sunk outright. Briefs leading to their capture are given.

Ten USNA officers survived the sinking of PERCH, GRENADIER, and TANG. All suffered indescribable beatings and torture and all were repatriated at the war's end.

PERCH was heavily damaged by enemy gunfire and depth charges. With no propulsion and sinking, she was scuttled on March 3, 1942, about 12 miles northwest of Surabaja. Taken prisoner were LCDR David A Hurt '25, LT Beverley R. Van Buskirk '34, LT John F. Ryder '36, LT Kenneth G. Schacht '35, and LT(jg) Jacob J. Vandergrift '39.

GRENADIER was fatally damaged by aircraft bombs and scuttled in the northeastern part of the Indian Ocean, off Penang, Burma, on April 22, 1943. Captured were LCDR John A. Fitzgerald '31, LCDR George H. Whiting '36, LT Alfred J. Toulon Jr. '39, and LT Arthur G. McIntyre '41.

The last submarine sunk with an alumni survivor was the TANG. In a surface attack, TANG fired her two remaining torpedoes at a crippled Japanese transport. The first torpedo ran true but the second broached and curved sharply (erratically) to the left, resulting in a dreaded circular run. At a speed of 46 knots, the torpedo completed its 1,000-yard diameter circle quickly and struck TANG's after torpedo room -- on October 24, 1944, in the northern end of Formosa Strait. Of the two officer survivors, CDR Richard H. O'Kane '34 was the lone alumni survivor.

Phil Eckert

SUBDEVRON TWELVE

In the Global War Games

In 1980 the Naval War College at Newport, RI, began hosting an annual research-oriented "War Game" with the world as a battlefield. For the past two years COMSUBDFVRON TWELVE has attended this three-week, mid-summer event which brings upwards of 300 participants to the war college. GLOBAL '85 marked the start of the second five-year set of games and was based on a scenario set in the 1990s.

Far more military, industrial, strategic and tactical issues dropped out of GLOBAL '85 than can be discussed here, but of particular interest are two which could significantly impact on the U.S. ability to conduct submarine warfare if not adequately addressed.

One of these issues is the use of mines to attrite submarines. The specific threat of concern is the use of mines in the defensive sense to deny mission success to U.S. submarines or to significantly increase the cost of executing their assigned missions. The mining threat is particularly insidious, since many of the obvious solutions for countering a specific mine threat either reduce the effectiveness of submarine sensors or impose a stiff penalty in reduced covertness of operations.

The second issue is that of the future role of countermeasures in ASW. It might seem irrational to reduce covertness with the use of energy-emitting devices. But there is logic to using what is necessary _after_ an enemy is known to have detected your submarine. Countermeasures are "post-counterdetection devices" which then take precedence over the minimizing of energy emissions. Their use becomes one of denying an enemy momentary locating information or classification confirmation. Without proceeding into specifics, there is probably no other area where "things", either dispensed from, or organic to the submarine itself -- which serve to mask, confuse, or seduce "other things" with a less than friendly intent -- lag so far behind the state of the art.

These two issues -- separate but also somewhat related -- will undoubtedly be resolved by a "least imperfect" set of technological and tactical answers. SUBDEVRON TWELVE has made an in-house commitment to this task, and welcomes the counsel of others.

T. D. Ryan, Captain, U.S. Navy

SUBMARINE TANKER UPDATE

The April, 1986 issue of the SUBMARINE REVIEW carried an important article -- "The Submarine Tanker." The article sets the stage for what, hopefully, will be a serious and continued dialogue on this subject in the REVIEW.

Since the 1956-1970 time period, during which the General Dynamics work referred to by Pisces was going on, there have been occasional papers dealing with the commercial petroleum cargo capabilities of such submarines. Not mentioned in the Pisces article, however, was a 1980 GD conceptual design study for an Arctic liquified natural gas (LNG) submarine tanker of 140,000 m^3 cargo capacity. This is equivalent to 58,000 deadweight tons of the liquid gas cargo -- carried in six cryogenic tanks. The 12-knot non-nuclear version of this LNG submarine tanker would have a displacement of 848,000 tons. The ratio, thus, between payload and displacement would be 1:14.4. In a nuclear propelled 15 knot version, the ratio for a 59,000 dwt LNG tanker would be 1:11.9. But neither seem practical for making money, since they must compete in the BTU market with other carriers of more cost effective fuels -- like oil, gasoline, naptha, methanol. Moreover the LNG submarine tanker would have little or no naval utility carrying this specialized fuel in cryogenic tanks. Figure 1 shows the GD steam turbine powered LNG submarine tanker design, which would use liquid oxygen (LOX) for the oxidizer and LNG boiloff for the fuel in a steam boiler plant.

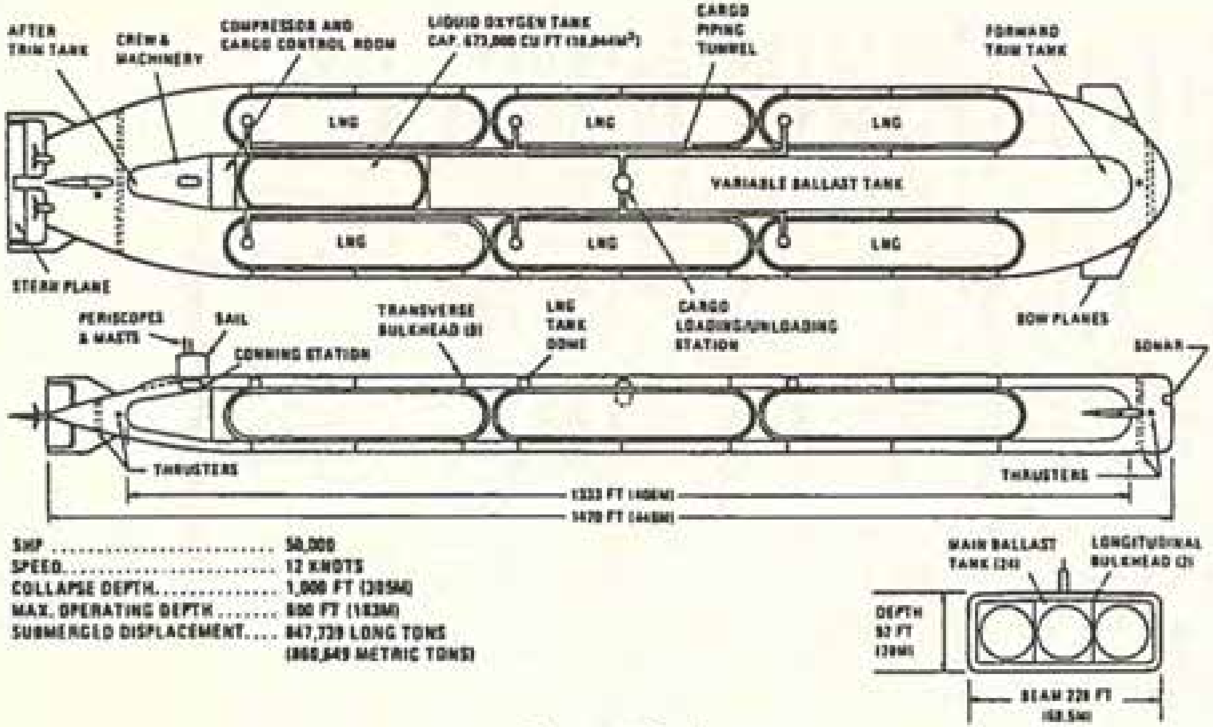


FIGURE 1.

140,000 M³ LNG TANKER DESIGN CONCEPT – NON-NUCLEAR

There have been other designs developed for submarine tankers. They are readily available to the serious student of the art of the submarine tanker. This means that one can readily learn a good deal more about the subject without the strictures of classification. In the April, 1986 issue of the SUBMARINE REVIEW the Editor makes note as to the matter of secrecy inhibiting innovation in the submarine technology field. However, in the submarine tanker field there is a significant amount of open literature. But none of the work has been sponsored by the Navy.

Work on LNG submarine tankers by the Maritime Administration moreover is now facing extinction due to Gramm-Rudman. Under this condition it becomes increasingly important for the Navy to "pick up the baton" of the submarine technology effort in the United States.

In 1974, MarAd sponsored a study of Arctic crude oil submarine transportation systems. The form of propulsion power was specified by MarAd as a 120,000 hp Consolidated Nuclear Steam Generator, driving steam turbines -- the naval architectural design of the submarine thus conforming to this surface ship type nuclear power plant. The steam generator design required a 65-foot tall cylindrical pressure containment vessel with hemispherical heads. This necessitated that the engine room portion of the submarine be housed in a horizontal cylindrical pressure hull of 85 ft. outside diameter. That accounts for the substantial hull diameter section shown amidships, in Figure 2. With 120,000 hp, the 278,000 dwt submarine would be capable of 20 knots.

The dwt payload to displacement ratio is only 1:1.5 -- which is quite good. However, the central pressure hull, in being sized to accommodate the surface ship type of reactor, skewed the economics of the system by as much as 30%, from that which would have been possible with a much smaller reactor.

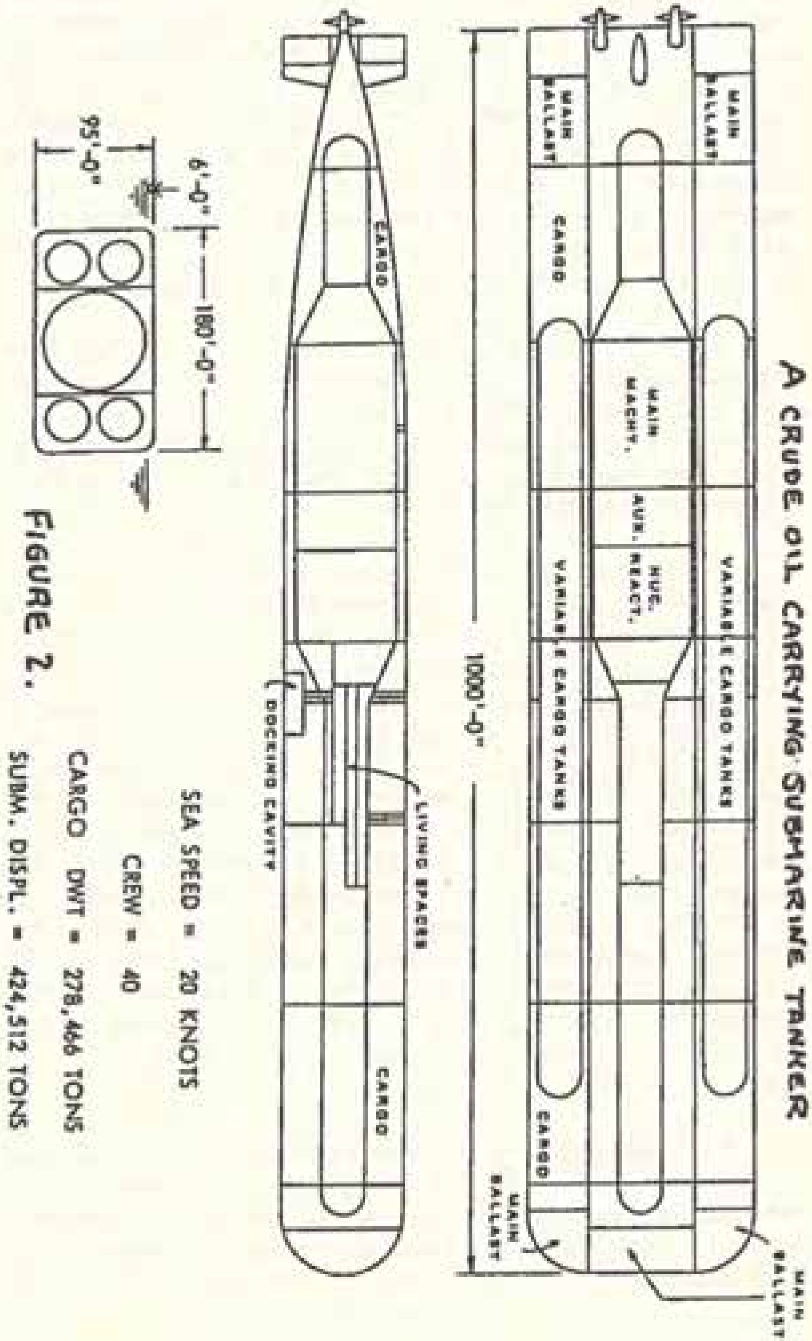


FIGURE 2.

