THE SUBMARINE REVIEW

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FROM THE PRESIDENT

Near coincident with the arrival of this issue of the REVIEW, a portion of the Navy's senior submariners will be changing jobs. While this is not an earth shaking event, it is significant in a few aspects. The transition of the submarine force to nuclear power was a difficult effort, fraught with a multitude of factors none of us will ever completely appreciate or comprehend. Most of us accept this and give credit where it is rightly due. Admiral Kin McKee's assignment, on relieving Admiral Rickover, in our estimation, was a Herculean task. How do you step into a legend's shoes? How does one generate the mystique to motivate a bureaucracy content in the status quo on technical, operational and human issues? These and countless other questions and issues were part of the environment Kin faced and had to meet head on each day. He was never reluctant to speak out and state the issues as he saw them. His presentations at Naval Submarine League functions often gave us challenges to bring our thinking processes into step with reality. These were not easy to accept nor necessarily what one wants to hear. But it was necessary to state the issue and in many ways Kin served without portfolio as our conscience. When all is said, reflected upon, and judged in future years, I strongly believe that we will agree that he did magnificently. I know we haven't seen the last of Kin, nor would we want it that way. The Submarine Force has too much to offer this country to allow him to escape his ascending role as elder. Similarly, the NSL must grow to fulfill our missions. We look forward to a long, close and continued relationship with a fine American and patriot.

It is the Navy's good fortune to have Bruce DeMars available to step into this patriarch's big shoes. Bruce has ably assisted the NSL in our six years of existence. Significant new NSL ideas and

initiatives were formulated during his tenure in the Pentagon. Some returned handsome dividends, others may have generated none. But overall a course was set, a mission accepted and a team effort produced. It is with pride and anticipation that we look to the future with Bruce as a NSL team member.

I ask that we make our appreciation known to Kin and Bruce when you see them in your travels. Bravo Zulu to Kin and Bruce.

Finally, the NSL Submarine Documentary film is gathering momentum. The script is finished, interviews have commenced and film is rolling in the camera. Our funding goal of $525,000 needs about $70,000 to keep me and Al Kelln out of jail. Those members associated with major corporations please review the bidding to see if your firm could bite off a chunk of the short-fall. Ample credit will be given to all firms that contribute, and these credit lines will be repeated in the future editions of the NSL FACT BOOK.

Shannon

P.S. The NSL is expanding its administrative staff and is accepting resumes for the position of NSL Executive Director. The salary range is negotiable and will be commensurate with executive experience and background. Send corresondence to: Naval Submarine League, Box 1146, Annandale, VA 22003. Attention: Search Committee.

CALL FOR VOLUNTEERS

Needed - Marian the Librarian!

Anyone with library skills or experience to advise the Naval Submarine League on the elements in establishing a central submarine oriented library.

AN EXCITING TIME TO BE IN SUBMARINES

Remarks by Admiral C. A. H. Trost, USN
Chief of Naval Operations
COMSUBLANT Change of Command
17 August 1988

This is a great day for the submarine force. And it provides a fitting and proper occasion to reflect on our splendid past, on the very satisfactory state of affairs in the present, and on the exciting future.

The present is well represented today -- just take a look around at these superb ships and the wonderful people who sail in them and command them. Those of you whose memories go back that far, recall that less than 35 years ago, our force was 100 percent diesel electric. Those were tough ships -- the best we had at the time -- and they could and did operate against the enemy in any environment. But the margins were much finer than today. Our skippers like Bart Bacon, (the new COMSUBLANT's father) had to get in very close to shoot; they had to attack at night or constantly watch their batteries during daylight submerged approaches; for every action there was a trade-off.

But look at where we are today. Like the Navy overall, the submarine force is in great shape. It is operating at a high tempo, with total professionalism and with historically high levels of readiness and capability. Our submarines can go anywhere undetected, and they can stay on station indefinitely. A lot of people share in the credit for today's success. Some of them are standing beside me on this ship, others are visible in their neat ranks all around you, and one man, Vice Admiral Dan Cooper, whom we honor in this ceremony, has played a particularly important role. I'll have more to say about Dan's superb performance in a moment, but for now, think

of the total support, the incredible investment in training and material throughout the chain of command that make ships like USS NORFOLK and her sisters such going concerns.

Now that leaves the Future, and what a thrilling era that promises to be. In my 39-plus years of wearing a uniform, I can think of few times when the future has excited so much attention, not only in the submarine force, but throughout the navy. It may be the approach of the next millennium; it may be what is happening in the Soviet Union and the prospect that there will perhaps be fundamental changes in relationships among the community of nations; it may be the tremendous explosion of new technology and the anticipation that the navy in general, the submarine force in particular, is going to depart from the present plateaus and begin one of its periodic adventures scaling heretofore unknown heights of capabality. Whatever the reason, "the future" has become almost a finite entity for our ambitions. It seems much closer than the horizon, and there has been a tremendous activity aimed at capturing all of its remarkable potential.

What potential? Well, for submarines, the potential that having become true submersibles, with unparalleled advantages in covertness, mobility, and endurance, they would now turn those advantages into perfect integration with the other capable platforms of the striking fleet; and that, increasingly undetectable to potential adversaries, they would become increasingly employable, responsive, and capable in support of all the warfighting missions a fleet commander may have to undertake.

Specifically, we see a potential that submarines could apply forward pressure against virtually any aggressor -- not just against its submarines and surface ships, but against land or air systems essential to the offensive military

operations on which its aggression would depend. Today, we know that the potential of our submarines to undertake expanded missions in strike and anti-air warfare deeply worries the Soviet union. As Marshall Ahkromeyev told us during his visit to the United States last month, the Soviet military consider the NATO navies their number one military threat. They see themselves surrounded by the distributed, offensive firepower of highly capable aircraft carriers and, increasingly, by sea-based cruise missiles. In the 1960s and 1970s, one of the primary elements of their strategy was to attempt to nullify the striking power of our carriers through anti-carrier weapons systems like the CHARLIE-class submarine with the SS-N-7 missile. We have countered that effort through superiority in both area and battle force ASW. And now we have made their problem even harder through development of the TOMAHAWK missile system capability that will go to sea on nearly 200 surface and submarine platforms. That worries them a lot. That really does put them in a defensive frame of mind, no matter in which direction their doctrine goes, that's deterrence working, and it's something we must be careful to protect.

In the future, the prospect that our submarines and surface platforms will be able to undertake new missions, that the battle sphere will be electromagnetically knit together from the seabed to deep space, and that submarines themselves could be used to help reconstitute our satellite space capability in the event of degradation -- these things can only increase the uncertainties of potential adversaries and thus enhance our own security.

Now all this will not happen in one magical night, of course. We won't wake up and find ourselves living in an era called "the future." Our advantages will have to be won day by day, step by step, just as they are being won today.

The recent highly successful operational demonstration of the MARK-48 advanced capability torpedo, fired from almost directly under my feet on this submarine, is one example. The evolutionary process that took the SSN-688 class and improved-688 class as far as it could go, and that then designed the SSN-21 to incorporate capabilities already proven at sea, is another example. The identification of a dedicated research and development submarine to maintain submarine technology on the leading edge will be a third.

All these things don't mean that the problems are solved. A lot more work needs to be done in nitty-gritty areas; areas like produceability and maintainability, which in turn depend on the technical training and education of our nation's youth; areas like affordability, which depends in part on the right national political will; and areas like operability across the spectrum of hostile environments, to make our platforms superior to anything that can be brought to bear against them; even seemingly mundane areas like electromagnetic engineering need our continued attention if our strength in the future is to be real and not merely perceived.

The threat is also improving. To meet this challenge, our submarines, armed with new sensors and weapons, invested with new mission responsibilities, must nevertheless continue to lead the way in antisubmarine warfare; but as all submarines become quieter, that gets tougher.

Still it is a bright future, a future limited only by imagination and ambition.

Regardless of potential, however, the key to success for any naval force is taking what you have today and making it work. And those are two things that the submarine force Atlantic has done superbly. And for that, much of the credit goes to Vice Admiral Dan Cooper.

As COMSUBLANT, Dan Cooper has been both the administrative and the operational commander of 29 nuclear-powered ballistic missile submarines, 54 nuclear attack submarines, one nuclear research submarine, one diesel attack submarine, and 23 supporting surface ships. His responsibilities have included every aspect of those 108 ships from start to finish -- from development and execution of a constrained budget; to maintenance support at every level from depot to ship's force to training and tactical innovation; to geostrategic planning in the national, NATO, and bi-and tri- lateral arenas; and finally, to the bottom line, successful employment at sea. He has discharged all responsibilities with absolute professionalism and inspirational command leadership. He has operated his submarines in virtually every ocean environment, from under the Arctic ice to the Drake Passage. In the process he has saved millions of dollars in maintenance and operating costs by doing things more efficiently. He's led the way in proving submarine technology for tomorrow and in the design and development of systems beyond tomorrow. He has inculcated in his command an attitude of being war-ready at all times -- the obverse of national political will, and just as indispensable to deterrence. Finally, he's continued to place his emphasis on people, on personnel excellence, on challenging each sailor in his command to do his or her best and become the best. And as we look toward the future, we know that no matter how capable our systems become, good navy people will continue to be the irreducible difference in our greatness.

Dan, yours has been a superb tour in command. Now we need you to head up all our undersea warfare programs to help make that future a reality. Congratulations to you on outstanding success across the board.

Roger (Bacon), you too have been in the forefront of submarine operations. For nearly two

years you have helped to maintain the credibility of our deterrence in that vital region on the southern flank of NATO, at a time when the navy's operational requirements around the globe, and in particular in the Persian Gulf, constrained our ability to operate in other theaters. You did a great job as Commander Submarines Mediterranean, and it is in recognition of your abilities that you now come to this, our most important submarine command. I know it will be an exciting and productive tour for you.

SUBMARINE WARFARE

Submarine warfare today holds little resemblance to that experienced in the past two major wars of the twentieth century -- i.e., World Wars I and II. This is startlingly evident when the impact of nuclear powered submarines and nuclear warhead weapons are added to the character of sea wars. In addition, present submarine technologies and submarine weapons along with the new technology for supporting activities -- communications, navigation, airborne surveillance, command and control, etc. -- have developed such radically improved efficiencies for submarine operations as to preclude any simple comparisons with past submarine strategies and tactics in conflicts.

The use of conventional submarines in war today, as carried out by the diesel electrics differs from that experienced in World War II in considerable ways. Present conventional submarines can use far higher speed submerged, can stay fully submerged for many days, can operate very quietly for prolonged periods of time and can use long range "smart" weapons (both cruise missiles and torpedoes) to make accurate attacks on both surface ships and submarines.

On the other hand, nuclear submarines,

whether strategic submarines (SSBNs) or attack submarines (which now encompass both SSNs and SSGNs, since all can now utilize guided missiles and should be classified under the one designation of SSN) have created a revolution in submarine warfare. Nuclear strategic submarines have produced a new role for submarines -- that of projecting a tremendous magnitude of weapon power from the seas against objectives in the enemy's homeland. While at the same time, nuclear attack submarines have achieved a uniquely high potential for effective submarine operations -- which should make them the dominant force in sea warfare. At the same time, nuclear submarines have caused antisubmarine operations to be a primary mission -- with very quiet nuclears independently fighting noisy nuclears and the noisy nuclears combating the quiet ones by using coordinated operations with surface, air and other supporting units.

In general, even the smallest navies with a few conventional submarines now have a strike capability that can destroy the warships of a greater naval power -- while avoiding air antisubmarine efforts by remaining covertly submerged. They can thus effectively gain a degree of sea control over a limited area of the oceans for a short period of time -- sufficient to carry out limited missions. Such conventional submarines as well as the large sophisticated ones of major navies relying on passive acoustics for detecting enemy ships can conduct covert operations until a surprise attack is consummated. However, with ships becoming significantly quieter, the use of active sonar for fire control can be expected in some tactical situations. Additionally, reliance on external sources for targeting information is increasingly employed.

Fortunately, since World War II there have been several examples of submarine operations which illuminate the character of the submarine warfare which might be seen today.

The sinking of the Argentine cruiser GENERAL BELGRANO by the British nuclear submarine CONQUEROR -- using pre-WW II Mk VIII torpedoes -- in the Falkland Islands War of 1982, demonstrated a new dimension to sea warfare created by the advent of the nuclear powered submarine. Though the GENERAL BELGRANO was well escorted by two destroyers and was about to exit an exclusion zone, the CONQUEROR was able with the assistance of external targeting sources to rapidly close the Argentine warships and carry out a surprise, optimum-positioned attack with three torpedoes which sank the BELGRANO. The great mobility and covertness of the nuclear submarine in a sea war and its capability to capitalize quickly on a suddenly disclosed opportunity while starting at a considerable distance from its target, showed totally new submarine capabilities for anti-surface-ship engagements. Earlier, the five British nuclear submarines which were in the Falkland Islands war-area at virtually the commencement of the conflict, had arrived undetected by the Argentines from North Atlantic stations over 6,000 miles away. This demonstration of the great high-speed submerged endurance of nuclear submarines and their ability to quickly respond to very distant war objectives, not only established the practicality of submarine warfare on a world-wide basis but also established the ubiquitous threat of submarines early in a conflict. The third of these sparse examples of submarines in war were the unsuccessful attacks by the Argentine diesel-electric type 209 submarine against British warships off the Falkland Islands. They illustrated two important points for today's sea warfare, i.e., that diesel-electric submarines with their improved quiet submerged endurance can ubiquitously make a large force of enemy surface and air ASW units expend an inordinate amount of ordnance on false contacts. This showed the continued viability of the conventional submarine in war despite the great advances made in ASW technology since WW II.

There have also been peacetime submarine activities which resemble wartime operations and give a good indication of how submarine special operations should fit into actual conflict. The strategic submarine deterrence patrols are in ocean areas where their ballistic missiles can threaten an enemy's homeland and their present mode of operations are likely to be duplicated in war. Similarly, the continuing forward-area intelligence gathering submarine patrols reveal the way this mission can be conducted in wartime. Finally, the considerable activity of midget submarines in Swedish territorial waters during this decade presage an increased activity of minisubmarines in conflicts.

There are, today, 955 submarines (not including the small midget submarines) in the fleets of 42 or more countries -- over 60% of which are nonnuclears. But all submarines should play a dominant role in conflicts between the major powers of the world as well as between third power countries. Significantly, the largest submarine fleet worldwide, that of the Soviets -- with more than one third of all the submarines in the world -- is structured on the premise that submarines are the first line warships of today's navies, with ballistic missile submarines felt to be the controlling factor in favorably influencing the outcome of major land wars.

STRATEGIC SUBMARINES

Strategic nuclear-armed submarines provide the major threat to an enemy and the antisubmarine warfare efforts against them -- best carried out by attack submarines --comprise a new kind of submarine warfare, strategic ASW. This involves two widely differing modes of strategic submarine operations. On the one hand, the Allies strategic submarines (including SSNs with very long range nuclear-armed cruise missiles) will operate independently in the vast reaches of the oceans,

depending on their great covertness and external sources intelligence to minimize enemy strategic ASW efforts. With launches of less than a full load of strategic missiles likely, and their detection as these rise above the sea expected, the firing of a half salvo in only a few minutes plus high speed evasion should take an SSBN clear of the firing area before an effective counter attack by an enemy can be realized.

On the other hand, the Soviet's force of noisier strategic submarines (particularly their SSBNs) are expected to be operated in "bastions" close to the Soviet homeland. The more than 4000 n.mi. range of their ballistic missiles permit Soviet submarines to effectively target strategic objectives within the United States from these havens. The protection of Soviet SSBNs which operate in close to home bastions, is provided by first an escort from their bases, of warships using active sonar. Then a perimeter of ASW defense around the bastions is likely, consisting of diesel-electric submarines, mines, ocean-bed detection systems, ASW aircraft and possibly ASW warships -- making it difficult for an enemy attack submarine to penetrate into the bastion plus the probability that such havens might be on the edge of the polar ice cap or even under it. Finally, -- if the bastion was penetrated by an enemy antisubmarine unit, it would find the strategic submarine closely supported by an attack submarine, with both operating at quiet low speeds.

This elaborate protection of strategic submarines is consistent with the priorities set by the Soviets for their naval forces. Of first priority is the assurance of carrying out the strategic nuclear-weapon mission. Of next priority is the ensuring of the survival -- during all levels of sea warfare from conventional war to all-out nuclear war -- of the Soviet strategic submarines.

Strategic ASW is not considered to be destabilizing, causing an escalation to strategic nuclear war. Nor is it believed that such ASW actions promise much success for either side in a big war. The inherent survivability of U.S. strategic submarines due to their undetectability by acoustic or non-acoustic enemy sensors should result in few losses over a long period of war -- even if nuclear weapons are being used at sea. Similarly, the heavy protection accorded the Soviet strategic submarines should make their attrition very costly for enemy SSNs. However, strategic ASW frees all submarines from the constraint of having to identify enemy submarines before an attack. It also reduces the blackmailing threat which such a force-in-being exerts over an enemy and offers some degree of damage limiting. But still, the cost of a major offensive against the enemy's strategic submarines appears to be high for what may be gained.