At the conclusion of that study, an extension of the study to carry out a redesign of the submarine tanker was proposed. A redesign was looked at based on two loop-type nuclear reactors, housed in the port and starboard pressure hulls. This would eliminate the necessity for a central large diameter pressure hull section. The twin reactor arrangement would also provide backup power for a worst-case scenario of a single reactor breakdown under the Arctic icecap.

In 1982, the Department of Energy sponsored a study of a fuel cell propelled submarine tanker system. This study was performed by Arctic Enterprises Inc.. The study was based on carrying Prudhoe Bay natural gas energy in the form of methanol. The presently reinjected solution natural gas, which is produced along with the oil, would be made into 450,000 barrels per day of methanol, to be carried to the U.S. East Coast via an Arctic Ocean route under the icecap, in six 165,000 dwt submarine tankers. This submarine tanker design was also capable of carrying crude oil. When carrying 165,000 dwt of methanol it would displace 262,000 tons. This configuration was based on liquid oxygen and methanol fuel, fuel cell power and twin screw electric drive. The ratio would be 1:1.59. See Figure 3. At 165,000 dwt the percent of potential cargo weight allocated to liquid oxygen is 1.7%, to the methanol used in propulsion 2.1% and to the tankage required for these two consumables another 0.8% -- only 4.6% of the deadweight tonnage.

The rationale for the use of the fuel cell propulsion is persuasive. The 20 Megawatt power plant of this design consists of four 5 MG modules providing suitable backup capability. Compared to the roughly 33% conversion efficiency of a steam turbine system, the phosphoric acid fuel cell power plant on methanol and liquid oxygen has a conversion efficiency of 55%.

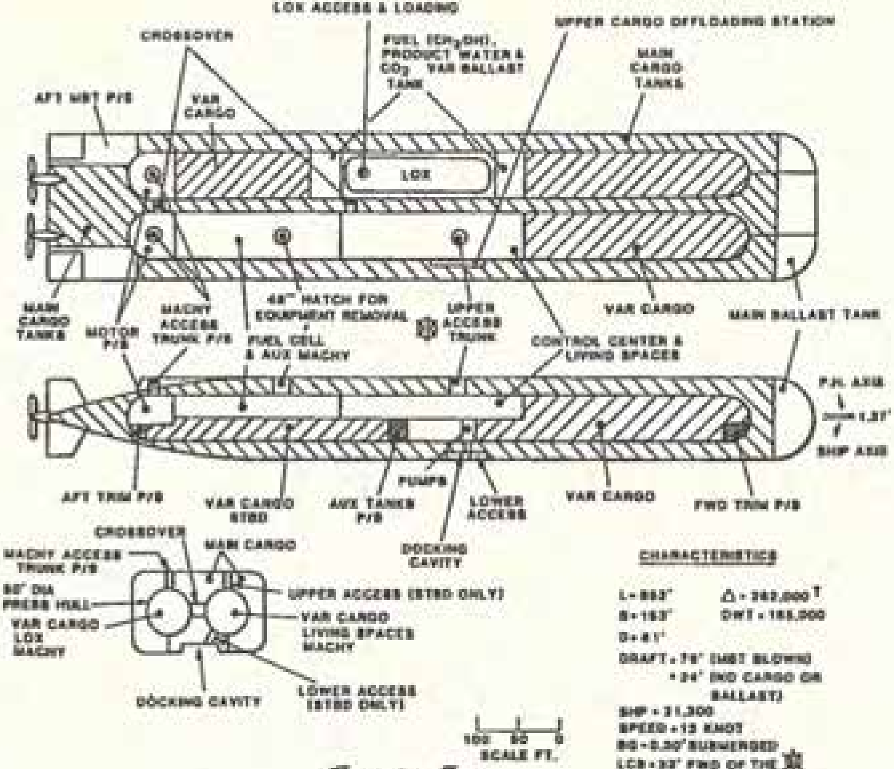


FIGURE 3.

FUEL CELL PROPELLED SUBMARINE TANKER

More recent work on molten carbonate fuel cells using diesel fuel could raise the conversion efficiency to 65% or more. It is the electrochemical nature of this direct energy conversion which outclasses the heat engines which are inherently Carnot Cycle-limited in their energy conversion.

The needs of the Navy for increased survivability of its fuel oil tankers, the fleet resupply of aviation gas to carriers, and the prepositioning of fuels, strongly suggests the use of tanker systems that are not visible on the ocean surface by surveillance satellites. Carrier task force underway replenishment with probe and drogue fuel transfer systems was alluded to in the Pisces paper. However it was indicated that the perennial Navy "limited budget" was used as the turndown reason in the early 1970s. This is still the condition today, 15 years later, even though the threat to naval surface tankers has dramatically increased in the intervening years -- as ocean surveillance has improved and anti-shipping submarine fleets have grown.

The naval logistic fuel support submarine tanker need not be nuclear propelled. Fuel cell technology has advanced in the last 15 years. The cargo deadweight fraction which needs to be devoted to fuel, onboard oxydizer and tankage is entirely reasonable. The argument that fuel cell propelled Navy submarine tankers would somehow be charged against a budget assigned to "a 100 submarine nuclear powered fleet" is a non sequitur.

Navy evaluation of the fuel cell propelled submarine tanker for carrier task force jet fuel underway replenishment is timely. Many of the SUBMARINE REVIEW's readers no doubt still consider the surface fleet as rivals. Here is one case where the submarine-surface fleet relationship can be strengthened and become complementary. There is more to submarining than just SSN and SSBN operations.

Bill Kumm

NEW IDEAS

USE OF BRAIN WAVES FOR SELECTING SONAR OPERATORS

The job of the submarine sonar operator is one of the most demanding of all activities on board a submarine. It requires an individual who is able to perform complex auditory and visual discriminations, maintain attention over prolonged periods of time, and effectively keep track of many different sonar signals simultaneously. Additionally the operator must be able to classify the signals received and determine which ones signify a threat to the submarine.

Some individuals are better able to perform these tasks than others. Unfortunately, paper and pencil tests for screening prospective sonar operators have not been able to predict on-the-job performance. Such tests still produce unacceptably high rates of attrition from "A" and "C" sonar training schools -- rates that vary between 10 and 20 percent, with the highest rate associated with the "A" school. And, over 30% are lost during the total cycle of sonar training. Thus, a measurement system that could differentiate between good and poor sonar operators should greatly reduce training costs by predicting which individuals will become the good operators.

It is known that measures of brain wave activity are sensitive to such environmental stresses as fluctuations in air pressures, the dulling of the senses by overdoses of nitrogen, and the effects of oxygen poisoning. Brain waves are also affected by decreases in the alertness of an individual, and they can identify impairment in thought processes as well as disabilities in learning capability.

Navy research has examined the performance of sonar operators, radar intercept officers, and physical security personnel. These studies all report differences between high and low performers in the electrical amplitude of their brain waves in specific areas of the brain. These studies also show that there are differences in the electrical activity of the two sides of the brain during the performance of certain verbal and visual-spatial tasks.

If measurements of the electrical activity and nature of brain waves can discriminate between good and poor sonar operators, they might logically be used to differentiate between prospective candidates for sonar training who should become good operators and those who will not. If, however, brain wave differences are the result of learning rather than inherited differences, then brain wave measurements could be used to monitor the effectiveness of training techniques to determine a best way to teach prospective sonar operators.

Electrical measurement of brain waves have several advantages over the tests previously used. After a short period of preparation, a five minute test can provide enough data on many aspects of the information processing in a man's brain to make judgements on his basic sensory capability as well as his level of attention on his job. These electro-physiological tests eliminate problems that many people have with paper and pencil tests, particularly since they do not require a written or verbal "answer" to the questions asked. It is thus much more difficult to malinger or fake such tests.

The Naval Submarine Medical Research Laboratory in Groton is currently giving a series of tests to a large number of experienced submarine sonar operators. The tests cover both visual and auditory sonar, target-detection tasks. After these tests, each sonar supervisor is asked to rate the sonar operator's abilities; each operator is also requested to estimate his own performance as a sonar operator.

The goal of this work is an improved way to select candidates for sonar training. It should also suggest a system of hardware for this screening process. This year the Navy needs about 700 new sonar operators. With a present 30% being lost in training, the cost to the Navy of these failures amounts to several millions of dollars. If the failure rate can be reduced, the potential payoff is great.

(This work is being performed under a workunit, "Neurometric assessment systems for identification of specially skilled sonar personnel," at the Naval Medical Research and Development Command.)

Christine Schlichting, Ph.D.

DISCUSSIONS

STRATEGIC ASW

"Strategic ASW" as presently used implies anti-submarine warfare against strategic submarines -- i.e. ballistic missile submarines, both nuclear (SSBNs) and conventional (SSBs). If, however, the word "strategic" is used in the dictionary sense, then "strategic ASW" more correctly means the way to combat the entire enemy submarine threat.

"Strategic" as used in classic terminology pertains to the word strategy and "strategy" is the art of directing the military movements and operations of a campaign -- in this case, an anti-submarine campaign. And for this campaign, a strategic ASW plan should be required to bring an enemy's submarines under control. In the case of the Soviet Navy this would mean a Plan to decimate a submarine force of almost 400 submarines.

Is the proper use of the term "strategic ASW" -- which would include all enemy submarines, not just ballistic missile ones -- important?

Yes, it probably is, because it makes evident a need to have a comprehensive plan for significantly reducing the Soviet submarine threat, and it focuses attention on the requirement to do this in a time-urgent fashion in accordance with "The Maritime Strategy" recently outlined by Admiral Watkins, the former Chief of Naval Operations. What is called for by Admiral Watkins is a quick destruction of the Soviet submarine force in order to permit U.S. surface battle groups to operate close to Soviet land objectives so they can, by projection of power from the seas, create a decisive effect on the conduct of a big war with the Soviets. To carry out such offensive operations calls for the operating areas of the U.S. carrier forces to be swept relatively free of opposing enemy submarines.

To do this quickly and efficiently requires a well-laid Plan. It is not enough to have a plan for air ASW, a plan for surface ASW and a separate plan for submarine ASW. Without a coordinated single integrated ASW plan, the ultimate goals called for by Admiral Watkins are not likely to be achieved -- in a major war at sea. Reasonably, the developers of such a single Plan should be the Submarine Force since submarines have to make the major contribution in achieving a quick decimation of enemy submarines at the initiation of a conflict with the Soviets. Surface and air ASW are not likely to be effective as rapid means for bringing the enemy submarine threat under control -- except where their efforts are closely coordinated with the submarine effort. Undeniably, surface and air ASW are effective means of destroying submarines -- but basically, only in a drawn-out attrition manner. Quick attrition or neutralizing of enemy submarines is required. This takes a submariner-generated Plan.

If the Soviets choose not to send their submarines to sea at the initiation of hostilities, or if a significant portion of their sub force has been based overseas, or if their bastions are not used for the protection of their submarines, or if it is evident that a Soviet "first salvo" strategy is likely to be employed -- then a "strategic ASW Plan" becomes a requirement to adapt to such options and still rapidly bring the Soviet submarine threat under control.

The U.S. Submarine Force might prefer to limit its responsibility for controlling the enemy submarine threat to only a lone-wolf type of submerged effort against deployed enemy submarines. But this effort in itself will not do the job called for. U.S. submarines in a sound, "Strategic ASW Plan" will have to: be sure that enemy surveillance and communication satellites are destroyed if air and surface ASW is to function efficiently in coordination with submarine activity; be capable of destroying enemy submarines in port areas or shallow waters; have the proper guidance capability on their cruise missiles for destroying submarine facilities ashore; be able to mine submarine base areas to prevent submarines from getting to sea; be capable of interdicting submarine support activities including their support ships; ensure the necessary intelligence on enemy submarines, wherever; even, possibly, shoot down threatening enemy aircraft which could affect the rapid destruction of the enemy submarine force; and coordinate the Allied ASW effort with that of the United States.