SSNs carrying 1600-mile nuclear-tipped land attack cruise missiles must also be considered as a part of strategic submarine warfare. Although the range of such missiles limit enemy strategic objectives to mainly coastal areas -- naval bases, port installations, airfields etc. -- their destruction is useful both to aid in ensuring control of the seas as well as to deter the escalation of war to massive strategic nuclear exchange.

ATTACK SUBMARINES

The latent capability of nuclear attack submarines for winning battles at sea -- against even the strongest combination of warships -- needs only a major conflict to prove itself. The covert, highly maneuverable nuclear submarine, using long-range, large-warhead, programmed missiles and torpedoes with accurate terminal homing, can use the offensive to attack with a maximum element of surprise, with weapons which can maneuver in their trajectories to provide a

concentration of force on a well-defended clearly defined objective -- a target or group of targets. (The underlined words comprise the well agreed upon "principles of war", which nuclear submarines enjoy with a high level of competence.) Additional "principles of war" are embodied in the nuclear submarine's capability to control the tempo of operations, to mass the battle efforts of a group of submarines without having to be in close proximity to each other, to use a calculable level of weapon power to accomplish a mission with an economy of force while producing a bonus shock or disorienting effect on enemy defenses -- under all-weather conditions. And, with a high likelihood of achieving decisive results in naval engagements.

Today the "offensive" is greatly favored over a strong defense for winning battles. Taking the offensive along with the surprise which modern nuclear submarines can generate promises the gaining of attack positions against merchant ships, warships and submarines without alerting their targets until shortly before weapon arrival. SSNs can also be massed for a surprise attack on a grouping of targets -- a unique new quality in sea warfare.

Additionally, in using long range "smart" weapons, SSNs have little need to "maneuver" to produce a concentration of weapon power against enemy ships. Their programmed weapons supply the tactical element of "maneuver" for effective penetration of enemy defenses. (SSBNs emphasize maneuver of their MIRVs -- rather than platform maneuver -- for mission success).

The great "concentration of force" achievable by several nuclear submarines acting in concert, provides a new level of destruction never contemplated for sea battles. This concentrating of weapon force may also be seen in coordinated

submerged wolfpacks of submarines using long-range "smart" torpedoes.

Consider the "shock effect" produced by nuclear submarine attacks. A battle group or other grouping of ships, if hit by a considerable number of missiles or torpedoes over a short period of time, are likely to have their defenses disintegrate and their command element disoriented. Effective mop-up operations are then likely to follow, producing a level of decisive action never before experienced in sea wars.

A new kind of submarine warfare evolves from nuclear submarines (and possibly long-submerged endurance conventionals) being able to fight under the ice. Strategic submarines operating under the ice cap and underwater transits from the Pacific and Atlantic, including moves from Soviet Arctic bases over to the Pacific will be subject to submarine attacks. Submarines have shown the capability to maneuver under the dangerous downward projecting ice ridges and have proved the operability of torpedoes under the ice. Hence, submarine warfare in this environment is a reality with new strategies probably involving the use of mines expected for fighting this type of war.

CONVENTIONAL SUBMARINES

Conventional submarines (excluding the midgets) comprising nearly two thirds of the total submarines in the world's navies, have considerable submerged mobility. Still, technological advances in acoustic and non-acoustic detection systems, greatly limit the conventional submarine's usefulness in major sea wars. They are useful in barriers where patrol area coverage need not be great, in shallow waters where coastal features limit their target's freedom of movement and in areas close to forward bases where their transits to station are of short duration. Their long-range, terminal-homing weapons (cruise mis-

siles and torpedoes) and their increased submerged endurance make them far more effective than WW II submarines in attacks against merchant convoys, independent ships and enemy submarines. Their quietness may even cause nuclear submarines to blunder into a conventional's field of fire.

The appearance of short-range anti-air missiles on the bridges of conventional submarines presage a capability to drive ASW aircraft away from close-in attacks.

Conventional submarines are expected to be used extensively in the mining of ocean areas. Laying mines in restricted passages which enemy submarines may transit, and mining of shallow waters and entrances to overseas ports just ahead of large movements of ships in or out of a port -- to counter minesweeping efforts -- are an effective use of today's conventional submarines. Additionally, their attacks on ships in port areas with standoff cruise missiles adds a new dimension to the threat they pose in sea warfare.

Of first importance for today's conventional submarines is their utilization in third power conflicts. As evidenced by the Argentine 209's experience with British ASW forces, the conventional submarine continues to have a distinct advantage over today's technologically improved surface and air ASW forces. Hence, in third power wars of revolution, civil war, etc., conventional submarines are likely to be used in interdiction of enemy shipping and enemy warships, along with mining of enemy port areas. And, because of the clandestine nature of submarine warfare, it is likely that the submarines of other navies which have an interest in the outcome of such a war may be covertly interjected into the conflict -- remaining unidentified, as were the foreign submarines which were used in the Spanish Civil War in 1936.

Midget (or mini-submarine) operations are being emphasized -- at least by the Soviets -- who are using them for underwater delivery of Spetznaz teams (teams used for sabotage, destruction of shore facilities, intelligence gathering, etc.) to enemy coasts. Navies have developed means for delivery by their big submarines of mini-subs to shallow water areas. Accurate navigation in these midgets allows them to move efficiently to their target areas and carry out missions which in the past have been fraught with great uncertainty and high risk.

There are additional submarine activities which should play important roles in submarine warfare. First is surveillance. Submarines will collect information on potential enemy targets for other submarines and fleet units. They will do beach reconnaissance for amphibious operations. And they will be active in covert intelligence gathering missions. Submarines will also be active in electronic warfare, using their electronic equipment to: jam enemy radio transmissions; input spurious information into an enemy's communications; countermeasure enemy weapons in their trajectories; provide false targets; etc.. This form of submarine warfare may possibly become more intense and important than other better recognized submarine activities. Making an enemy uncertain of his communications to his strategic submarines, for example, may be of critical importance to political decisions involving escalation to nuclear war. Similarly, the use of submarines in anti-satellite warfare amy appear in near-term wars. Control of sea areas where satellites can be destroyed at launch or in their initial pass around the earth may become a nuclear submarine mission.

The potential of submarines in sea wars seems only partially recognized. After the start of a conflict, however, there should be an expanded and

dominating use of submarines -- much as with the aircraft carriers in World War II.

Phoenix

THE FORWARD TO JANE'S FIGHTING SHIPS 1988-89

"We overestimated our intelligence." At the start of any campaign it is a military cliche that an honest commander will have to admit that he was inadequately informed about the enemy. The latest to join this distinguished company is Admiral (William J.) Crowe (Jr.), Chairman of the U.S. Joint Chiefs of Staff, who made his confession last September when talking about the damage to merchant shipping caused by Iranian mines laid from an assortment of transport vessels, and by small arms carried in the first patrol launches of the Revolutionary Guard. It isn't easy for those educated in the atmosphere of superpower confrontation between ships and submarines of unimaginable firepower to take seriously either horned mines that look as though they had escaped from an exhibition of WWII memorabilia or men in open boats with hand-held rocket launchers. We can be sure that the admiral's advisers knew about the mines and the small craft, but in the deluge of information available they failed to isolate what proved to be the most important elements at the start of the U.S. Navy's involvement, and my guess is that the mining expert was unable to make himself heard above the roar of SILKWORMS, EXOCETS, and midget submarines.

The same problem of too much information, too many choices, confronts almost every aspect of naval affairs, starting with equipment procurement and selection of weapon systems and moving on through command and control and tactical data handling. To find a path through this jungle you need experts, which means people with previous experience of all aspects of the particular prob-

lem which you are trying to resolve. And yet so much second-hand information is available that men of intelligence and goodwill who have no knowledge of the sea still feel competent to make judgements and choices, buoyed up by the sheer volume of indiscriminate or "selective" evidence with which they can be presented by the products of modern information technology. The trouble is, of course, that many of the experts are also people with a vested interest in the preservation of the status quo plus a little bit better and a little bit more, so providing a readily available rationale for those who wish to undermine or supplant their judgements in the competitive struggle for budget priorities. But whereas there may be justification for turning to independent advice to balance special pleading, in the end it is essential to trust the judgement of those who have first-hand knowledge of the environment, regardless of suspicions about their motives. This seems to me particularly important in maritime affairs where the scale of events is so easily distorted by focusing on small-scale maps. To a generation brought up with the daily images of satellite weather photography allied to the certainty of being able to fly anywhere in the world in a few hours, the whole maritime scene is as though viewed through the wrong end of a telescope. The sea is still as vast as it was in the days of Raleigh and Columbus because ships still move at a speed which both of those two global explorers would have no difficulty in recognizing. If you leave Portsmouth harbour (the English one that is) and take the second turning on the right as depicted on the TV weather map you finish up in the Norwegian Sea; in reality you would be up the creek in Southampton Water less than 20 miles from your point of departure. Perhaps to the professional sailor one of the few satisfying aspects of the Gulf war has been the education of at least a section of the western media into the difficulties of identifying radar contacts in what is by oceanic standards a tiny area of sea. Naval

spokesmen don't always help themselves in explaining their time and space problems by talking about barriers and choke points. Bottling up the Irish sea to prevent submarine egress seems a comparatively simple business as an abstract idea. At the northern end there are just less than 15 miles between Scotland's Mull of Kintyre and Northern Ireland's Rathlin Island, and yet such are the sonar conditions in that stretch of water that detecting a submarine by the most modern of active or passive acoustic devices generated difficulties which by comparison make even the identification of the Pasdaran launch in the Gulf a relatively easy task. Much of the ill-informed comment on the vulnerability of ships to shore-based air attack could be countered by releasing a statistical analysis of the efforts needed by planners to ensure that contact of any kind is made between ships and aircraft during exercises even quite close to the airbase concerned; and a warship's ability to launch "for exercise" surface-to-surface missiles against lighthouses or other non-offending bits of a coastline, to say nothing of friendly and neutral shipping, is remarkable even when not subjected to the stress and fog of war.

There is both above and on the surface of the sea today a hopeless imbalance between the range to which weapons will go and the firing platform's ability to be certain of its target, hence the pressures for better third-party targeting, improved IFF identification equipment (well, almost anything would be an improvement), more computer-based automation (as though this will somehow alleviate the situation), and greater communications compatibility between ships of different countries who may find themselves being a greater danger to each other than to the enemy. In an extreme case, an exchange between two detached task group units might go like this: "Request send your helicopter to identify the radar contact bearing due north range 30 miles from me." "On my plot the contact 30 miles to the

north of you is me and my helicopter is at this moment refuelling on your flight deck." The possibility exists that in war this exchange might have been preceded by a missile fired in panic. Such difficulties ought to be containable by improved data-link capability which, with the need to control active electronic emissions, becomes more and more important, but air and surface-plot compilation is subject to a range of human frailties even in an environment free of electronic countermeasures. If the theorists are correct, in the future the task unit commander described earlier could ask the all-seeing satellite to identify his unresolved contact, which is an application of what is described as "real-time targeting by satellite." Such a thing is possible now under trial conditions in carefully chosen scenarios and within a benign electronic environment; but applied to the sandstorms of the Gulf, the darkness of northern Norway, the gale-lashed Atlantic, or major shipping routes anywhere in the world, satellite targeting on demand is an armchair fantasy believed in only by those who do not know the sea or who have been so long away from it that they have forgotten the reality. Straying into unknown territory myself, I would venture that leakproof ballistic missile defences come into much the same category of self-interested science fiction. But, if by virtue of the size of the ocean and the largest identification problem, and not least because of its own passive and active defences, the modern well-run task force or air defence ship is not as vulnerable to hostile long-range air attack as its detractors would like to believe, there is lurking in the depths a far greater problem, and that of course is the nuclear-powered attack submarine (SSN).

There is probably more nonsense talked and written, at every level of classification from Top Secret to the Washington Post, about anti-submarine warfare than any other military subject. The major navies are under few illusions about the

power of the nuclear submarine, but a profitable anti-submarine industry has developed which is dedicated to understating their decisive potential as ship killers and trying to convince itself that as a threat the SSN is containable. In spite of the millions of dollars spent on acoustic equipment improvements in the last 20 years, it is no secret that passive sonar detection ranges which were always unreliable are now decreasing as well, and the laws of physics combined with the structure and contents of the oceans have got active sonar developments in a vise-like and short-range grip. Very low frequency transmitters have some potential but mobility and fire control complexities are always going to limit practical application. Non-acoustic devices are equally flush with development funds and even less productive in achieving anything like a guaranteed area search capability. Meanwhile, the weapon delivery potential of these underwater cruisers continues on a steadily rising curve of improved performance in payload, range, and lethality. As they dive deeper and go faster and the hulls get stronger, the difficulties of a successful counter attack are further compounded. So far, only one SSN has fired a shot in anger and the sinking of the GENERAL BELGRANO effectively excluded a navy with relatively unsophisticated anti-submarine capabilities from the remainder of the Falklands War. But supposing the Argentines had had three or four SSNs, would Britain with all its anti-submarine expertise have sent the task force in the first place? And supposing Iran had a couple of modern SSNs out there in the Indian Ocean, would the U.S. battleships have been so readily deployed? And if you can convince yourself that the answer to those two questions is still "yes," how about taking a carrier attack group into the Norwegian Sea in the face of 90 or so Soviet nuclear attack submarines?

NATO navies subscribe to the principle of layered defence against air attack. The first

layer is to attack the air base, which like everything else that is static is genuinely vulnerable; there are no certainties in weapon systems' effectiveness, but now that the earth's surface has been mapped from space with such accuracy, and firing platforms know precisely where they are themselves, the one really easy target is the one whose geographical coordinates can be punched into the computer and no allowance needs to be made for movement during weapon time of flight. That is real vulnerability because all the difficult fire control solution problems -- search, detection, classification, localization, target motion analysis -- don't exist. The fixed target survives only if its defences are better than the attacker's weapons or it can quickly be repaired after the attack. So, having had a go at the air base, the second line of defence against air attack is to use shore-based interceptor aircraft on those rare occasions when geography is in your favour and the aircraft can be spared from other tasks. Much more cost-effective in this role are carrier-based fixed-wing aircraft because the mobile airfield can be positioned to allow maximum effective use of precious flight time, control is exercised at the scene of action, and response is immediate and not dependent upon uncertain long lines of communication. The third line of defence is the area surface-to-air missile fired by the specialized air defence ship and further augmented by the close-in hard-kill weapons such as SEASPARROW and VULCAN PHALANX which are now fitted in most warships of corvette size and above. Finally, there is the whole armoury of so-called soft-kill systems -- including deception devices, decoys, and jammers -- which force the attacking aircraft and its "intelligent" weapon to make instant judgements if the weapon is to find the intended target, always supposing the aircraft has first arrived in the right area. In summary, the maritime air-defence business requires coordination, alertness in short bursts, and fast reactions.

By contrast, the anti-submarine battle is conducted at a slower and more deliberate tempo. Unlike the aircraft, the submarine is independent of its base for weeks at a time and the use of depot and support ships adds further mobility. So, although the shore base is still an attractive and easy target, a pre-emptive surprise attack would be necessary to catch the submarines alongside. In transit, the nuclear submarine is more at risk than at any other time because much of the detectable radiated noise is augmented by speed, and at the same time the submarine's own sensors are dulled by flow noise. Nonetheless the ocean is vast, there is no underwater sensor remotely equivalent to radar, and the submarine wishing to avoid detection can make the complex environmental water structure work to its advantage. Then once on patrol the nuclear submarine can use its mobility and endurance to search, detect, shadow, and attack at a time and a place largely of its choosing against a defence less alerted than will normally be the case with air attack.

And what about the effectiveness of ASW in depth? Can the same attrition factors be expected as in layered air defence? The trouble is that all anti-submarine search systems depend on the vagaries of sound propagation in a noisy and unreliable medium. In the early days both passive and active sonars relied upon noise or echo returns being above ambient or background sea levels. The first breakthrough was the application of correlation techniques which enabled selected broad-band frequency noise to be recognized even though it was below ambient levels. The principle was the same as that of the human ear being able to detect someone speaking its owner's name below the noise level of a crowded room. Then came narrow-band frequency analysis which allowed specially tuned receivers to pick out, focus, and magnify individual or discrete sounds which at the bottom end of the

frequency spectrum travel greater distances through water the lower you descend the frequency ladder. By good fortune such noises were common to the propulsion and auxiliary machinery of the early classes of nuclear submarines, as they are to surface ships, but because the submarine operated alone, and often in deep-water channels, conditions were better for the propagation of noise than in the surface layer or duct. That was the good news; the bad news was that reception was unreliable, being affected by such things as depth of water, temperature, salinity, surface weather, the target submarine's aspect and depth, the amount of machinery it was running, and in addition there had to be an open or clear acoustic path between target and sonar receiver, a path which could be interrupted by circumstance, for instance shallow water or a noisy ship in the vicinity, or by countermeasure devices. Whether the passive sonar receiver is installed in another submarine or towed behind a surface ship or monitored from an aircraft or from shore, all these difficulties apply and even when a detection is achieved it provides only a single line of bearing, and the lower the frequency, broadly speaking, the less accurate that bearing will be, hence the need for long hydrophone arrays.

The really bad news is that all the detectable noises can be virtually eliminated by better design and operating techniques, so closing the so-called passive sonar window, and at the same time jamming and deception devices are being developed to disrupt further this already fragile acoustic environment. There is still some potential gain to be made in improving sensitivity circuits and computerized target recognition equipment and it seems probable that this may buy a bit more time. Also, because the technology has been operating in conditions which need human skills of a high order, it takes years to build up operator expertise and adequate training facilities. To expect to be able to buy a towed sonar

array and go out and detect so-called "noisy" nuclear submarines is to misunderstand the nature of the problem. The state of the art amongst those navies with experience of low-frequency passive sonar equipment is that spectacular ranges can be demonstrated as having been achieved on carefully selected occasions, but even then detection, when it happens, is often not continuous and may not always lead to attack criteria being accomplished; as the primary method of anti-nuclear-submarine warfare the passive sonar has never been reliable, its capabilities are frequently and wilfully exaggerated, and for all the efforts of modern technology the situation is now steadily deteriorating.

So, of the two primary threats to surface shipping, multiple air attacks can be contained if the defence is adequately equipped and well organized, and in the worst case of multiple raids has carrier-borne fighter aircraft and an action data automation system approaching the capacity of the AEGIS system. It also helps the defence if the airbase can be disrupted, an option not exercised in the last major campaign at sea in the South Atlantic in 1982. There can be no such confidence in the outcome of the underwater battle, where the nuclear submarine's mobility and stealth give it such a decisive advantage over surface forces. Of the other elements of the maritime battle none has the same obvious potential for major impact as air defence and anti-nuclear submarine warfare, but all of them could be decisive in some circumstances. Mines have had much publicity recently both in the Gulf and in the Red Sea and can cause great inconvenience and much loss of shipping. But, as with the diesel-powered submarine, which is a formidable type of advanced mobile intelligent floating mine, there is a requirement for cooperation by the target in that it must first go where the minefield has been placed so making the mine a weapon primarily of defence and attrition rather than one of offence

and initiative. Land attack cruise missiles and dedicated amphibious ships are key elements of the "ships against the land" strategy which forms part of the armoury of any well-balanced modern fleet, as is the whole range of logistic support vessels. It is reach, the ability to operate other than in coastal sea denial, that separates the major navies from the others. In spite of the complications generated by maritime strategists, and the proliferation of scenario-based operational concepts which provide harmless employment for naval staffs all over the world, seapower in the late 1980s remains fundamentally about the protection or disruption of economic and supply shipping, whether as an end in itself or as an adjunct to the land battle. This makes it peculiarly idiosyncratic to individual nations since not all will suffer evenly if shipping is disrupted. It also means that those dependent upon the sea cannot give up the unequal struggle just because defence of shipping has become more difficult and expensive.

[THE SUBMARINE REVIEW is privileged to digest portions of "The Foreward to Jane's Fighting Ships" 1988-89, by special permission of the editor, CAPT Richard Sharpe.]

AN ECONOMIC AND TECHNOLOGICAL ASSESSMENT OF THE SOVIET NAVY 1986-1995

Over the last five years, the previously sustained high level of Soviet naval activity has declined dramatically. Ships and aircraft operate less frequently far from home fleet areas, in fewer numbers and over less distance than during the 1970s to the present. Following two large-scale Soviet naval exercises in 1984 and 1985, annual Soviet naval exercises, once a continual

focus of official NATO interest, did not recur in 1986, 1987 nor in 1988. Only small-scale, unit-level naval training events have been noted during the last three years, these limited principally to the in-area sea regions within a few hundred miles of Soviet naval bases. Even there, in the Barents Sea for example, Norwegian defense officials report that Soviet naval operations are down by 50% since 1985. Moreover, permanent, out-of-area Soviet naval forces -- squadrons deployed since the 1960s in the Mediterranean and Arabian Seas -- are observed to operate at relatively lower levels of activity than in the earlier years.

Meanwhile, Soviet naval building programs appear to have had their delivery schedules stretched out -- apparently taking longer to produce fewer ships. These building programs seem to be encountering technical difficulties in delivering ships. Submarine building programs, which have run at a flat rate of production for SSBNs over the past ten years, have shown a decrease in the rate of production of SSNs. Thus, the Soviet Union's growth of naval forces now gives evidence of having been cut back to a level considerably less than expected.

Explanations of the Soviet's unusual operations phenomena have been inconclusive. In 1987 the U.S. Secretary of the Navy said that whatever the cause, "the net strategic result appears to be a Soviet fleet positioning and training to counter the U.S. maritime strategy." Moreover, in 1988 the editor of Jane's Fighting Ships discussed the possibility that the Soviet Navy's reduced operations could indicate ominous preparations to vigorously attack NATO naval forces entering Soviet home waters in the event of war, thus requiring the Soviet Navy to concentrate and train only in those areas.

The changed nature of Soviet naval operations

and of naval hardware programs is seemingly not caused by a fear of the U.S. forward maritime strategy since the Soviets appear not to regard it as particularly threatening or innovative. Nor is the down turn in Soviet naval activity a diplomatic gesture in support of the changed Soviet arms control policies.

Rather, the new nature of Soviet naval readiness and force structure is in keeping with that of the other Soviet military services since 1985. It represents the new national economic, political and technological policies and practices of the Soviet Union's government. Based on the late 1985 reformulation of the USSR's national economic plans for the period 1986 through 1995 as well as economic and scientific forecasts through 2000 and 2005 respectively, these new policies and national plans were approved in March, 1986 by the 27th Congress of the Communist Party of the Soviet Union. These are policies and plans based on glasnost (i.e., internal frankness in monitoring and reporting the new plans' status and progress) and perestroika (i.e., the reformation of organizations and ways of going about the daily businesses of the USSR). In turn, these government measures are aimed at realizing the time-projected and defined goals of uskorenie (i.e., the technological acceleration and scientific rejuvenation of the USSR) which, unlike the means of glasnost and of perestroika, is the end-game.

To achieve progressively the ends required at three critical points in time, 1995, 2000 and 2005, the Soviet Union has taken the extraordinary step of re-aligning its entire science and technology resources by re-distributing its science and technology resources from the 60/40 split which characterized the fifteen-year outlook from 1971 - 1985, to a new ratio of 10/90 pertaining to the outlook period, 1986 - 2000. The long-term consequences of depriving the pursuit of science in the USSR in order to drive up sharply the achievements

of technology are potentially disastrous. But the short-term results for technology can be as dramatic. Moreover, the actual distribution of resources on the order of 35/65 seems a more likely possibility.

The way in which the five Soviet military services, the Navy included, are required to restructure their activities in order to accelerate technological force modernizations is to pay for those modernizations at the near-to-mid term expense of readiness and force structure.

But, sacrificing present military readiness and force structure in order to achieve technological advancements is uncharacteristic of the Soviet Union even though they strongly believe in producing technological surprise. The re-structuring of the Soviet defense budget resources over the period, 1986 through 1995 (the 12th and 13th Five-Year Plans) is seemingly based on a military strategy which is "defensive" and which carefully calculates a low likelihood of war over the period of the total plan period. Such a strategy must, in practice, ensure the low probability of war by means of a series of substantial diplomatic maneuvers and accomplishments. This limits the development and deployment of armaments and, importantly, the operations of military forces while lowering incentives to maintain high military readiness and constantly renew force structure. Such measures, moreover, are time phased to provide a payoff at a particular point in future time. It is by such a device that the political leadership of the USSR gains the cooperation of the military for a temporary reducing of force structure and readiness in order that technological advancements will eventually provide even more capable armed forces.

In fiscal year 1988, the operations and maintenance (O&M) component of the U.S. defense budget (that part which funds military training

and readiness) was 28.5% of the total defense budget and 8.2% of the total federal budget. For the same year, the O&M equivalent component of the USSR's defense budget was only 4.6% of the USSR's total national budget, i.e., slightly more than half of the U.S. commitment to military readiness.

Soviet military readiness during the period 1986 - 1995 is apparently being resourced at half the level of the United States in terms of national budgets. This means that the Soviet Navy can not be expected to operate as extensively as it has in the past. It becomes a "technology development Navy" in contrast to a previous "readiness and force structure Navy."

Operations at sea are not the only scene of change. The acquisition of new ships, aircraft and materiel as well as the rates of replacements of older hardware also have fallen off.

General Secretary Gorbachev stated that shipbuilding norms would remain unchanged for the entire 12th Five-Year Plan (1986-1990).

For each Plan the goals of readiness training have been defined. For the 12th Five-Year Plan "proficiency training" is the only goal; there is no rationale as in the past for training for prolonged conventional war-fighting or theater nuclear war-fighting or wars of national liberation, as in previous five-year plans. In the Soviet Navy there is now a reduction in individual ship training while there is a new emphasis on formation and fleet training in home areas. This is not a hedge against war nor part of a new coastal defense strategy, but rather the result of cuts in readiness and hardware resources. Soviet naval flag officers (captains first rank and above) are being enjoined not to go to sea to train individual ship commanders, but to go to sea only to train their whole formation at once in order to economize on labor and resources. Subma-

rine weapons drills are being discouraged except as they are conducted annually as "fitted into an exercise or a joint cruise by a formation of ships."

Conclusion

Indications are that in terms of the USSR's current period of economic and technological reformation, i.e., 1986 through 2000, the economic and technological causes of Soviet naval conduct as suggested in this paper, corresponds reasonably well with reality. It is important to note the reports over the last three years of uncustomary Soviet naval behavior pertaining not only to operational behavior essential to readiness but also to shipbuilding and systems acquisition behavior. The now uncertain technologies of strategic anti-submarine warfare, particularly non-acoustic technologies for detection and tracking of submarines will have the opportunity to mature into reliable capabilities.

The present emphasis on technological acceleration, means that Soviet defense R&D must become more distributed. The impediment to the Soviets will be the difficulties they encounter by their quantitative orientation, while trying to use qualitative measures by which to technologically evaluate change and progress.

In the near term, NATO should not have to guard against technological surprise, though attention ought to be perked for it in the next decade. It is necessary now to determine how applied R&D and technological developments, which now are being bought at the costs of readiness and force structure, will re-shape and improve the Soviet Navy over the remainder of this century.

James T. Westwood

MINITRUDERS

The hesitancy to embark on revolutionary, or markedly different, submarine designs is readily understandable. Economy of effort, satisfaction (more or less) with the way things are going and avoidance of risk, militate against dramatic changes. But the fact is that, on the other side of the coin, we must expect changes in anti-submarine warfare whether we like it or not; and, although there is nothing yet to imply that the oceans are becoming transparent as some people would have us believe, it would be unwise to reckon on the tactical balance between current submarines -- big SSNs specifically -- and ASW units (including ASW submarines) remaining as it is today.

It might be said that the major navies have drifted into a Cadillac philosophy; and some lesser navies are bent on following if they can. More rationally, a nation like India may feel that the acquisition of nuclear submarines will make it prohibitively expensive for a major power to interfere in what India deems to be its private lake. Canada seems to want a fleet of SSNs for both reasons.

Big submarines have been necessitated by powerful nuclear plants and a multiplicity of weapon systems. Designers have been unable to meet wide-ranging operational requirements with smaller boats. Generally speaking, besides being able to carry a heavier and more varied weapon load, a bigger submarine can go faster and further than a little one.

With submarines becoming quieter on all sides, and with non-acoustic signatures probably becoming more important, it seems that active detection will tend more and more to replace passive methods and make small submarines more attractive. Finding enemy submarines in broad

areas of the oceans is becoming inefficient using passive means and bringing enemy submarines to battle is increasingly more difficult.

A disinterested observer would say experience shows that the best place to strike at an enemy is at his base or as close to it as possible. He would propose that there are two reasonable places to annihilate killer bees. They can either be swatted while they buzz around a honeypot or they can be destroyed in their nest. The first method is apt to be expensive both in honey and effort: in terms of cost-effectiveness it is better to kill them in their nest. He adds, by the way, that anyone who tries to hit killer bees between their nest and the honeypot will soon discover that the attrition rate is low and the hunter is exposed to painful surprise flank attacks from his quarry.

In submarine ASW, as in bee-hunting, there are two reasonable places to seek and kill the enemy; and neither are on his underwater transit routes where there are doubts about the success rate measured against own losses. The first is in a focal zone to which the enemy is attracted (around a convoy, fleet or in a missile-launching area); the other, is near to his base -- even inside it if practicable -- before he is properly underway. There is reason to think that maritime strategy does not envisage forward submarine operations that are quite so far forward as the latter option -- at least not against the USSR. It is, presumably, unthinkable that SSNs would venture into the Kola complex although they might very well lurk off potential enemy ports elsewhere in the world. Moreover, the potential of SSNs is largely wasted in shallow or confined waters; and we certainly can not imagine them penetrating ports or anchorages anywhere. Nor, are even the smallest current NATO SSKs suitable for buccaneering in the style of World War II midgets such as X-craft.

So it looks as though very desirable underwater onslaughts at, or close to, enemy bases -- other than with long-range missiles whose effectiveness is problematical against enemy submarines in the process of deployment -- are not a practical proposition with large submarines.

However, the picture changes radically if we take into account a revolutionary small design submarine which, virtually unnoticed, has been under development by the Italian company Maritalia since the early 1970s, -- and deserves urgent consideration. Unfortunately, the only expert team from outside Italy to display serious interest was sent -- not long ago -- by the Pentagon. Reactions elsewhere indicate that nobody wants to rock either the nuclear boat or the new hybrids which are coming along in Germany and Sweden.

Signor G. C. Santi, the inventor of a totally new integrated submarine system reasoned that a primary problem with submarine construction was finding space for a propulsion plant which would give both high speed and long endurance while still affording plenty of room for weapon systems. Generally speaking, with traditional power -- either diesel-electric or nuclear -- it is the propulsion system (which would include batteries, or a reactor, and its shielding) which has initially dictated the size of a hull.

Alternatively stored chemical energy of the right kind is perfectly capable of supplying an anaerobic closed-circuit engine for practically any desired performance -- just so long as there is sufficient storage space. Santi, an advocate of midget submarines and intent on reducing size while achieving high performance, asked himself how sufficient energy could be stored without taking up an undue amount of space and thereby requiring a large hull. The elegant answer was to use the hull itself.

If the hull were constructed of circular pipes welded together to look rather like a Michelin Man on his side, each torus could be used for energy storage -- gaseous oxygen at 350 bar was chosen -- while diesel fuel could be carried in tanks either internally or externally. The engine itself would be a compact closed-cycle diesel; and its exhaust was also to be stored rather than ejected to sea, thus avoiding difficulties resulting from back pressure at depth while not leaving a detectable wake.

The net result was a wakeless and truly air-independent submarine of modest size -- a midget -- with no need of a snorkel or a large battery and an exceptionally large usable internal volume in proportion to its envelope displacement. In fact, his first fully operational midget, completed in mid-1988, has eighty percent internal space free (for whatever) which compares with twenty-five percent available in a comparable plated hull with traditional propulsion.

By 1988 a closed-circuit gaseous oxygen/diesel propulsion plant had run for some 25,000 hours underwater without problems; and, being to all intents and purposes an ordinary diesel engine, it proved easy to maintain with minimal training for the engineers. No shore infrastructure was required other than an oxygen-producing plant and a compressor.

Meanwhile, a trial toroidal hull was subjected to pressure testing in a tank. A normal hull of steel of the same weight would have been expected to show weakness at the equivalent of 206 metres depth. The toroids however held up until, eventually, one section caved in at the equivalent of 1186 metres which is about what the Soviet ALFA is able to withstand with an immensely expensive titanium hull.

The diameter of the toroids, and the

thickness of their metal (ordinary steel) would be dependent, naturally, on the energy storage required, the size of the submarine being built and its required diving depth. It seems that relationships follow a constant formula; and it is considerably easier to build an ideal tear-drop or ALBACORE shape -- by reducing toroidal circumferences successively from the center -- than it is to bend thick sheet metal in two planes.

The generic title given by Maritalia to submarines built on these lines is gst, standing for gaseous storage toroidal; and gst boats can come in all sizes to suit. All would be completely independent of the atmosphere.

The initial midget examined was a '3gst9' -- meaning that the toroid pipes are of three-inch diameter and the overall length is in the 9 metre bracket. A scaled up larger mini-sub was built at 100 tons standard displacement and 27 metres long. The latter craft are naturally, more capable of distant offensive inshore operations than the smaller which are primarily intended for harbour-penetration, mine-planting or as challengers to enemy mini-subs, swimmers and swimmer delivery vehicles.

There is a wide variety of weapon systems for the 27 metre boat: options include ground mines, mine-delivery vehicles, torpedoes (heavyweight or lightweight) together with active/passive sonar and fire-control, and Commando vehicles. Attacks on enemy ports and anchorages are entirely feasible with any of these variants. The range of the 27-metre midget, fully submerged throughout and carrying two heavyweight torpedoes, is 2,000 n. miles at a transit speed of eight knots: burst speed is 25 knots and sustained top speed is 16 knots. The entire Mediterranean and Adriatic are within reach from an Italian base. Obviously the Kola, if that ever becomes the target, is not attainable without a forward base -- but the base

could be a ship or 'mother' submarine. The cost, incidentally of a 27 metre midget is estimated at around $33 million plus $3.6 million for Plessey Hydra sonar.