Are these submarine activities at the start of a war unreasonable? ....Or essential to an ASW Plan to do the job called for in "The Maritime Strategy?"

Why should so vital an issue as the development of a strategic plan to counter the Soviet submarine threat be in question? The answer seems fairly straight-forward. In an armed conflict with the Soviet Union, the U.S. might not have sufficient resources or time to adequately contain the Soviet submarine threat on the tactical level by means of forward U.S. submarine operations, as well as carrier battle group outer & inner zone ASW operations.

The Soviets have enjoyed a numerical superiority in total number of submarines for several decades. In the past, most western naval analysts generally agreed that the West's qualitative advantages in anti-submarine technologies would be adequate to off-set the Soviet's quantitative edge. With the introduction of seven new Soviet submarine classes in the last five years, these views are changing.

The latest Soviet submarines present U.S. ASW forces with some grave problems. Since the introduction of the Victor III-Class SSN, the Soviets have steadily reduced the technological gap with their American counterparts -- especially in the area of acoustic silencing.

The Soviet's narrowing of the submarine technology gap is the result of a combination of uniquely-Soviet innovations (titanium hull construction, liquid-metal reactors, more efficient hulls, etc.) and acquired western technologies (acoustic silencing, computerized sonar systems, etc.). The end result is that the Soviet submarine force seriously threatens the superiority of the United States' primary ASW sensor -- its fixed-array, long-range passive acoustic sonar system known as SOSUS. Also, the vulnerablilty of the SOSUS system to overt or covert attacks makes possible a wartime shift in the advantage held by the U.S. in controlling the oceans depths.

Since the United States might lack sufficient forces and resources (attack submarines, torpedoes, sonobuoys, etc.) to deal with the Soviet submarine threat on a continuum of tactical warfare scenarios, what are the available options? The optimal solution appears to be the establishment of a comprehensive strategic ASW policy involving the overall Plan.

The first, and foremost, requirement of an effective U.S. strategic ASW policy is the ability to obtain and maintain intelligence on the posture of the Soviets' submarine and supporting forces. With a declining effectiveness of SOSUS, the U.S. would need to evaluate the expanded use of shorter-range acoustic sensors. Additionally, the U.S. might be wise to take a page from the Soviets and broaden its exploration of the use of non-acoustic ASW sensors, (e.g. space-based synthetic aperture radar, etc.).

Secondly, the Soviets best-case surge capability, outside Soviet waters, should see a large portion of its SSBNs and SSNs moving quickly to sea at the initiation of a conflict. Thus, it would be vital to initiate attacks on Soviet submarine bases and support facilities prior to the large-scale deployment of their submarines. When this fact is coupled with the Soviet strategy of using defended ocean bastions, a "strategic" ASW operation becomes potentially more valuable. Combined overt (aircraft) and covert (submarine) mining operations of enemy ports and choke points, aircraft strikes, and cruise missile attacks, may significantly reduce the effective Soviet submarine threat. When one expands the targeting list to include Soviet C^3I networks, ocean surveillance and communication systems, and supporting forces, the capability of deployed Soviet submarines should also suffer markedly.

It is important to note that regardless of the amount of "strategic warning" the U.S. and her Allies might have, the lack of a strategic ASW contingency plan <u>in being</u> would likely present the West from containing the Soviet submarine threat. Additionally, to count on having adequate warning prior to the initiation of a conflict, as the solution to the problem, runs contrary to the history of modern warfare.

The priority of strategic ASW activities reflects an emphasis on immediate, near-term goals. However, some might argue that strategic ASW should be geared toward longer-range implications. This could result in a complete reversal of mission priority. But regardless of mission priority, the all-inclusive definition of strategic ASW would involve more than tactical ASW operations against enemy SSBNs.

So if a strategic plan is necessary to "quickly" counter the Soviet submarine threat, are any of the existing ASW plans sufficiently comprehensive to do the job? It may be useful to engage in an open discussion and debate on the potential value of a United States strategic ASW policy, spearheaded by the submarine community.

In sum, the Soviet submarine fleet -- with its numerical superiority and approaching qualitative parity with their western counterparts -- is such a threat to the naval objectives of the West, that the United States Navy can no longer expect to adequately contain the Soviet submarine threat on the tactical level. A strategic ASW plan is indicated, along with a broad based discussion to gain valuable insight into the best approach to meet this critical national problem.

Robert T. Wirt

TRIDENT - A MAJOR SUBMARINE COMMAND?

"Major command" is a term that as a young midshipman conjured up thoughts of battleships, cruisers and carriers as a stepping-stone to Flag. Those thoughts were tucked in the deep recesses of my mind as I attacked the important tasks at hand -- getting through Nuclear Power School, Prototype, Sub School, qualifying in submarines, qualifying as a nuclear engineer, qualifying for command while running an onboard division, department, or being the Executive Officer. During the latter part of my first twelve years in the Navy, I felt I was going to reach the goal of every line officer -- command at sea. So simultaneously I rekindled the thought of "major command."

Just where did today's submariners go for their Flag ticket?

In the diesel-boat era it frequently meant surfacing to get a cruiser or amphib group because of the limited number of submarine squadron commands. But today such options are closed to the nuclear submariner. By the early sixties, moreover, the submarine force was absorbing the best and brightest prospects of the Navy, who after a shore tour or a second command tour on a first generation Polaris submarine were hopefully going to go on to command of a squadron. There, of course was, what appeared to be a second echelon major command, -- the submarine tender -- from which a token few might be selected for Flag. During this heyday of submarining, with many of the top Academy and NROTC midshipmen and conscripts from the surface community being brought into the submarine force, there was no shortage of top-notch talent for the submariners' fair share of Flag selections.

However, as the number of nuclear submarines grew and the number of squadrons and tenders remained essentially constant, the opportunity for a major command, and therefore eligibility for Flag, dwindled.

The advent of a second generation strategic weapons system, i.e. the TRIDENT, made a major command. Based on the fire-power and overall cost of this platform this seemed clearly warranted. But was the submarine community ready to believe that TRIDENTs were truly a major afloat command?

To many, TRIDENTs were only another submarine command. With about the same size crew, more but similar equipment, the same training requirements, etc., they garnered no greater respect in some circles than any other submarine command -- and they certainly were not considered on a par with squadron or tender commands. This was brought to view when I had an opportunity to read a fitness report of a Captain who was leaving a TRIDENT command. Its words essentially said that this man's sterling performance indicated that he was ready "to assume a major command." What should have been meant, in reality, was <u>another</u> major command.

Is another type of major command necessary, and will the submarine force be able to sustain TRIDENTs as a major command when nominally twenty TRIDENTs, requiring forty captains, become a reality in the 1990s?

The first question as to whether TRIDENTs were recognized as a major afloat command was seemingly answered by the clear recognition of

TRIDENT as a major command with the selection of Captain Richman to flag rank. He had evidently served his major command as a TRIDENT Commanding Officer. While, the current assignment of post TRIDENT Commanding Officers are now to positions heretofore reserved for post Squadron Commanders or tender Commanding Officers.

The answer to the second question is not so apparent, especially with the current nadir in the ranks of eligible submarine Captains and most post command Commanders -- to fill the many required billets. It is however believed that the desire to remain on active duty and assume TRIDENT command has been intensified with the new bonus arrangement and the clear indication that post TRIDENT Commanding Officers are competitors for Flag.

As a recent TRIDENT Captain, I can heartily support TRIDENT as a major command -- based on the principle that the strategic deterrent posture for the United States into the 21st century is structured around the TRIDENT. As such it deserves the same consideration and recognition as other submarine major commands.

Captain Robert W. Boyce, USN

THE MARGINAL ICE ZONE

Captain LeMarchand's "Under Ice Operations" in the October, 1985 SUBMARINE REVIEW was focussed on the problems of warfare under the Arctic polar ice cap. In this environment, a sound velocity profile shows a steady increase with depth, producing in effect a good sound channel with the axis close to the surface. The transmission of sound in such a channel, consequently, is long-range and acoustic scattering is produced only by the irregularities in the lower surface of the ice-covering and particularly from the ice keels which extend downward. He also notes that the ambient noise is low under this ice cover. Overall, then, conditions for long range detections of enemy submarines are generally very good.

But Anthony Wells, in his January, 1986 SUBMARINE REVIEW article sounds a note of caution for U.S. submariners carrying out their ASW mission against Soviet submarines in their Arctic "bastions." He suggests that U.S. submarines operating within the marginal ice zone (MIZ) -- where the polar ice is not solidly joined and consists of ice floes -- might have a significant ASW problem against well-handled Soviet SSBNs, (in fact against enemy subs in general) which would be "like looking for a needle in a haystack in a hostile environment."

Why then wouldn't some Soviet submarines be operated in MIZ bastion areas which favor their survival -- rather than under the polar ice cap where sound conditions make their detection by U.S. submarines a lot easier?

The Office of Naval Research has been conducting, since 1979, a series of basic science field investigations (along with other nations in an international program) in the unclassified MIZ, to better understand this environment relative to naval operations within such an area. The area chosen for the investigative MIZEX exercises is shown in Figure 1. and is generally between Svalbard and the east coast of Greenland. The marginal ice zone in this area has a changing geography as the ice edge moves hundreds of kilometers north and south on a seasonal cycle.

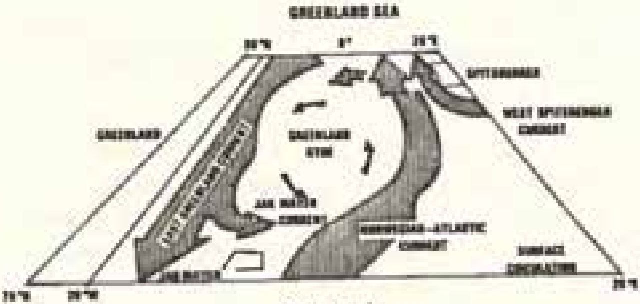
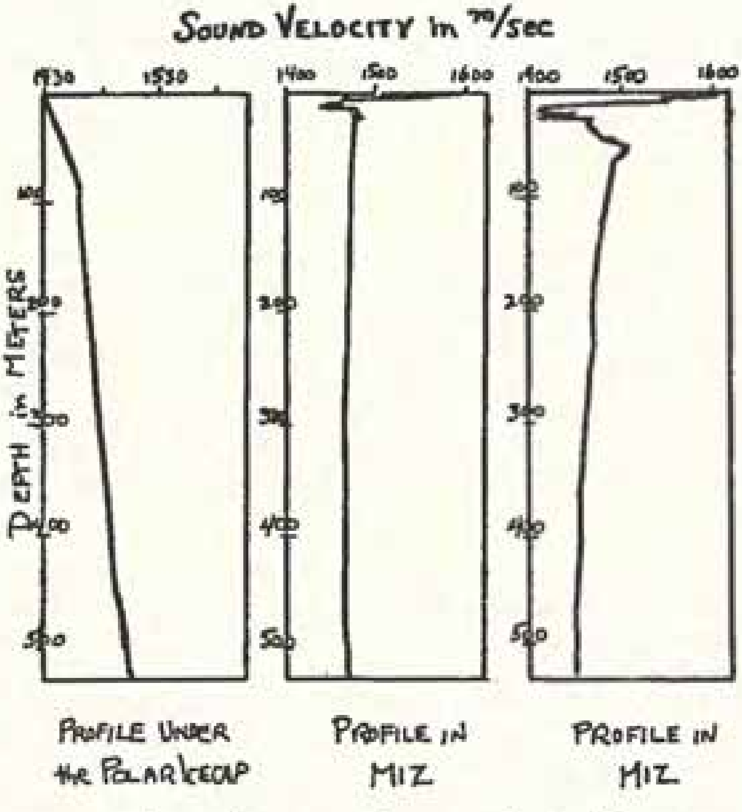


Figure 1.

In Captain LeMarchand's article, the sound velocity profile under the permanent ice cover of the Arctic ocean "is essentially all positive." The sound velocity profiles taken in the Marginal Ice Zone of the area shown above indicate somewhat different characteristics -- with sound channeling unlikely and anomalies confusing the acoustic sound paths. See Figure 2.