However, the prospect of middling-sized submarines, each armed with six bow tubes and a dozen or more reload weapons, may excite more interest, in some quarters, than mini-subs. The following performance can be confidently predicted for a 2,800 tonne gst boat:

30 knots plus	-	3,000 n. miles
25 knots	-	3,900 n. miles
23 knots	-	4,600 n. miles
9 knots	-	27,000 n. miles
5 knots	-	50,000 n. miles

These figures, impressive though they be, do not equate with SSN high-speed endurance. Eyebrows will undoubtedly be raised at Maritalia's claims; but there is no reason to doubt them if midget performance, so far, is extrapolated.

Thus, from the evidence available, the size problem has been solved.

Gst radiated noise levels have not been published but they are expected to be low. The toroids muffle radiated noise in the same way as a double hull; there is no noisy exhaust system (because exhaust gases are stored); airborne noise is certainly very low and one-inch thick sound-absorbent quilting lines the inside of a hull around the engine space.

The gst diesel-generators provide ample power for all conceivable purposes including high-performance sonar; and a modest battery is available for ultra-quiet periods. Noise arising from vortices is largely eliminated forward by substituting an Archimedian ram, nested amongst the torpedo tubes, for forward hydroplanes in

a 2800 tonne design. This instantly changes displacement at the bows to achieve pitch or maintain a level trim: it is, in effect, a static hydroplane.

Active sonar detectability is reduced by a 48 mm anechoic coating applied in two layers of strakes like a clinker-built boat: it would appear that strakes are much less likely to drop off than tiles.

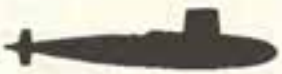
In short, what is offered is a series of exceptionally fast, powerful and hard-to-detect little submarines which might be termed Minitruders.

Some disturbing questions spring to mind.

What if Third World navies, hitherto content with fairly pedestrian submarines, acquire an affordable minitruder capability? What if Iran had effective midgets instead of the reputedly unsatisfactory craft she has herself assembled? What of maritime strategy for the major powers if gst submarines proliferate?

What indeed! It would surely be advisable for the leading navies to investigate gst potentialities very carefully indeed for themselves -- and, if possible, prevent Maritalia's designs getting into the wrong hands.

Richard Compton-Hall



DUTCH SUBMARINES IN COMBAT, 1940-45

On May 10, 1940, massive Nazi forces invaded the Netherlands, overrunning the neutral nation within five days. Among the few naval units escaping under fire to England were 9 submarines, joining 16 other Dutch submarines stationed in the Netherlands East Indies. Of these 24 boats, 22 were capable of conducting war patrols (in some cases after a major refit). Three additional submarines were made available by the Royal Navy for operation by Dutch crews. Over the next five years the 25 submarines of the Royal Netherlands Navy conducted 184 war patrols in the Atlantic, Mediterranean and Pacific submarine campaigns, carried out 82 special missions, and sank 42 confirmed enemy naval and merchant vessels totalling 115,198 tons; 13 additional vessels totalling 86,952 tons were damaged. Of the 25 operational boats, 12 were lost with 255 men.

The Dutch submarines were sturdy boats with such innovative features as the first snorkels, traversing torpedo tubes, and dry 40mm gun mounts. The O-class were designed for North Sea service, and the K-class for defense of the Netherlands East Indies, but after the early 1930s the O designation was used for all submarines. Dutch naval strategists believed that a powerful undersea force made economic sense for a smaller naval power. The Netherlands Submarine Service was well-equipped, and manned by professionals with a centuries-old naval tradition and a magnificent fighting spirit.

Operations in the European Theater

Dutch boats based principally in Dundee fought under British control from Gibraltar to North Cape. They protected convoys against major enemy surface raiders, landed agents on enemy-held beaches, carried out other intelligence missions, and joined Royal Navy submarines in futile

attempts to intercept high-speed German warships. No damage was inflicted on enemy ships in these patrols, and O-13 and O-22 were lost with 83 men in German minefields off the Norwegian coast.

In the Mediterranean, Tyrrhenian and Aegean Seas, Dutch submariners achieved greater tactical success, interdicting vulnerable Axis supply lines with gun and torpedo attacks. Initial problems encountered in firing British torpedoes from Dutch tubes were quickly analyzed and fixed by the crews themselves, supported by H.M.S. MAIDSTONE at Gibraltar. Enemy vessels destroyed included two submarines: U-95 east of Gibraltar by O-21, and the Italian MALACHITE off Corsica by DOLPHIN. Before she encountered DOLPHIN, the veteran MALACHITE had sailed more than 29,000 miles in 36 war patrols. After Italy surrendered, DOLPHIN intercepted the submarine CORRIDONE off Corsica on September 9, 1943. The Italian boat was not flying the prescribed surrender signal, so DOLPHIN was suspicious, but reluctant to sink her after the armistice. Invoking a time-honored Mediterranean naval tactic, DOLPHIN skillfully rammed the CORRIDONE aft to disable her stern planes, neatly putting her out of action. With 2 other enemy warships damaged and 10 vessels sunk, DOLPHIN was one of the Allied aces of the Mediterranean. In that campaign 4 Dutch boats in 26 war patrols sank 20 vessels totalling 59,353 tons, without suffering a loss.

Operations in the Southwest Pacific Theater

When news arrived of the Japanese air strike against Pearl Harbor on December 7, 1941, seven Dutch submarines on patrol moved rapidly to intercept anticipated invasion fleets driving southward toward Singapore and Java. The Allied submarine campaign against Japanese supply lines was launched four days later in the Gulf of Siam when K-XII sank the freighter TORO MARU (1932 tons) anchored off Kota Bharu, and on the

following day sank the tanker TAIZAN MARU (3525 tons). O-16 in a brilliant night attack in shallow water off Sungei Patani on December 12th torpedoed and damaged the transports TOSAN MARU (8666 tons), SAKURA MARU (7170 tons), ASOSAN MARU (8812 tons) and AYATA MARU (9788 tons). Three days later O-16 was lost in a newly-laid enemy minefield, which may also have claimed K-XVII. K-XIV struck invasion forces off Kuching, Sarawak, on December 27th, sinking the big transports KATORI MARU (9848 tons) and HIYOSHI (or HIE) MARU (4943 tons), and damaging HOKAI MARU (8416 tons) and NICHIRAN MARU (6503 tons). On January 10th O-19 sank the transport AKITA MARU (3817 tons) in the Gulf of Siam.

Warships were also attacked with determination. On the night of December 19th O-20 was lost in a spirited gun and torpedo battle with destroyers in the Gulf of Siam; next morning 32 survivors were picked up by the Japanese. Her loss was avenged on December 24th by K-XVI in a bold attack on the 1940-ton destroyer H.I.J.M.S SAGIRI, which became the first of 50 Japanese destroyers, destroyer escorts and torpedo boats to be sunk by Allied submarines in World War II. To put this into context, the first of the 48 sunk by U.S. submarines was the 1900-ton destroyer NATSUSHIO, torpedoed by the USS S-37 (LT James C. Dempsey) in a night surface action off Makassar City on February 8, 1942.

These initial battles demonstrated the high degree of combat readiness of the intrepid Dutch submariners, and their worth as comrades in arms. Their effectiveness was a welcome contrast to the ineffectual efforts of other Allied forces in the opening weeks of the Pacific war.

Although the Dutch undersea corsairs harried enemy sea lanes with skill and determination, their handful of boats could not block the overwhelming invasion forces. Nor could the 29

submarines of the U.S. Asiatic Fleet prevent the fall of the Philippines. On December 25th, 1941, Manila was declared an open city and evacuated by U.S. forces; Hong Kong fell the same day. On February 15, 1942, Singapore surrendered, and the Netherlands East Indies was overwhelmed in early March. The battered Dutch submarine force retreated with Allied boats to Western Australia and Ceylon to continue the fight. From submarine bases at Fremantle and Colombo they fought beside American and British submariners for the rest of the war.

Many examples of aggressive Dutch war patrols could be cited. A determined submerged attack on a six-ship enemy convoy in shallow waters near Penang by O-23 demonstrated the utility of traversing torpedo tubes, which could be swung for broadside shots to port or starboard from their location in the superstructure forward of the conning tower. Avoiding an escort, O-23 fired her last 2 forward torpedoes at the leading MARU from 1000 yards, but the first torpedo hit bottom with a devastating explosion. O-23 was severely shaken up, and a huge column of water and mud soared skyward to alert the convoy. With his traversing tubes already trained 90° to port, Captain Valkenburg coolly fired them at the second ship as he swung the boat to starboard, continuing his swing to fire two stern torpedoes as they came to bear on the fourth ship. Three solid hits sank the passenger-cargo ships ZENYO MARU (6411 tons) and OHIO MARU (5893 tons). On her next patrol in the same area, O-23 sank SHINYU MARU (4621 tons) and barely missed a second ship in the convoy -- but the miss turned out to be providential when intelligence discovered that the surviving MARU was bound for a Burmese prison camp with 1700 Dutch prisoners in her holds.

An incident in the Java Sea illustrated Dutch chivalry. ZWAARDVISCH departed Fremantle on September 7, 1944, for her fourth war patrol. On

October 6th she sank the unescorted U-168 (1140 tons) with three torpedo hits -- two of which were duds. Twenty-seven German survivors were fished from the water, after which three officers and a badly wounded sailor were stowed below and the rest transferred safely to a nearby fishing vessel. But chivalry did not interfere with aggressiveness: in the same patrol ZWAARDVISCH sank KAIYO MARU (143 tons) with gunfire, and on October 17th torpedoed two Japanese minelayers, sinking ITSUKUSHIMA (2330 tons) and severely damaging WAKATAKA (1990 tons) -- an outstanding patrol.

With intimate local knowledge of the East Indian Archipelago and its people, the Dutch boats were adept at landing missions, minelaying, and clandestine inshore operations. In 84 war patrols in the Southwest Pacific and Indian Oceans, the Dutch submarine force completed 50 special missions and sank 22 enemy ships totalling 55,845 tons. Of the 17 Netherlands submarines operating in the Pacific campaign, 9 were lost with 136 men.

The combat record of the Dutch submariners in World War II, and the price they paid for their valor, are summarized in this table:

ROYAL NETHERLANDS SUBMARINE SERVICE IN WORLD WAR II

	THEATER OF OPERATIONS			
	ATLANTIC	MEDITERRANEAN	PACIFIC	TOTALS
Patrolling Submarines #	12	4	17	25
War Patrols Conducted	74	26	84	184
Enemy Subs Sunk #(Tons)	0	2(1,384)	1(1,144)	3(2,528)
Other Naval Sunk	0	0	2(4,269)	2(4,269)
Merchant Sunk	0	9(55,436)	13(50,121)	22(105,557)
Under 500 Tons Sunk	0	9(2,533)	6(311)	15(2,844)
Warships Damaged	0	0	3(16,400)	3(16,400)
Total Sunk & Damaged	0	21(64,832)	34(137,318)	55(202,150)
Special Missions #	29	3	50	82
Submarines Lost #(%)	3(25%)	0	9(53%)	12(44%)
Crew Casualties #	83	0	136	255*

*Includes crews lost in the sinkings of Hr. Ms. Submarine Tender *Columbia* (torpedoed by *U-516*), and British Transport *Abosso* (torpedoed by *U-575*).

Perhaps the best professional commentary on our Dutch submarine allies in the Pacific War was made by the late Vice Admiral Charles A. Lockwood, U.S. Navy. In a letter published in Veertig Jaren Onderzee-Dienst, he declared:

> "We remember the hospitality and assistance rendered by the Royal Netherlands Submarine Service at Soerabaja when our submarines were forced out of the Philippines and based temporarily at that place early in 1942. We can never forget the valiant fighting spirit exhibited by Royal Netherlands submarines during the remainder of the war in our operations through the Malay Barrier from southwest Australia, and their full cooperation with our own submarine service."

A fine tribute indeed, from a great Submarine Admiral to a gallant Submarine Service.

Thomas O. Paine

THE CHINESE ON SUBMARINE COMBAT SURVIVABILITY

The Peoples Republic of China (PRC) entered the nuclear-powered submarine field in the 1970s with the introduction of the HAN nuclear-powered attack submarine. In 1981, the PRC introduced the XIA nuclear-powered ballistic missile submarine. The HAN SSN design appears to be based on the U.S. ALBACORE diesel-electric submarine design, while the XIA SSBN design seems to be based on the Soviet YANKEE, or U.S. GEORGE WASHINGTON SSBN design.

At sea photography indicates that both submarines are of double-hull construction. It is significant that the PRC chose to build double-hull nuclear-powered submarines, rather than follow the West's lead and build single-hull nuclear-powered submarines. Other PRC submarines,

such as the Soviet designed ROMEO diesel-electric submarine and the Soviet designed and built GOLF diesel-electric ballistic missile submarine are also of double-hull construction.

A review of PRC submarine design literature indicates that PRC naval architects embrace the Soviet concepts of submarine combat survivability. This is not surprising since the Soviet Union had an early and apparently profound influence on PRC submarine programs. PRC submarine design literature strongly suggests that the HAN SSN and XIA SSBN incorporate post-attack combat survivability similar to those built into Soviet submarines.

Below are several quotations (along with the author's comments) extracted from a PRC book titled "Fundamental Knowledge of Submarines," which illustrate Chinese submarine combat survivability philosophy.

In a discussion of post-attack combat survivability or what the PRC naval architects call the "Maintenance of Combat and Mobility of Submarine After Being Attacked," **Safety Radius** is defined as: "... the shortest distance from the center of an explosion of an anti-submarine weapon to the submarine body and its equipment so that the explosion effects will not harm the main combat capacities defined by tactical technical requirements." Note that this definition corresponds to the Western definition of "safe standoff range" and the Soviet definition of "safe radius." PRC naval architects, moreover, state that a weapons survivability design criteria is considered during the very early stages of a submarine design.

Danger Radius or **Critical Radius** is defined as: "... the shortest distance from the center of explosion of an anti-submarine weapon at which the damage inflicted upon the submarine body, machinery and crew causes the submarine to lose

its combat capacity, but the submarine can still float on the surface." This definition corresponds to the (currently in vogue) Western definition of "mission kill." In this case, the submarine cannot remain submerged because personnel are injured, equipment is seriously damaged (shock, fire, flooding), and the pressure hull is damaged (dented, ruptured, or with a hull penetration). According to the Chinese, "the safety radius and danger (or critical) radius are the major specifications concerning the resistance of a submarine to anti-submarine weapons. Improvements of the submarine's resistance to explosion of anti-submarine weapons means shortening the safety radius and danger radius." This suggests a requirement to improve post-attack survivability by increasing hull strength and equipment shock hardening, and improving damage control.

Some further guidance is supplied: "Structural strength and rigidity of the submarine body, the danger radius of a nuclear explosion should be used as the basis of calculation, and the structural strength of the submarine body should be near the value required by the parameters of the danger radius." This is a very important point. PRC submarine designers believe that a pressure hull should be designed to withstand both hydrostatic loading and dynamic (i.e., underwater explosion) loading. Apparently, dynamic loading criteria "drives" PRC pressure hull design. Dynamic loading criteria is very probably based on underwater nuclear weapon effect parameters.

Submarine Survivability is defined as the: "... ability to maintain combat force and cruising performance during both daily (peacetime) duty navigation and combat tasks." Then the two types of submarine survivability are discussed. Daily (Peacetime) Survivability is "... the submarine's ability to carry out normal operations under

unfavorable natural conditions, such as sway caused by wind and waves, vibration, corrosion, and operational abrasion of mechanical parts. Daily (Peacetime) survivability is guaranteed by the performance of the various parts of the submarine." And, Combat Survivability is "... the submarine's ability to protect itself from serious damage in performing combat duties."

In a discussion of measures to improve submarine survivability, the following quotes are of interest: "Tactical and technical measures (to improve submarine survivability) include improvements in the submarine's concealability, mobility, seaworthiness, unsinkability, defenses, etc. In addition, the ability of the technical equipment itself to survive is also extremely important and can influence the manifestation of the total submarine performance. Therefore, improvements of the survivability of equipment must be taken into consideration in the design and type-selection phase of the submarine. The basic regulation is that the function of any piece of equipment, under normal conditions, should be able to be taken over by at least two (other) means." Note that PRC submarine designers and naval personnel believe that "survivability" includes both pre-hit (i.e., stealth, concealability, mobility, defense) and post-hit survivability (i.e., shock hardening, system redundancy, unsinkability).

A discussion on the importance of a crew during damage control has this quote: "Survivability of a submarine also depends on the subjective initiative of its crew. Under existing conditions, the crew's efforts in repair work and peacetime maintenance can strengthen the submarine's survivability." Importantly, a survivable submarine design provides the crew with a framework of options to counter a casualty, but improper crew response or faulty equipment can quickly turn an otherwise survivable submarine into a crushed heap of metal.