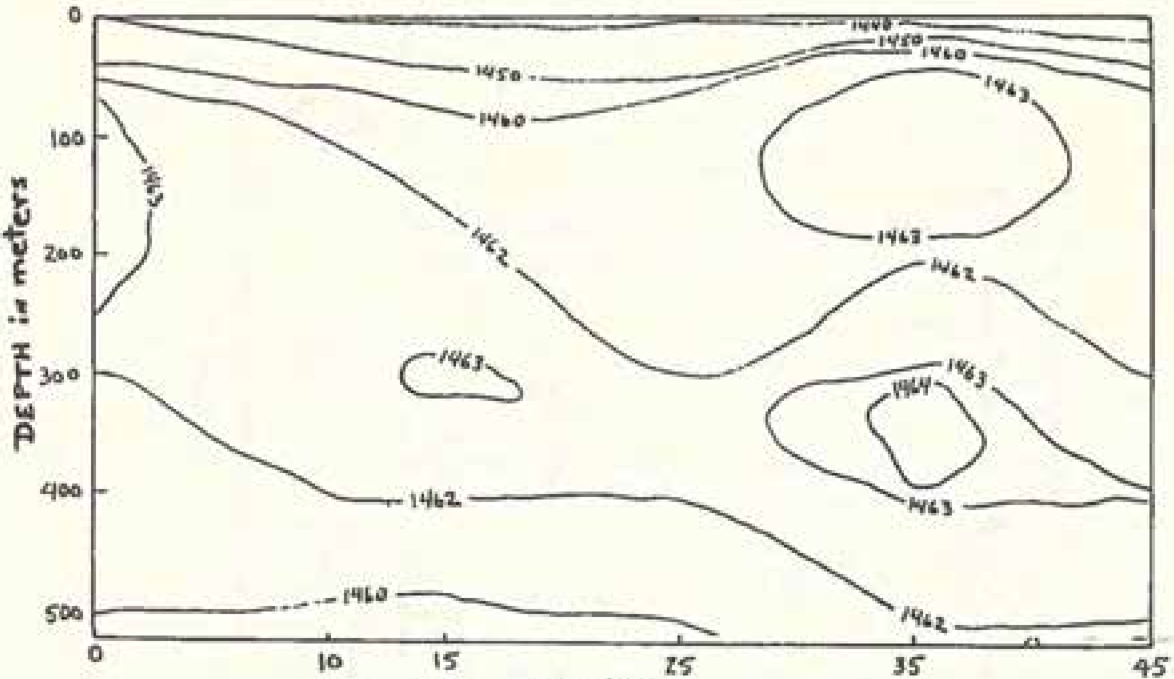
SOUND VELOCITY PROFILES in the ARCTIC
FIGURE 2

The irregular nature of the sound velocity profiles in the Marginal Ice Zone is perhaps better shown by a plot of the sound velocities taken over a stretch of 45 miles within the area shown in Figure 1. The effect of surface warming or cooling in the ice floe areas produce greatly varying velocities in the first one hundred feet of depth, but below that there is an almost constant velocity. Thus, a submarine hiding near the surface might easily pose a problem "like hunting for a needle in a haystack." See Figure 3.

The bathythermograph readings taken in the Marginal Ice Zone show considerable variance when taken at relatively close intervals of range or within a few days of each other. See Figure 4. An almost constant reevaluation of sound conditions appears necessary when operating within this area -- plus an almost continual changing of submarine trim when moving rapidly through this zone.

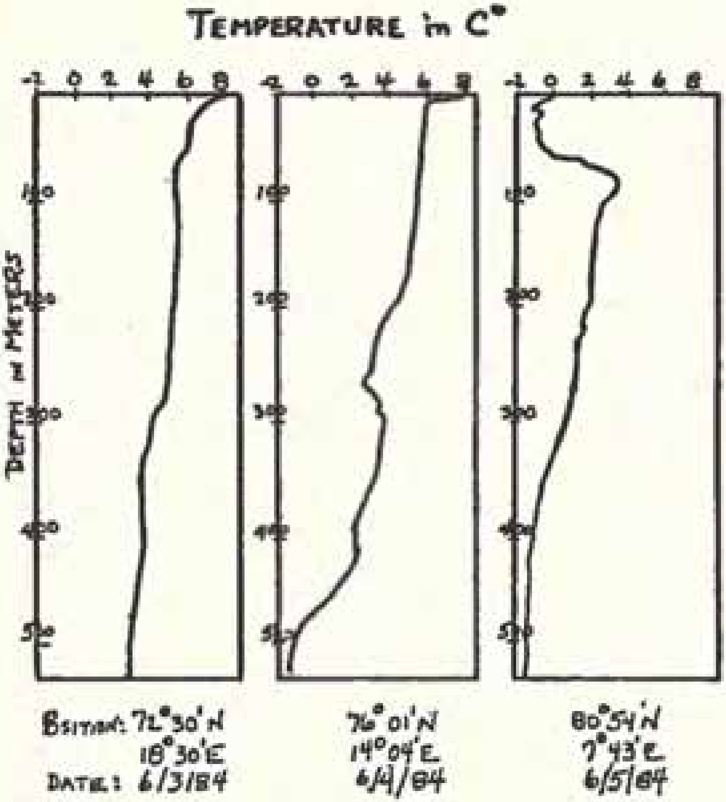
It should be recognized that the relatively warm, saline Norwegian-Atlantic branch of the Gulf Stream moving toward the Pole, hugs the Svalbard side of the MIZ, while the far colder, ice-choked and fresher Arctic waters flow southward close to Greenland. This results in a pronounced frontal and current system called the East Greenland Polar Front. The tremendous interchange of energy between these cold and warm waters makes the area an extremely dynamic and unstable region characterized by complex oceanographic and atmospheric structures. In addition, fresh water derived from ice-melting creates additional instability due to density differences.

Unlike the low ambient noise enjoyed under the polar ice cap, the ambient noise is far higher in the MIZ. The ice floes become progressively smaller as one nears the edge of the "ice pack." The first and multi-year ice floes in the inner



Observed Sound Velocity Differences in 45 miles

FIGURE 3.



BATHYTHERMOGRAPH READINGS in MIZ
FIGURE 4.

zone of the MIZ tend to be a few hundred meters across and 2-5 meters thick. Leads through these floes are choked with pieces of thinner ice, with solar energy melting, for the most part, the first year ice. The ice floes in a transition zone of 5-15 kilometers in width, between the inner and outer zones, are uniformly broken and smaller, with an ice-concentration in this area of 70-90% and with the leads free of brash. The outer zone is a complex region of brash and tiny floes near the extreme edge of the Arctic ice. The ice floes in the MIZ are pushed together and pulled apart by surface winds, they drift into circular patterns where transient ocean eddy currents exist, they expand and contract with varying surface temperatures and they grind against each other, all of which results in a considerable production of noise. Also, surface gravity waves can break individual ice floes near the ice edge and ice-ocean eddies at the edge can cause high shear between adjacent bands of ice floes, each of which can radiate a significant amount of noise. It has been determined that ambient noise levels in the 6,000 Hz range can be attributed to thermal stress when ice drifts into warmer water, or from floe-floe crushing. The lower frequency 5 to 100 Hz noise results from ice "quakes" as the ice breaks in response to wind and current stress. Mid-frequency noise, 100 to 4,000 Hz, correlates with atmospheric cooling. In the range of 1,000 Hz, high frequency noise can be related to wind-driven snow impacting upon the ice. In addition, there is more animal life in this MIZ area (whales, seals, etc.), increasing the ambient noise level somewhat. On the plus side, this area is not often contaminated by any ship noise.

During the 1984 MIZEX operation, internal waves were observed in the marginal ice zone which could cause unpredictable fluctuations in a submarine's trim while it is cruising well below the surface. A sample inner wave had a 20 minute period and a vertical displacement of 10 meters.

The propagation of acoustic signals through the highly variable oceanographic and ice conditions of the MIZ show a scale of acoustic fluctuation -- as measured by the bandwidth-spreading over a range of 100 kilometers -- which is much higher than that observed in the central Arctic, or even in the temperate oceans of the world. At the same time, the floe-bumping and shearing noise, the moment and gravity induced noise, and the atmospheric cooling-induced noise all contribute -- with great variability -- to the ambient noise level in this area of the ocean. Added to these effects is the considerable variability in the sound velocity profile for any particular, relatively small area of the MIZ. Thus, the predictability of sonar range capability tends to be low and the actual acoustic ranges for detection of enemy submarines are likely to be low as well as extremely variable.

[This discussion item is derived from numerous research reports on the Marginal Ice Zone submitted to the Office of Naval Research.]

LETTERS

IN VINO VERITAS

June 22nd, 1963, was a day such that the Navy is unlikely ever to see again.

In 1963 the Polaris program was finalized. The Special Projects Office of which I was Director, was ordered to build a total of 41 SSBNs. The entire force was scheduled to be operational by 1967. This meant a shipbuilding pace that was unprecedented for such complex ships. The two private shipbuilding yards, Electric Boat and Newport News, and the two government yards, Portsmouth and Mare Island, responded magnificently.

Our "Boat of the Month Club" saw the launching of 12 SSBNs in 1963. On June 22nd alone we launched four: TECUMSEH and FLASHER in Groton, JOHN C. CALHOUN in Newport News, and DANIEL BOONE in Mare Island.

Seizing on this exceptional day to publicize the urgency and importance of our task, my public information officer, CDR Ken Wade, planned to have me participate in each launching -- though the events would take place on opposite coasts. Ken had me being rushed to airports under police escort, then sped by Navy Jet to the next port. Unfortunately, the submarines were launched at slack water, and his plan would have to conform -- making our public relations blitz impossible. So I settled for a trip to Mare Island for the launching of DANIEL BOONE.

The sponsor for DANIEL BOONE was Peg Wakelin, wife of our Assistant Secretary of the Navy for Research & Development. I asked their two college-going sons who were at the launching if they'd like to ride the ship down the ways. Both were eager, so I arranged that space be reserved for the three of us. As soon as I had concluded my brief remarks in the Ceremony, the three of us climbed to the bow of the unfinished submarine. While Secretary James Wakelin gave the principal address, we stood topside within the lifelines awaiting the smash of the bottle of champagne and the exhilarating slide down the ways amidst cheers, music, and tooting of whistles.

As we took our places, next to us were men of about my age dressed in black, clerical garb. Both were tall, lean, friendly and of open countenance. I remarked pleasantly to them, "I guess you're here because that's Christian Brothers champagne being used."

"Yes, how did you know? I'm brother Timothy and this is Brother Jonathan," one of them said.

He also noted that he was the expert cellarmaster of Christian Brothers Winery in the Napa Valley, not far from Mare Island.

I'll never know how many of our ships received their baptism with that special brand of champagne. But no doubt another Christian Brother, John P. Holland, the "Little Professor" from Liscannor, Ireland, looked down approvingly as a descendent of his "first" submarine slid down the ways in Vallejo, California.

I. J. Galantin

HOW THE "NUKES" DO IT.

The tactical situation was: a submerged transit from Fort Lauderdale to New London; at 1/2 test depth; at Full speed; the time since last "at periscope depth" was 3 hours; and the present time was 1245 local.

The CO entered the Attack Center, coming from the Wardroom where the movie "Body Heat" had just completed its 5th showing and where the CO and Navigator had just agreed to a revision of the Night Orders.

CO: "Officer of the Deck, scrub the 0102 NAVSAT in the Night Orders, and get the 2153 pass instead, in 8 minutes. Revised Night Orders will be routed shortly."

OOD: "Scrub the 0102 pass and get the 2153 pass instead, aye. I intend to come to periscope depth in the Transit Mode."

CO: "Very well. Officer of the Deck, come up in the Transit Mode."

OOD: (Who is night adapted), "Chief of the Watch, rig for black. Sonar, Conn, coming to periscope depth in the Transit Mode. Helmsman, ALL STOP." Then, after the submarine's speed decays to 3-4 knots, "Diving Officer, make your depth 58 feet."