A discussion of watertight compartments says: "To improve the submarine's survivability, protect crewmen's lives and save them from wreckage, several watertight compartments inside the pressure hull also have the function of lifesaving compartments .... the lifesaving depth for the lifesaving compartment(s) depends on the pressure strength of its cross (transverse) bulkheads. This depth should be in accordance with the operating depth of the submarine. However, due to the limitations of structural weight and arrangement dimensions, the strength of the cross (transverse) bulkheads is usually less than that of the pressure hull." Hence, multiple watertight compartments are installed into all PRC submarines. Several compartments are designated as refuge compartments. Bulkhead weight and volume problems have apparently forced design compromises, such as test depth vice collapse depth rated bulkheads.

As for Underwater (Submerged) Unsinkability: "As with surfaced unsinkability, when a pressure bulkhead (compartment) and one or two of the adjacent main pressure ballast tanks (MBTs) are damaged and water enters, the submarine will still be able to dive, surface and navigate underwater. Modern submarines, however, may not be able to navigate underwater even when only one of the pressure compartments is damaged (flooded). Therefore, what we call the underwater unsinkability refers to the ability of the submarine, when one of the pressure compartments and the two main pressure ballast tanks adjacent to it are flooded, to use compressed air to blow water out of the undamaged main pressure ballast tanks to allow the submarine to surface automatically at a slight vertical angle. "In theory, submerged operations with flooding in one compartment is possible ... but double-hull and multiple compartment submarines have a smaller degree of submerged unsinkability than optimum requirements might suggest". PRC naval architects are not quite as optimistic

about the submerged unsinkability features of their submarines as Soviet naval architects apparently are.

John Engelhardt

DISCUSSIONS

PENETRATING A MINEFIELD

The modern American SSN, the spearpoint of the nation's Maritime Strategy, is simply too valuable to be operated where mines can obtain an easy kill. The best in anechoic coatings, towed array sonars or digital fire control systems are helpless against a well-placed rocket-propelled rising mine. An effective mine detection and neutralization system is needed if our submarines are to continue to sail through hostile minefields. Our expensive and complex submarines cannot be used to fulfill the Mineman's prophecy that "Every ship can be a minesweeper -- once!"

Current hull-mounted submarine active sonars are designed to detect ships and Arctic ice and not such small shapes as mines and their associated cables. Yet tethered underwater search vehicles which can do the job are available now for surface minehunter craft and should be modified for submarine use. Such tethered vehicles are in the Navy's newest minesweeper, the AVENGER. The depths of the oceans have not hindered the development of tethered search vehicles either. The submersible ALVIN operated a camera-carrying vehicle that explored the interior of the S.S. TITANIC in depths of over 2 miles.

A tethered vehicle suitable for minehunting needs to be developed for combatant submarine use. One such vehicle is torpedo-sized and would operate from an open torpedo tube. It would swim

out of the tube and search in front of the mother submarine for either moored or bottom mines. The vehicle is self-propelled using long-lived batteries and has today's proven torpedo and battery technology. A fiber-optic tether would connect the mother submarine and vehicle to carry sensor and control signals. Mine detection sensors include high resolution side-scanning sonars, high intensity lights, low-level light TV cameras and magnetic gradiometers. A vehicle search speed of 10 knots allows the mother submarine to safely transit a minefield at 5 knots through the swept wake of her tethered vehicle. Mine neutralization features such as explosive cable cutters and small demolition charges could also be incorporated into such a vehicle if mine destruction in addition to mine avoidance was desired.

Deployment from a torpedo tube is vital to allow this system to be used by any submarine without expensive hull modifications. The vehicle would be stored on a weapons skid until needed and then loaded into a torpedo tube for operations. Torpedo tube breech door electrical penetrations would be used to provide electrical power to tube-mounted support equipment and the breech door torpedo guidance wire fitting would pass the fiber-optic link into the ship. The vehicle swims out of the tube and the muzzle door remains open to connect the tether to the vehicle. The tether could either be deployed from both the vehicle and torpedo tube simultaneously to prevent any motion through the water, or a high-strength fiber tether be developed to withstand the water drag forces. A one-man vehicle control and display console would be installed wherever convenient in the submarine. Any mine location information would then be passed to Control using existing communication circuits. Technical problems on how to deploy and retrieve the tethered vehicle may be difficult, but not insurmountable. Such a torpedo-sized minehunting vehicle is an object

easily handled onboard existing submarines without costly modifications.

The threat to our submarines from mines will continue to grow as smarter mines are developed. It is time now to develop the smart submarine anti-mine system. The loss of one weapon stowage position, for the system described above, would be worth the increase in operational flexibility to go "In Harm's Way" through minefields, in relative safety.

LCDR Robert C. Barnes

IDENTIFICATION: COOPERATIVE EFFORT

As we returned to Pearl on the surface in WW II, we scrambled to pop the bridge identification flare as a B-24 dropped out of the overcast headed directly toward us with bomb-bay doors open. He passed over at about 100 feet. It was difficult for him to identify us even with our distinctive submarine shape and flying stars and stripes.

The recent tragic downing of a passenger jet by VINCENNES might have been avoided had the jet properly shown IFF to the cruiser's radar. By showing an ambiguous double IFF, the Jet had evidently failed adequately to cooperate. Those in air warfare and anti-air warfare have at least provided the technical means for a potential target to cooperate in identification.

In WWII we in submarines in the Pacific had a minor problem in this respect. We went in close enough to see the target in most cases, and without a red cross it was fair game on the basis of geographical position.

The consequences of error in the sinking of ships can be enormous. The LUSITANIA sinking in WWII had a lot to do with getting the U.S. into

the war. It was a mistake in policy rather than identification, but the result can be the same next time.

With longer ranged weapons and possibly more complex political situations of the future, we may in the next fracas produce much more tragic results unless we somehow come up with better means of identification of ships within firing range. We may not have sufficient knowledge of the routing of thousands of ships to safely do the long range job.

Sonar classification of warships may prove adequate but even this seems doubtful as a potential enemy provides his ships to possible neutrals. The use of cooperating friendly air to make visual identification can do much but is limited by a variety of factors. The use of submarine launched remotely-piloted aircraft shows much promise but it too faces limitations.

It would seem in the interest of the submarine community to develop for those ships which do not desire to be targets, the technical devices by which they can indicate their friendly character. It might be an electronic radio signal for reception through the air or a sonic signal received through the water, or a combination.

We submariners will have the degree of control over an identification system consistent with the trust we put in it. The system must contain characteristics which make it undesirable for use by enemies as a ruse. It might, for example, vastly increase the detectability of the using ship. Or, it might severely interfere with the enemy ship's detection gear. Since we must proceed covertly, the system must not require emission by the submarine which decides not to fire. These are areas where such a system must differ from the radar-activated IFF systems used by aircraft.

Practical matters such as cost and reliability are probably best left to others. But with modern technology it is difficult to believe the goal is not achievable. Portable towed sonic devices and/or coded radio beacons are not much removed from what we now do.

The utility of the system would be much greater if it also protected the user ship from attack by air or surface ship and also informed satellites.

To those submariners who might think it's not our responsibility, one need only think of the political fallout should we sink another LUSITANIA. I think we must at least give the subject our best thought. We should provide for the proper cooperation so that errors in sinking are the fault of the victims.

CAPT R. B. Laning, USN(Ret.)

A SUBMARINE RESERVE?

Richard D. Laning Jr. had an interesting article, in the July issue of THE SUBMARINE REVIEW, dealing with the Submarine Reserve. He raised a number of questions. I have no answers at present, but think it may be useful to review how the Submarine Reserve program came to be where it is today. That might provide a background for some in the active force to comment on the utility of the current Submarine Reserve, and what, if anything, they might suggest as a new approach.

In 1969 Reserve Units were focused around reserve status diesel submarines in various ports, which served to provide basic submarine qualification training. The Reserves regularly embarked in active diesel subs for underway training. Essentially the Reserve Unit Commander was told

"Act as if it's your submarine and carry out the scheduled operations. If I, the CO, or my watch-standers see that you or your men are about to do something dangerous, we will step in and take over. Otherwise it's yours to operate."

It was clear that reserve units were qualified to carry out their assigned mission of activating reserve diesel submarines and manning them in wartime as well as providing relief crews for diesel submarines.

At this time however, those missions were becoming less and less realistic. It was less and less likely that SSs would be activated from the mothball fleet in the future. Their acoustic sensors would be no match for newer Soviet submarines, and they themselves were noisy at best, even on the battery -- because of lack of streamlining. The reality was that in a future war, relief crews would be needed for a much larger number of SSNs than for SSs. It was obvious that the Submarine Reserve program was in need of modification to match it more closely to the active force so that it would be prepared to effectively support the active submarine force in wartime -- a force of eventually all SSNs.

However there were problems in maintaining an adequate level of training of reserve nuclear submarine personnel. Admiral Rickover maintained such high standards of qualification for operators of naval nuclear power plants that it would be impossible to maintain personnel in that state without frequent training sessions either on active SSNs or on nuclear power plant simulators. The shortage of SSNs alluded to by Laning, and the high priority of other employments for their available operating time precluded the first possibility. Admiral Rickover's lack of enthusiasm for nuclear power plant simulators effectively eliminated the second alternative. Given the full training loading of the various

reactor prototypes, there was no possibility of relief there either. It was clear at that time that there was no realistic possibility of maintaining the qualification of submariners to operate nuclear power plants once they had left active duty.

The other part of the training problem involved advanced acoustic sensors and fire control systems. NAUTILUS and SEAWOLF, and the SKATE and SKIPJACK classes had basically the same sonars, fire control systems, and weapons as the TANG and BARBEL class diesel subs. However with advances to 594 and 637 class submarines, the newer sonar and fire control systems in those classes were entirely different and more capable than the newest SS systems. There was no way that proficiency in operation and maintenance of the more advanced systems could be maintained using existing Submarine Reservists.

What then might mobilization needs be? SSN relief crews would be needed. Their role, if WW II experience was useful as a guide, would be to carry out refits while the regular crews were in rest and recuperation from their patrols. Therefore recent experience in submarine repair would be most appropriate. What about personnel for new construction SSNs? Whether any replacement SSNs could enter combat before the end of hostilities seemed unlikely. In any case there would be a fallback supply of nuclear submarine personnel in the second crews of SSBNs. In wartime, it appears that SSBNs might operate at far less than 100% personnel rotation after each patrol.

The possibility of a program of placing SSNs in a reserve status so that current systems would be available for reserve training has not been considered. Such a proposal would be dismissed out of hand, because of the high demand for SSN time in high priority operations.

Attempts to recast the Submarine Reserve program into a new mold would move submarine reserve personnel into units associated with submarine bases and submarine tenders. This would take advantage of the submarine experience of former active duty personnel and utilize them in repair and other support functions. Although there is no doubt that you don't require submarine qualified personnel for repair and support billets, those officers and men so qualified have a leg up on unqualified personnel in doing the job, all other things being equal.

Gradually all the submarine reserve units have been changed over to base/tender support units and associated reserve training SS have been scrapped.

Richard Laning made a number of points. The first three: that utilization of reserve submarine officers and enlisted men has been marginal (considering their level of experience in SSN operations and the cost of training them); that many submarine reserve billets have only a remote association with submarines; and that reserve submariners are stranded ashore. It <u>is</u> a loss of valuable submarine experience not to fully use that experience in the reserve component. Perhaps the pertinent question is, does the current Submarine Reserve program meet the mobilization needs of the active submarine force? If it does, then the stranding of reserve nuclear submarine personnel ashore may be a fact.

There probably can be made a case for more SSNs for wartime employment, either for patrol operations or for providing ASW training for our own forces. The POM, in the past at least, always called for more submarines than were in approved force levels. But it seems unlikely that some older SSNs could be kept in a reserve training capacity, with a mission of maintaining reserve units qualified to operate them in wartime.

As for conventional submarines in a reserve training role, available SS suffer from the same lack of modern equipment which drove the change in direction of the reserve submarine program 19 years ago.

Enough on background. Richard Laning has aired an interesting topic. The active side of the submarine community might talk to the adequacy of the current Submarine Reserve Program to meet its mobilization needs.

John F. O'Connell

FUNDAMENTAL PRINCIPLES OF SUBMARINE WARFARE

The initial talk by Admiral McKee at last year's Submarine League's Symposium and the follow-on comments by CDR Ryan are striking in their different approaches to the concept of what is "fundamental." Admiral McKee limits his first offering on the "fundamental" principles of submarine warfare to a few which seem to bear directly on the success of wartime missions. Some may want to restate his principle "shoot first and at short range" to perhaps "shoot first effectively". But, there can be little doubt that "remaining undetected" until forced to risk forfeiting stealth, "maintaining propulsion" (to get there, fight the ship, and return for a reload), and "knowing the boat" are fundamental keys to success. And few would argue that "learning to fight hurt" is not basic to all types of warfare.

On the other hand, the bulk of CDR Ryan's article is concerned with the concept of "know your people and treat them fairly." However, this is not a principle of submarine warfare, but a principle of leadership -- as applicable to an infantryman as a submariner. Thus, mentioning it in the same context as "fundamentals" of submarine warfare is disturbing because it belies both the

notion that in wartime the relationship of leaders to those led changes somewhat, and that the concept of a soldier or sailor's duty in war must cause him to rise above peacetime social and organizational expectations. Although there is likely to be a place and reason for a "peacetime" mentality in this regard, this must be supplanted quickly by a "wartime" mentality when the shooting starts. And "fairness" is primarily a peacetime notion.

General S. L. A. Marshall has some comments on this:

> .....a final thought is that there is a radical difference between training and combat conditions.
>
> In peacetime training, a commander may be arbitrary, demanding, and a hard disciplinarian. But so long as his sense of fair play in handling his men becomes evident to them, and they are aware that what he is doing is making them more efficient, they will approve his methods, if only grudgingly, be loyal to him, and even possibly come to believe in his lucky star.
>
> His men are more likely to do what the commander demands however, if the commander takes a fatherly interest in their personal welfare. But this element is not as important as the commander winning the respect of his troops. If he shows he knows his business, his men are on his team.

A second aspect of "fairness" which makes it questionable as a fundamental principle of submarine warfare is that in war, on board a sub in combat, the crew must understand that fairness is a matter of opinion, and that the perceived welfare and fair treatment of individuals is no longer a matter of primary concern when compared with winning the battle. Each sailor and soldier

must place his personal welfare and his perception of fairness secondary to the combat performance of the unit.

Enough on fairness.

This is CDR Ryan's major point about leadership. But it falls far short of the reality of combat and the lessons of military and specifically submarine history which stress the element of courage. General S. L. A. Marshall sheds some light on this historical experience:

> "When it comes to combat, something new is added. Even if they have previously looked upon the commander as a father and believed absolutely that being with him is their best assurance of successful survival, should he then show himself to be timid and too cautious about his own safety, he will lose hold of them no less absolutely. His lieutenant, who up till then under training conditions has been regarded as a mean creature or sniveler, but on the field suddenly reveals himself as a man of high courage, can take moral leadership of the company away from him and do so in one day.
>
> "On the field, there is no substitute for courage, no other binding influence toward unity of action. Troops will excuse almost any stupidity, but excessive timidity is simply unforgivable."