Everything that followed this 30-second exchange of orders and acknowledgements was the standard series of watchstanders' orders and acknowledgements common to the practice of going to periscope depth and obtaining a navigation satellite fix -- modified only by those few items peculiar to this "Transit Mode" method of going to periscope depth. The CO had only to watch and enjoy the spirited and disciplined action. Four minutes after "NAVSAT onboard" was reported, and 21 minutes after the CO entered the Attack Center, the submarine was again at Full speed at transit depth -- with a satellite relayed radio broadcast also in hand.

A submarine that transitions smartly and safely from the deep, fast Transit Mode to the Periscope Depth Mode, and back, with only such sparse communications between the skipper and Officer of the deck just might be "ready to fight."

The young people that operate a submarine in this disciplined and aggressive fashion can take one heckuva lot of pride in their capabilities.

The crew that's organized to operate shipwide in a similar fashion might also have a heckuva lot of fun.

I know it's all possible -- because that's the way it's done, even after seeing "Body Heat" five times.

Il Gotto Negro

VADM BILL BEHRENS REMEMBERED

I had just passed my twentieth birthday and was serving my last year as an enlisted man in the Navy. The electronics training I had received assured me employment at RCA when I got out. So my life game plan seemed cast in concrete.

I was lying in my bunk, half awake, when the Executive Officer of my submarine, the CLAMAGORE, gave me a brisk shake and firmly demanded, "Get up, Ulmer, you've got to take an exam for the Naval Academy Prep School." Then he slyly said, "Why you?"

Yes, why me? My head was now clear enough to make me wonder what was going on. He answered my quizzical stare with, "We can't afford to have you wasting good bunk space any longer." His typical sly little smile accompanied his order, "Go get some breakfast."

My response was the only satisfactory one for Mr. Behrens; "Yes sir." So I took the exam -- a tough one. When it was announced that I had passed, the CLAMAGORE seaman gang gave me the ceremonial toss into the drink -- as was the custom in Key West. Looking up from the water, I saw Mr. Behrens, who wanted to know how I could take time for a swim when there were so many administrative items to be attended to -- and he added his congratulations.

My presence at Prep School was required on a short fuse. So, watching Mr. Behrens whip a lethargic shore establishment into action was really something to behold. In order to meet the tight deadline, my case had to be moved to the top of several bureaucratic priority lists -- including the physical exam and dental requirement for entry to the Prep School with <u>no</u> cavities. Moreover, Mr. Behrens was advised that the seven cavities I had, could not be filled in a single sitting. But persistently he pursued how it could be done in one afternoon session. The ensuing marathon drilling session -- in the days of no novocain and slow-speed drills -- caused me many moments when I actually wished Mr. Behrens would give up on me. Yet tirelessly he spared no effort in clearing obstacles between me, his candidate, and a fair shot at his Alma Mater in Annapolis.

On the day of departure from the CLAMAGORE, LT Behrens gave me a pair of embroidered dolphins. He explained that although I had not earned them officially, he was making my qualification official and he hoped that they would provide an inspiration to return to the "boats" after I was commissioned as an Ensign. I was too inexperienced to understand the doors that LT Behrens had opened for me. So, my perfunctory "thanks" at our parting fell far short of what he deserved.

Recently, after a long career in submarines, the importance of what Mr. Behrens had done for me was made dramatically apparent when I read of his death in the April SUBMARINE REVIEW.

I had waited too long. Now, all I can say is: "God speed you to safe harbors, Admiral Behrens. From the bottom of my heart I thank you for that wake-up call in CLAMAGORE -- many years ago."

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

SILENT SERVICE?

Going through the April REVIEW, as I faithfully do upon each arrival, I was surprised to find the article A SILENT SERVICE on page 60. At first I was a little miffed about the tone of the "Editor's Note," but upon rereading the piece, I understood how it might have been misunderstood.

You should realize that I am a strong supporter of the REVIEW, and of an honest discussion of the issues by capable people who pay appropriate care towards not inadvertantly giving "aid and comfort to the enemy." The issue that I obviously semantically mismanaged was that of less aware people discussing obviously classified information, including numerical specifications and performance values.

By the way, my reference to "fiction" was meant to apply to HUNT FOR RED OCTOBER, which, if you or I had written we'd have gone to jail for, but to whose actual author several "ex-submariner" neighbors had divulged much sensitive information.

Jim Patton

WWII EXPERIENCE - USEFUL TODAY?

With respect to FDW's (Francis D. Walker?) note, "WWII Experience -- Useful Today?" (Apr 86), he is in my opinion wrong. His contention that the experience ...."of those who took diesel submarines to sea against the enemy...." is of no benefit to the modern submarine commander just isn't true. Obviously the systems, tactics, sensors, weapons, i.e.: the "technical parts" are radically different and anyone who gets ready for the last war will undoubtedly do poorly in the next. However, there are lessons in training for combat, flexibility, independence, aggressiveness, imagination and persistence that I consider timeless. These submariners can teach us lessons that may very well make the difference in success or failure in combat.

As a current Commanding Officer, I would ask FDW to write down his observations, ideas and conclusions from his combat experience and let me try to see if I can develop some useful ideas for modern submarine warfare from them. I promise him a receptive audience.

Commander W. J. RIFFER, USN
Commanding Officer
USS BOSTON (SSN 703)

INTERNATIONAL SUBMARINE ASSOCIATIONS'S 24TH CONGRESS

Baden, Austria was host city for the 24th International Submarine Congress from April 24th to the 27th, 1986.

Thirteen American submarine veterans were the first official U.S. delegation to the Congress, as we have been associate members of the British Division in the past -- at the Congress in Deauville, France last year when the various nations urged we Americans to form our own Division and become part of the International.

The German President, Kurt Diggins, announced that the 1987 Congress location would probably be changed to the city of Willingen, north of Frankfort, Germany. Captain Hannes Erverth, the current Commander of the German Submarine Force, and who had duty aboard the BLUEBACK in the 60s -- and wears American gold dolphins -- advised me that he would like to attend the U.S. Submarine Veterans of WW II national convention in Baltimore in August, 1986. Dr. Wolfgang Pohl of the German Nuclear Agency and a U-boat veteran, advised that he and about 25 other U-boat veterans also planned to attend the Baltimore convention.

Later I presented each country copies of a letter from our National President James Haywood of the U.S. Submarine Veterans of WW II, stating that we want to follow and promote International policy extending a hand of friendship to the world's submariners, and expressing honor, and respect for those who have gone before us.

The heartwarming and repeated welcome given to the Americans sure did help make a lot of new friends.

Hugh Latham

<u>IN THE NEWS</u>

o *The Washington Post* of April 22 reports that the President has decided (but still subject to the opinions of our allies), to begin dismantling two POSEIDON submarines in order to remain below the missile limit set by SALT II. With the TRIDENT submarine NEVADA's commencement of sea trials in May, the limit of 1200 launchers of multiple warhead missiles would have been exceeded by 22 missiles without the reduction of the 32 missiles in the two POSEIDONs being dismantled. This decision rescinds the plan to put the two POSEIDON boats in "caretaker status" -- disarmed but not dismantled. At the same time, the Administration notes that if the Soviets fail to stop their violations of the SALT II treaty, an exceeding of the SALT II limit on launchers can be effected with the initiation of sea trials of future TRIDENT Submarines.

o The NAUTILUS was dedicated on April 20 as the centerpiece of the Nautilus Memorial and Submarine Force Library and Museum. As of 21 April, this $7.9 M project officially opened for the public -- admission free. More than 1500 people attended the afternoon ceremony, including about 850 former NAUTILUS crew members and their families. Built at Electric Boat more than three decades ago, the NAUTILUS was retired from the Active Fleet in 1978. "She was a winner in whatever she did", said VADM E. P. Wilkinson, her first commanding officer. "She logged over 500,000 miles and established records in virtually all of her operations", was emphasized by Wilkinson. She was the first submarine to cross the North Pole when she went under it in the summer of 1958. Admiral Kinnaird McKee was the principal speaker at the dedication ceremony. "The NAUTILUS went to sea only five years after Congress appropriated the funds," he noted, "while the TRIDENT took twice as long."

o The Washington Post of 5 April reports, in an article by Walter Pincus, that the Administration is asking the Congress for money to prepare for the production of a nuclear antisubmarine standoff weapon. This ASW missile-carried nuclear depth bomb can be launched from surface ships or submarines and destroy enemy submarines at great ranges. Admiral James Watkins, the CNO, in February, 1985, noted to an Armed Services Subcommittee that after an explosion of this nuclear weapon "ensonification of the water for a period of time would rule out sensors for anybody in the immediate vicinity," but that the blackout would fade in a matter of hours. Hence, while "it disappears," Admiral Watkins noted, "our systems are sensitive enough within a short period of time to be picking up the kinds of information we need to continue progressing the conflict." Because of damage to sonars in the area of the depth bomb explosion, a neutron warhead is planned to be used so as to affect a smaller area -- the neutron weapon produces large amounts of radiation energy but less heat and blast than traditional nuclear warheads.

o A Navy release tells of the decommissioning of the USS SKATE in the fall of 1986. SKATE was the third nuclear boat built at Electric Boat and was the first of a class of nuclear powered submarines -- and was similar in design to NAUTILUS. The main propulsion was a pressurized water-cooled S3W Westinghouse reactor with two steam turbines. In the spring of 1958 under the command of Commander James Calvert, SKATE established a record of 31 days submerged with a sealed atmosphere. In August, 1958, SKATE reached and became the first submarine to surface at the North Pole. In March of 1959, SKATE made the first dead of winter operation under the Arctic ice cap and confirmed the fact that nuclear submarines could operate in the Arctic environment year round.

During the past 28 and a half years of operations she was refueled six times. On decommissioning she'll be towed to Bremerton and berthed in the Inactive Ship's Facility in the Puget Sound Naval Shipyard -- her work with the U.S. Navy completed.

o <u>Navy News and Underseas Technology</u> of 28 March reports on the Navy's program for modifying nuclear submarines for the transport of swimmer-delivery vehicles in support of embarked SEAL teams. Six STURGEON class subs are apparently being provided large cylindrical hangers bolted to the forward deck which can carry the 20-foot cigar-shaped underwater vehicles for special operations forces to conduct clandestine coastal operations. "Before an operation, the hanger is pressurized to enable the SEAL team in its vehicle to exit the hangar while the sub is still submerged." At present, the SSN's SAM HOUSTON and JOHN MARSHAL are each modified to carry two swimmer delivery vehicles. The STURGEON class subs will each carry one vehicle. The Navy's coordinator of this program says that the basic mission of these manned submersibles will be "maritime sabotage where we're primarily interested in those things which have access to the water."

o In recent Congressional hearings, as reported in <u>Navy News & Undersea Technology</u> of 14 March, RADM Stephen Hostettler, program manager of the TOMAHAWK cruise missile program outlined the

Navy's requirements for the future -- $790 million for 324 cruise missiles in the FY'87 budget and a buy of 410 missiles for $908 million in FY'88. Hostettler said that 15 SSNs are now capable of launching cruise missiles and another 10 will be TOMAHAWK capable at the end of this year. Also, that the Navy hopes to eventually make 107 subs capable of launching cruise missiles. The cruise missile is launchable from an SSN's torpedo tubes as well as from the vertical tubes installed in new 688s.

o *Defense Daily* of 3 April reports on testimony by a Congressional Research Service analyst to the Congress in which the figure of 30 SSN-21s were believed to be the goal of the U.S. Navy by the turn of the century. The analyst's estimates were that the first SSN-21 would cost $1.6 billion in FY'85 dollars with the fifth and follow-on boats costing $1 billion each.

o As reported in *Navy News and Undersea Technology*, a report written by the Institute for Defense and Disarmament says that in order to counter the U.S. submarine offensive against Soviet submarines in their bastions, the Soviets are deploying a vast number of mines around their ports and their ballistic missile submarine operating areas. The most effective Soviet mine "it is claimed" is called CLUSTER BAY. "It is a moored, rocket-propelled torpedo with a detection mechanism which activates the mine when the acoustic signature of the U.S. sub is detected. An active sonar guides the torpedo to the sub." (Like the U.S. CAPTOR mine.) "It has an estimated range of 500 meters." The report further states that "the Soviets will deploy mines on older submarines and surface ships. Besides laying mines around Soviet ports, minefields could be laid in waters not controlled by the Soviet Navy since submarines contribute much of the mine-laying capability". Also, "the Soviet Navy could install moored submarine simulators to emit characteristic Soviet submarine sounds to lure U.S. SSNs into the mines."

o Only three conventional submarines remain operational in the U.S. Navy. All are of the BARBEL class. The BARBEL and one other diesel boat are being based at Sasebo, Japan to render ASW training services to deployed surface ships and aircraft with the Seventh Fleet. The third is being used on the East Coast. The BARBEL departed for its new homeport of Sasebo in October, 1985 -- ending 23 years of operations out of the island of Oahu and also ending the homeporting of diesel submarines at Pearl Harbor. The original BARBEL, the SS 316, was credited with sinking 10 ships in her first three patrols for a tonnage sunk of 55,200 tons. But on her fourth patrol she was lost after what was believed to be a successful aerial attack by a Japanese aircraft that dropped two bombs. The current BARBEL (SS 580) was commissioned in January, 1959, has the high-speed shape of the ALBACORE, and will continue to carry out its target-training mission for ASW units.

o A Navy News Release of 25 March notes that the USS OLYMPIA (SSN 717), the Navy's 140th nuclear-powered submarine, arrived at her homeport, the Pearl Harbor Submarine Base, on 28 March. Enroute she visited Olympia, Washington.

o <u>Navy News and Submarine Technology</u> of 25 April reports that the Navy had issued a request for proposals for a low-cost, antisurface ship torpedo which precluded the use of high-tech guidance systems. Thus, wire guidance would not be included, but mainly because of its cost. The torpedo "must be fully compatible with the fire control system for the Navy's MK 48 torpedo, use the same handling mechanism, require no changes to the submarine and no special training for operators." It is also noted that "the torpedo must be fitted with a passive and active homing head -- partly because it must operate near the surface and in shallow water -- and because of the range and target speed specifications set by the Navy."

o A New York Times story of 19 May notes that Admiral Carlisle A. H. Trost was nominated by President Reagan to become the next Chief of Naval Operations relieving Admiral James Watkins. The 56-year-old submariner took over his command on 30 June in a change of command ceremony at the Naval Academy. In 1968 the Admiral had command of the Polaris submarine SAM RAYBURN and after promotion to Rear Admiral in 1973 he commanded a submarine group based in San Diego. The duty that best prepared Admiral Trost for his new job was being director of Navy program planning from 1981 to 1985 when he was instrumental in putting together and shepherding through Congress the budgets that Secretary of the Navy John Lehman, Jr. needed to build a 600-ship Navy. Admiral Trost is described as "a real people man", who "in his post as Commander in Chief of the Atlantic Fleet reduced the time ships spend at sea, so that sailors are not away from their families so long."

o In the same story referenced above, another submariner, Vice Admiral Frank B. Kelso, II, the Commander of the Sixth Fleet in the Mediterranean who organized the recent U.S. air raids on Libya on April 15, was expected to replace Admiral Trost as commander of the Atlantic Fleet. "Although only a three-star admiral, he was reported to have been a candidate for the post Admiral Trost has now received."

o Vice President Bush in a New York Times article on 28 May is quoted as saying at the Air Force Academy graduation ceremony that the cadets should not be "seduced by technology" ... "For the low-intensity conflicts of the future, you must not let the highly sophisticated technology become your master ... The U.S. military's most important technology is the electrical activity in your own brain."

o A Los Angeles Times story of 2 June quotes Secretary of Defense Caspar Weinberger as saying -- in relation to the Administration's decision to abandon the unratified SALT II agreement -- that there will be a deployment of air-launched cruise missiles later this year, exceeding the Treaty limits. Also, that while President Reagan's decision to dismantle two POSEIDON submarines -- to keep the U.S. in "technical compliance with the Treaty for a few more months" -- that ballistic missile submarines are being shelved primarily for economic reasons. SALT II sets a limit of 1200 long-range missile launchers and a ceiling of 1320 multiple-warhead missiles and long-range bombers carrying cruise missiles.

o An article in the Washington Post of 26 April discusses a book by William Lind, the "MANEUVER WARFARE HANDBOOK." (This handbook reflects some of the ideas put forward by Captain Tom Jacobs in his April SUBMARINE REVIEW article, "Is the SSN a Maneuver Weapon?") In Lind's book "maneuver warfare" is likened to a screen pass used in football. "You let the enemy break through your line and then (you) attack his rear flank", Lind explains. But Lind's doctrine goes well beyond battlefield tactics and includes weapon systems and personnel practices as well. As observed by the Post writer, "Lind is distrustful of high-tech weapons, because he thinks they are too complex for the ever-changing circumstances of war. And he and Hart (Senator Gary Hart) for years have been calling on the Navy to build more submarines and fewer aircraft carriers. In a showdown between carriers and subs, they say subs win."

o The Washington Post of 2 May features an article by George Wilson which tells of the grounding of two U.S. nuclear submarines in the month of April. The NATHANIEL GREENE, an SSBN, is reported to have run aground in the Irish Sea on April 1 and sustained such "major" damage that the Navy decided to scrap it as part of a formula for staying within the nuclear warhead limits of the SALT II treaty -- when the next TRIDENT submarine goes to sea. (The NATHAN HALE is the other POSEIDON submarine to be dismantled.) On April 29, the SSN ATLANTA reportedly "ran aground in the Strait of Gibraltar .... with such force that it punched a hole in a ballast tank and smashed the sonar gear in its nose ..... The ATLANTA disengaged itself from the sloping sea bottom, officials said, and limped into port at Gibraltar."

o Sea Power magazine of February, 1986 notes that "A big explosion at a missile fuel plant has forced the Soviet Union to drastically cut back production of (SS-N-20) missiles for its TYPHOON-class submarines," according to a Tokyo daily. "The blast occurred in September at a missile fuel plant in Blysk, 50 miles southeast of Novosibirsk." Sabotage was suspected.

o The Public Affairs Office of the Naval Academy released a story on Midshipman John DeNuto, relative to his designing a high-speed submarine as a project for his first class year. DeNuto is a TRIDENT Scholar, one of seven chosen for independent research work. His project will look at innovative submarine hull shapes -- particularly as to bow configurations, to see how certain shapes are compatible with new sonar systems and how they affect a submarine's performance. The first part of DeNuto's project is to develop the capability to test submarine models in the Academy's 380-foot towing tank. "The first model to be tested will be the most difficult one because it is smaller and faster than the rest." He expects to be assigned to submarine duty after graduation.

o A Navy release on 23 May announced the first rendezvous of three U.S. nuclear submarines at the geographic North Pole, on 6 May. The RAY, HAWKBILL and ARCHERFISH all remained surfaced at the pole for several hours to allow crew members out on the ice for recreation. The subs' Arctic mission was to collect scientific data and test their readiness under Arctic conditions while detached from logistics base support.

o On 2 May, the Secretary of the Navy, John Lehman, during SUBICEX '86 visited Ice Camp APLIS in the Arctic for a first hand look at the Navy's effort to counter Soviet intentions under the Arctic ice. During Secretary Lehman's visit, he also embarked in a U.S. submarine to observe under-ice operations. Secy. Lehman noted that, "the continued presence of the United States in the Arctic may put a kink in Soviet strategic planning... They may end up regretting they ever drew our attention to these Arctic waters." The main objective of SUBICEX '86 is to collect and analyze data about the Arctic ice cover and the waters underneath. Earlier, the Secy. of the Navy approved a Navy Arctic Service Ribbon to recognize people who serve in support of the Navy's Arctic warfare program. This Arctic Service Ribbon is retroactive to January 1, 1982.

o A Navy release notes that on April 1, a TOMAHAWK cruise missile which was launched from an attack submarine off the coast of California, flew more than 460 miles before it arrived at its target on San Clemente Island. Once over its target -- an aircraft surrounded by protective bunkers -- the missile's warhead exploded, with its blast fragments destroying the aircraft on the ground.

o An article in <u>Defense Daily</u>, March 19, 1986, relates: "The Commander-in-Chief of the U.S. Atlantic Command, Admiral Lee Baggett, Jr. has told the Senate Armed Services Committee that qualitative advances in Soviet nuclear attack submarines have reached a point where the numerically-superior Soviet submarine fleet could be successful enough against U.S. forces for the Soviets to win a conventional war in Europe. ADM. Baggett is quoted as having told the Committee:

"Soviet submarines continue to have a numerical advantage of three to one over U.S. submarines. Coupled with this quantitative advantage is the fact that the `Soviets have rapidly closed the technology gap between our submarines and theirs in terms of quality. The sophistication and capability of their new submarines, and their sensors, C^3 and weapon systems are, in many areas, comparable to ours. It can no longer be said that our numerical disadvantage can be offset by our technological superiority. This situation has developed, not because we have lacked support for our programs, but because the Soviets have made vast improvements in their submarines. Their large investments in research and development, and the apparent ease with which they have acquired Western technology, have permitted them to build submarines which are very much quieter, and therefore more and more difficult to detect.

Although our submarine force is the most capable in the world today, the Soviets are a close second and that may be good enough to provide them with an overall victory in a war. The Soviets do not have to be victorious at sea, they require only enough success to slow or blunt our offensive capabilities and prevent our reinforcement and resupply of Europe."

o <u>The Washington Times</u> of March 17, 1986, in an article by Bill Gertz, reports that Libya is shopping for small submarines, to be used for destruction of commercial passenger and cargo liners. So far, only Yugoslavia, it is claimed, appears to be negotiating with Libyan officials.

The Yugoslavian minisub, which is modeled after a Soviet design, is called the M-100, carries a crew of seven and is a diesel-electric boat. (The Soviets are credited with building, since mid-1960s, towards a 200-boat minisub fleet.) Minisubs, the author says, weigh 150 to 200 tons, and cost $20 m. to $50 m. to build.

o A Jack Anderson and Dale Van Atta column in the Washington Post of 23 May, 1986, tells of the employment of mini-submarines by the Soviets' "Spetznaz" special forces. The column claims that Sweden has been "invaded" more than 100 times by Spetznaz mini-subs. These 65-foot boats with a "maximum operating depth of 344 feet" are launched from a mother submarine and can crawl along the bottom, if desirable to do so. "They can be used to attack shoreline targets or can be used against interior targets when sea infiltration is preferred..... In Sweden's case, the minisubs are undoubtedly conducting reconnaissance and training activities."

o The Historic World War II submarine BOWFIN -- a popular visitor attraction at Pearl Harbor was designated on 5 March a "National Historic Landmark" by the Secretary of Interior. Also, ABC Circle Films has expressed interest in using BOWFIN for the filming of submarine scenes for the upcoming television series, "War and Remembrance" -- stemming from Herman Wouk's book of that title. Assuming all goes well, and according to schedule, BOWFIN will be drydocked in June, then if declared fit for tow in open seas, will be used for at-sea filming for a 2-3 week period in the Fall. This is in addition to the filming at BOWFIN Park. Most exciting, however, is the Navy approval to move the Pacific Submarine Museum located at the Pearl Harbor Submarine Base to land adjacent to BOWFIN Park where a 10,000 square foot building will be constructed to house this museum. This will allow expansion of the present 4,000 square feet of submarine displays to include many presently non-displayed artifacts and BOWFIN-related memorabilia as well as professionally designed "hands on" types of displays to increase viewer participation. A considerable increase in BOWFIN visitors is expected from this planned addition.

GOVERNMENT AFFAIRS

The TRIDENT Program

With this report, the Submarine League's Government Affairs Committee begins a series of overviews of specific major submarine development programs. This article on the TRIDENT program stems from a meeting of the Committee with RADM Ted Lewin, the Director of the Strategic Submarine Division of OPNAV (OP-21).

The Committee's first question was about the current status of the SSBN force. Admiral Lewin noted that in the period since GEORGE WASHINGTON made the first POLARIS patrol in the fall of 1960 there have been over 2400 SSBN patrols and the strategic submarine force now numbers some 28 POLARIS/POSEIDON class ships and 7 operational TRIDENT boats. The 28 POLARIS/POSEIDON boats are of the 616, 627 and 640 classes which originally numbered 31 but the SAM RAYBURN was decommissioned last year to stay within the SALT limits on SLBM launchers, and two others are being dismantled now. Additionally ten boats of the 598 and 608 classes have either been decommissioned or are serving as attack boats. NEVADA (SSBN 733), a TRIDENT, is due to be delivered in the fall of this year, with more TRIDENTS to be delivered by December of 1990 for a rate of about one a year. Two TRIDENTS were authorized in each of the FY 75 and 78 budgets.