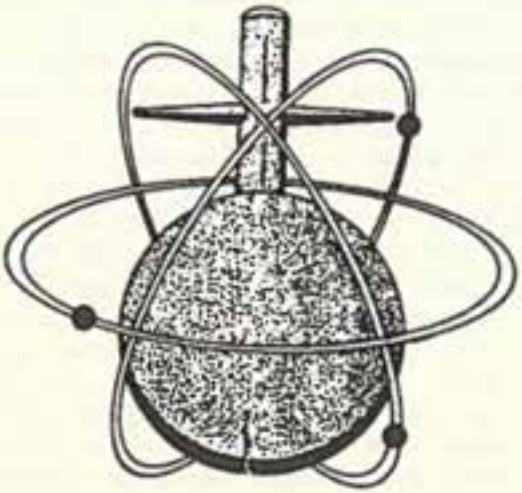
We only have to reflect on the history of submarine warfare to see the truth in this statement. The first Pacific war patrols averaged about 1/2 ship sunk per patrol. In 1942, about 30 percent (40 out of 135) of the U.S. submarine commanding officers were summarily relieved of command, the majority for non-productivity. In 1943 and 1944, about 14 percent were relieved each year for mainly the same reason. A quick review

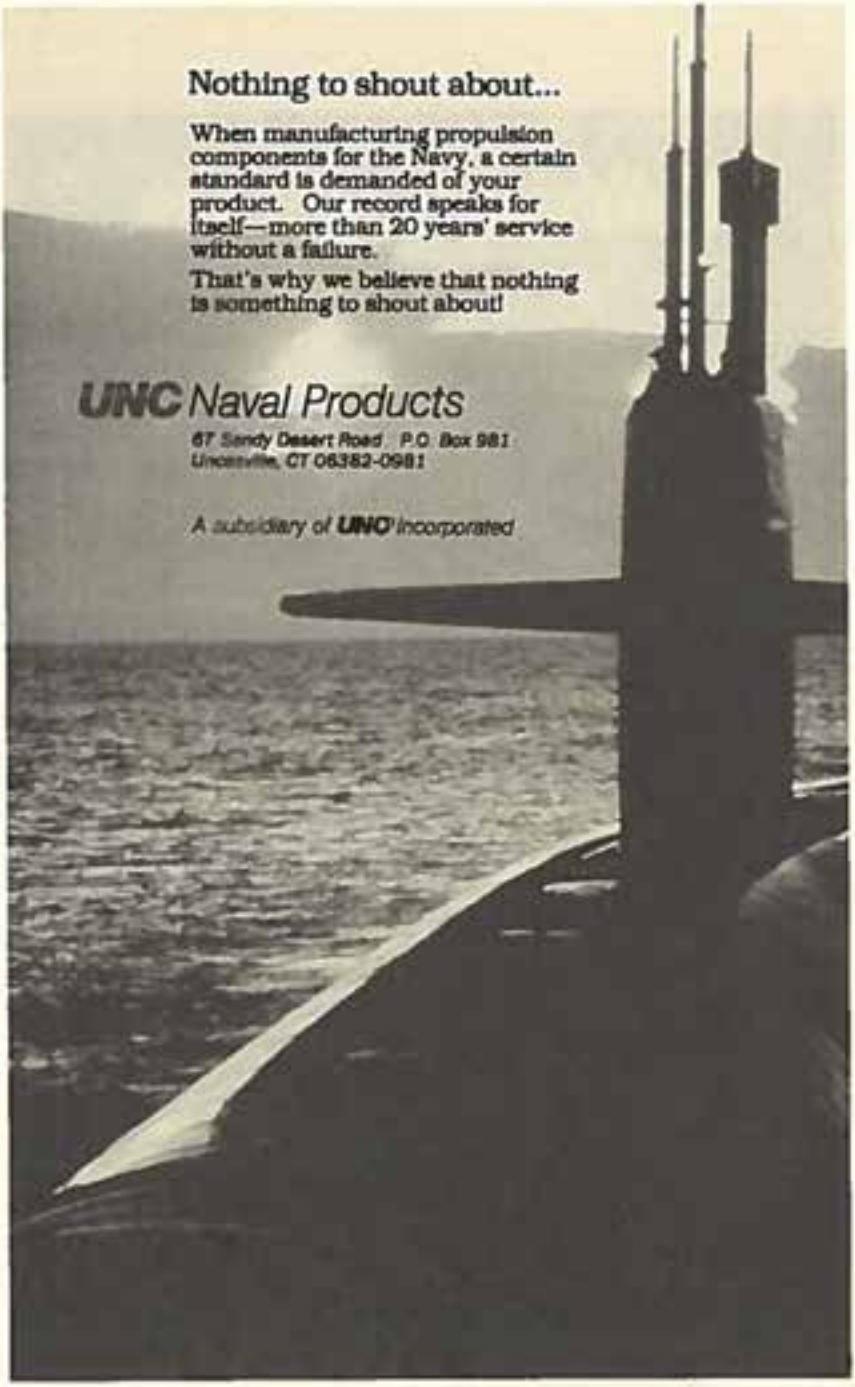
of the records reveals that roughly 25 percent of the submarine commanding officers sank about 75 percent of the Japanese ships sunk by submarines. Such ratios were common in other countries as well, (and in some cases worse).

Thus, a "fundamental" principle of leadership in combat is "courage." Nothing substitutes for courage, not even "luck." But courage may well have a different character and be more of a cornerstone of submarine warfare, than for other warfare branches for two reasons. Leading a submarine in combat is somewhat different than leadership in surface ships or in the air. In WW II, Sir Winston Churchill stressed that "England expected each man to do his duty", because all of England "was watching." But each submarine CO is alone, with no one there to question his courage, supply heroic examples, define targets, and help him press an engagement to success. His human enemy is unseen, the tactical "truth" is unknown, the skipper is not in the view of the battle group nor is he visibly a member of a flight squadron. His engagements may go on interminably, and his temptation to break off or await a better moment to engage may be great. A second reason is that in any future undersea war, we simply can't afford low sinking ratios from the majority of our submarines. We have to get more productivity from each submarine, and it is not likely that we will have a year to season our skippers and get our act together. Our national security is more highly leveraged on submarine successes from the outset with the first patrol having to be the best. We must have each submarine hitting hard and hitting fast. Courage in our skippers will prevent the recorded conflicts which Executive Officers had with their skippers in WW II over aggressiveness in battle. The seeds have to be sewn in sub school, nurtured through shipboard assignments, and brought to fruition in PCO school.

A final thought is that another new "fundamental principle" of submarine warfare seems to have emerged with the changed nature of submarine warfare in the past thirty years. A submariner leaving port must be preoccupied today with having as clear and complete an understanding of the sonar environment as possible. A submariner who does not know and exploit the sonar environment, both offensively and defensively, is imposing a severe handicap on himself. Hence the fundamental principle: "know and exploit the sonar environment."

Frank Lacroix




Nothing to shout about...
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JULES VERNE! WHERE ARE YOU?

We appear to be employing brute force methods in the design of our new submarines to make minor improvements while scarcely looking around to see if the nature of naval warfare has changed. Signs of this are increases in submarine size and cost. These tend to reduce our submarine operational effectiveness by putting too many eggs in a very limited number of baskets. More importantly, we seem to be paying little attention to the rapid changes occurring in the nature of warfare -- and the possible new submarine roles and missions indicated. And, there is little evidence that we are employing available new technologies to produce major advances in submarine design and employment strategies. Briefly, we appear to be in a rut where bigger is considered better with little regard for war-fighting effectiveness.

Just as the invention of firearms led to the replacement of the longbow and the crossbow, so the development of land and carrier based military aircraft made the battleship obsolete. Now the carrier battle group is being made obsolete by a combination of nuclear submarines employing long range nuclear or conventional tipped smart missiles; surveillance, radar and elint satellites; and C^3I networks. Effective warfare within and from the sea should now be conducted by submarines of advanced design based on recent new technology. The design of new nuclear submarines must be responsive to their employment on innovative missions using new strategies -- as a replacement for aircraft carriers in sea warfare.

While there is no claim to being able to see the future with 20/20 vision, it seems certain that future submarine missions and strategies must support the nature of future warfare and not that of World War II.

Today, research and development advances at lightening speed. Therefore, we must take positive steps to prepare for future war in a more aggressive and intelligent manner than has been done in the past. In short, the effectiveness of our future submarine designs and strategy depend upon how well we can define the future.

The range of sea warfare for the coming decade may extend from "conventional" to "limited", and on to "all-out nuclear" war. For conventional and limited nuclear warfare there is a real problem in preparing scenarios. They tend to escalate into all-out nuclear war when the losing opponent possesses a significant nuclear delivery capability.

Recent and most commonly used scenarios usually define the enemy as the USSR. That has been the most likely scenario. But for the 1990's or early 2000's, war with other nations without the financial burden of maintaining huge conventional forces may find the answer in exerting military power through the use of nuclear weapons. The list of nations with nuclear weapon capability is growing year by year. As nuclear weapons get smaller, lighter, and of longer lethal range, new delivery concepts are proliferating. These include unsophisticated methods such as nuclear mines planted by merchant ships and submarines. A single scenario of future warfare is certainly inadequate. Only after a number of scenarios of future wars have been defined can we answer questions as to the warfare roles that submarines will assume -- and from them determine new missions and submarine performance requirements.

There is a tendency to believe that military strategies and missions are correctly defined prior to the advent of war. That has been rarely true. By and large, military strategists have not been very capable of visualizing and forecasting

future warfare strategies and requirements. Instead, they prepare to refight the last war rather than prepare for the next. The problem caused by lack of foresight is revealed only after war begins. That lesson has not been well learned. Twenty years after the German subs' WW I success against shipping, Japanese strategists made a most serious blunder. Japan was a country with very limited natural resources and heavily dependent upon imports. Early in World War II Japanese strategists somehow lost sight of the vulnerability of their extended overseas shipping. As their ships became strung out over the vast Pacific, losses to our submarines mounted. Japan soon lost the ability to support her outlying possessions, and to import vital goods to the homeland.

Another major failure to correctly visualize the nature of future warfare also occurred early in World War II. Allied military leaders refused to admit that battleships were vulnerable to air attack. The British fell into this trap and lost the battleships PRINCE OF WALES and REPULSE to Japanese aircraft off the Malay coast just two days after the Pacific war began. The U.S. had already lost their battleships at Pearl Harbor to the unexpected shallow-diving Japanese aircraft-delivered torpedoes.

Innovation based on new concepts and advanced technology has always been a major contributor to success in war. The Germans introduction of radio-guided bombs at Bari, Italy on 2 December 1943 found the Allies' off-loading 30 support ships unprepared for this technological innovation and 16 ships were sunk. Nine more were badly damaged in the worst catastrophe since Pearl Harbor. Luckily, a means to jam the bomber's guidance frequencies was quickly brought into action -- preventing future disasters.

Innovations in naval warfare have had important effects on world history since ancient days.

Roman naval strategy employed at Mylae in 260 B.C. is a prime example. After defeat by a fleet of the great Mediterranean naval power, Carthage, in 264 B.C., the Romans developed a strategy to allow their famed legionnaires to be used at sea. They equipped each galley with a long wide gangway to which was affixed a huge iron spike at the outer end. Roman galleys closed the Carthaginian galleys and dropped these gangways onto them. When a spike pierced an enemy deck, it held it fast. Roman legionnaires then swarmed aboard and massacred their enemies. The naval power of Carthage was destroyed. Rome then controlled the Mediterranean to change the entire course of European history.

The development of new concepts and strategies is a most difficult job. Machiavelli wrote about innovation:

> "Nothing is more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all who profit by the old order, and only lukewarm defenders in all those who would profit by the new order. This lukewarmness arises partly from fear of their adversaries, who have the law in their favour, and partly from the incredulity of mankind, who do not truly believe in anything new until they have had actual experience of it."
> (From "The Prince", 1513).

In brief, the imagination and foresight of military planners is apt to be poor and their opposition to a new order strong. In this environment the ability to institute new methods of submarine warfare and new submarine system designs will be difficult. Nonetheless, the results of well thought out innovations have often been decisive in war.

There is no doubt that Soviet innovative thinking has brought about the wide variety of recently built Soviet submarines. They range from midget bottom crawlers to the undersea mammoth TYPHOON of 25,000 to 40,000 tons. How will TYPHOON be used, and where? This giant was not built as a lark.

Since the U.S. public has no intention of starting a major war, we must stay prepared and advertize our intent to counter any major attack with nuclear retaliation. We cannot deter war by threatening would-be adversaries with bows and arrows. We must be ready and armed for nuclear war -- until the millenium when all nations outlaw it.

Despite difficulties in predicting the future, we must apply a massive effort in that direction. The conduct of future submarine warfare depends largely on three things; revised submarine warfare roles, advanced technology applied to submarine system design, and new methods of employing our submarines. Importantly, we are weakest today in defining the roles and related mission requirements for our future military submarines.

We must loosen the shackles constraining naval thinking and construct widely different "what-if" warfare scenarios. Then, with further analysis we must define submarine missions and related performance requirements to win these scenario wars. At the same time we must apply new technology to the design of propulsion, structure, weaponry, communications, etc.

New and improved missions and capabilities? How about:

- o Anti-submarine warfare in the open sea.
- o Tactical land attack with medium range ballistic missiles.
- o Destruction of key enemy land and sea

based facilities/ships which support nuclear weapon delivery and C^3I capabilities by means of special Spetsnaz type combat teams.

- o Nuclear-mine laying.

You may want to add to this list.

It is time to be unconventional in thought; to come up with radical ideas. An example that is intriguing would be an advanced form of anti-submarine warfare. Using extremely low frequency electromagnetic transmissions to communicate during high speed submerged maneuvers by very small 50 knot fighter-submarines, they could use coordinated fighter aircraft-like tactics against enemy submarines. Impossible? Porpoises seem to indulge in formation maneuvers without much trouble. Of course, we will need a new power plant, improved underwater optical imagery and some special but simple underwater rockets for such fighters. Those matters are challenges for our laboratories and industry. How about a mother sub, wire-guiding several small one-man fighter subs into close combat with a big enemy sub? How about a submerged aircraft carrier battle group? Or, how about sweeping up Soviet acoustic nets outside ports, bases and choke points?
If you don't like these ideas, formulate a few of your own. We need some free thinkers with a Jules Verne's type of imagination.

"Calling Jules Verne. Where are you Jules Verne?"

William P. Gruner

WANT TO STUDY ABOUT MODERN SUBMARINE DESIGN?

Although there are a number of submarine publications available in book stores for popular and easy reading, there is a remarkable dearth in this country of serious engineering textbooks that deal with the arcane and little discussed subject of modern submarine design. One of the rare books -- and this by a layman -- is Norman Friedman's SUBMARINE DESIGN AND DEVELOPMENT published in 1984. On page 8 of this book one notes the following statement with incredulity:

> "For U.S. design practice, the standard sources are two technical papers, 'Recent Submarine Design Practices and Problems', by Rear Admiral Andrew I. McKee, USN (Society of Naval Architects and Marine Engineers, 1959) and 'Naval Architectural Aspects of Submarine Design', by CAPT

E. S. Arentzen, USN (Society of Naval Architects and Marine Engineers, 1960); no comparable papers have been published in the more than two decades since 1960."

Can it be true that no engineering papers or books have been published in the U.S.A. concerning the science of modern submarine design for 28 years??? After diligently combing the various SNAME publications, ship design periodicals and nearly all the general books published on submarines in the Western world, one can only come to the conclusion that this is, indeed, true. Why?

There are hundreds of textbooks dealing with modern aircraft design, and many more dealing with various aspects of aircraft such as propellers, jet engines, material structures, etc., even several on flap design. Of course, these are backed up with , literally, thousands of NASA reports on every little detail that might be involved with even our most recent frontline aircraft. And even in the underwater world, there are seminars given on modern sonar design and the volume of technical papers dealing with underwater sound is considerable.

The irony of this situation can best be illustrated by another quotation, this from Dr. Edward Wenk in the Discussion section following the Arentzen SNAME paper in 1960:

"While the occulted nature of submarine warfare has earned for that naval arm the piquant caption of 'silent service', there has been a corresponding stillness in the technical literature concerning the design of the submarine itself. The recent paper by A. I McKee and this current paper are thus exceedingly welcome contributions..."

Dr. Wenk's "stillness" has become a stellar vacuum for the last 28 years. Little did he know, at the time, that these papers would not only be the last published in this country, but that they would help start an intense and very serious submarine design publishing effort in another country, Russia.

Six books have subsequently been published in Russia from 1964 to 1978. The first: Atomic-Powered Submarine Design by V. M. Bukalov and A. A. Narusbayev (published in Leningrad in 1964 by the Sudostroyeniye Publishing House) is primarily a summary of Western, i.e., U.S. submarine designs with factual details and numbers not found anywhere else. In fact, in the 1960 Arentzen SNAME paper, nearly 1/3 of the 32 odd graphs shown have no finite numbers on the vertical scales. They are only shown as relative quantities. But the Bukalov paper replaces these relative quantities with actual numbers and republishes the same graphs! Amazing.

One year later Moscow's Military Publishing House of the Ministry of Defense published N. N. Yefim'yev's Fundamentals of Submarine Theory. Is it possible that there is competition in Russian sub design? This effort was followed by Bukalov and Narusbayev, again, with Design of Nuclear Submarines published in Leningrad in 1968.

Then in 1973, The Submarine Structure by S. N. Prasolov and M. B. Amitin was put out by the same Moscow Military Publishing House. Four years later another Moscow agency, Voyenizdat, came out with Yu. I. Bol'shakov's Basic Theory of Submarines. Not to be outdone by the capital city, Leningrad's Sudostroyeniye Publishers countered with Design of Manned Submersibles by A. N. Dimitriyev in 1978.

This might not seem so abnormal if this proliferation of titles was in the free West, but

it all happened in pre-Gorbachev Russia with not one single title published in the United States. Even the Chinese are sufficiently interested in the art and science of underwater vehicles to have done a book: the very good Fundamental Knowledge of Submarines by S. Zhong published in Beijing in 1985. West Germany's Ulrich Gabler published his excellent work, Submarine Design about this same time, although it is primarily concerned with smaller diesel submarines.

The new NAUTILUS memorial in Groton is a very worthwhile addition to help build public knowledge of the submarine threat to our nation and to help encourage young people to not only serve in our submarine Navy but also to contribute new ideas to constantly improve our submarine defenses. There is a library in this new facility, but none of the above publications are in this library.

In perusing and digesting the above publications, it becomes very apparent that Russians, in particular, are really enthusiastic about their submarine work and want very much to improve the state of the art. Much of their early published work is concerned with the details of western submarines; nonetheless, they have subsequently come forth with many different classes of attack submarines since the mid 1960's when our last design, the 688 class, was determined. Their later texts show much originality of design, far beyond anything attempted in this country. Ironically, there is considerable open discussion on sonar techniques in the U.S., and this technology along with serious quieting efforts has been our greatest advantage over the Russians for 30 years. But the Russian subs are becoming more quiet also while they are learning many things from the use and operation of their many new sub classes. Meanwhile our latest SSN design, in service, is nearly 20 years old and cannot match the speed or depth capability of the latest Russian boats. There is also good reason to suspect that our

single-hull subs are not as survivable -- fighting hurt -- as the double-hull Russian designs. It is apparent that the Russians have performed some serious tests on underwater survivability. (Certainly, they have had enough practice with all the operational accidents that we have observed over the years.) How can our submarine designers be so sure about survivability?

It may not be obvious to some, but all of our first-line Air Force and even U.S. Navy aircraft have been designed by many competitive quasi-private industrial firms in this country. However, none of today's submarine designs have been created in the hot crucible of competitive effort, and we know that competition makes better products. In 1961, when this author was retained by the Electric Boat Company to wind-tunnel test a SKIPJACK-class control plane, there were only three or four engineers in this great company's Hydrodynamics design department! At that same time there were literally hundreds of aeronautical engineers at any one of our 20-odd aircraft companies. The Navy's BUSHIPS at that time did virtually all the design of every sub, and the sub builders were left with only the construction and mechanical design of any given sub class.

1) Meanwhile, the Russians had at least five shipyard's design teams competing fiercely with their varied and numerous sub classes.

2) Just because our subs are quieter and better manned does not mean that we shall forever have an overwhelming superiority over the numerous Russian.

3) What if Russian boats can take a MK48 hit and still fight back?

4) What if Russian boats can neutralize or destroy our torpedoes, and get off several of their own which we cannot avoid?

5) What if we have a melee situation with "other" enemy submarines and our quiet but unwieldy boats cannot maneuver against this threat?

It is axiomatic that the free, untrammelled brains of American engineers have been the driving force behind our military superiority since the end of World War II. But this freedom of inquiry was stifled in the arcane secret world of sub design nearly 30 years ago. The great torpedo fiasco -- TINOSA's "hitting torpedoes which didn't explode" -- of our Pacific sub fleet against the Japanese should be sufficient example today to alert all of us against repeating the same mistake with our attack submarines today. And even when our torpedoes would explode sometimes the results were unexpectedly embarrassing -- as with LANG's circular torpedo sinking. The Air force and Navy Air were caught off base with the surprising emergence of the MIG-15 in Korea, and the unexpected success of the SA-2 in Vietnam. But they have changed their equipment and tactics very effectively as proven in various skirmishes -- witness Syria and Libya -- in the last 10 years where the latest Russian equipment has been destroyed decisively.

There is no doubt that our 637 and 688 subs have been able to regularly ambush the underwater Russian with their superior underwater stealth. There is strong evidence that this is still the case today. But underwater combat with sonar only is not the same as with live exploding weapons. What unexpected technical surprise lies in wait for our submariners when live torpedoes are fired in place of sonar pings?

Surely the Navy could encourage one or more of its prolific technical writers to publish an original U.S. work on modern submarine design. If our secrecy constrained bureaucracy just cannot bear the idea, then have them do a book of Russian sub design. We are fortunate to have the Naval

Institute's Proceedings monthly journal and the NSL quarterly as the only U.S. publications that maintain a dialog on submarine matters. But as noted in the October 1982 issue of the former:

> "Morskoy Sbornik is a monthly naval journal published in the Soviet Union in Russian .... Moreover, Morskoy Sbornik can be an excellent source of unclassified data on numerous U.S. and other Western naval systems. In terms of accuracy and detail, some of the articles in Morskoy Sbornik are among the best to be found on Western systems in the open literature."

This writer is embarrassed to have to refer to Russian texts to answer most questions concerning modern theory of underwater design and technology. And some of these texts offer better clarity of sub theory than the above SNAME papers. Surely this sad state of affairs should not be allowed to continue.

Henry E. Payne III

LASER COMMUNICATION SYSTEM TO SUBMARINES

Some discussions of Laser communications systems to submarines, while describing blue-green beams down to the submarine from satellite or aircraft with a footprint large enough to cover the uncertainty of position of the submarine, also provide the submarine with the same laser for up-link from the deep submarine.

It is probably incorrect to think that the security of the submarine is better preserved by his beaming up from the deep than coming to shallow depth. Tyndal scattering will cause the laser beam to bloom to a large and highly visible area of illumination on the surface easily detectable by satellites or aircraft. In early VP-SS barrier exercises we used up-aimed diver's lights on the decks of SSK's to call the attention of VP's.

The great value of Laser communications from high altitudes will be to get the SSN at any time. In many cases no reply will be needed; in others the reply will be a response and can be done at the discretion of the SSN's CO, depending in part on his willingness to come shallow. When it is made, it should be as undetectable as possible and the transmission as short as possible. It will probably be best made by a laser tuned for best atmospheric penetration and sent from a mast-mounted device with beam as narrow as feasible. Since a signal sent from a deep laser would travel through paths of different lengths, some coherence would be lost and the signal have to be longer to keep bits apart. The increased time of transmission required could be significant.

Dick Laning

SUBMARINE "BOATS"

I have to respond to Joe Pursel's "Bit of History" (July 1988 issue of THE SUBMARINE REVIEW) on the subject of calling submarines "boats" with some of my own. Early 1960, DEPCOMSUBLANT had put out a directive mandating that the word "boat" was verboten henceforth and the XO read it to us at morning quarters with a stern follow-up, "If I hear anyone referring to this ship as a "boat," you will be turned over to the Chief of the Boat for indoctrination."

YNCM(SS) C. Tompkins, USN(Ret.)

"THE U-BOAT CAMPAIGN OFF THE U.S. IN 1942"

The author might be interested to know that according to the German U-boat scholar Jurgen Rohwer (Axis Submarine Successes, USNI Press, 1983, p. 105), the American tanker S.S. RAWLEIGH WARNER, commanded by his best friend, was sunk on 23 June 1942 (at 28.53N, 89.15W) by U-67, commanded by Gunther Mueller-Stockheim, an experienced skipper from the crew (or class) of 1934. The U-67 was a Type IX C, or "large" U-boat with a surface displacement of about 1100 tons. She was on her fifth war patrol, during which she claimed sinking 8 ships for 48,000 tons, confirmed in postwar records as 8 ships for 44,846 tons. This success earned Mueller-Stockheim a coveted Iron Cross.

The U-67, in turn, was sunk on 16 July 1943, by aircraft from the CVE, USS CORE. Mueller-Stockheim was killed but three U-67 crewmen were rescued (to become POWs) and are possibly reachable in Germany. They were: the 1st Watch Officer (or Exec) Walter Otto, who was born in Clow in 1920; Johann Burck, a native of Frankfurt; and Walter Janek, a native of Festenberg.

I am able to provide these guidelines for Overton because for the past year I have been conducting research for an operational history of German U-boats in World War II, designed to be similar in size and scope to my Silent Victory: The U.S. Submarine War Against Japan. In this connection I, in turn, would appreciate hearing from anyone who had significant wartime or postwar experiences with U-boats or U-boat personnel which would be helpful to an operational history.

Clay Blair

IN THE NEWS

o NAVY NEWS & Undersea Technology of 30 May, tells of a study by the Institute for Policy Studies which notes that 16,000 of the world's nuclear warheads are made for use at sea. The U.S. and Soviet Russia have between them 15,500 of these sea based nuclear weapons. China, France and England have a total of 600 warheads. The U.S., according to the report, has 5,632 nuclear warheads on ballistic missiles and 3,645 more on cruise missiles, antisubmarine rockets, bombs and anti-air missiles. The Soviets have 3,447 nuclear warheads on their SLBMs and 2,705 tactical nuclear warheads on cruise missiles, torpedoes, etc.. China is listed as having 24 nuclear warheads, one on each of its CSS-N-3 ballistic missiles. England has 128 strategic warheads and France has 292 strategic warheads.

o Highlights of VADM Bruce DeMars talk at the Submarine League's Symposium, June 1988, included: "I'm very pleased that the fragility of communications with strategic submarines is now being put to rest by some writings -- much of it in the open and some of it done by members of the League here. In the SSBN world we have some 40

plus SSNs underway today all over the world. We have 37 688-class submarines and about 59 authorized and will probably build 65 before the line is terminated. We're building the improved 688s and have taken the margin from some 250 tons in the original ship in 1976 down to basically zero tons today. The SSN-21 will be commissioned in December of 1994 on the original plan that was laid down some 6 years ago. The operational requirement for the Mk 48 ADCAP torpedo was written in 1975 and we are very proud that it will start entering the fleet this Fall. Some critical modernization to keep our older SSNs viable are the hull coatings and thin-line towed arrays. The hull coating's payoff in quieting, reduced noise into your sonar, and reduced reflected echo, etc., is phenomenal. We have program money for thin-line arrays for all 688s and for between half and two-thirds of the 637s. We have managed to hold down crew size on the submarines while capability has increased significantly. We're out to twelve years between overhauls for SSBNs and are now moving from 7 to 14 years for the SSNs. We have made a revolution in strategic warfare without really realizing it. We're now preeminent in that area. We should put our mind now toward the revolution that is taking place in naval warfare, and how the SSN contributes to that. We have cost-effectiveness and we have stealth -- we have a very stealthy platform. Stealth is becoming increasingly important and so we have to work hard to extend the weapon range of the submarines. How can we extend the punch of this very, very potent weapon system -- to project power ashore and extend into third world contingencies and businesses? We've built the truck, the SSN-21, that's on track -- and now we need to work hard at accessorizing that truck."

o Sea Technology/July 1988 advises that the H. A. Perry Foundation and Atlantic University's Ocean Engineering Department are sponsoring a race for two-person, human-powered submersibles.

The competition calls for the designing and building of such submersibles and then competing for the $5,000 Grand prize, on June 23-25, 1989 at West Palm Beach, Florida. Extra prizes of $500 will be awarded for speed, innovations, cost-effectiveness, etc.. Submarine buffs who want to join in this action, write M. L. Merrill, H. A. Perry Foundation, 147 Martins Lane, Hingham, MA 02043.

o Navy Times of 8 August reports on the imminent moves of senior admirals. Included amongst these moves are the following submariners: Admiral Kinnaird McKee, Director of Nuclear Propulsion, to retire and be relieved by Vice Admiral Bruce Demars, the current Assistant Chief of Naval Operations for Submarine Warfare. Admiral Frank Kelso II, now Commander in Chief U.S. Atlantic Fleet, becomes Commander in Chief Atlantic Command and Supreme Allied Commander Atlantic, (SACLANT). Vice Admiral Nils-R. Thunman, the Chief of Naval Education to retire in November. Rear Admiral Virgil L. Hill, Jr.,, now Commander Submarine Group 5 becomes Superintendent of the Naval Academy. Rear Admiral James D. Williams, now Director of the Office of Program Appraisal, Office of the Secretary of the Navy, becomes Commander 6th Fleet. Vice Admiral Daniel L. Cooper, Commander Submarine Force Atlantic Fleet, is relieved by Rear Admiral Roger F. Bacon. Cooper is slated relief for DeMars as Assistant Chief of Naval Operations for Undersea Warfare.

o NAVY NEWS & Undersea Technology of 1 August tells of the expected signing of a Memorandum of Understanding on September 6, between the U.S. and Great Britain to develop a torpedo-defense system. "The project's goal is to develop a system that can protect surface ships and submarines from torpedoes, either by destroying the weapons in the water, decoying them or otherwise disabling them." Negotiators of this Memorandum of Understanding discussed focussing the joint

program on defeating the wake-homing torpedoes used by the Soviet Union. "The idea was, if you can beat a wake-homer, you can beat anything. The consensus within the U.S. and U.K. navies is that they will need the torpedo defense in low-intensity conflict. In such a conflict the torpedoes are likely to be straight runners. It's not likely they can be decoyed so they'd have to be hit with some sort of anti-torpedo weapon."

o An important article by Admiral C. A. H. Trost, USN, the present Chief of Naval Operations, in the Proceedings/August 1988, analyzes the effects that the new Soviet leader, Mikhail Gorbachev is having on Soviet goals and methods. Excerpting the points Admiral Trost made, of interest to the submarine community, in his "Soviet Politics of Maneuver and U.S. Response," there is the emphasis that "In remarkably short time, relations between the two superpowers have changed from the politics of stalemate to the politics of maneuver. The new situation poses challenges to international security. (Whereas) the nuclear strategies of both countries contained a low order of risk (because deterrence worked), now there is movement and with movement comes uncertainty. It is clear that the Soviet leadership is as aware of the new uncertainties as we are and is exploiting them. At the end of these maneuvers the U.S. and the Soviet Union must take up new positions. To some extent our perceptions are being managed by the Soviet leadership. Gorbachev recognizes the imperative to correct a tremendous imbalance in Soviet planning, and the mismatch between Soviet resources and Soviet interests -- while Soviet military spending absorbs about 16% of the national product. To redress the imbalance, a holiday from the military buildup is indicated. Also, it is the Soviet Union and not the U.S. that is overextended around the world. And, despite an excellent educational system and a heavy investment in scientific research, innovation has failed to

reach the factory floor. It is proper to ask what are the general principles we should follow in responding to the Soviet politics of maneuver? First, it must be recognized that arms reductions with the Soviet Union cannot be done on a quid pro quo basis since many categories of systems will be asymmetrical. We must test whether meaningful reductions are really the Soviet intent (to adopt a "defensive" rather than an "offensive" doctrine). In particular, our naval forces must not become a bargaining chip. And, our unrestricted use of the sea is more important to us than any agreement (focused on zones of peace). Second, how should the U.S. respond to Glasnost and Perestroika? We must recognize that detente may be dangerous. Our perspective can no longer be rooted in comfortable assumptions. In the politics of maneuver, actions, not words, are the reality."

o In the Washington Post of August 2, an article about Defense Secretary Frank Carlucci's visit to the Soviet Union says that the Secretary "accused the Soviet Union of continuing to emphasize offensive military strategies and weapons while claiming at the same time that it is shifting to a defensive doctrine."

o The Washington Post of 25 July reports a collision between a Japanese submarine and a fishing boat in Tokyo Bay -- which sank the boat and killed more than six persons. "The submarine was on the surface, and the collision could have been averted if the fishing boat had not made an unexpected turn."

o NAVY NEWS & Undersea Technology reports that Congress has authorized only $65 million for FY '89 to carry on the DARPA administered advanced submarine development program. Congress voted $113 million of FY '88 and the program calls for about $100 million a year for five years. But because of a slow startup, the $65 m. for '89 was

felt by the Congress to be adequate. The language in the bill restricts the program to basic research; exploratory development and advanced technology development for submarine hull, mechanical and electrical systems and to non-nuclear propulsion technology.

o The Washington Post of 23 July in an article by R. J. Smith discusses the Soviet arms control proposals relative to cruise missiles -- used on submarines and ships. The exclusion of these sea-launched weapons from a strategic accord, as recommended by the Soviets, means, according to U.S. negotiator Max Kampelman, that the Soviets "cannot be serious." A Soviet negotiator said, "The cruise missile is a very tricky weapon. I would even say it is a most destabilizing weapon -- because it is a low-flying missile it cannot be seen by (Soviet) radar." And, "Are there any countermeasures against cruise missiles? I will tell you there are none." The Soviet's proposal is to limit each side to 1,000 sea-launched cruise missiles with each side deciding how many would be equipped with nuclear warheads. U.S. and Soviet teams stationed at key naval ports would inspect and count each missile before it was loaded aboard a submarine or ship. Only two types of submarines and one type of surface ship would be allowed to carry sea-launched cruise missiles.

o SUB NOTES/May-June 1988 reports that the German sub, U-27, hit the anchor chains of an oil rig in the North Sea while running at 30 meters depth. "Damage to the submarine was extensive." The U-27 was on a free play tactical exercise with two other subs and they were "hiding" from 4 ASW surface ships. Another item in the same SUB NOTES reports that the French Navy is testing contra-rotating propellers within a shroud on one of their diesel submarines. It has been developed for their SSBNs and will offer improved effeciency and a lower noise signature.

o NAVY NEWS & Undersea Technology of 13 June notes that the CNO, Admiral Carlisle Trost, had approved plans to devote an SSN 688-class submarine to research and development now. "The submarine will be taken from the fleet. It will still do its annual qualifications and be in some exercises. But it won't be deployed, so it will be available for R&D work half of the year." Then in about 1993 when some other sub is in overhaul, it will get modest modifications to enhance its R&D role. The first submarine will be used to test new weapons and sensors.

o The Intrepid Museum of New York City, at 46th Street on the Hudson and centered around the aircraft carrier INTREPID, will add the submarine GROWLER to the museum in about March 1989. At that time she will be transferred from Bremerton, Washington to New York. There will be guided tours of this World War II submarine -- made famous by Commander Gilmore's dying words as he ordered, "Take her down" when the sub was under heavy gun attack and he had been mortally wounded. He stayed on the bridge as the submarine submerged.

o INSIGHT/June 27, 1988 says that Swedish coastal patrols have a go-ahead to destroy foreign submarines penetrating Sweden's territorial waters. A recent rash of believed-to-be midget submarine contacts in Swedish waters has triggered this use of force to try to cripple or kill suspected intruders. "An unidentified vessel tripped a seabed magnetic alarm near Stockholm last month, and the navy responded by setting off an underwater mine. A few days later, naval vessels in pursuit of another contact unleashed dozens of depth charges and antisubmarine grenades."