Twelve of the 28 POLARIS/POSEIDON boats have been backfitted with the 4000 nautical mile range TRIDENT I missile (C4) and are currently operating out of Kings Bay, Georgia. A tender provides for their maintenance, but later a large, modern base presently under construction will be the east coast version of the present base at Bangor, Washington. The other 16 POLARIS/POSEIDON boats still carry the 2500 n.m. POSEIDON (C3) missile. They operate out of Holy Loch, Scotland and Charleston, South Carolina. (Rota, Spain was discontinued as an SSBN forward site a number of years ago.)

In the Pacific, with the phase out of the short range POLARIS missile, SSBNs no longer operate out of Guam. The new construction TRIDENTS with their greater range C4 missiles, operate from the base at Bangor.

The exact size of the TRIDENT submarine force has not yet been determined, but the expectation is for about 20 new TRIDENTS. The exact force size according to Admiral Lewin, should be determined by requirements for replacement of the present SLBM force, future arms control agreements, the balance required within the strategic TRIAD, and the perceived need for survivable strategic forces.

The TRIDENT submarines of the OHIO class are built to accept the much larger TRIDENT II missile (D5) when it becomes operational. At 130,000 pounds, it weighs twice as much as the shorter and thinner C4. It can be recalled that as the original 41 POLARIS/POSEIDON boats progressed from the 30,000-pound A1 and A2 single warhead missiles to the 35,000-pound A3 with its multiple warheads, only relatively minor changes were required to refit the older boats to the newer missiles. Major differences in ship structure however, resulted from re-engineering of the SSBN to accommodate quieting improvements and provide for more space forward.

The POSEIDON boats' ballistic missiles weigh 65,000 pounds and their diameter was 74 inches instead of the 54 inch diameter for the POLARIS missiles. Tube liners were removed from later classes of SSBNs to accommodate the larger diameter, but the growth in weight could not be tolerated by the earlier boats. Such problems however are not envisioned for the 726-class TRIDENT boats, and eventually all will be backfitted with the D5 missile. That will still mean that the U.S. SSBN force will have three types of missiles since there are no current plans to backfit the C4 into those boats now carrying the POSEIDON missile.

Production of C4 missiles is ended, with the NEVADA (SSBN 733) being the last of the TRIDENT I subs. A restart of C4 production to extend this capability beyond the first eight TRIDENT subs would cost several billion dollars for a new run of missiles and about one billion more to acquire equipment to go into the ships. The whole process would also take longer than that now needed to reach 100 units with the D5 missile.

The mix of POSEIDON, TRIDENT I and TRIDENT II systems does not offer the flexibility of a single system but the TRIDENT systems give increased range, increased accuracy and increased payload over the POSEIDON. The TRIDENT II's D5 missile moreover responds to the need for a ballistic missile with a hard target kill capability. This would hold at risk those hardened facilities (missile silos, etc.) that the Soviets prize highly. The D5 will permit significant increases over the C4 in payload and a significant improvement in accuracy but its fully loaded range is comparable to the fully loaded C4.

The new D5 missile will use all the available space within the launch tube, have greater propulsive power, and its total weight will be greater. To achieve hard target kill capability, a larger and heavier high-yield warhead, designated the MK5 is being developed. Thus for the same number of multiple warheads there is no significant increase in range over the C4.

The D5 missile will also be capable of carrying the same MK4 warhead used on the C4 missile. Thus, with a full load of MK4s, the D5 will have a substantial increase in range over the C4's 4000-mile range.

The D5 is currently in full scale engineering development and all initial system testing is proceeding satisfactorily toward a first flight test early in 1987 from Cape Kennedy. The ninth 726 class submarine, USS TENNESSEE (SSBN 734), to be delivered in late 1988 will be used for the evaluation launches from an SSBN. The first Demonstration and Shakedown Operation is expected in 1989. That SSBN will then be the first of the big boats to be based at Kings Bay in Georgia.

The first West Coast operation for the D5 will probably happen about 1994 -- out of Bangor, Washington. By 1989 the D5 missile production line should be up to speed and about six missiles per month produced for as long as it takes to outfit the entire 726-class.

The evaluation of the D5 was aimed at minimizing technical risks, shortening the development period and containing overall program costs. The D5 missile itself is not just an enlarged C4. The missile's electronics, guidance system, rocket nozzles and post boost control are all new designs. Other features, such as the thrust vector controls, are scaled up from the C4. The rocket propellant is a technical descendent of the MX development program -- and that had its origins in the original C4 program.

Other elements of the complete TRIDENT II system however are evolutionary from the earlier TRIDENT I program. The launcher retains the C4 launch control system but requires a new gas eject system to launch the much heavier D5. On the other hand, the navigation subsystem will use an electrostatic gyro for navigation instead of as a monitor and will have such new sensors as a velocity-measuring sonar and a gravity-sensing system in order to meet the improved accuracy specifications. In the fire control system, the same basic computer architecture is used but the memory is greatly expanded.

Overall, the operations to date of the TRIDENT system were characterized by RADM Lewin as "superb". He said that the 40 patrols and over 45 successive, successful missile launches in the last three years have shown that the boats and missiles, with their support structure, are all highly reliable and noted that the new TRIDENT submarines are both faster and quieter than the design specifications called for. High reliability of the system was a key objective and can be seen in the improved maintainability built into the TRIDENTs, their better integrated logistics support systems, and their improved shore based facilities which were designed from the ground up as a part of that goal.

The TRIDENT subs have special accesses for removing and reinstalling equipment without having to cut the pressure hull or clear massive interference in the submarine. There is a very large logistics hatch around the familiar man-sized hatch and inside that logistics hatch there are no major equipment or ventilation lines or cable runs that have to be moved in order to get whatever in or out of the ship. In addition, the process of repair and maintenance is enhanced by the creating of a TRIDENT repairables pool. The use of complete spare "modules", such as a pump, can be offloaded and the spare immediately put in as a replacement so that the offloaded piece of equipment can be repaired, tested, and quality-checked in the ship before taking its place in the repairables pool. Logistical loading of provisions and consumables is also done on a pre-planned basis and utilizes containers that go through the logistic hatches.

The total support aspect of the shore based facilities can be seen in Bangor, with home port, refit site and off crew training all on the same base. This colocation provides obvious advantages while both the Blue and Gold crews can work on their TRIDENTs during a refit period.

The patrol cycle reflects this built-in efficiency. The cycle consists of about 95 days with the refit being allotted 18 days, the refresher training and final loadout 7 days, and the patrol itself being about 70 days long. That in itself is not very different from the POLARIS/POSEIDON routine but the real difference shows up in the overhaul cycle. Overhauls will probably still take between 12 to 18 months but the frequency between them has been stretched out to 10 years. That means that OHIO, the first TRIDENT, will be operating until 1991 and the realized time-at-sea portion of the boat's life will be up to about 66% as opposed to about 55% for POSEIDON boats.

Admiral Lewin summed up the TRIDENT development program, stressing the efforts that have been made to look for cost-saving initiatives and to use off-the-shelf hardware. In discussing contractor competition in the strategic submarine program, Admiral Lewin noted that there is an effort to have TRIDENT constructed at Newport News in addition to their present sole construction at the E.B. division of General Dynamics.

Within the SSPO managed strategic weapon system there are six major areas in which

contractors are now working on the TRIDENT II program. They are:
NAVIGATION, Sperry, assisted by Autonetics and G.E.; FIRE CONTROL, General Electric; LAUNCHER, Westinghouse; MISSILE/REENTRY, Lockheed, assisted by Hercules Thiokol, CSD-UTC, and General Electric; GUIDANCE, Charles Stark Draper Labs, assisted by G.E., Raytheon, SKD and HAC. TEST INSTRUMENTATION, Interstate Electronics Corp.

Admiral Lewin also stressed the importance of the continuing and ongoing SSBN Security Program which his office oversees in order to assure the highest possible degree of survivability for the strategic submarines during their operation. It is the business of that program to assess all potential threats and insure that adequate counter-measures are in place or are being developed to be ready when the threat might be operational. In looking at ASW threat technology, both acoustic and non-acoustic are examined and the security program secures the assistance of the most capable members of the scientific community as well as strategic programs' own technical staff. About $50 million per year is put into this comprehensive program of analyses, consultation, examination and development in order to keep ahead of the threat to U.S. strategic submarines.

Admiral Lewin stated most emphatically that there is no forseeable breakthrough in ASW technologies over the forseeable future. He further said that the Intelligence Community shared in that assessment. The point of the program is not to stand on any such determination but to continually survey the spectrum of possibilities, then when any particular technology shows potential, to develop counter-measures for defeating this threat.

CAPT Jim Hay, USN(Ret.)

BOOK REVIEWS

SUBMARINES OF THE IMPERIAL JAPANESE NAVY
By Dorr Carpenter and Norman Polmar
Naval Institute Press

This is one of those delightful books which reviewers only occasionally come by. It is 177 pages in length, profusely illustrated, handy and of the best quality in every way. The reader may leaf through it for the sake of its multitude of fabulous illustrations, accompanied by concise explanations, or settle down to read the five principal chapters of text entitled, "Strategy and Operations". This text commences in 1904-05, when both Russia and Japan purchased submarines from the United States and ends with total defeat and disaster in 1945.

From the first, the Imperial Japanese Naval Command was composed of dedicated submariners. At the start of World War II the Japanese had 63 operational submarines in commission and some 29 submarines under construction, and viewed objectively, its submarine force was comparable in strength to that of the United States. However, 73 were under construction in the United States, with many, many more to come. Moreover, the quality of the IJN submarine was never up to the magnificent quality of the United States submarines. There was no comparison, especially in terms of quietness, shock mounting of machinery, non-singing propellors, double hull protection from depth charges and habitability. Of particular merit in U.S. submarines was the Torpedo Data Computer with built-in automatic settings for torpedoes which enabled U.S. submarines to fire on any fire control solution, confident that the proper angles were set on the torpedoes.

Survivability has to be a criterion of quality of design and construction, as well as evasive tactics. U.S. submarine torpedoes accounted for 20 Japanese submarines, and mines 4 more. We may assume that in World War II no submarine could survive torpedoes or mines. However, other losses to our ASW forces were so catastrophic as to question every facet of Japanese submarine design, construction and operation. The record shows that of 18 RO class of 1,447 tons submerged displacement, only one survived the war. One was sunk by SEA OWL, one by aircraft, and 15 by U.S. surface ASW!! Total losses from December, 1940 to August, 1945, totaled 136. In addition, many Japanese submarines still afloat were unable to go to sea because of damage suffered from U.S. anti-submarine forces -- which shipyards were unable to repair by the war's end.

One may be led to believe that Japanese submarines were as fragile under attack as were Japanese destroyers which could withstand very little punishment as was shown at Wake Island and elsewhere.

There appear to be two principal factors which led to the ineffectiveness and final total catastrophe which befell the Imperial Japanese submarines. They are clearly described by authors Carpenter and Polmar in the book, so the reviewer will not go into detail. The first, and most total deficiency was failure of the Japanese High Command (and lower command, as well) to make up its mind on strategy, design or tactics, and stick to it. The second deficiency was the hopeless task of waging submarine war without radar detection or ranging against an enemy fully equipped with many types of radars.

The authors state the case very well in saying that the Japanese submarine force changed its tactical concepts six times in the four years of conflict with the United States. Further:

"and it was the Japanese Navy's repeated use of submarines for purposes for which they were not designed that was a major reason for the failure of the submarine force to achieve a credible combat record."