NAVY NEWS & Undersea Technology of 4 July reports that the Australian Minister of Defense said that Australia is planning on building two

Swedish design conventional submarines using an air-independent, closed-cycle Stirling engine which uses bottled oxygen to run while staying completely submerged. As programmed, Australia would build the first six conventional subs as diesel-electrics, with Kockums of Malmo, Sweden as the assisting contractor. Then seven and eight would have the Stirling engine. "The Swedish now have it inserted into a KNACKEN-class submarine and have tested it under submerged circumstances." And, "They will be the most significant arm of the Australian Navy (the eight submarines) into the next century. We operate in shallow waters, and the relative silence of the diesel-electrics gives them substantial advantages." It is also noted that the Australians field a wide-aperture sonar array on their submarines.

o NAVY NEWS & Undersea Technology of 25 July describes Navy plans to use new stern designs and automated controls for follow-on SSN-21s. The stern configuration on the first SEAWOLF will be a variation on the conventional cross-tail used by current submarines. In addition to the standard four control planes, the SEAWOLF will have two more which will project at 45 degree angles below the horizontal diving planes. Other alternatives such as a three-plane Y or X tail will be examined. "The automated control system would be analogous to the computerized 'fly-by-wire' control systems used in high performance jets." A single officer would man the controls. "One significant advantage of the automated controls, is a quieter submarine."

o The Washington Post tells of psychologists' observations, relative to submarine duty, at a meeting of the American Psychological Association in Atlanta. "Submariners," they say, "have significantly lower hospitalization rates for mental disorders than surface-ship personnel." and that, "submariners have lower hospitalization rates for alcohol, drug abuse and personality disorders than

crew members of Navy surface vessels." In fact, "Submarine duty does not appear to affect the mental health of U.S. naval personnel." However, these notes of optimism about submariners are tempered by the consideration that tighter psychological and medical screening plus the higher levels of education among submariners may account for the differences.

o NAVY NEWS & Undersea Technology of 15 August reports that a new shaft of reinforced composites is being developed by the David Taylor Research Center to possibly replace steel propulsion shafts in submarines. A composite shaft is said "to weigh a fraction of the weight of a traditional steel shaft" (at least 50% lighter). Additionally, "composites don't conduct electricity." Thus, they don't produce magnetic signatures which might be detectable and identify a submarine. The shaft would be a composite of glass and carbon in an epoxy resin. By minimizing current flow, corrosion and galvanic effects on metallic parts are greatly reduced. So far, all developmental work on composite shafts have involved surface vessels, but "people are beginning to look at the submarine application."

o In the same issue of NAVY NEWS it is noted that the commissioning of the SSN 751, the SAN JUAN, on August 6, marks the first operational submarine to have the BSY-1 combat system. It also has retractable planes -- in the bow. The newly installed BSY-1 computer system "integrates the vertical launch missiles, the torpedoes and the sub's three-inch flare launcher systems into one switchboard, making it easier for weapons operators to coordinate an attack, as well as reducing the weight, noise and volume required to house the equipment."

o The present publicity about Vice President George Bush's rescue by a submarine in World War II makes FINBACK's 10th war patrol

report of great interest. This portion tells about how R. R. Williams, the skipper, picked up LT(jg) George Bush along with the subsequent rescue of another pilot, Ensign J. W. Beckman.

2 September 1944

0933 Received word of plane down 9 miles NE of MINAMI JIMA. Started around southern end of CHICHI JIMA, maintaining minimum range of 7 1/2 miles to island.

1156 Picked up LT(jg) George H. W. Bush, File No. 173464, USNR, pilot of plane T-3 of VT-51, USS SAN JACINTO, who stated that he failed to see his crew's parachutes and believed they had jumped when plane was still over CHICHI JIMA, or they had gone down with plane. Commenced search of area on chance they had jumped over water.

1236 Received word of rubber boat seen from air. Position given was in hills of HAHA JIMA but started south anyway, asking for jigs, repetitions, and confirmations, until we heard one plane state he was circling over the boat. An unknown plane on the circuit was heard to mention a spot "west of HAHA." This was at least as good as any dope we had, so headed for a position about 9 miles west of HAHA JIMA. This seemed to make our cover feel better, although they tried to conn us through the island a few times. Plane reported that the raft, about 1 1/2 miles from beach, was being shelled. Spirits of all hands went to 300 feet.

1505 Dived to 55 feet with planes in sight zooming a spot in water 1 mile WSW of MEGANE IWA.

1530 Sighted rubber boat.

1550 Roared by the rubber boat, backing full and still making 4 knots. We must have misjudged his mast-head height a bit. We twisted around and started stalking him.

1620 Pilot hooked on and we headed out away from beach. Tried to make two-thirds speed, but the pilot had one arm around the periscope and the other around the life raft with a bailing bucket bringing up the rear. Stopped to see if he would get in the boat. This took about 10 minutes, during which a discussion developed below concerning the precedence of simultaneous orders to blow, pump, and flood. Finally got way on towing pilot in his boat. Two-thirds speed filled the boat, and there he was in the water again. Finally came up to 38 feet to keep him out of the water until at range of 5 miles from beach, planed up, opened the hatch and recovered the pilot. Got on 4 engines and cleared area to westward. Pilot was Ensign James W. Beckman, File No. 301442, USNR, VF-20, USS ENTERPRISE, who stated that it was known that only one man had parachuted from BUSH's plane. This decided us to discontinue any further search of that area, particularly as our air cover had left.

o A Reuter's dispatch of 27 August tells of the sinking of the Peruvian diesel-submarine, PACOCHA, on 26 August, as a result of a ramming by a 412-ton, steel-hulled Japanese fishing boat. The PACOCHA, formerly the USS ATULE-403, sank in 110 feet of water off Callao -- eight miles west of Lima, Peru. Twenty-three sailors were removed from the forward room of the submarine with the help of Peruvian frogmen and were brought to the surface by means of a diving bell. Twenty-two more of the PACOCHA's crew were pulled from the sea as the submarine sank. Seven of the submarine's crew, including the commanding officer, lost their lives in the sinking. A U.S. Navy rescue crew was requested but arrived after the removal of the survivors from the bottomed submarine.

o NAVY NEWS & Undersea Technology of 8 August reports on a paper delivered at the U.S. Naval Institute's seminar on 28 July, on the future of the Navy. The author of the paper, K. J. Moore, the president of Cortana Corporation, says that in order to win congressional support of submarine programs, there has been an excessive detailing of submarine characteristics which gives the Soviets "precise information that could help them in war." He adds, "A wealth of information about the SSN-21 SEAWOLF has appeared in the press, giving the Soviets insight into the submarine's capabilities nearly a decade before the submarine will have reached the fleet." The Soviets, Moore said, believe that "secrecy and its relationship to surprise, is a principle of the military art, and seems to be much more important to the Soviets than deterrence." As for submarine R&D here in the U.S., "Research in the Fifties and Sixties was innovative, but in the Seventies and Eighties R&D has been focussed on reducing risk, to ensure continuing favorable congressional support." And hence, U.S. submarine technology is likely to stagnate.

o An Associated Press release of 31 August reports on a Soviet book which was published this year, entitled "The Navy: Its Role, Prospects for Development and Employment." This book was edited by Admiral Sergei Gorshkov and is considered the most important Soviet monograph since Admiral Gorshkov's 1976 "Sea Power of the State." The book indicated that the Soviets intend to continue emphasizing their submarine force in the future. It tells of building 50 to 60 knot submarines "in the near term." And it tells of 2000 meter diving submarines and torpedoes in the future with thermal and laser-homing and speeds up to 300 knots. Three key naval missions are highlighted: (a) destroying strategic submarines of the West, (b) using submarine nuclear strikes to destroy Western military and economic targets, and (c) "destroying hostile naval forces to gain

command of the seas around the Eurasian periphery."

NOTEBOOK

o "Command and Control of Submarine Combat Systems" is being offered as a three-day course at the Professional Development Center of the Armed Forces Communications and Electronics Association, Fairfax, Virginia, on 6, 7, and 8 December 1988. The course is a comprehensive overview of the capabilities and limitations of submarines. The unique command and control and communications (C^3) arrangements used in submarine warfare as well as the equipment and procedures which support them are explained.

Persons engaged in planning, management, design and production of submarine associated systems and equipments or who have C^3 responsibilities for policy, arms control or C^3 matters will find the course useful.

The course is classified. A SECRET clearance and a certified "Need to Know" are required.

Reservations can be made and further information obtained by calling Fran Haas at (703) 631-6137 or (800) 336-4583.

o USS ANDREW JACKSON (SSBN 619) is having a decommissioning reunion in Charleston, SC, tentatively scheduled for the second week of March 1989. If interested in attending this reunion, please contact Kevin Lynch, 303 Longleaf Road, Summerville, SC 29483. Phone (803) 873-1570 or 743-3826.


In the defense
of our nation, there can be
no second best.
716
Newport News
Shipbuilding

SUBMARINE WARFARE IN THE ARCTIC: OPTION OR ILLUSION?

By Mark Sakitt
Center for International Security and Arms Control
(Occasional Paper)
Stanford University, May 1988
63 pp with 4 appendices & bibliography

The title of this brief, thoughtful and well-structured monograph leads the reader to expect a discussion of under-ice submarine combat, which the author does provide. First, however, he examines the New Maritime Strategy, from which stems the anti-SSN/SSBN missions for U.S. submarines, and therefore, the Arctic combat scenarios. The SSN threat to Soviet SSBNs is expected to achieve two goals: first, to prevent their SSNs from contesting U.S. control of the seas by keeping them back to protect SSBNs; and second, to reduce the incentive for the Soviets to escalate to nuclear war by destroying their SSBNs, thus shifting the balance of forces to the U.S. side. This study examines whether the force structure proposed has a reasonable chance of success.

The author reviews the assumptions of our strategic ASW strategy and questions their validity. He discusses three general criticisms: one, that the task cannot be accomplished successfully; two, that even if successful, it will not have a major influence on a land war; and three, that unexpected results detrimental to U.S. interests are likely to occur. Having identified SSN vs SSBN operations in the Arctic region as a key element of our strategic ASW strategy, he then describes the opposing U.S. and Soviet naval forces, and the physical features of the Arctic region. He proceeds to develop an analysis to test the outcome of SSN vs SSBN combat operations,

using acoustic detection, search, and countermeasures models and certain environmental acoustic information. The results of this analysis indicate an outcome unfavorable to the U.S. Having raised serious questions, the author identifies different assumptions in order to maintain control of Sea Lines of Communications (SLOC), and recommends a critical discussion of the strategic ASW strategy and alternatives thereto. One alternative would lead to surprising SSN force levels.

Mr. Sakitt has produced a well-developed treatment of a subject of major importance to U.S. submariners, albeit no doubt unpalatable to their leaders. As in all analyses, assumptions are arguable. In this study, his limited use of Arctic environmental acoustic data introduces considerable uncertainty as to the validity of both hypotheses and analytical results. Specifically, his opinion of passive submarine detection capability is too negative, and he neglects to consider the potential of U.S. ice-mounted surveillance systems, which recent work with vertical line acoustic arrays has demonstrated.

His paper has sections dealing with: New Maritime Strategy, U.S. Naval Forces, Soviet S/M Forces, Physical Features of the Arctic Region, Detection in the Arctic, Combat and Attrition, Soviet Northern Fleet, Soviet Countermeasures, and Conclusions. He includes (and uses) four valuable appendices, with which SSN operators should be familiar:

A. Submarine Search Models
B. Submarine Attrition Models
C. Arctic Ambient Noise
D. Propagation of Sound in the Arctic

His bibliography contains many references useful to SSN operators.

The author's ideas and conclusions are worthy of serious consideration and discussion by submarine supporters. They will certainly get

such treatment from other parties interested in SSN force levels. This monograph is highly recommended reading for all SSN planners and operators, and for inclusion in PCO school curricula as an exercise in submarine planning and analysis.

Charles B. Bishop

ASW versus SUBMARINE TECHNOLOGY BATTLE

By Louis Gerken
American Scientific Corp.
3250 Holly Way
Chula Vista, California, 1986
ISPN # 0-9617163-0-4

This book is a superb summary of Submarine Developments throughout its entire history, from early beginnings to recent times. It is a reference that Tom Clancy would have admired when he wrote The Hunt For RED OCTOBER. It would have saved him a lot or research time. Much of it is a graphic and unclassified portrayal of the evolution of submarine technology. It is a catalog of pro- and anti-submarine developments on an international scale.

STRENGTHS

This volume should be especially valuable as a compendium of institutional knowledge about submarining and how various friendly and adversary nations are trying to limit their effectiveness in time of war. For students and managers of submarine and ASW warfare it should be required reading and always available for ready reference. Of great interest are the chapters dealing with ASW Surface Ships, Aircraft, and Communications. At the last Submarine Symposium (Washington, D.C., 1987) it was announced by a high official of the U.S. Navy that under consideration was the

formulation of a Unified Navy Command for ASW. This book gives a dramatic overview of why this unifying command is so long overdue. It is essential that the air, surface and submarine forces become more focused on the ASW problem. On page 729, the author states that a major need exists for a new ASW "CZAR."

WEAKNESSES

Always, when an author is dealing with a subject so heavily bounded by classification limitations, the coverage must be overly general. In the later chapters of the book (Chapters 17 to 26), the manuscript does avoid touching on advanced technology developments that have not yet become fully operational or have not appeared in non-classified publications. The coverage is focused primarily on technologies that have been tested to some degree and are in the operating forces. The most sensitive areas (Chapters 24 and 25) are an interesting summary of events already in the public domain and provides for the curious or serious reader an insight into current operational concerns facing Commanders in the active duty navies of the world, but who have not provided official commentaries on these subjects pro or con. Each reader, depending on his experience-background can come to his own conclusions about the validity of this authored work and his opinions.

CONCLUSIONS

Overall, this is a very readable book which is an excellent dissertation on a major problem facing the Defense Establishment of this country and other nations. It should be a memorable book for "old salts" and a useful overview for those responsible for solving the problems of Anti-Submarine Warfare.

Charles H. Hoke

THE CARDINAL OF THE KREMLIN

by Tom Clancy.
G.P. Putnam's Sons, New York, 543 pages
ISPN 0-399-13345-3

More than a novel, THE CARDINAL OF THE KREMLIN is a polemic for the Strategic Defense Initiative, and a good one at that. Also, it is a convincing argument for the U.S. Navy's strategic missile submarines and for continuing development of that arm -- (as well as for a strong program to develop U.S. strategic ASW capabilities to eliminate potential Soviet missile-firing submarines before they can launch their strategic weapons).

But those looking for another submarine yarn will not find it here. While one submarine plays a relatively minor role in the action, most of the story takes place far inland -- Moscow, Afghanistan and Dushanbe, the Soviet site for development of their missile defense system.

The story is about the further adventures of Jack Ryan, Clancy's incredible hero who makes James Bond seem like a rather dull wimp. Although described as a "desk man" at the CIA, Ryan gets around with the President of the United States, the head of British Intelligence Service, the General Secretary of the Communist Party of the Soviet Union, and the Chairman of the KGB. He talks the KGB Chairman into defecting and arranges his escape, along with the CARDINAL, better known as Colonel Misha Filitov.

Filitov, the only man living who ever won three Hero of the Soviet Union medals in battle, is the trusted personal aide to Marshal Yazov, the Soviet Defense Minister. Nevertheless, in the story Filitov has operated for many years as an agent who passes "most secret" information to the CIA.

While the CIA, the KGB and Filitov are parrying with each other in Moscow and Los Alamos, a band of intrepid Afghan freedom Fighters led by the "Archer", an expert at firing Stinger missiles, and an Afghani major, trek seventy miles into Soviet territory and attack the secret laser research site at Dushanbe. Their attack is a limited success in which the Archer and his men are killed. After that the Major and what is left of his men head back to Afghanistan.

(The failure of Soviet air power to overwhelm the Afghan Freedom Fighters on the ground -- using the shoulder-launched, simple, low-cost Stinger missile -- marks a dramatic change in the dominance of air power in war. This also suggests that a Stinger-type missile, covertly fired from U.S. submarines might be equally effective against enemy ASW aircraft hunting our subs.)

There are many more facets to the story, and many more characters than can be mentioned in a short review. But one thing can be revealed: Jack Ryan comes through with no more damage than a sore leg. Since he is only thirty-five years old, readers can expect continuing accounts of his exploits.

Charles Rush

IN REMEMBRANCE

REV. JOHN F. LABOON (JAKE) CAPT, USN(RET.)
CAPT ANTHONY L. PALAZZOLO, USN(RET.)
CAPT CHARLES E. STASTNY, USN(RET.)
CAPT PETER DURBIN, USN(RET.)
JEANNIE EASTON

"SUBMARINE PATROL"

The Naval Submarine League, with the assistance of the DCNO (Subs) is sponsoring the production of a video film entitled "Submarine Patrol." This film will initialy be shown as an hour-long PBS Documentary and later distributed to the Navy for recruiting and educational purposes.

Donors making this production possible are listed below in the order consistent with their contribution:

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LANCE SORENSEN

MEMBERSHIP STATUS

	Current	Last REVIEW	Year ago
Active Duty	918	924	889
Others	2779	2761	2582
Life	158	153	121
Student	31	28	24
Foreign	39	38	32
Honorary	10	11	0
Total	3935	3915	3648

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