Japanese submarines were variously used as aircraft carriers, as supply ships, for refueling and re-arming flying boats, to bombard enemy coasts, to launch suicide KAITEN mini-subs in addition to sinking ships. Before and during the war, design changes came so frequently as to impede ever achieving excellence or the standardization so necessary for mass production. Confusion also infused tactics. To quote a Japanese skipper who was on a line of nine boats in the Gilbert and Marshall Islands in 1943:

> ...."submarines were dashing back and forth between various stations assigned to them by the Sixth Fleet. First, an order would say "move". Then it would be changed to "move, navigating on the surface." Still later, it would become "wait, remaining on surface." These orders ignored completely the strong and weak features of a submarine. I'm positive that most of our submarines that were lost went down during this hectic and confused period."

The record shows that six of the nine submarines "on the line" were promptly lost -- shades of the tragic period of "playing checkers" with submarines (to use his own words) when Jimmy Fife in Brisbane directed, shifted and reshifted submarines, from headquarters on New Farm Wharf. The results were the sudden and tragic loss of ARGONAUT, AMBERJACK, GRAMPUS and TRITON and the near loss of GATO in quick succession before "playing checkers" ceased.

The reviewer reads with grim foreboding the news that soon, employing lasers via satellite, communication from headquarters can be had with submarines at any depth or location! In the words of Santayana, "Those who forget history are doomed to live it all over again."

The tactical advantages of radar to a submarine are well enough known to require no elucidation here. The advantages of radar far transcend even the excellent assists of ULTRA, making a submarine the master of the night. Almost as important as everything else is the peace of mind which radar grants the skipper and crew. The reviewer made a number of patrols in early 1942 in the Caribbean in command of S-17. At night we felt continually at risk, subject to air or surface threats, day or night. Even in good visibility, we were subject to surprise at any time from our own patrols as well as German U-boats, which seemed to fill the Caribbean at that time. Navigation, after being submerged all day, could become a nightmare. Surfacing at night in those days never gave the skipper the peace of mind which we always enjoyed when cruising, day or night, protected by the blessed SUGAR DOG and the SUGAR JIG radars. The saving grace for S-boats in the Caribbean was the fact that the enemy probably had no radar either, so we were on a par with them. Not so the unfortunate Japanese, who not only had no radar for search and attack, but they were faced with a relentless enemy that had submarine, surface and air radar -- even PT boats. Here are a Japanese skipper's words:

> "American PT boats turned out to be the unconquerable enemy of Japanese submarines. They were very small, which made them hard to see -- either at sea or against a shoreline. It did no good to fire torpedoes at them, as the MODE 95 passed well beneath them. And they had radar. While they could hide under the smallest cover, cast by an overshadowing cloud or in a cove, they could still see us at a great distance with their electronic eyes. They could dart in and attack.... before a submarine could do anything."

Everything said about PT boats could be said about U.S. submarines, aircraft and surface ships. For the Japanese submarine skipper on patrol, there was no rest for the weary, and death threatened every minute of the day or night.

It would appear that inability to formulate and implement major policy was characteristic of submarine design, as well as strategy and tactics. The authors catalogue no less than ten or eleven major changes in submarine design during the period of hostilities. On the other hand, U.S. submarines were produced by assembly line procedures and late alterations and additions of newer equipment were made after completion and acceptance. Nothing was permitted to disrupt production. After completion and acceptance, it often took a month to install new equipment and make modifications based upon war patrol experience. Thus the U.S. outbuilt the Japanese in submarines several times over during the war.

A word about torpedoes -- Japanese and American. The Japanese Long Lance and other oxygen or oxygen-enriched torpedoes achieved some very great successes, due in some cases to long legs. Chapter 16 covers torpedoes, but fails to explain the source of oxygen on submarines. This is very dangerous stuff and oxygen storage and generating facilities present real dangers. Perhaps some degree of the fragility of submarines, destroyers and cruisers of the Imperial Japanese Navy may be attributed to this fire hazard. Perhaps there are some articles written on this subject. The writer knows, from his own experience, that oxygen enrichment was under study at Newport in 1934. Later on, at the War College in 1941, the problem of oxygen supply for surface ship torpedoes on Japanese ships was negatively evaluated because of the fire hazard presented by high pressure oxygen and oxygen generators. More study is needed on the subject of whether high pressure oxygen was a tolerable hazard for submarines. The book points out that early Type 95 Mod 1 submarine oxygen torpedoes presented grave problems with pressurization and had to be re-designed in 1943. The numerous RO class used the Type 6 air-kerosene torpedo with a maximum speed of 36 knots. Other submarines used Type 89 air-kerosene engines with characteristics similar to the U.S. MK 14. The Type 95 Mod 2, oxygen-kerosene torpedo was a superior one -- in general use in 1943 and afterward.

As for the Mark 14 U.S. torpedo, its only defense is that others (Germans) had torpedo problems as well. Aside from the influence exploder, which was a bust for everyone, the depth and exploder problems of the MK 14 Mod IV were largely confined to the high speed mode (later corrected). At low speed (31.1 knots) it performed pretty well from the start. My personal problem stemmed from doctrine taught me at PCO School "to get in below 1000 yards to fire." I experienced every bit of bad luck there was, until I learned from Tom Dykers to lay off at about 1600 yards preferably at night and use low power. Analysis during the war should have warned skippers that to attempt to get in under 1000 yards was a bad tactic. It was better to shoot from 1600 to 2000 yards for maximum effect at night. I would like to hear of more wartime-experienced opinion on optimum range.

If the Japanese had any torpedo or exploder problems, Carpenter and Polmar fail to report them (other than oxygen leakage on Type 95). However, I know that they suffered from their share of duds and some under-runs.

Now the reader must savor this very fine book on his own. He may be assured that the exploits and a full description of Japanese submarine participation in World War II will be found. Well written, beautifully illustrated and free of all but an occasional minor error (p. 47 -- HARDER not

DARTER sank three DDs in four days off TAWI TAWI); this book is a keystone book for every submariner's library. My congratulations to Dorr P. Carpenter, Norman Polmar and the Naval Institute Press.

Brooks J. Harral
Rear Admiral, USN(Ret.)

SUBMARINE CAPTAIN

By A. T. Irvine, Anchor Publications, £7.75

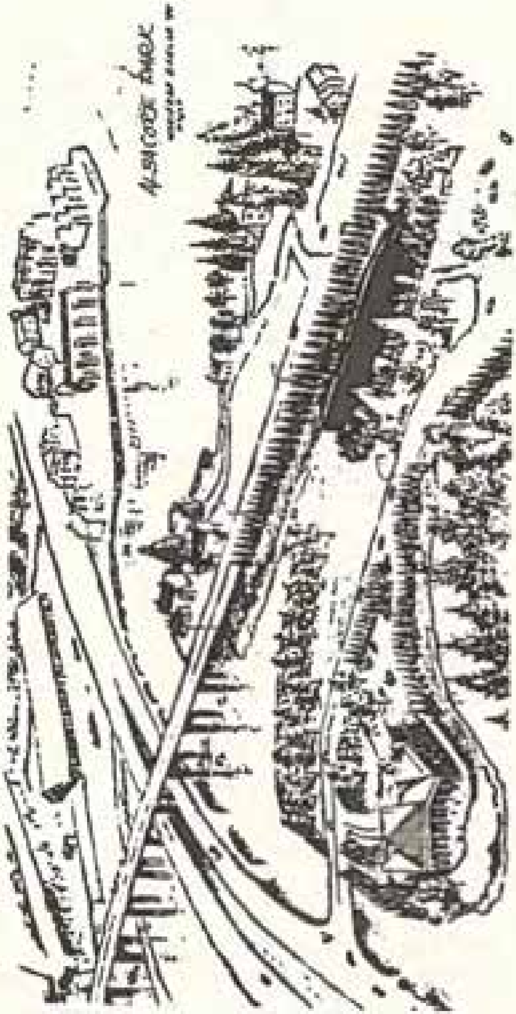
During World War II, Lieutenant Commander Irvine served as a young Sub Lieutenant in the British T Class Submarines TORBAY and TIPTOE and it is this experience that provides the background for his novel.

Life in a diesel submarine is vividly displayed in this story which starts with a North Sea battle in which Peter Manley takes command of the Submarine when his Captain is killed by an attacking German E Boat. He is decorated and given command of a T Class Submarine in overhaul. The story tells of the experiences, often thrilling, sometimes frightening of the ships' company ashore and afloat from UK to Gibraltar and on into the Mediterranean.

The style of writing at first appears old fashioned until one realises that it accurately reflects the atmosphere 40 years ago whilst showing how many aspects of submarining remain the same today.

This book highlights the great responsibilities of a submarine Captain in the environment of war. Most of the time he is the only person who is knowledgeable about the enemy's movements. And then he alone decides the course of action for his submarine. Thus, the successful submarine Captain is an outstanding leader, of high courage, and is absolutely committed to the job at hand.

Commander Phil Higgins, Royal Navy



This artists concept of how Albacore Park will eventually look is so charming that it was felt it should be published herewith. The Albacore (SS 569) is a part of the Port of Portsmouth's Maritime Museum -- in Portsmouth, NH.

NSL 1986 AWARDS PROGRAM

The NSL and DCNO (Submarines) select five fleet or fleet support individuals for special recognition at the annual NSL Symposium, held on 10 July in Washington, DC. There are three categories of awards. The first category, (NSL CHARLES A. LOCKWOOD Award for Submarine Professional Excellence) is awarded to a commissioned officer, chief petty officer and non-commissioned officer (E6 or below) for achievement, contribution, specific action or consistent performance which best exemplifies the traditional spirit embodied by the Submarine Force.

The awardees for this year were:

LCDR David W. Hearding, USN
USS GATO (SSN 615)

RMC(SS) Benjamin D. King, USN
USS STURGEON (SSN 637)

MM1(SS) William W. Scott, USN
USS STONEWALL JACKSON (SSBN 634)

The second award (NSL LEVERING SMITH Award for Submarine Support Achievement) is presented to an individual for submarine support actions which have most contributed to furtherance of the spirit of fighting mettle of the Submarine Force.

The awardee this year was:

MMCM(SS) John M. Maldonado, USN
Trident Refit Facility, Bangor

The third award (NSL FREDERICK B. WARDER Award for Outstanding Achievement) recognizes a specific action, contribution or continuing performance which most positively influenced the reputation, readiness or future well-being of the Submarine Force.

The awardee this year was:
TMC(SS) Michael J. Brown, USN
USS HADDOCK (SSN 621)

There were 64 fleet nominees for this initial NSL Awards Program. The selection of finalists was done by the Office of the DCNO (Submarines) and approved by the NSL. The presentations were made by Admiral R. L. J. Long, USN(Ret.), NSL Chairman of the Board of Directors.

Vice Admiral Levering Smith, USN(Ret.), and Rear Admiral "Freddie" Warder, USN(Ret.) were present and assisted at the award ceremony. These five outstanding representatives of the Navy exemplify the outstanding men and women associated with todays Submarine Service and give all NSL members cause to further the aims of the NSL.

MEMBERSHIP STATUS

	Current	Last REVIEW	Year ago
Active Duty	728	658	568
Others	2094	1987	1889
Life	62	60	44
Total	2920	2735	2519

Non-Renewal Total -- 384

HAVE YOU GOTTEN 2 NEW MEMBERS FOR 1986?

Circulation of this issue exceeds 5,000

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SUBMARINE PHOTOGRAPHS

The Naval Submarine League has obtained some very good colored pictures of nuclear submarines suitable for framing. We have one glossy print that is an 8 x 10, and all others are 16 x 20, all of SSBNs. 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. P.O. Box 1146, Annandale, VA 22003. Or call (703) 256-0891.

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VADM GLYNN ROBERT DONAHO, USN(RET.)

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Many of our members have requested copies of previous issues of THE SUBMARINE REVIEW. We have made arrangements with our publisher to reprint back issues, minimum run of 50 copies per issue. Unfortunately, the cost is high .... $10.00 per copy, but these books are unique, and very much in demand. The first run of back issues has been delivered to our office, and a few are still available for purchase. If you are interested in completing your library with all issues of THE SUBMARINE REVIEW to date, please indicate the issues desired, and remit $10.00 for each copy.

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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.

A $50.00 stipend will be paid for each major article published. Although this is not a large amount, it will help offset the authors cost for paper, pen and typing. Annually, three articles are selected for special recognition and an honorarium of up to $400.00 will be awarded to the authors.

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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